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February 2018 to February 2022

Coordinating Organization
Crops Division
Bangladesh Agricultural Research Council



Project Implementation Unit
National Agricultural Technology Program-Phase II Project
BANGLADESH AGRICULTURAL RESEARCH COUNCIL

New Airport Road, Farmgate, Dhaka-1215, Bangladesh

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Program Based Research Grant (PBRG)
Sub-project Completion Report
on
**Collection, Conservation and Characterization of
Important Plant Genetic Resources**

Implementing Organization

1. Plant Genetic Resources Centre, Bangladesh Agricultural Research Institute
2. Genetic Resources and Seed Division, Bangladesh Rice Research Institute
3. Genetic Resources and Seed Division, Bangladesh Jute Research Institute
4. Breeding Division, Bangladesh Sugarcrop Research Institute
5. Plant Breeding Division, Bangladesh Institute of Nuclear Agriculture
6. Cotton Development Board
7. Bangladesh Sericulture Research and Training Institute
8. Department of Horticulture, Bangladesh Agricultural University



Project Implementation Unit

National Agricultural Technology Program-Phase II Project
Bangladesh Agricultural Research Council
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Abbreviation and Acronyms

AFLP	: Amplified Fragment Length Polymorphism
ANOVA	: Analysis of Variance
ARS	: Agricultural Research Station
BARC	: Bangladesh Agricultural Research Council
BARI	: Bangladesh Agricultural Research Institute
BAU	: Bangladesh Agricultural University
BBS	: Bangladesh Bureau of Statistics
BI	: Bioversity International
BINA	: Bangladesh Institute of Nuclear Agriculture
BJRI	: Bangladesh Jute Research Institute
BRRI	: Bangladesh Rice Research Institute
BSPC	: Breeder Seed Production Centre
BSRI	: Bangladesh Sugarcrop Research Institute
BSRTI	: Bangladesh Sericulture Research and Training Institute
CBD	: Convention on Biological Diversity
CDB	: Cotton Development Board
Co-PI	: Co-Principal Investigator
CTAB	: Cetyl trimethylammonium bromide
CV	: Coefficient of Variation
DAE	: Department of Agricultural Extension
DNA	: Deoxyribonucleic Acid
DUS	: Distinctness, Uniformity, Stability
EC	: Executive Chairman
EDTA	: Ethylenediamine tetraacetic acid
FRG	: Fertilizer Recommendation Guide
FSRD	: Farming System Research and Development
GI	: Geographical Indication
GIS	: Geographic Information System
GO	: Government Organization
GoB	: Government of Bangladesh
GPC	: Germplasm Centre
GPS	: Geographical Positioning System
GRSD	: Genetic Resources and Seed Division
GT	: Genotype by Trait
HARS	: Hill Agriculture Research Station
HRC	: Horticulture Research Centre
HYV	: High Yielding Variety
IBPGR	: International Board for Plant Genetic Resources
IFAD	: International Fund for Agricultural Development
IPGRI	: International Plant Genetic Resources Institute

IPR	: Intellectual Property Rights
JAF	: Jute and Allied Fibre
LoA	: Letter of Agreement
NARS	: National Agricultural Research System
NATP	: National Agricultural Technology Program
NBPGR	: National Bureau of Plant Genetic Resources
NGO	: Non-Government Organization
NTSYS	: Numerical Taxonomy System
OFRD	: On-Farm Research Division
ORC	: Oilseed Research Centre
PBD	: Plant Breeding Division
PBRG	: Program Based Research Grant
PC	: Principal Component
PCA	: Principal Component Analysis
PCR	: Sub-project Completion Report
PCR	: Polymerase Chain Reaction
PGR	: Plant Genetic Resources
PGRC	: Plant Genetic Resources Centre
PGRFA	: Plant Genetic Resources for Food and Agriculture
PI	: Principal Investigator
PIC	: Polymorphism information Content
PIU	: Project Implementation Unit
PMU	: Project Management Unit
PRA	: Participatory Resource Appraisal
RAPD	: Random Amplified Polymorphic DNA
RARS	: Regional Agricultural Research Station
RCBD	: Randomized Complete Block Design
SAHN	: Sequential agglomerative hierarchical non-overlapping
SAU	: Sher-e-Bangla Agricultural University
SD	: Standard Deviation
SDG	: Sustainable Development Goal
SDS	: Self-Directed Search
SE	: Standard Error
SSR	: Single Sequence Repeat
TSS	: Total Soluble Solids
USA	: United States of America
WB	: World Bank

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Executive Summary

Plant genetic resources are the most valuable and essential basic raw materials for crop improvement providing biological basis for world food security supporting livelihoods. Cultivated varieties, obsolete varieties, primitive cultivars (landraces), wild and weedy species, near relatives of cultivated species etc. are considered as component plant genetic resources. Bangladesh is characterized by a mixture of tropical and sub-tropical environments offering congenial growing condition for numerous agri-horticultural crops. It is bestowed with immense agro-biodiversity and rich diversity of landraces, traditional/farmers' varieties in several agri-horticultural crops with a good number of timber and medicinal plants which are indigenous to the country. The diverse 30 agro-ecological regions of the country have sustained rich genetic resources of crop plants. Collection and conservation of the plant genetic diversity is essential for present and future human well-being. Adoption of modern agriculture, destruction of habitat, aggression of local and overseas private seed companies and other reasons have caused high genetic erosion in the country. With a view to collect, characterize (morphological and molecular), conserve and documentation of important plant genetic resources including Geographical Indication (GI) crops, landraces and released varieties for establishing 'Intellectual Property Rights (IPR)' a coordinated sub-project titled "Collection, Conservation and Characterization of Important Plant Genetic Resources" (ID: 128) has been implemented by seven NARS institutes viz. BARI, BRRI, BJRI, BSRI, BINA, CDB, BSRTI and one University viz. BAU. As coordinating organization, BARC arranged meeting, inception, training and review workshops. It also monitored and evaluated technical activities at field and laboratory levels as well as edited and compiled reports (half yearly, annual and sub-project completion reports) submitted by implementing organizations. Participating organizations collected germplasm from target areas following appropriate procedures and the germplasm were conserved preliminary in active/short term storage and were characterized following standard descriptors for respective crops.

In total 1184 germplasm of different crops were collected by implementing institutes where BARI collected 600 (Cereals -14, Pulses-39, Oilseeds-26, Vegetables-455, Spices-36, Fruits-14, Medicinal plants-12 and Other crops - 4), BRRI collected 247 rice, BJRI collected 35 (*Corchorus capsularis*-23, *Corchorus olitorius*-9 and *Hibiscus sabdariffa*-3), BSRI collected 68 sugarcane, BINA collected 199 (Rice-151, Chilli-5, Turmeric-2, Ginger-2, Bitter gourd-3, Brinjal-9, White gourd-3, Sweet gourd-3, Bottle gourd-1, Sponge gourd-1, Okra -3, Bean -8, Groundnut-4, Mustard-1, Sesame-2 and Black gram -1) and BAU collected 35 Yam germplasm during sub-project tenure.

In total 1936 germplasm were characterized morphologically under the sub-project among which BARI has characterized 844 (Pumkin-64, Cucmber-26, Brinjal-284, Bitter gourd-48, Mungbean-97, Bottle gourd-223, Amaranthus-80 and Guava -22), BRRI characterized 264 rice (T. aman-120, Boro-96, Aus -48), BJRI characterized 97 jute (Deshi jute-62 and Tossa jute-35), BSRI characterized 51 sugarcane, BINA characterized 141 (Rice-73, Sesame-30, Groundnut-33 and Chilli-5), CDB characterized 343 cotton, BSRTI characterized 60 mulberry and BAU characterized 136 (Banana-60, Aroids-45 and 31 Yam) germplasm during the project period.

Molecular characterization of 526 germplasm of different crops has been completed by the implementing organizations. Twenty five mustard germplasm were characterized by BARI, whereas 216 rice (T. Aman-120; Boro-48 and Aus-48) and 66 jute germplasm were characterized by BRRI and BJRI, respectively. Likewise, BINA and BAU characterized 83 rice and 136 (Banana-60, Aroids-45 and Yam-31) germplasm, respectively.

All the germplasm comprised of orthodox seeds collected by BARI, BRRI, BINA and BJRI have been conserved in short term storage/active collection in the respective institutes. After completion of necessary procedures the seeds will be conserved in the base collection/long term preservation units. Recalcitrant seed germplasm collected by BARI, BSRI and BAU have been conserved in field gene bank of corresponding organizations.

An outstanding achievement of the sub-project came out with the release of 15 varieties (Banana-5, Aroids-4 and Yam-5 and chewing type sugarcane variety-1) by BAU and BSRI, respectively. All the released varieties are supposed to bring a positive impact in nutrition improvement of the farming community as the varieties are known as potent source of various health promoting stuffs. However previously collected germplasm were also been evaluated under the sub-project. Five research articles (BAU-4; BARI-1) are published and six are under process (BRRI-2, BJRI-1, BINA-2 and BSRI-1) from the results of this research.

10. Methodology in brief:

10.3. Bangladesh Agricultural Research Institute

To fulfill the objectives of the sub-project a series of experiments and activities were conducted. Germplasm were collected from 69 upazilas of 12 AEZs of Bangladesh which were covered by six Regional Agricultural Research Stations (RARs), one Hill Agriculture Research Station (HARS) and one (1) Farming System Research and Development (FSRD) Site of On-Farm Research Division (OFRD) of Bangladesh Agricultural Research Institute (BARI). Regional stations were: (1) Jashore, (2) Ishwardi, Pabna, (3) Rahmatpur, Barishal, (4) Hathazair, Chattogram and (6) Burirhat, Rangpur; Hill Agriculture Research Station was Khagrachari; FSRD site was Kapasia, Gazipur (Fig. 19). Activity wise methodologies are stated below.

10.3.1. Exploration and Collection of Plant Genetic Resources

Fourteen (14) collecting missions were made for collection of different crops' germplasm (vegetables, cereals, oilseeds, pulses, spices, fruits and medicinal plants) from different regions of Bangladesh. Eleven teams such as NSR, SU, NRI, MRI, NSR, NQR, SN, SNQR, SAA, SSR and NQ were formed comprising 1-3 scientists in each team. Each expedition was conducted 2 to 6 days. Upazila wise collection sites are presented in Fig.19. Number of samples of a crop were depleted on the extent and availability of varieties observed during collection. The teams were equipped with plastic carton, GPS, compass, digital camera, hand lens, envelop, knife, scissors, drying sheet, pencil, stapler etc. Germplasm of target crops were collected from farmers' field/house/threshing floor and market especially from floating seed traders (Arora, 1991). Local extension services and scientists of BARI assisted the team in exploring the crops. Collector's number and date were recorded during collection. Name of crop species along with English, Bangla, local and cultivar name were recorded. Name of donor with ethnic group, village, union, upazila/thana, district, latitude and longitude were noted. Type of soil, topography, sample status, sample source, habitat, frequency, type of materials, cultural practices, season, sole or mixed with, sample type, sampling method, insect and disease, agronomic score and plant characteristics were documented. Passport Data Form was developed to record passport information. The samples were registered in Germplasm Collection Register after collection and conserved in medium term conservation unit following appropriate procedure. At least 2-4 sites in each region were sampled for collecting germplasm. A grid map of Bangladesh was used for demarcating the survey area and collection sites (Fig. 19). Germplasm were collected directly from the farmers during farm and home visiting. Collected germplasm are in progress of characterization in the PGRC, Gazipur research field. Data relating to passport and characterization are documenting in both hard copy and computerized data base system. Open-source programming tool MySQL has been used to develop database application software. Three Participatory Rural Appraisal (PRA) survey were conducted in the communities for documenting farmer's perception on conservation and utilization of plant genetic resources including the GI characters (if any).

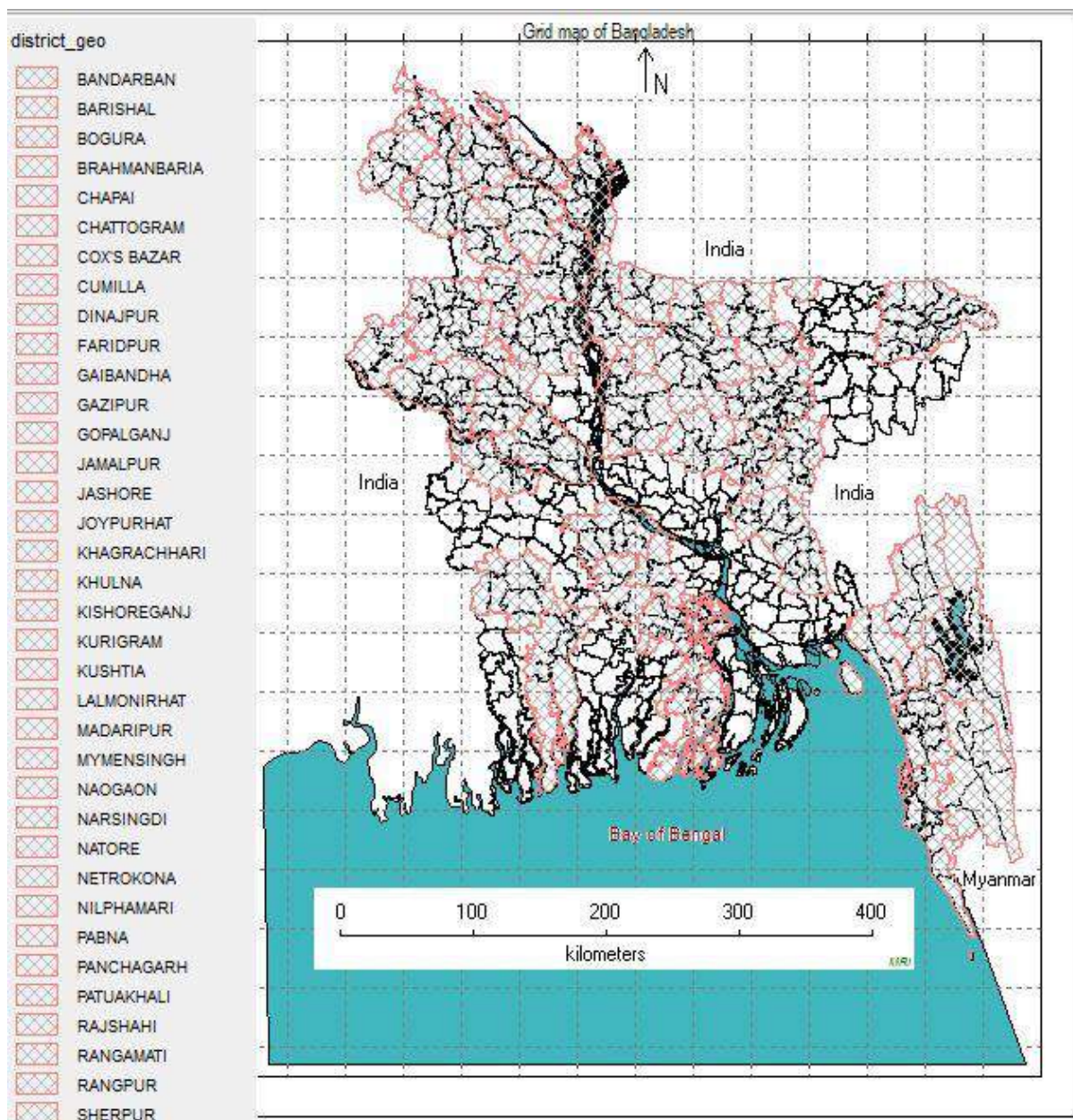


Fig. 19. Grid map of Bangladesh showing targeted collection sites

10.3.2. Morphological Characterization of Pumpkin Germplasm

The experiment was conducted at the Plant Genetic Resources Centre of BARI, Gazipur during winter 2017-18. Sixty-four (64) germplasm of pumpkin were sown in the plastic pot on 16 November, 2017. Plant spacing was 2x2 m and unit plot size was 3 x 4 m. The seedlings were transplanted on 10 December 2017. The recommended doses of manure and fertilizers such as 5 ton/ha cow dung, 100 kg N, 48 kg P, 80 kg K, 28 kg S, 3 kg Zn and 2.1 kg/ha B in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc-sulphate and boric acid were applied in the experimental field (FRG, 2012). The full doses of cow dung, TSP, MP, gypsum, zinc-sulphate and boric acid were applied during pit preparation before one week of transplanting. The urea was applied in the four installments as top dressing at 15, 35, 55 and 75 days after transplanting. Normal cultivation techniques and intercultural operations were followed to have a good crop.

Pheromone trap was used for insect control. Thirty-three observations on qualitative (21) and quantitative (12) characters were recorded as per Minimal Descriptors of Agri-Horticultural Crops. Part II (Srivastava, 2001). Range, mean, standard deviation and coefficient of variation of quantitative characters were calculated.

Descriptor and descriptor states of Pumpkin

A. Qualitative descriptor

1. Early plant vigor: 3 Poor, 5 Good, 7 Very good, 99 Others
2. Plant growth habit: 3 Short viny, 5 Medium viny, 7 Long viny, 99 Others
3. Stem pubescence density: 1 Smooth, 2 Pubescence, 99 Others
4. Stem shape: 1 Rounded, 2 Angular, 99 Others
5. Tendril: 0 Absent, 1 Present
6. Tendril type: 1 Coiled, 2 Straight, 99 Others
7. Tendril branching: 1 Unbranched, 2 Branched, 99 Others
8. Leaf margin: 1 Entire, 2 Serrate, 3 Multifid, 99 Others
9. Leaf shape: 1 Cordate, 2 Oblong, 3 Ovate, 4 Obovate, 5 Orbicular, 99 Others
10. Leaf size: 3 Small, 5 Medium, 7 Large, 99 Others
11. Leaf pubescence density: 0 No hairs, 3 Sparse, 5 Intermediate, 7 Dense, 99 Others
12. Color of leaf spot: 3= Silver
13. Sex type: 1 Monoecious, 2 Gynomonoecious, 3 Andromonoecious, 4 Androgynomonoecious, 5 Hermaphrodite, 6 Androecious, 99 Others
14. Peduncle shape: 1 Nearly, cylindrical, 2 Smoothly grooved, 3 Angular grooved, 99 Others
15. Fruit shape: 1 Globular (round), 2 Flattened, 3 Disk, 4 Cylindrical, 5 Elliptical (oval), 6 Acorn/Heart shaped, 7 Pyriform, 8 Dumbbell, 9 Elongate form, 10 Terminate superior, 11 Crowned, 12 Terminate inferior, 13 Curved, 14 Crooked neck, 99 Others
16. Mature fruit skin color: 1 Creamish, 2 Yellowish, 3 Green, 4 Red, 99 Others
17. Fruit skin pattern: 1 Uniform, 2 Mottled, 3 Striped, 99 Others
18. Stem end fruit shape: 1 Depressed, 2 Pointed, 3 Flattened, 4 Rounded, 99 Others
19. Blossom end fruit shape: 1 Depressed, 2 Pointed, 3 Flattened, 4 Rounded, 99 Others
20. Fruit ridge shape: 1 Superficial, 2 Rounded/Grooved, 3 Intermediate, 4 Deep grooved, 5 Narrowly winged, 99 Others
21. Mature flesh color: 1 Yellow, 2 Deep yellow, 3 Orange, 99 Others

B. Quantitative descriptor

1. Number of primary branches: Data were recorded as average of same 10 plants at the end of flowering stage. The branch that arises from the main vine/stem is known as primary branch.
2. Days to 1st male flower: Data were recorded at first appearance of male flower.
3. Days to 1st Female flower: Data were recorded at first appearance of female flower.
4. Nodal position of 1st male flower: Nodal position where the first male flower was appeared.
5. Nodal position of 1st female flower: Nodal position where the first female flower was appeared.
6. Number of ridges per fruit: Data were recorded in cross section at full maturity stage.
7. Flesh thickness (cm): Data were recorded as average of same 5-10 fruits at marketable stage.
8. Fruit length (cm): Data were recorded as average of 5-10 random fruits at marketable stage.

9. Fruit breadth (cm): Data were recorded as average of same 5-10 fruits at marketable stage.
10. Fruit weight (kg): Average fruit weight of five fruits per accession.
11. Number of fruits per plant: Data were recorded as total number of fruits in each picking.
12. TSS (Brix) %: Pulp tissues of pumpkin were cut into small pieces and measured by Brix meter. Data were recorded in percentage.

10.3.3. Characterization of Landraces of Cucumber

The experiment was conducted at the Plant Genetic Resources Centre Farm, BARI, Gazipur during the period from March to June, 2019. Twenty-six accessions of cucumber were included in this study. Among them eighteen accessions seed were finally harvested. Some of plant has died due to excessive rain just after transplanting of seedling. The materials collected from different parts of Bangladesh. The experiment was laid out in a non-replicated design. One accession represented one treatment, with two plants. The unit plot size was 2 m x 2 m maintaining 0.5 m between the plots. Treatments were randomly assigned to different plots of each block separately. After final land preparation, the bed was raised about 30 cm from the ground level. The cucumber seeds of different accessions dibbled in the pot on 12 March 2019. The seedlings were transferred to the field on 10 April, 2019. Necessary intercultural operations were done throughout the cropping season for proper growth and development of the plant. Trail was made with bamboo and plastic wire for proper growth and development of the cucumber plants. Harvesting of mature fruits continued up to end of June, 2019. Data were collected on qualitative and quantitative characters following descriptor and data were analyzed to find out the variable characters among associations of Cucumber.

Descriptor and descriptor states of Cucumber:

A. Qualitative descriptor

1. Plant growth type: 1 Indeterminate and 2 Determinate
2. Leaf intensity of green color: 1 Light, 2 Medium and 3 Dark
3. Tendril presence: 1 Presence and 0 Absence
4. Stem end fruit shape at table maturity stage: 1 Necked, 2 Acute and 3 Obtuse
5. Blossom end fruit shape at table maturity stage: 1 Flat and 2 Deep raised
6. Fruit skin texture at table maturity stage: 1 Smooth and 3 Rough
7. Fruit shape at table maturity stage: 1 Oblong, 2 Oval, 3 Ellipsoid and 4 Blossom end
8. Fruit skin color at table maturity stage: 1 Light green, 2 Yellowish green and 3 Green
9. Fruit skin color at mature harvest stage: 1 Brown and 2 Yellow

B. Quantitative descriptor:

1. Internode length (cm) at fruiting stage: Average of 10 internode length
2. Leaf length (cm) at fully developed leaves: Average of 10 fully developed leaf length
3. Leaf width (cm) at fully developed leaves: Average of 10 fully developed leaf width
4. Days to staminate flower: Days to produce male flower after sowing
5. Days to pistilate flower: Days to produce female flower after sowing
6. Fruit length (cm) at edible stage: Average of five fruit length.
7. Fruit width (cm) at edible maturity stage: Average of five fruit length.
8. No. fruit per plant: Average of fruits number per plant
9. 100 seed weight (g): Measured 100 seed weight after drying
10. Days to mature fruit harvest: Days to harvest mature fruit

10.3.4. Characterization of Brinjal Germplasm

The experiment was conducted in the experimental field of Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur during winter 2018-19. A total of 240 accession and four check varieties were used in this experiment. Direct seeding was done in the well-prepared seed beds on 14th November, 2018. Thirty-eight days aged seedlings were transplanted in the prepared pits of main experimental field on 28th December 2018. The plot size was 3x2.1 m². Each germplasm was planted in a plot of three rows. Row to row and plant to plant distance was 70x60 cm. The experimental design used in the study was Augmented Randomized Complete Block Design (Augmented RCBD) with four check varieties and 12 blocks. All check varieties received 12 replications, giving a total of 284 experimental plots. Fertilizer doses were 10 ton/ha Cowdung, 210 kg/ha Urea, 33 kg/ha TSP, 200 kg/ha MP and 5 kg/ha Borax (Mondal *et al.*, 2011). The full doses of Cow-dung, TSP and Borax were applied during land preparation before one week of transplanting. Urea and MP were applied in the three equal splits at 15, 35 and 50 days after transplanting. Weeding and mulching were done four times at 25 days' interval starting from mid-December. Individual net was used per plot to avoid the cross pollination. Sevin 75 WP @ 0.1 g/pit, Sumithion 60 EC @ 2.5 ml/L and Vertimac 18 EC @ 1.2 ml/L were sprayed for controlling insect and mite, respectively. The Data were recorded as per the descriptor developed by IBPGR, 1990.

1. Accession number: This number serves as a unique identifier for accession and is assigned by the curators/gene bank scientist when an accession is entered into his collection. Once assigned this number should never be assigned to another accession in the collection. Even if an accession is lost, its assigned number is still not available for re-use. 'BD' letter has been used before the number to identify the accession that comes from the PGRC, BARI, Gazipur, Bangladesh.

2. Collector's number: Original number assigned by collector of the sample normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identifying duplicates in different collections.

Descriptor and descriptor states of Brinjal

A. Qualitative descriptor

1. Plant growth habit: 3- Upright, 5- Intermediate, 7- Prostrate
2. Leaf blade lobing: 3- Weak, 5- Intermediate 7- Strong, 9- Very strong
3. Leaf blade tip angle: 1-very acute (>15 cm), 3-acute (~45 cm), 5-intermediate (~75 cm), 7-obtuse (~110 cm)
4. Leaf prickles: 0- None, 5- Intermediate (6-10), 7 -Many (11-20), 9- Very many (>20)
5. Leaf hairs: 1-Very few (<20), 3- Few (20-50), 5- Intermediate (50-100)
6. Corolla color: 5-pale violet, 7-light violet, 9-bluish violet
7. Calyx color (to be recorded at flowering stage): 1 Green, 2 Light purple, 3 Dark purple, 99 other
8. Calyx spininess (to be recorded at flowering stage): 3 Smooth, 5 Medium thorny, 7 High thorny, 99 Others
9. Fruit calyx prickles: 0 None, 1 Few (1-5), 2 Many (>5), 99 Others
10. Fruit color distribution: 1 Uniform, 3 Mottled, 5 Irregular striped, 7 Regular striped, 99 Others
11. Fruit curvature: 1 None, 3 Slightly curved, 5 Curved, 7 Snake shaped, 8 Sickle shaped, 9 U shaped, 99 Others
12. Fruit apex shape: 3 Prostrate, 5 Rounded, 7 Depressed, 99 Others

13. Fruit cross section: Data were recorded at near maturity stage.
14. Fruit color at ripening: 1 Milky white, 2 Green, 3 Deep yellow, 4 Fire red, 5 Scarlet red, 6 Lilac red, 7 Purple, 8 Purple black, 9 Black, 10 Light purple, 99 Others
15. Fruit flesh density: 1 Very loose (spongy), 3 Loose (crumbly), 5 Medium compact, 7 Compact, 9 Very compact, 99 Others
16. Fruit position: 3 Pendent, 5 Semi pendent, 7 Erect, 99 Others
17. Seed color: 1 White, 2 Light yellow, 3 Grey yellow, 4 Brownish yellow, 5 Brown, 6 Brown black, 7 Black, 99 Others
18. Seed size: 3 Small, 5 Intermediate, 7 Large, 99 Others

B. Quantitative descriptor

1. Leaf blade length (cm): Averages of five mature leaf length were measured.
2. Leaf blade width (cm): Averages of five mature leaf width were measured.
3. Fruit length (cm): Fruit length was measured from the neck region to blossom end at mature stage.
4. Fruit width (cm): Fruit width was measured by slide calipers, placing in the middle position of the fruits.
5. 100 seed wt.: Data recorded as the weight of 100 mature and dry seeds.
6. Plant height (cm): Averages of five plant height of individual germplasm were measured.
7. Days to 50% flowering: Days required to 50% of the flowers to open.
8. Number of fruits per plant: The sum of the total fruit harvested at different date was divided by number of plants to get number of fruits per plant.
9. Yield per plant (g): The sum of the total fruit weight at different date was divided by number of plants to get yield (average) per plant.

10.3.5. Characterization of Landraces of Bitter Gourd

The experiment was conducted at the Plant Genetic Resources Centre of BARI, Gazipur during summer 2018-19. Forty-six germplasm along with two check varieties of bitter gourd were used in this study. Passport data of germplasm used in this experiment are given in Table 26. Two seeds were sown in each plastic pot (6 cm in diameter approximately) on 14 March 2019. Pits of 40x 40 x40 cm were prepared 10 days before transplanting the seedlings in the main field. Plant spacing was 2x2 m and unit plot size was 3 x 4 m with two replications. The seedlings were transplanted on 31 March 2019. The plants were given support of 4 m height bamboo stick. Two plants were used for each germplasm. The recommended doses of manure and fertilizers such as 5 ton/ha decomposed cow dung, 100 kg N, 40 kg P, 60 kg K, 20 kg S and 1.5 kg/ha B in the form of urea, triple super phosphate, muriate of potash, gypsum and boric acid were applied in the experimental field (FRG, 2012). The full doses of cow dung, TSP, MP, gypsum and boric acid were applied during pit preparation before one week of transplanting. The urea was applied in the three installments as side dressing at 20, 40 and 60 days after transplanting. Normal cultivation techniques and intercultural operations were followed to have a good crop. Pheromone traps were used for controlling insects (Fig. 20). Data were recorded as per NBPGR (2001) descriptors for bitter gourd. Nevertheless, selection was done based on total fruiting period and yield for future use.



Fig. 20. Field view and pheromone trap

Descriptors and descriptor states of Bitter gourd

A. Qualitative descriptors

1. Classes of bitter gourd: 1 Uchche and 2 Korolla
2. Early plant vigor: 3 Poor, 5 Good and 7 Very good
3. Plant growth habit: 3 Short viny, 5 Medium viny and 7 Long viny
4. Stem pubescence: 0 Absent and 1 Present
5. Stem shape: 1 Rounded and 2 Angular
6. Twining tendency: 0 None, 3 Slight, 5 Intermediate and 7 Pronounced
7. Tendril branching: 1 Unifid, 2 Bifid and 3 Multifid
8. Leaf margin: 1 Entire, 2 Serrate and 3 Multifid
9. Leaf shape: 1 Ovate, 2 Obovate, 3 Cordate, 4 Oblong, 5 Reniform and 6 Orbicular
10. Leaf size: 3 Small 5 Medium 7 Large
11. Leaf pubescence: 0 No hairs, 3 Sparse, 5 Intermediate and 7 Dense
12. Sex type: 1 Monoecious, 2 Gynomonoecious, 3 Andromonoecious, 4 Hermaphrodite, 5 Androecious and 99 Others
13. Flower color: 1 White, 2 Light yellow, 3 Yellow and 4 Deep
14. Fruit shape: 1 Spindle, 2 Elliptical, 3 Oblong, 4 Long cylindrical, 5 Top shaped and 6 Globular
15. Fruit surface: 1 Smoot, 2 Light tubercle and 3 Deep tubercle
16. Nature of tubercles: 3 Sparse, 5 Medium and 7 Dense
17. Blossom-end fruit shape: 1 Blunt and 2 Acute
18. Fruit skin color: 4 Light green, 5 Green and 6 Dark green
19. Fruit skin luster: 3 Matt, 5 Intermediate and 7 Glossy
20. Fruit bitterness: 3 Mild, 5 Moderate and 7 Strong
21. Seediness: 3 Low, 5 Medium and 7 High
22. Seed luster: 3 Matt, 5 Intermediate and 7 Glossy

B. Quantitative Descriptors

1. Internode length (cm): Data were recorded as average of distance between 4th and 5th node on 2 plants at full foliage stage.
2. Petiole length (cm): Data were recorded as average of 5 random leaves in the middle region of the vine at full foliage stage.
3. Days to 50% flowering: No. of days required from sowing date to the date when at least 50% of the plants show first female flower open.
4. Sex ratio: Data were recorded as ratio of male flowers to female flowers on a plant at flowering stage.
5. Peduncle length (cm): Data were recorded as average of 5 random fruits at marketable stage.
6. Vine length (cm): Data were measured at peak fruiting stage from ground level to the tip of main stem on 2 plants.
7. Number of primary branches: Data were recorded as average of 2 plants at the end of flowering stage.
8. Days to first fruit harvest: Data were recorded as number of days from date of sowing to the date of first marketable fruit harvest.
9. Days to last fruit harvest: Data were recorded as number of days from date of sowing to the date of last marketable fruit harvest.
10. Number of marketable fruit harvest: Data were recorded as total number of fruit pickings.
11. Number of fruits per plants: Data were recorded as average of 2 plants.
12. Yield of marketable fruits per plant (g): Data were recorded as average of cumulative yield of all pickings in 2 plants.
13. Fruit weight (g): Data were calculated on the basis of fruit yield and number of fruits per plant.
14. Fruit length (cm): Data were recorded as average of 5 random fruits at marketable stage.
15. Fruit width (cm): Recorded as average of same 5 fruits at marketable stage.
16. Number of seeds per fruit: Data were recorded as average of 5 randomly selected mature fruits.
17. 100 seed weight (g): Data were measured as average weight of 100 randomly dry seeds.

10.3.6. Regeneration of Black Cumin and Fenugreek Germplasm

The regeneration and characterization program of different crops was performed at the experimental field of PGRC, BARI, Gazipur during 2018-19. All germplasm of different crops was sown in winter season. The plot having the size 3 x 2 m maintaining a space of 30 x10 cm and seed harvest was done. The required land for all the selected crops was prepared finely with special care and the crops were fertilized with recommended dose (Mondal *et al.*, 2011). After harvesting, the seeds were properly dried and cleaned to ensure seed quality for the conservation.

10.3.7. Characterization of Brinjal Germplasm (Set-II)

The experiment was conducted at the Regional Plant Genetic Resources Center, RARS, Ishwardi, Pabna during 2019-2020. The experiment involves thirty-six brinjal accessions. Main field was prepared 10 days before transplanting the seedlings. The recommended doses of manure and fertilizers such as 5-ton ha⁻¹ cow dung, 120 kg N, 36 kg P, 90 Kg K, 15 kg S and 2.0. kg ha⁻¹ Zn in the form of urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate (monohydrate), respectively were applied in the experimental field (FRG, 2018). The full doses of cowdung, TSP, gypsum and zinc sulphate were applied during land preparation before one week of transplanting. Urea and MP were applied in the three equal splits at 21,35 and 50 days after transplanting as ring method around the plant followed by irrigation (105) days interval during dry season. The experiment was conducted in a non-replicated design. The unit plot size was 3 m X 2 m and 9 plants were accommodated in a plot with a plant spacing of 75 cm apart and row to row distance of 100 cm (excluding 50 cm drain). The seedlings were transplanted on 19 October, 2019. The plants were given support of 1 m height bamboo sticks. Admire (0.5 ml per liter) was applied for controlling aphids. Twenty-five observations on qualitative (12) and quantitative (13) characteristics were classified into descriptor state as per Descriptors for Eggplant (IBPGR, 1990). Range, mean, standard deviation and coefficient of variation of quantitative characters were calculated.

Passport Descriptors

1. Accession number: This number serves as a unique identifier for accession and is assigned by the curators/gene bank scientist when an accession is entered into his collection. Once assigned this number should never be assigned to another accession in the collection. Even if an accession is lost, its assigned number is still not available for re-use. 'BD' letter has been used before the number to identify the accession that comes from the PGRC, BARI, Gazipur, Bangladesh.

Descriptor states of brinjal

A. Qualitative characteristics

1. Cotyledon color: 3 Green, 5 Light violet and 7 Violet
2. Plant growth habit: 3 Upright, 5 Intermediate and 7 Prostrate
3. Leaf blade lobing: 3 Weak, 5 Intermediate 7 Strong and 9 Very strong
4. Leaf blade tip angle: 1 Very acute (>15 cm), 3 Acute (~45 cm), 5 Intermediate (~75 cm) and 7 Obtuse (~110 cm)
5. Number of leaf prickles: Number of leaf prickles on upper surface of the leaf 0 None, 5 Intermediate (6-10), 7 Many (11-20) and 9 Very many (>20)
6. Leaf hairs: Number of hairs per mm² on lower surface of the leaf 1 Very few (<20), 3 Few (20-50) and 5 Intermediate (50-100)
7. Corolla color: 5 Pale violet, 7 Light violet and 9 Bluish violet
8. Fruit curvature: 1 None (fruit straight), 3 Slightly, 5 Curved and 7- Snake shaped
9. Fruit shape: 5 About 1/2 way from base to tip and 7 About 3/4 way from base to tip
10. Fruit apex shape: 3 Protruded, 5 Rounded and 7 Depressed
11. Fruit color at commercial ripeness: 1 Green, 2 Milk white, 5 Scarlet red, 6 Lilac grey, 7 Purple, 8 Purple Back and 9 Black
12. Fruit color distribution at commercial ripeness: 1 Uniform, 3 Mottled, 5 Netted and 7 Striped

B. Quantitative characteristics

1. Days to first flowering: Number of days required from planting to first opening of the flower. 3 Early (<91 days), 5 Optimum (91-105 days) and 7 Late (>105 days)
2. Days to 1st edible fruiting stage: Number of days required from planting to first edible fruiting. 3 Early (<121 days), 5 Optimum (121-130 days), 7 Late (>130 days)
3. Plant height (cm): Data were recorded on 5 randomly selected plants at edible fruiting stage, 3 Short (~30 cm), 5 intermediate (~60cm) and 7 Tall (61-100cm)
4. Plant breadth (cm): Data were recorded on 5 randomly selected plants at edible fruiting stage, 7 Broad (61-90cm) and 9 Very broad (91-105 cm)
5. Number of primary branches: Mean number of primary branches was measured on 5 randomly selected plants. 3 Weak (3-5) and 5 Intermediate (6-10)
6. Leaf blade length (cm): Data were recorded at vegetative stage. 3 Short (<10cm), 5 Intermediate (11-20 cm) and 7 long (21-30 cm)
7. Leaf blade width (cm): Data were recorded at vegetative stage. 3 Narrow (<5cm), 5 Intermediate (5-10 cm) and 7- Wide (11-15 cm)
8. Fruit length (cm): From base of calyx to tip of fruit: 1 Very short (<1 cm), 3 Short (3-5cm), 5 Intermediate (6-10cm), 7 Long (11-20cm) and 9 Very long (>20cm)
9. Fruit breadth (cm): Diameter at broadest part: 3 Small (2-3cm), 5 Intermediate (4-5cm), 7 Large (6-10cm) and 9 Very large (>10cm)
10. Number of fruits per plant: Mean number of edible fruits was measured on 10 randomly selected fruit. 1 Very low (<7), 3 Low (7-12), 5 Intermediate (13-18), 7 High (19-24) and 9 Very high (>25)
11. Fruit weight (g): Mean weight of edible fruit was measured on 10 randomly selected fruit. 3 Low (<30g), 5 Intermediate (30-60g) and 7 High (>60g)
12. Fruit weight per plant (kg): Mean weight of edible fruit was measured on 10 randomly selected fruit. 100-seed weight (g): Mean weight of 100 randomly selected seeds after sun drying. High (>0.40 g)

10.3.8. Characterization of Mungbean Germplasm

The experiment was carried out with 91 germplasm of mung bean with 6 check varieties at Plant Genetic Resources Centre, BARI, Gazipur during kharif 2020. The seeds were directly sown in prepared land dated on 08 March, 2020. The distance between line to line and accessions to accession was 30 cm and 50 cm in Augmented design with 6 check varieties. Measurement was performed on five individual plants of each accession. Optimum cultural practices were followed mung bean production system. Data were recorded in qualitative and quantitative traits as per pulse descriptor on International Board for Plant Genetic Resources (IBPGR).

Descriptors and Descriptor states

A. Qualitative characters

1. Hypocotyl color (Data were recorded at seedling stage): 1 Green
2. Epicotyl color (Data were recorded at seedling stage): 1 Light green
3. Growth habit (Data were recorded at vegetative stage): 1 Erect
4. Growth pattern (Data were record when the first pod change color): 2 Determinate

5. Terminal leaflet shape (Data were recorded at vegetative stage): 1 Deltoid and 2 Ovate
6. Terminal leaflet length (Data were recorded for the leaf at fourth node): 1 Small (<10 cm)
7. Leaf pubescence (Data were recorded for the leaf at fourth node): 1 Glabrous
8. Leaf color (Data were recorded at 50% flowering stage): 2 Green
9. Petiole color (Data were recorded at 50% flowering stage): 2 Greenish purple
10. Petiole length (Data were recorded for the leaf at fourth node): 1 Short (<12 cm) and 2 Medium (12-18 cm)
11. Raceme position (Data were recorded when the first pod change color): 1 Mostly above canopy and 2 Intermediate
12. Calyx color (Data were recorded when the first pod change color): 1 Green
13. Corolla color (Data were recorded at full blossom at about 8-10 a.m.): 1 Yellow
14. Pod color at immature stage (Data were recorded at fruiting stage): 2 Deep green
15. Pod color at mature stage (Data were record at maturity stage): 4 Black
16. Leafiness (Data were recorded at 50% flowering stage): 1 Sparse, 5 Medium and 9 Abundant
17. Seed color (Data were recorded after harvest of seed): 1 Deep green and 2 Deep brown

B. Quantitative characters

1. Days to germination: This was recorded in days from sowing to seed germination
2. Days to 1st flowering: This was noted from date of sowing of seeds to 1st flowering
3. Days to 50% flowering: This was noted from date of sowing to 50 % plants with flowering
4. Number of primary branches per plant: Number of branches from base level per plant
5. Plant height (cm): Plant height was measured in centimeter from ground level to tip of main axis of the plant.
6. Number of pods per plant: Number of pods per plant was counted on five randomly selected plants and averaged.
7. Pod length (cm): Length of pod was measured in centimeter. Mean length of five pods from each plant was considered and averaged.
8. Number of seeds per pod: Seeds of five pods from each plant were counted and averaged.
9. 100 seed weight (g): The test weight of 100 counted seeds was recorded in grams for individual germplasm
10. Seed yield per plant (g): The selected plants were harvested, threshed and winnowed separately.

10.3.9. Characterization of Bottle gourd Germplasm

The experiment was conducted at the Plant Genetic Resources Center, BARI, Joydebpur, Gazipur during 2019-2020. Two hundred eighteen (218) accessions of bottle gourd collected from different districts and five (5) check varieties were taken in this study. The seeds were sown in poly bags on 13 November, 2019. After 15 days, the seedlings were transplanted in prepared pits in the field. Lay out: Pit to pit and line to line distance was 4m X 4m. The experiment was conducted in Augmented design with 5 check varieties.

Fertilizer: When land was prepared the following fertilizers and manure were mixed in each pit, Cow dung-10kg, Urea- 50g, TSP-200g and MP-150g, Gypsum-75g. In vegetative stage, 20g Urea with water was sprayed per pit. Normal cultivation techniques, intercultural operations and irrigations were followed to grow the crop. Observations were recorded on eighteen (19) qualitative and fifteen (15) quantitative traits as per IBPGR Cucurbitaceae descriptor.

Descriptors and descriptor states

A. Qualitative characters

1. Early plant vigor: 3 Poor, 5 Good, 7 Very good and 99 Others
2. Plant growth habit: 3 Short viny, 5 Medium viny, 7 Long viny and 99 Others
3. Stem Pubescence: 0 Absent, 3 Sparse, 5 Medium, 7 Dense and 99 Others
4. Stem shape: 1 Rounded, 2 Angular and 99 Others
5. Tendril: 0 Absent and 1 Present
6. Tendril type: 1 Coiled, 2 Straight and 99 Others
7. Tendril branching: 1 Unbranched and 2 Branched
8. Leaf margin: 1 Entire, 2 Serrate, 3 Multifid and 99 Others
9. Leaf shape: 1 Cordate, 2 Oblong, 3 Ovate, 4 Obovate, 5 Orbicular, 6 Reniform, 99 Others
10. Leaf size: 3 Small, 5 Medium, 7 Large and 99 Others
11. Leaf pubescence nature: 3 Soft, 5 Intermediate, 7 Hard and 99 Others
12. Calyx color: 1 Green
13. Leaf pubescence density: 0 No hairs, 3 Sparse, 5 Intermediate, 7 Dense, 99 Others
14. Sex type: 1 Monoecious, 2 Gynomonoecious, 3 Andromonoecious, 4 Androgynomonoecious, 5 Hermaphrodite, 6 Androeious and 99 Others
15. Flower color: 1 White, 2 Cream and 99 Others
16. Fruit shape: 1 Elliptical, 2 Elongate, 3 Pyriform, 4 Oblong, 5 Club shaped, 6 Top shaped, 7 Globular, 8 Dumbbell shaped, 9 Kamandal shaped, 10 Lengthened cylindrical and 99 Others
17. Matured fruit skin color: 1 Light green, 2 Green, 3 Dark green, 4 Patchy green and 99 Others
18. Fruit pubescence: 0 Absent and 1 Present
19. Fruit pubescence density: 3 Low, 5 Medium, 7 High and 99 Others

B. Quantitative characters

1. Days to seed germination: Data were recorded in days from sowing to seed germination
2. Internode length (cm): Data were recorded the distance between 4th and 5th node in random 5 plants at full foliage stage
3. Petiole length (cm): Data were recorded as average of 5 random leaves in the middle region of the vine at full foliage stage
4. Days to 1st flowering: Data were recorded as number of days from sowing date to the date when the first flower open
5. Nodal position of 1st female flower: Data were recorded the nodal position where the first female flower open
6. Days to 1st male flower: Data were recorded as number of days from sowing date to the date when the first male flower open

7. Nodal position of 1st male flower: Data were recorded the nodal position where the first male flower open
8. Peduncle length (cm): Data were recorded as average of 5 random fruit at edible stage
9. Days to edible fruit: Data were recorded as number of days from sowing date to the date of edible fruiting stage
10. Fruit length (cm): Data were recorded as average of 5 random fruits at matured stage
11. Fruit width (cm) Data were recorded as average of 5 random fruits at matured stage
12. Fruit weight at matured stage (kg): Data were recorded as average weight of 5 random fruits in centimeter at matured stage
13. 1000 seed wt. (g): Data were recorded as average weight of 1000 random dry seeds (g)
14. Number of fruits per plant: Data were recorded of the number of fruits per plant in edible stage
15. Yield per plant (kg): Data were recorded for total fruit yield per plant in edible stage

10.3.10. Characterization of Amaranth Germplasm

The experiment was conducted in augmented block design at the Plant Genetic Resources Centre of BARI, Gazipur during winter 2019-20. Eighty accessions of amaranth were considered in this study. Line sowing was done on 2 rows in 3m long plot maintaining 15 cm plant spacing. Row to row distance was 50 cm and plot to plot distance was 100 cm (Fig. 21). The seeds were sown on 09 December 2019. Chemical fertilizers such as urea 250 kg/ha, TSP 100 kg/ha, MoP 150 kg/ha and gypsum 75 kg/ha were applied (FRG, 2018). The half quantity of urea and all TSP, MoP and gypsum were applied during land preparation. Urea was applied in two equal installments at 25 and 45 days after sowing. Sevin 20 WP was applied periodically in early stage to control ants. Normal cultivation techniques and intercultural operations were followed to have a good crop. Data were recorded as per NBPGR (2001) descriptors for Amaranth. However, under the pandemic status of the world due to COVID-19 some of the parameters stated in the descriptor were not possible to execute.



Fig. 21. Amaranth germplasm characterization (A) and classes of amaranth (B).

Descriptors and descriptor states of characterization

A. Qualitative descriptor

1. Classes: 1 Leaf amaranth, 2 Stem amaranth and 3 Grain amaranth
2. Early plant vigor: 1 Poor, 2 Good and 3 Very good
3. Plant growth habit: 1 Erect, 2 Spreading and 3 Drooping
4. Leaf color: 5 Green, 10 Reddish green, 11 Red and 12 Dark red

5. Inflorescence color: 3 Yellowish orange, 8 Purple, 9 Red, 10 Reddish green and 11 Green
6. Inflorescence compactness: 3 Lax, 5 Intermediate and 7 Dense
7. Stem color: 5 Red, 6 Reddish green and 8 Green
8. Stem surface: 1 Smooth and 2 ridged
9. Inflorescence shape: 1 Globose, 2 Semi drooping, 3 Completely drooping and 4 Straight
10. Inflorescence spininess: 1 Smooth, 2 Glabrous, 3 Prickly and 4 Spiny
11. Seed shattering: 3 Low (%), 5 Intermediate (10-50%) and 7 High (>50%)
12. Seed color: 2 Creamish, 5 Red and 7 Black

B. Quantitative Descriptors

1. Number of days to germination: Data were counted from the sowing date to the day when 50% of seeds in a row germinated.
2. Leaf length (cm): Data were recorded on fully grown leaf at the heading stage.
3. Petiole length (cm): Data were recorded at heading stage.
4. Number of days to 50% flowering: Data were counted from the sowing date to the day when 50% of plants in a row flowered.
5. Number of branches per plant: Data were counted as number of branches on the main stem (average of 5 random plants).
6. Plant height (cm): Data were measured from ground level to the highest tip of inflorescence.
7. Lateral spikelet length (cm): Data were recorded on longest lateral spikelet.
8. Inflorescence length (cm): Data were recorded at maturity time (average of 5 random plants).
9. Seed yield per plant (g): Data were recorded as weight of fully dried seeds per plant (average of 5 randomly selected plants).
10. 1000 seed weight (g): Data were recorded as weight of thousand random seeds in grams (average of 5 random plants).

10.3.11. Characterization of Guava Germplasm

The study was conducted in the fruit orchard of Agricultural Research Station (ARS), Pahartali, Chattogram and Regional Agricultural Research Station (RARS), Hathazari, Chattogram during 2019-20. About 22 diverse guava germplasm were included in the experiment. The Data were recorded as per the descriptors for guava.

Descriptor states of characterization

A. Qualitative descriptor

1. Leaf shape: 2 Oblong, lanceolate and 3 Elliptical
2. Mature leaf Color: 1 pale green and 2 green
3. Fruit shape: 2 Globose, 3 Pear shape and 4 Oblong
4. Fruit surface: 1 Smooth, 2 Bumpy and 3 Ridge
5. Fruit skin color: 3 Yellow white and 4 Greenish white
6. Pulp color: 1 White, 2 Creamy white, 3 greenish white and 6 light red
7. Pulp texture: 1 Very soft, 3 Soft and 5 Medium hard
8. Pulp flavor: 3 Mild and 5 Moderate

9. Fruit taste: 3 Less sweet, 5 Medium sweet and 7 Highly sweet
10. Seediness: 0 Seedless, 3 Low, 5 Medium and 7 High
11. Seed hardness: 3 soft, 5 intermediate and 7 hard

B. Quantitative Descriptors

1. Plant height (m)
2. Base girth (cm)
3. No. of branch
4. Canopy (N-S)
5. Canopy (E-W)
6. Fruit diameter (cm)
7. Fruit length (cm)
8. TSS (%)
9. Fruit weight (g)
10. Yield/ plant (kg)

Data were recorded like Plant height (m), Base girth (cm), NO. of branch, Canopy (N-S), Canopy (E-W), Leaf shape, Mature leaf Color, Fruit shape, Fruit surface, Fruit dia (cm), Fruit length (cm), Fruit weight (g), Fruit skin color, Pulp color, Pulp texture, Pulp flavor, Fruit taste, TSS, Seediness, Seed hardness and Yield/ plant (kg).

10.3.12. Molecular Characterization of Rapeseed-Mustard Germplasm using SSR Markers

Plant sample and extraction of genomic DNA

The study “molecular characterization of rapeseed-mustard germplasm using SSR markers” was carried out at the Molecular Biology Lab., PGRC, BARI, Gazipur. In total 25 rapeseed-mustard germplasm (seven varieties, nine land races/local cultivars and nine advance lines are used as test materials (Table 25). Total genomic DNA was purified from young fresh leaf tissues following Sodium Dodecyl Sulphate (SDS) extraction (phenol: chloroform: isoamyl alcohol (25:24:1,v/v/v). DNA quality was checked by electrophoresis and quantified using a spectrophotometer (Spectronic[®] Genesis[™], New York, USA).

Table 25. List of mustard germplasm used for molecular characterization

Sl. No.	Genotypes	Species	Source	Status	Sl No	Genotypes	Species	Source	Status
1	BD-6952	<i>B. rapa</i>	PGRC, BARI	TC	14	BD-10108	<i>B. napus</i>	PGRC, BARI	TC
2	BD-6957	<i>B. juncea</i>	PGRC, BARI	TC	15	BD-10115	<i>B. juncea</i>	PGRC, BARI	TC
3	BD-7104	<i>B. juncea</i>	PGRC, BARI	TC	16	JBC-05117	<i>B. rapa</i>	ORC, BARI	AL
4	BD-7115	<i>B. rapa</i>	PGRC, BARI	TC	17	BARI Sarisha-10	<i>B. juncea</i>	ORC, BARI	RV
5	BD-10111	<i>B. rapa</i>	PGRC, BARI	TC	18	BARI Sarisha-11	<i>B. juncea</i>	ORC, BARI	RV
6	BD-10112	<i>B. rapa</i>	PGRC, BARI	TC	19	BARI Sarisha-16	<i>B. juncea</i>	ORC, BARI	RV
7	Nap-0564	<i>B. napus</i>	ORC, BARI	AL	20	SAU-01	<i>B. juncea</i>	SAU, Dhaka	RV
8	Jun-536	<i>B. juncea</i>	ORC, BARI	AL	21	Nap-0567	<i>B. napus</i>	ORC, BARI	AL
9	BJDH-12	<i>B. juncea</i>	ORC, BARI	AL	22	Tori-7	<i>B. rapa</i>	ORC, BARI	RV
10	BARI sarisha-8	<i>B. napus</i>	ORC, BARI	RV	23	BD-7114	<i>B. rapa</i>	PGRC, BARI	TC
11	BARI sarisha-13	<i>B. napus</i>	ORC, BARI	RV	24	BD-9343	<i>B. rapa</i>	PGRC, BARI	TC
12	BD-6950	<i>B. juncea</i>	PGRC, BARI	TC	25	BD-9348	<i>B. rapa</i>	PGRC, BARI	TC
13	BD-6958	<i>B. rapa</i>	PGRC, BARI	TC					

PGRC: Plant Genetic Resources Centre; BARI: Bangladesh Agricultural Research Institute; ORC: Oil Seed Research Centre, SAU: Sher-e-Bangla Agricultural University; TC: Traditional cultivar; AL: Advance Line; RV: Released Variety

Selection of Simple Sequence Repeats (SSR) primers

In total 15 SSR primers were employed for diversity analysis and among the primers 10 were polymorphic (Table 25a). Diversity analysis was performed following Turi *et al.*, 2012 with minor modifications. PCR reactions were carried out in 10 µl volume containing 5X Green GoTaq® Reaction Buffer (Promega, USA) (15 mM MgCl₂, 1.25 U Taq DNA polymerase, 0.4 mM each of the dNTPs, 10 µM forward and reverse primers and 50 ng template DNA). The mixtures were prepared at 0°C and transferred to the thermal cycler. The reaction was carried out in Mastercycler® nexus Gradient thermal cycler (Eppendorf, Germany). Amplified products were stored at 4°C until further use. The reproducibility of the amplified products was checked twice for each primer.

Thermal profiles for SSR markers

Step	Temperature (°C)	Time	No. of cycle
Initial	94	3 min	1
Denaturation	94	1 min	35
Annealing	50-54	1 min	
Primer elongation	72	1 min	
Final extension	72	10 mins	1

Table 25a. List of test primers

Sl.	Locus	Forward Primer	Reverse Primer	Motif type	Ann.T.	Exp. Size (bp)
1.	Ol11-C02	gcattgcaatctgttggtc	cgttccatacagatcgtaagac	di GT/CA	54°C	132
2.	Ra2E07	attgctgagattggctcagg	cctacacttgcgatcttcacc	di GA/CT	54°C	152
3.	Ra2-F11	tgaaactagggtttccagcc	cttcaccatgggtttgtccc	di GA/CT	52°C	240
4.	Na12D04	acggagtgatgatgggtctc	cctcaatgaaactgaaatatgtg g	di GT/CA	52°C	241
5.	Ni3G04b	atactgggataggtgtgcg	catgtggcaatcctacatttac	di GA/CT	54°C	123
6.	Ol12A04	tggttaagtaactgtggtggc	agagttcgcatactctggagc	di GA/CT	54°C	144
7.	Na10-D03	atgatttgcttgaaatgcc	gatgaaacaataacctgagacacac	di GT/CA	52°C	158
8.	Na12-A02	agccttggtgctttcaacg	agtgaatcgatgatctcgcc	di GA/CT	54°C	190
9.	Na12-E01	attccatgactccattgtc	aaatccctgtctctgtcg	di GA/CT	54°C	244
10	Ni4-B10	gtccttgagaaactccaccg	ccgatcccatttctaattccc	di GA/CT	54°C	194

Electrophoretic separation and visualization of amplified products

Amplified products were electrophoresed on a 5% denaturing polyacrylamide gel containing 19:1 acrylamide: bis-acrylamide, 10X TBE buffer, 10% APS and ultrapure Temed. Electrophoresis was done using the Triple Wide Mini-Vertical Electrophoresis System, MGV-202-33 (CBS Scientific, USA) using cooling system (Julabo, Germany). After electrophoresis, separation the gel was stained with ethidium bromide (0.1%) and the individual bands were scored for analysis.

Scoring and analysis of microsatellite data

SSR markers were scored as co-dominant, so homozygous and heterozygous genotypes could be distinguished in individual plants. The bands representing particular alleles at the microsatellite loci were scored manually and designated as A, B, C, etc. from the top to the bottom of the gel. The genotypes of different individuals were hypothetically scored as AA, BB, CC, etc. for homozygous or as AB, AC, BC etc. for heterozygous. A single genotypic data matrix was constructed for all loci. This was use to estimate polymorphic loci, genetic variation (Nei's gene diversity, Shannon's information index), gene distance and construct a UPGMA dendrogram using computer program POPGENE (Version 1.31) POPGENE (Version 1.31) (Yeh *et al.*, 1999).

The polymorphism information content (PIC) of the SSR used or gene diversity value was calculated as $PIC = 1 - \sum f_{ij}^2$; where f_{ij} is the frequency of the i th allele for the j th SSR locus (Anderson *et al.* 1993). The software DNA FRAG version 3.03 was used to estimate allelic length (Nash, 1991).

10.3.13. Database Development and Data Entry for Germplasm Documentation

Building the system

1. Listing of required information
2. Building empty structures of database files/tables
3. Setup links between different database files
4. Developing screen forms for entering, modifying searching and deleting data
5. Developing report for information retrieval

Building of screen form

- Background information of PGRC, genebank, objectives, requirements of each management procedure, identification of descriptor occurring with the germplasm and data formats analyzed thoroughly
- Passport data, characterization data, evaluation data, distribution and management data selected
- Designing of landing page with general information, purpose of the genebank, guidelines and information/services obtained
- Forms for data entry, data modification, distribution of germplasm and related management procedures designed
- Open-source programming tools php-MySQL, CSS, Java script adopted for designing homepage, data entry/editing forms (Fig. 22).



Fig. 22. Homepage of created database for administrators and users

Curators can manage their data themselves and print various reports along with the customized queries. Facilitate multiple accesses for the user for obtaining limited source of information for research purposes (Fig. 23).



Fig. 23. Data entry/data modification forms for the users

Define data file- Open-source programming tools MySQL was used to develop web-based database application (Fig. 24). A data entry form displaying all fields in each data file has been developed for data entry and modification. CSS, Java script, J-Quarry Ajax etc. were used to develop the screen form. The screen form has options of viewing data and saving the data too. The stored data can be updated locally or on network, distributed centralized data to off-site systems, and enable third party data sharing. Operational activities like data entry, data edit etc. will be done offline mode.

[illegible]

Fig. 24. Passport data entry form

Publication for wider access

Information about germplasm conserved at gene bank is being made available to the breeders and researcher through uploading publication, annual reports, catalogues.

10.3.14. Development of Mobile Applications for PGR Passport Information Collection

Description of Technical Area:

A. Developing Tools(s):

- (i) Framework: Flutter (A Google Product. Most recently introduced and most sophisticated cross platform customize smart phone application developing technology.)
- (ii) Language: DART (A Google Product)
- (iii) Database: Firebase (A Cloud based Data Storage)
- (iv) UI/UX: Adobe XD (An Adobe Corporation Product)

B. Why we use these tool(s):

Since Google ruled over the time in the field of Technology World that's why we have been selected a Google product "Flutter". It is cross platform compatible single code base which support simultaneously Android device and iOS devices.

C. Apps Name: BARI PGR Passport App

D. Apps Feature:

- (i) Fully Automated
- (ii) Cloud based database
- (iii) Dual language supported

10.4. Bangladesh Jute Research Institute

10.4.1. Germplasm collection

Effort of genetic exploration of JAF crops has been made from Chattogram, Khulna, Rangpur and Barishal Divisions. Collection mission was made in Rangpur, Kurigram, Nilphamary, Panchagarh, Dinajpur, Bogura, Cumilla, Patuakhali, Barguna and Barishal districts during February 2018 to November 2020. The collection program was mission oriented, targeting season and location specific and involving different GO, NGO and private sector personnel. A grid map of Bangladesh was used for the demarcating survey area and collecting sites. Germplasm were collected from the farmers and seed store of collecting sites (Fig. 25). Collected germplasm were processed and characterized in the Manikganj Research Station. Useful information was gathered from local Agricultural Officers, forest officers and community leaders, which facilitated collection programme. Jute and allied fibre (JAF) germplasm were collected from 20 upazilas of Kurigram, Nilphamari, Panchagarh, Dinajpur, Bogura, Rangpur, Patuakhali, Barisal, Barguna and Cumilla districts. Collectors explored the target areas and the selected germplasm were recorded with passport information as per prescribed passport data form during germplasm collection. Seven collection teams were made for this purpose comprising one to two members in each team.

Collection team for collecting of germplasm

Collector's code	Collection team
RS	Md. Rafiqul Islam & Dr. A. K. M. Shahadat Hossain
AS	Dr. Md. Ayub Khan & Dr. A. K. M. Shahadat Hossain
ACK	Dr. Md. Ayub Khan & Dr. Chandan Kumar Saha
FM	Dr. Abul Fazal Mollah
FMN	Dr. Abul Fazal Mollah & Noor A Alam
TZ	Md. Tipu Sultan & Md. Zahidul Islam.
TP	Md. Tipu Sultan & Md. Parvez Howlader

The teams were equipped with GPS apps, compass apps, digital camera, envelop, knife, scissors, ball pen, pencil, stapler etc. Targeted farmers for collection of germplasm were located with the help of field level workers of Department of Agricultural Extension (DAE) and other research personnel of different research institutes. Each expedition was conducted 2 to 5 days. At least 2-4 sites in each region were sampled for collecting Jute germplasm.

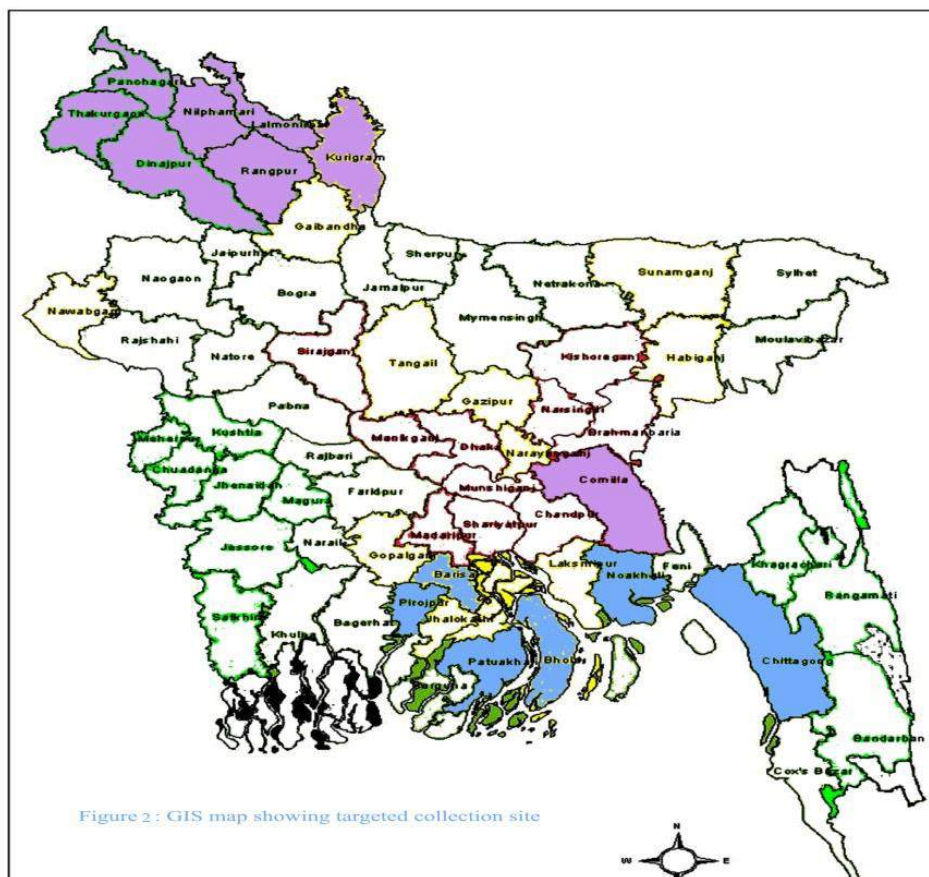


Fig. 25. Germplasm collection sites on map

10.4.2. Conservation

BJRI has to conserve 90 jute and allied fibre germplasm collected from target areas and seed received from different sources. The collected germplasm were cleaned, processed, dried and conserved in short term storage room of BJRI Gene Bank at Manilmia Avenue, Dhaka. The collected JAF germplasm samples were registered in conservation book immediately after collection (February 2018 to November 2020). Each sample was assigned a registration number according to the source of acquisition and passport information. The collected germplasm have so far been conserved in short term storage as an active collection.

10.4.3. Morphological Characterization

BJRI has characterized 90 germplasm of JAF crops at morphological level. A total of 27 deshi jute germplasm were characterized at morphological level during 2019. In the year of 2020, thirty five deshi jute and thirty five tossa jute germplasm were also characterized at the Jute Agriculture Experimentation Centre, Jagir, Manikganj by two separate experiment.

Single row of 4 m length for each germplasm was maintained. Row to row distance was 30 cm and about 5-6 cm between plants. The plot was fertilized with recommended doses of cow dung (5 ton/hac), 100 kg/hac urea, 25kg/h TSP and 45 kg/hac Murate of Potash respectively. The whole amount of TSP, MP and half of urea were applied at final land preparation. The remaining half urea was applied in the equal installments of the 1st (20 days after sowing) and final (45 days after sowing) weeding. Appropriate control measures were taken for insect pests, diseases and weeds as and when necessary. Data on six qualitative and 15 quantitative traits were recorded according to standard descriptors of jute.

A. Qualitative descriptor

1. Stem color: 1 Green, 2 Red and 99 Others (light red)
2. Leaf shape: 1 Ovate, 2 Ovate-lanceolate, 3 Lanceolate, 4 Elliptical, 5 Cordate and 6 Other (specify).
3. Leaf lamina color: 1 Green, 2 Red and 99 Others (light red)
4. Leaf vein color: 1 Green, 2 Red and 99 Others (light red)
5. Petiole color: 1 Green, 2 Red and 99 Others (light red)
6. Stipule: 0 Absent and Present 1
7. Stipule color: 1 Green, 2 Red and 99 Others (light red)

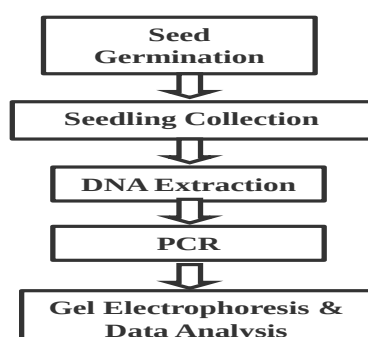
B. Quantitative descriptor

1. Plant technical height (cm): The height of the main stem measured from soil level to the point of forking at pre bud stage.
2. Node no. : Total number of nodes on main stem from soil surface to technical height at harvest time.
3. Stem diameter basal (mm): Measured as close to soil surface as possible using slide calipers at harvest time.
4. Stem diameter Middle (mm): Measured at midpoint between base and top at harvest time.
5. Stem diameter top (mm): Measured at the point of forking i.e. at technical height at harvest time.
6. Basal core diameter (mm): Measured at same position as base diameter but after removal of outer bark to expose core (stick) at harvest time.
7. Dry fibre wt. (g): Average of all 10 plants after defoliation, retting, fibre extraction and drying of fibre.
8. Dry stick wt. (g): Average of all 10 plants After defoliation, retting, fibre extraction and drying of core (stick).
9. Branch habit: 0-Non-branching no Growth of axillary bud, 1- Very weak, 3-Weak, 5-Intermediate, 7-Strong, 9-Very Strong.
10. Leaf angle: The angle between the stem and the line connecting; the base and the centre of midrib of the leaf at pre-bud stage Measure the 10 leaves starting from the 6th leaf from top of main stem (i.e. ignore first 5 leaves). 1 for 0-20⁰ ...erect, 2 for 21-40⁰..., 3 for 41-60⁰.... intermediate, 4 for 61-80⁰..., 5 for 81-100⁰....horizontal, 6 for 101-120⁰..., 7 for 121-140⁰...descending, 8 for 141-160⁰..., 9 for 161-180⁰...drooping.
11. Leaf length (cm): Average maximum length of 10 starting from the 6th leaf from top of main stem (i.e. ignore first 5 leaves) at pre-bud stage.

12. Leaf width (cm): Average maximum width of 10 starting from the 6th leaf from top of main stem (i.e. ignore first 5 leaves) at pre-bud stage.
13. Petiole length: Measurement in mm. using same 10 leaves at pre-bud stage.
14. Leaf area (sq. cm): Average area of 10 leaves from the 6th leaf from the top of stem. Calculate from length and maximum breadth or use leaf area at pre-bud stage.

10.4.4. Molecular Characterization

A total of 66 jute germplasm including 15 varieties have been characterized at molecular level using SSR primers. DNA was extracted from 4 days old seedlings using modified mini preparation CTAB method. Electrophoresis was conducted with 8% Polyacrylamide gel in vertical gel electrophoresis system. 1kb⁺ DNA ladder was used for allele scoring. Gel documentation system was used for visualization of DNA bands. Three software were used for Data analysis. Molecular weight for each amplified allele was measured in base pair using Alpha Ease FC 4.0. The summery statistics including the number of alleles per locus, major allele frequency, genetic diversity, polymorphism information content values were determined using Power Marker version 3.25. NTSYS-pc was used to construct dendrograms showing relationship among the genotypes.



10.5. Bangladesh Sugarcrop Research Institute

10.5.1. Germplasm collection

Local germplasm were collected from 31 upazilas of 20 districts of Bangladesh. The collection program was mission oriented, targeting season and location specific and involving different GO, NGO and private sector personnel. For collection, especial emphasis was given on remote areas like hilly, coastal and beel/haor areas. Three collecting mission were made for collection of sugarcane germplasm. On the other hand, short visit and personal communication was also practiced for germplasm collection. Sugarcane germplasm were collected from 31 upazilas of 20 districts. The teams were equipped with GPS apps, compass apps, digital camera, envelop, knife, scissors, ball pen, pencil, stapler etc. Targeted farmers for collection of germplasm were located with the help of field level workers of Department of Agricultural Extension (DAE) and other research personnel of different research institutes. Collector's name, number and date were recorded during collection. Name of crop species along with English, Bengali, local and cultivar name were recorded. Name of donor with ethnic group, village, union, upazila, district, latitude and longitude were noted. A 'Passport Data Form' having passport information was filled up during germplasm collection. Planned areas for collection are shown in Fig. 26.

Collector's no.: Original number assigned by collector of the sample normally composed of the name or initials of the collectors followed by a number. The item is essential for identifying duplicates in different collections.

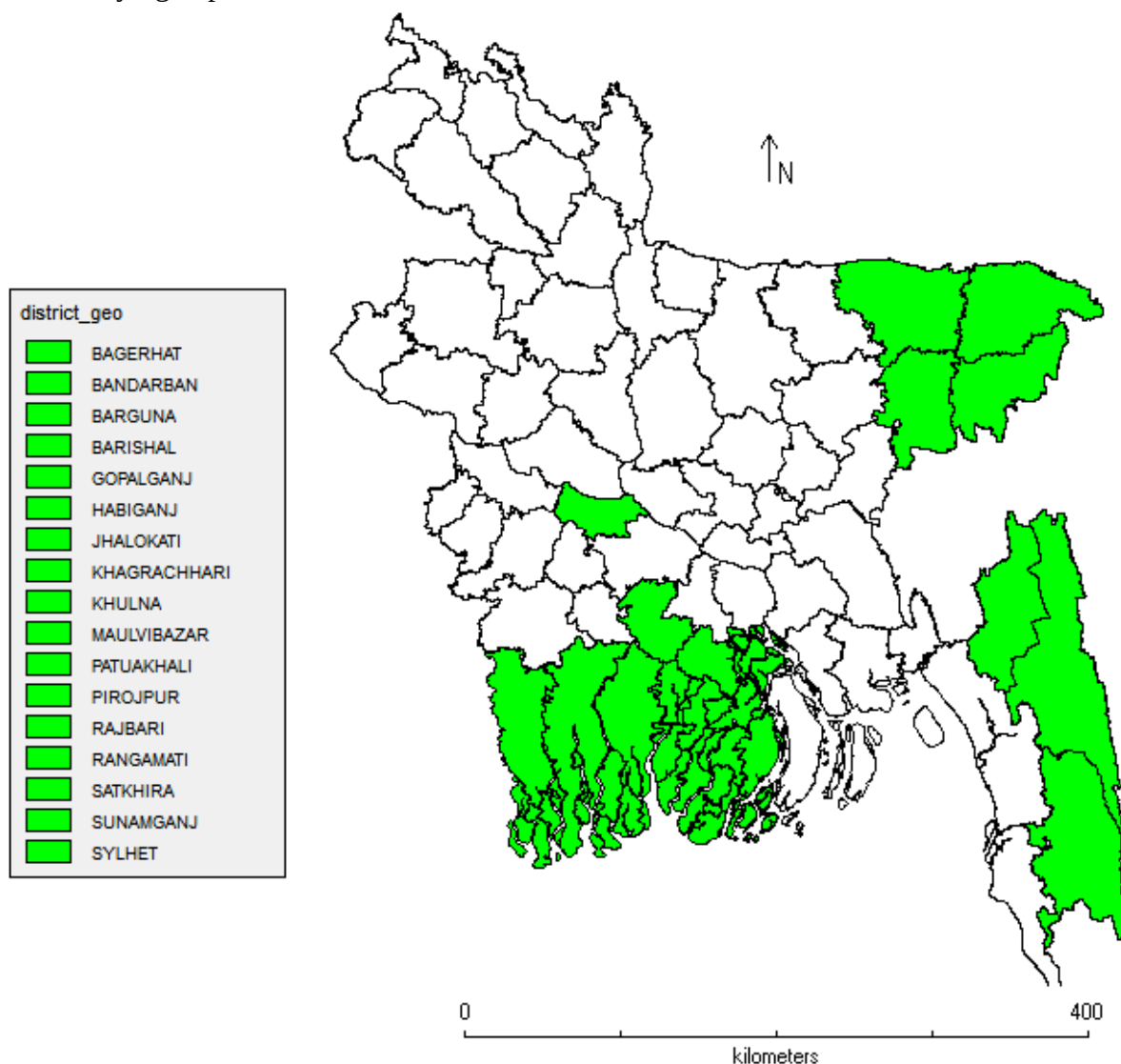


Fig. 26. Targeted areas for sugarcane germplasm collection

10.5.2. Conservation of collected germplasm

The collected germplasm were treated with carbendazim fungicide @1g/L and planted in BSRI germplasm bank just after collection during January 2018 to October 2020. After characterization it was conserved at field gene bank of BSRI, Ishurdi, Pabna.

10.5.3. Morphological characterization

Morphological data of 51 germplasm were taken according to the DUS descriptor of sugarcane. Thirty seven parameters were considered to find out the distinctness among the germplasm. Growth parameters were measured at 8-10 months of plant age and the maturity parameters were taken at 12 months. Genotypes were grouped according to character stated (Table 26).

Table 26. DUS descriptor of sugarcane used for morphological characterization

SI No.	Characteristic	State	Note	Stage of observation (days)
1.	Plant: Growth habit	Erect Semi-erect	1 2	210-240
2.	Plant: Adherence of leaf sheath	Weak (self de-trashing) Medium (semi clasping) Strong (tight clasping)	3 5 7	270-300
3.	Plant: Number of millable canes (NMC) per stool	Low (<3.0) Medium (3.0 – 5.0) High (5.1 – 7.0) Very high (>7.0)	3 5 7 9	300-360
4.	Plant: Leaf carriage	Open Compact	1 2	210-240
5.	Plant: Intensity of green color of leaf canopy	Light Medium Dark	3 5 7	210-240
6.	Plant: Cane height (from the base to the TVD leaf)	Short (<1.75 m) Medium (1.75-3.0 m) Tall (>3.0 m m)	3 5 7	300-360
7.	Internode: Diameter	Thin (<2.2 cm) Medium (2.2 – 3.0 cm) Thick (>3.0 cm)	3 5 7	270-300
8.	Internode: Shape	Cylindrical Tumescant Bobbin shaped Conoidal Obconoidal Curved	1 2 3 4 5 6	270-300
9.	Internode: Cross- section	Round Oval	1 2	300-360
10.	Internode: Colour (Exposed to sun)	Green yellow group (RHS 1) Yellow green group (RHS 144-154) Yellow group (RHS 3-13, 22) Greyed group (RHS 160-182, 184, 199) Brown group (RHS 200) Purple group (RHS 59-65, 77)	1 2 3 4 5 6	270-300
11.	Internode: Colour (Not exposed to sun)	Green (RHS 138-143) Green yellow (RHS 1) Green white (RHS 157) Yellow (RHS 2-11) Yellow green (RHS 145 - 154) Yellow white (RHS 158) Orange white (RHS 159) Greyed green (RHS 193) Greyed yellow (RHS 160)	1 2 3 4 5 6 7 8 9	270-300
12.	Internode: Split/growth crack	Absent Present	1 9	270-300
13.	Internode: Alignment	Straight Zigzag	1 9	270-300
14.	Internode: Appearance (rind surface)	Smooth Corky patches only Ivory marks only Corky patches and ivory marks present	1 2 3 4	270-300
15.	Internode: Pithiness	Absent Present	1 9	300-360
16.	Internode: Waxiness	Absent Light Medium Heavy	1 3 5 7	270-300

Sl No.	Characteristic	State	Note	Stage of observation (days)
17.	Node: Width of root band	Narrow (< 6mm) Medium (6-8mm) Broad (> 8mm)	3 5 7	270-300
18.	Node: Bud shape	Triangular-pointed Oval Obovate, Pentagonal, Rhomboid, Round Ovate Rectangular Beaked	1 2 3 4 5 6 7 8 9	270-300
19.	Node: Bud prominence	Flat Bulging	1 9	270-300
20.	Node: Depth of bud groove	Absent Shallow Medium Deep	1 3 4 5	270-300
21.	Node: Size of bud (Measured from base of bud to the tip)	Small (6 mm or less), Medium (6-9 mm), Large (9 mm or more)	3 5 7	270-300
22.	Node: Bud tip position in relation to growth ring	Clearly below growth ring Touching the ring Clearly above growth ring	1 3 5	270-300
23.	Node: Pubescence on the bud	Absent Present	1 9	270-300
24.	Node: Bud cushion (Space between bud base and leaf scar)	Absent Present	1 9	270-300
25.	Node: Growth ring appearance	Weak (Not swollen) Strong (Swollen)	1 9	270-300
26.	Node: Root primordial arrangement	One row Two rows Three rows Four rows Irregular	1 2 3 4 5	
27.	Leaf sheath: Number of hairs (groups 57)	Absent Few Many	1 3 5	210-240
28.	Leaf sheath: Distribution of hairs	Absent Only dorsal Lateral and dorsal	1 3 5	210-240
29.	Leaf sheath: Shape of ligule	Strap-shaped Deltoid Crescent-shaped Bow-shaped	1 2 3 4	210-240
30.	Leaf sheath: Shape of inner auricle	Sloping transitional Straight transitional Ascending transitional Deltoid Dentoid Unciform Calciform lanceolate Falcate	1 2 3 4 5 6 7 8 9	210-240
31.	Leaf sheath: Shape of outer auricle	Sloping transitional Straight transitional Ascending transitional Deltoid Dentoid Unciform	1 2 3 4 5 6	210-240

SI No.	Characteristic	State	Note	Stage of observation (days)
		Calcareform lanceolate Falcate	7 8 9	
32.	Leaf sheath: Colour of dewlap	Greenish-yellow Yellow Yellowish-green Brown Purple	1 2 3 4 5	210-240
33.	Leaf blade: Curvature	Erect to tip Curved near tip Bent near tip Curved near middle	1 2 3 4	210-240
34.	Leaf blade: width at the longitudinal midpoint	Narrow (< 3.0 cm) Medium (3.0-5.0 cm) Broad (>5.0 cm)	3 5 7	210-240
35.	Leaf blade: Serration of margin	Absent Present	1 9	210-240
36.	Cane top: Waxiness	Absent Weak Medium Strong	1 3 4 5	210-240
37.	Special feature: (If any)	-	-	-

10.5.4. Molecular characterization

DNA extraction: Total genomic DNA of 51 sugarcane genotypes were extracted from shoot apical meristems as per the method described by Aljanabi *et al.* (1999) with some modification. DNA of each genotype was quantified using spectrophotometer and quality were judge by running the DNA in 1 percent agarose gel with known standards. All the DNA samples were diluted uniformly to have a final concentration of 20ng/μl.

SSR analysis: Screening of polymorphic SSR primer pairs were practiced. For PCR amplification, a final volume of 20μl are used containing: 5μl of genomic DNA (20ng/μl), 2μl of 10X enzyme buffer, 2.4μl of MgCl₂ (25mM), 0.4μl of dNTP (10mM), 0.1μl of Taq DNA polymerase (5U/μl) and 0.5μl of both forward and reverse primer (10μM). All PCR reactions were performed on thermal cycler with PCR profile: Initial denaturation at 94°C for 4 minutes, followed by 34 cycles each of which consisted of 2 minutes denaturation at 94°C, 2 minutes annealing at respective annealing temperature and 1 minute extension at 72°C, then a final extension at 72°C for 5 minutes. The amplified products were then mixed with equal volume of loading dye, denatured at 95°C for 5 minutes and 3.6μl were run on a denaturing 5% polyacrylamide (20:1) gel with 1x TBE buffer at 70W (100mA). Electrophoresis times varied according to size and act of different primers amplified fragment accordingly (2-3 hrs). Then the gel was stained with silver nitrate followed by visual observation on light tray.

10.6. Bangladesh Institute of Nuclear Agriculture

10.6.1. Germplasm Collection

BINA was assigned to collect local rice, oilseeds, pulses, spices and vegetables germplasm from Mymensingh, Tangail and Sylhet regions (Fig. 27 & 28). Germplasm were collected from farmer's field, farm house, seed market and NGO. Eleven teams such as MM, SB, F, ST, M, MI, SA, H, MK, I and A were formed comprising one member in each team. Each expedition was conducted for 1- 4 days. The teams were equipped with ice box, plastic carton, GPS, compass, digital camera, hand lens, envelope, knife, scissors, drying sheet, pencil, stapler etc. Germplasm of target crops were collected from farmers' field/farm store/threshing floor and market especially from floating seed traders. Targeted farmers for collection of specific germplasm were located with the help of field level worker of the Department of Agricultural Extension (DAE) and direct contact. Collector's name, number and date were recorded during collection. Name of crop species along with English, Bangla, local and cultivar name were recorded. Name of donor with ethnic group, village, union, upazila/thana, district, latitude and longitude were noted. Type of soil, topography, sample status, sample source, habitat, frequency, type of materials, cultural practices, season, sole or mixed with, sample type, sampling method, insect and disease, agronomic score and plant characteristics were noted. A 'Passport Data Form' having passport information was filled up during germplasm collection. The samples were registered in conservation book immediately after collection and conserved in short term conservation storage of following appropriate procedure.



Fig. 27. Bangladesh GIS map showing Sub-project Areas

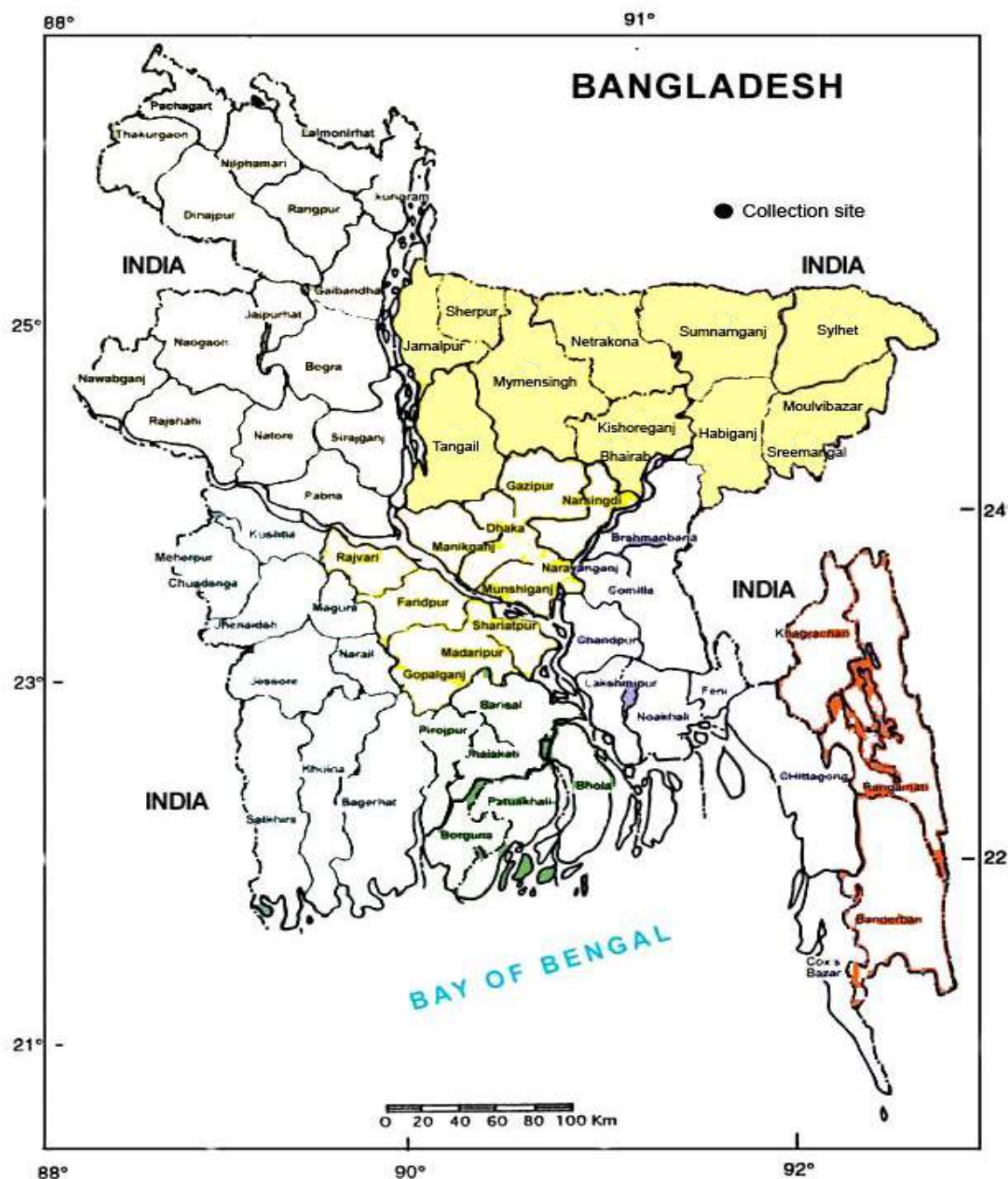


Fig. 28. Bangladesh GIS map showing targeted areas to be explored for germplasm collection

10.6.2. Morphological Characterization

A total of 143 germplasm of different crops have been characterized at morphological level during February 2018 to December 2020. Seventy three rice germplasm, five chilli, 33 peanut, 30 sesame and 2 bitter ground germplasm have been characterized during the period of 2018 to 2020.

10.6.2.1. Morphological characterization of local landraces of *Aman* rice collected from Mymensingh region during 2018:

The experiment was carried out during the period from July to December 2018. In this study, 31 rice germplasm were used as plant materials. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Unit plot size was 2m× 3m. The seeds were soaked in water for 24 hours. Then it was incubated in moist cloth sacks for 48 hours for quick germination. The pre-germinated seeds were sown in seedbed on 5 July, 2018. When the seedlings were 25 day old, one seedling hill⁻¹ was transplanted to the main plot on 01 August, 2018. Spacing between hills and rows were 15 and 20 cm, respectively. Basal dose of TSP and MP at the rate of 45kg and 25kg per hectare was applied. After transplanting the recommended dose of Urea (160kg/ha) was top dressed at three growth stages of rice. Irrigation and drainage were done as per requirement. The crop was kept weed free throughout the growth period. Insects and fungal attacks were negligible. Different germplasm attained their maturity at different times. Harvesting was done when 80% of the plant population of each plot reached to maturity and harvesting was done from 21 November to 08 December, 2018. Data of rice germplasm were recorded according to the “Rice Germplasm Descriptors and Evaluation Form” (BRRI-2018). The germplasm were agro-morphologically characterized on the basis of 31 qualitative and 10 quantitative traits of rice as per “Descriptors and descriptor states of characterization for Rice”.

Descriptors and descriptor states of characterization for Rice

Qualitative descriptor (31)

1. Blade pubescence: 1 = glabrous, 2 = Intermediate and 3= pubescent.
2. Blade colour: 1 = pale green, 2 = green, 3 = dark green, 4 = purple tips, 5 = purple margins, 6 = purple blotch and 7 = purple
3. Leaf sheath anthocyanin colour: 1 = absent and 9 = Present.
4. Basal leaf sheath colour: 1 = green, 2 = purple lines 3 = light purple and 4 = purple.
5. Leaf angle: 1 = erect, 5 = horizontal and 9 = drooping
6. Flag leaf angle: 1 = erect, 3 = semi erect, 5 = horizontal and 7 = descending.
7. Ligule colour: 1 = white, 2 = purple line and 3 = purple.
8. Ligule shape: 1 = acute to acuminate, 2 = 2-cleft and 3 = truncate.
9. Collar colour: 1 = pale green, 2 = green and 3 = purple.
10. Auricle colour: 1 = pale green and 2 = purple.
11. Culm anthocyanin colour: 1 = absent and 9 = present.
12. Culm angle: 1 = erect, 3 = intermediate, 5 = open, 7 = spreading and 9 = procumbent.
13. Internode colour: 1 = green, 2 = light gold, 3 = purple lines and 4 = purple.
14. Culm strength: 1 = strong, 3 = moderately strong, 5 = intermediate, 7 = weak and 9 = very weak.
15. Panicle type: 1 = compact, 5 = intermediate and 9 = open.
16. Secondary branching: 0 = absent, 1 = light, 2 = heavy and 3 = clustered.
17. Panicle exsertion: 1 = enclosed, 3 = partly exserted, 5 = just exserted, 7 = moderately well exserted and 9 = well exserted.
18. Panicle axis: 1 = straight and 2 = droopy.
19. Shattering: 1= very low 3 = low, 5 = moderate, 7 = high and 9 = very high.

20. Threshability: 1 = difficult, 3 = moderately difficult, 5 = intermediate, 7 = loose and 9 = easy.
21. Awn distribution: 0 = none (awnless), 1 = tip only, 2 = upper quarter only, 3 = upper half only, 4 = upper three-quarters only and 5 = whole length.
22. Awn color: 1 = straw, 2 = gold, 3 = brown (tawny), 4 = red, 5 = purple and 6 = black.
23. Apiculus colour: 1 = white, 2 = straw, 3 = brown (tawny), 4 = green, 5 = red, 6 = red apex, 7 = purple, 8 = purple apex and 9 = black.
24. Stigma colour: 1 = white, 2 = light green, 3 = yellow, 4 = light purple and 5 = purple.
25. Lemma and palea colour: 0 = straw, 1 = gold and gold furrows on straw background, 2 = brown spots on straw, 3 = brown furrows on straw, 4 = brown (tawny), 5 = reddish to light purple, 6 = purple spots on straw, 7 = purple furrows on straw, 8 = purple, 9 = black and 10 = white.
26. Lemma and palea pubescence: 1 = glabrous, 2 = hairs on lemma keel, 3 = hairs on upper portion, 4 = short hairs and 5 = long hairs (velvety).
27. Sterile lemma colour: 1 = straw, 2 = gold, 3 = red and 4 = purple.
28. Seed coat (bran) colour: 1 = white, 2 = light brown, 3 = speckled brown, 4 = brown, 5 = red, 6 = variable purple and 7 = purple.
29. Endosperm type: 1 = non-glutinous (non-waxy), 2 = glutinous (waxy) and 3 = indeterminate.
30. Decorticated grain scent (aroma): 0 = non-scented, 1 = lightly scented and 2 = scented.
31. Leaf senescence: 1 = very early, 3 = early, 5 = intermediate (one leaf still green at harvest), 7 = late and slow and 9 = very late.

Quantitative descriptor (21)

1. Seedling height (cm): Mean length of 15 randomly selected seedlings was measured at 5- leaf stage, approximately 20-25 days after seeding.
2. Ligule length (mm): Mean length of 15 randomly selected ligules was measured after anthesis.
3. Leaf blade length (cm): Mean length of 15 randomly selected leaf blades was measured at early reproductive stage.
4. Leaf blade width (cm): Mean width of 15 randomly selected leaf blades was measured at early reproductive stage.
5. Culm diameter (mm): Mean diameter of 15 randomly selected culms (from mother tillers in the lowest internode) was measured at reproductive stage.
6. Total tiller number: Mean tiller number of 15 randomly selected hills was measured after flowering.
7. Effective tiller number: Mean number of effective tiller was measured on 15 randomly selected hills at early ripening stage.
8. Culm length (cm): Mean length of 15 randomly selected culms was measured after flowering,
9. Panicle length (cm): Mean length of 15 randomly selected Panicles was measured at dough stage.
10. Plant height (cm): Addition of the mean of culm length and panicle length.

11. Days to 50% flowering: Number of days required from seeding days to 50% opening of the flowers.
12. Days to maturity: Number of days required from seeding to days of 80% panicle matured.
13. Number of filled grain per panicle: Mean number of filled grain/panicle was measured on 15 panicles.
14. Number of unfilled grain per panicle: Mean number of unfilled grain/panicle was measured on 15 panicles.
15. 1000 grain weight (g): Mean weight of 1000 randomly selected seeds (grains) was measured after sun drying.
16. Grain length (mm): Mean length of 15 randomly selected grains was measured after sun drying.
17. Grain width (mm): Mean width of 15 randomly selected grains was measured after sun drying.
18. Decorticated grain length (mm): Mean length of 15 randomly selected dehulling grains was measured before milling.
19. Decorticated grain width (mm): Mean width of 15 randomly selected dehulling grains was measured before milling.
20. Decorticated grain L/W ratio: Mean length and width ratio of 15 randomly selected de-hulled grains.
21. Yield (g/hill): Mean weight of grains of 10 randomly selected hills after threshing and drying (at 14% moisture content).

10.6.2.2. Morphological Characterization of rice landraces during Aman 2019 season

The experiment was carried out during the period from July to December 2019. In this study, 42 rice germplasm were used as plant materials. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Unit plot size was 2m× 3m. The seeds were soaked in water for 24 hours. Then it was incubated in moist cloth sacks for 48 hours for quick germination. The pre-germinated seeds were sown in seedbed on 14 July, 2019. When the seedlings were 25 days old, one seedling hill⁻¹ was transplanted to the main plot on 09 August, 2019. Spacing between hills and rows were 15 and 20 cm, respectively. Basal dose of TSP and MP at the rate of 45kg and 25kg per hectare was applied. After transplanting, the recommended dose of Urea, 160 kg per hectare was top dressed at three growth stages of rice. Irrigation and drainage were done as per requirement. The crop was kept weed free throughout the growth period. Insects and fungal attacks were negligible. Different germplasm attained their maturity at different times. Harvesting was done when 80% of the plant population of each plot reached to maturity and harvesting was done from 20 October to 05 November, 2019. The experimental plots were visited frequently and as per schedule, required data were collected. A data record book was used for keeping records of data related to the identification of the germplasm. Data on 31 qualitative and 10 quantitative traits were recorded on individual plant basis from 5 randomly selected plants as per BRR descriptor (2018).

10.6.2.3. Morphological characterization of chilli germplasm

A total of 5 local chilli germplasm have been characterized at morphological level during winter 2018-19 season. The genetically pure and physically healthy seeds of these germplasm were collected from the Horticulture Division, BINA. They have collected these germplasm from local area of Mymensingh. The experiment was set at BINA Head

Quarters Farm, Mymensingh. Data were recorded from experimental field according to IBPGR (1995) descriptor and evaluation form. Out of 63 observations, 43 qualitative and 20 quantitative characters were recorded. The seed beds were prepared by mixing vermicompost. Seeds were sown on 28 September 2018 in separate bed uniformly at a depth of 2-3 cm. Out of forty two-days old uniform growth and healthy seedlings were transplanted on 10 November 2018 in the pots at the evening and immediately after transplanting light irrigation were given. The pots were 17 cm × 30 cm with small holes to drain excess water. After transplanting subsequent irrigations were provided as and when required for growth and development of plants. Three random competitive plants per variety were selected; tagged and recorded data for quantitative and qualitative characters.

Descriptors and descriptor states of characterization for Chilli

A. Qualitative descriptor

1. Hypocotyl colour: 1 = White, 2 = Green and 3 = Purple
2. Hypocotyl pubescence: 3 = Sparse, 5 = Intermediate and 7 = Dense
3. Cotyledonous leaf colour: 1= Light green, 2 = Green, 3 =Dark green, 4 = Light purple, 5 = Purple, 6 = Dark purple, 7 = Variegated, 8 = Yellow and 9 = Other
4. Cotyledonous leaf shape: 1 = Deltoid, 2 = Ovate, 3 = Lanceolate and 4 = Elong-deltoid
5. Stem colour: 1 = Green, 2 = Green with purple stripes, 3 = Purple and 4 = Other
6. Nodanthocyanin (whole plant): 1 = Green, 3 = Light purple, 5 = Purple and 7 = Dark purple
7. Stem shape: 1 = Cylindrical, 2 = Angled and 3 = Flattened
8. Stem pubescence: 3 = Sparse, 5 = Intermediate and 7 = Dense
9. Plant growth habit: 3 = Prostrate, 5 = Intermediate (compact), 7 = Erect, and 9 = Other
10. Branching habit: 3 = Sparse, 5 = Intermediate, 7 = Dense
11. Tillering: 3 = Sparse, 5 = Intermediate and 7 = Dense
12. Leaf density: 3 = Sparse, 5 = Intermediate and 7 = Dense
13. Leaf colour: 1 = Yellow, 2 = Light green, 3 = Green, 4 = Dark green, 5 = Light purple, 6 =Purple, 7 = Variegated and 8 = Other
14. Leafshape: 1 = Deltoid, 2 = Ovate and 3 = Lanceolate
15. Lamina margin: 1 = Entire, 2 = Undulate and 3 = Ciliate
16. Leaf pubescence 3 = Sparse, 5 = Intermediate and 7 = Dense
17. Days to flowering: Number of days from sowing/transplanting until 50% of plants has atleast one open flower
18. Number of flowers per axil: 1 = One, 2 = Two, 3 = Three or more and 4 = Many
19. Flower position: 3 = Pendant, 5 = Intermediate, 7 = Erect
20. Corolla colour: 1 = White, 2 = Light yellow, 3 = Yellow, 4 = Yellow-green, 5 = Purple with white base, 6 = White with purple base, 7 = White with purple margin, 8 = Purple and 9 = Other
21. Corolla spot colour: 1 = White, 2= Yellow, 3 = Green-yellow, 4 = Green, 5 = Purple and 6 = Other
22. Corolla shape: 1 = Rotate, 2 = Campanulate and 3 = Other
23. Anther colour: 1 = White, 2 = Yellow, 3 = Pale blue, 4 = Blue, 5 = Purple and 6 = Other

24. Filament colour: 1 = White, 2 = Yellow, 3 = Green, 4 = Blue, 5 = Light purple, 6 = Purple and 7 = Other
25. Stigma exsertion: 3 = Inserted, 5 = Same level and 7 = Exserted
26. Male sterility: 0 = absent and 1 = Present
27. Calyx Pigmentation: 0 = Absent and 1 = Present
28. Calyx margin: 1 = Entire, 2 = Intermediate, 3 = Dentate and 4 = Other
29. Calyx annular constriction: 0 = Absent and 1 = Present
30. Anthocyanin spots or stripes: 0 = Absent and 1 = Present
31. Fruit colour at intermediate stage: 1 = White, 2 = Yellow, 3 = Green, 4 = Orange, 5 = Purple, 6 = Deep purple and 7 = other
32. Fruit set: 3 = Low, 5 = Intermediate and 7 = High
33. Fruit colour at mature stage: 1 = White, 2 = Lemon-yellow, 3 = Pale orange-yellow, 4 = Orange-yellow, 5 = Pale orange, 6 = Orange, 7 = Light red, 8 = Red, 9 = Dark red, 10 = Purple, 11 = Brown, 12 = Black and 13 = Other
34. Fruit shape: 1 = Elongate, 2 = Almost round, 3 = Triangular, 4 = Campanulate, 5 = Blocky and 6 = Other.
35. Fruit shape at pedicel attachment: 1 = Acute, 2 = Obtuse, 3 = Truncate, 4 = Cordate and 5 = Lobate
36. Neck at base of fruit: 0 = absent and 1 = Present
37. Fruit shape at blossom end: Average of 10 fruits. 1 = Pointed, 2 = Blunt, 3 = Sunken, 4 = Sunken and pointed and 5 = other
38. Fruit blossom end appendage: 0 = absent and 1 = Present
39. Fruit cross-sectional corrugation: 3 = Slightly corrugated, 5 = Intermediate and 7 = Corrugated
40. Fruit surface: 1 = Smooth, 2 = Semiwrinkled and 3 = Wrinkled
41. Seed colour: 1 = Straw (deep yellow), 2 = Brown, 3 = Black and 4 = others
42. Seed surface: 1 = Smooth, 2 = Rough and 3 = Wrinkled
43. Seed size: 3 = Small, 5 = Intermediate and 7 = Large

B. Quantitative descriptor

1. Cotyledonous leaf length (mm): Average of 10 cotyledonous leaves
2. Cotyledonous leaf width (mm): Average of 10 cotyledonous leaves
3. Plant height (cm): Recorded when in 50% of the plants the first fruit has begun to ripen. 1 = <25, 2 = 25-45, 3 = 46-65, 4 = 66-85 and 5 = >85
4. Plant canopy width (cm): Measured immediately after first harvest, at the widest point
5. Stem length (cm): Height to first bifurcation. Measured immediately after first harvest
6. Stem diameter (cm): Measured in the middle part to first bifurcation, immediately after first harvest
7. Mature leaf length (cm):
8. Mature leaf width (cm): Measured on the widest part of the leaf
9. Days to flowering: Number of days from sowing/transplanting until 50% of plants have at least one open flower

10. Corolla length (cm): Average of 10 petals of dissected corolla. 1 = <15, 2 = 1.5-2.5, 3 = >25
11. Anther length (mm): Average anther length of 10 representative flowers selected from different plants. Observed immediately at anthesis
12. Filament length (mm): Average filament length of 10 representative flowers selected from different plants. Observed immediately at anthesis
13. Days to fruiting : Number of days from transplanting until 50% of the plants bear mature fruits at the first and second bifurcation
14. Fruit bearing period (d): Number of days from first fruit set to last fruit formation
15. Fruit length (cm): Average fruit length of 10 ripe fruits of the second harvest
16. Fruit width (cm): Measured at the widest point. Average fruit width of 10 ripe fruits of the second harvest
17. Fruit weight (g): Average fruit weight of 10 ripe fruits of the second harvest
18. Seed diameter (mm): The maximum diameter of 10 seeds to two decimal places
19. 1000 seed weight (g)
20. Number of seeds per fruit: Average of at least 10 fruits selected from 10 random plants 1 = <20, 2 = 20-50 and 3 = >50

10.6.2.4. Morphological characterization of bitter gourd germplasm

Characterization of two germplasm of bitter gourd is being evaluated in this rabi season 2018. The purity and germination percentage were determined as 100 and 80, respectively. The genetically pure and physically healthy seeds of these germplasm were collected from the Horticulture Division, BINA. They have collected these germplasm from local area of Mymensingh. Seeds were sown in the plastic pot and healthy and vigorous seedlings of one month old were selected for transplanting in the main land. The seedlings were removed carefully from the small plastic pots by avoiding any injuries and were sown one seedling per pit in the evening time. Slight watering was provided after transplantation. Mechanical support was provided to the growing plants by dhaincha sticks to keep them erect and support the plant before flowering. The vines were tied with thin rope with the dhaincha sticks. A bamboo pandal (macha) was then prepared and allowed the vine to creep on the pandal. Fruits were picked on the basis of maturity, size, colour and age being determined for the purpose of consumption as the fruit grew rapidly and soon get beyond the marketable stage, frequent picking was done throughout the harvesting period. Fruits were picked with sharp knife and care was taken to avoid injury of the vine. Now the plants of bitter gourd are in harvesting stage. Data were recorded following IBPGR descriptors for bitter gourd.

10.6.2.5. Characterization of sesame germplasm

An experiment was conducted on Sesame at Genetic and Plant Breeding Experimental field of Bangladesh Agricultural University (BAU), Mymensingh, during March 2020 to July 2020. In this study, 30 sesame germplasm including three BINA varieties Binatil-2, Binatil-3 and Binatil-4 and two landraces Kalotil and Sadatil were used as plant materials. The germplasm were collected from Plant Genetic Resources Centre (PGRC), BARI, Joydebpur, Gazipur. Three sesame varieties of BINA and two landraces have collected from Plant Breeding Division, BINA, Mymensingh.

Thirty-eight observations on qualitative (22) and quantitative (16) characters were recorded as per Descriptors for Sesame (*Sesamum indicum*), the International Plant Genetic Resources Institute (IPGRI), 1985.

Descriptors and descriptor states of characterization for sesame

A. Qualitative descriptor

1. Plant growth type: 1 = Indeterminate and 2 = Determinate
2. Plant growth habit: 1 = Prostrate, 2 = Semi-erect and 3 = Erect
3. Stem hairiness: 0 = Glabrous, 3 = Weak, 5 = Medium and 7 = Strong
4. Branching pattern : 0 = Non branching, 1 = Basal branching, 2 = Top branching and 3 = Others
5. Leaf color: 1 = green, 2 = green with yellowish cast, : 3 = green with blue-grey cast, 5 = green with purple cast and 99 = Others
6. Leaf hairiness: 0 = Glabrous (hair absent), 3 = Weak or sparse, 5 = Medium, and 7 = Strong or profuse
7. Leaf shape: 1 = Linear, 2 = Lanceolate, 3 = Elliptic, 4 = Ovate, 5 = Narrowly cordate, 99 = Other
8. Basal leaf margin : 1 = Entire, 2 = Serrate, 3 = Dentate
9. Lobe incision of basal leaf : 0 = Absent (leaf entire), 3 = Weak and 5 = Medium
10. Leaf angle to main stem: 1 = Acute (<90°), 2 = Horizontal (90°), 3 = Drooping (>90°)
11. Petiole Color: 1 = Green, 2 = Greenish purple, 3 =Purple, 4 = Pink and 99 = Other
12. Petiole hairiness : 0 = Glabrous (hair absent), 3 = Weak or sparse, 5 = Medium and 7 = Strong or profuse
13. Number of flowers per axil : 1 = One and 2 = More than one
14. Extra floral nectar development : 1 = Rudimentary, 2 = Small, 3 = Medium and 4 = Large
15. Number of locules per capsule: 1 = Four, 2 = Six and 3 = Eight
16. Bicarpellate capsule shape: 1 = Tapered at apex, 2 = Narrow oblong, 3 = Broad oblong, 4 = Square
17. Capsule arrangement : 1 = Monocapsular and 2 = Multicapsular
18. Capsule hairiness : 0 = Glabrous (hair absent), 3 = Weak or sparse, 5 = Medium, 7 = Strong or profuse
19. Shape of capsule hair: 1 = Short and straight, 2 = Medium and straight, 3 = Long and bent
20. Colour of dry capsules : 1 = Green, 2 = Straw/yellow, 3 = Brown/tan and 4 =Purple
21. Type of capsule beak : 1 = Short, 2 = Long, 3 = Curved, 4 = Cleft and 99 = Other
22. Seed coat colour : 1 = White, 2 = Cream, 3 = Beige, 4 = Light brown, 5 = Medium brown, 6 = Dark brown, 7 = Brick red, 8 = Tan, 9 = Olive, 10 = Grey, 11 = Dull black, 12 = Bright black and 99 = Other

B. Quantitative descriptor of sesame

1. Plant height (cm): Measured at flower initiation on the main stem from the ground level up to the apex
2. Number of primary branches
3. Internodes length (cm): Measured as an average of 10 internode distances on the same stalk, with five replicate branches from the same plant
4. Length of basal leaf (cm): Mean length of five leaves from the basal portion of the main stem
5. Width of basal leaf (cm): Mean width of five leaves from the basal portion of the main stem
6. Length of top leaf (cm): Mean length of five leaves from the top of the main stem
7. Width of top leaf (cm): Mean width measured at the widest point of five leaves from the top of the main stem (five cm below the apex)
8. Petiole length of basal leaf (cm): Mean of five leaves from the basal portion of the main stem
9. Petiole length of top leaf (cm): Mean of five leaves from the top of the main stem
10. Days to 50% flowering : Number of days from sowing or first irrigation until 50% of the plants in a row initiate flowering
11. Number of capsules per plant : Mean of five randomly selected plants
12. Mean capsule length (mm): Measured on five randomly selected capsules from the middle of main stem, each from a different plant at physiological maturity
13. Mean capsule width (mm): Measured on five randomly selected capsules from the middle of main stem, each from a different plant at physiological maturity
14. Seeds per capsule : Mean number of seeds from five randomly selected capsules from five different plants taken from the middle of the main stem
15. 100-seed weight (g): Weight in grams of 100 random seeds taken from the bulk harvest
16. Seed yield per plant (g): Average seed yield from five randomly selected plants

10.6.2.6. Characterization of peanut germplasm

An experiment was conducted on peanut at Agronomy Experimental field of Bangladesh Agricultural University (BAU), Mymensingh, during March 2020 to July 2020. In this study, 33 peanut germplasm including one BINA variety Binachinabadam-4, and one BARI variety BARIbadam-9 were used as plant materials. The germplasm were collected from Oilseed Research Centre (ORC), BARI, Joydebpur, Gazipur. Two peanut varieties of BINA and BARI were collected from Plant Breeding Division, BINA, Mymensingh. Twenty five observations on qualitative (16) and quantitative (9) characters were recorded as per Descriptors for peanut (*Arachis hypogaea*), the International Plant Genetic Resources Institute (IPGRI), 1985.

Descriptors and descriptor states of characterization for groundnut

A. Qualitative descriptor

1. Plant growth habit: 1 = Procumbent-1, 2 = Procumbent-2, 3 = Decumbent-1, 4 = Dcumbent-2, 5 = Procumbent-3 and 6= Erect
2. Branching pattern: 1 = Alternate, 2= Sequential, 3 = Irregular with flowers on main stem, 4 = Irregular without flowers on main stem and 5 = others
3. Stem pigmentation: 0 = Absent and 1 = Present
4. Stem surface: 1 = Glabrous, 3 = Sub-glabrous, 5 = moderately hairy, 7 = Very hairy and 9 = Woolly
5. Peg pigmentation: 0 = Absent and 1 = present
6. Leaf color : 1 = yellow/yellow green, 2 = Light green, 3 = Green, 4 = Dark green, 5 = Bluish green and 6 = others
7. Leaflet shape: 1 = Cuneate, 2 = Obcuneate, 3 = Elliptic, 4 = Oblong-elliptic, 5 = Narrow-elliptic, 6 = wide-elliptic, 7 = Suborbicular, 8 = orbicular, 9 = ovate, 10 = Obovate, 11 = Oblong, 12 = Oblong-lanceolate, 13 = Lanceolate, 14 = linear-lanceolate and 15 = Others
8. Leaflet surface: 1 = Almost glabrous on both surface), 2 = Almost glabrous above, hairs below, 3 = Almost glabrous above hairs and/or bristles below, 4 = Almost glabrous below, hairs above, 5= Almost glabrous below, hairs and bristles above, 6 = Hairs on both surfaces, without bristles 7 = Hairs on both surfaces, with bristles at least on one surface, 8= Woolly without bristles , 9 = Woolly with bristles at least on one surface and 10 = Others
9. Leaflet margin: 1 = Entire, 2 = Hairy, 3 = Wavy and 4 = Others
10. Leaflet tip: 1 = Obtuse, 2 = Acute, 3 = Mucronate and 4 = others
11. Number of seeds per pod: 1 = 2-1, 2= 2-3-1/2-1-3, 3= 3-2-1/3-1-2 and 10 = Others
12. Pod beak: 0= Absent, 1 = Slight, 5 = Moderate, 7 = Prominent and 9 = very prominent
13. Pod constriction: 0 = None, 3 = Slight, 5 = Moderate, 7 = Deep, 9 = very deep
14. Pod reticulation: 0 = None, 3 = Slight, 5 = Moderate, 7 = Prominent and 9 = very prominent
15. Seed color: 1 = One color and 2 = Variegated
16. Primary seed color: 1 = white, 2 = Off –white, 3 = Yellow, 4 = Very pale tan, 5 = Pale tan, 6 = Light tan, 7 = Tan, 8 = Dark tan, 9 = Greyed orange, 10 = rose, 11 = Salmon, 12 = Light red, 13 = Red, 14 = Dark red, 15 = Purplish red, 16 = Light purple, 17 = Purple, 18 = Dark purple, 19 = Very dark purple and 20 = Others

B. Quantitative descriptor

1. Height of main stem (cm): Measured from cotyledonary axil up to terminal bud, recorded 60-85 days after emergence
2. Plant width or spread (cm): Measured as widest point, from branch tip to tip. Recorded 45-60 days after emergence
3. Leaflet length (mm): Measured on the third leaf, apical leaflet, of the main stem when fully expanded
4. Leaflet width (mm): Measured on the third leaf, fully expanded apical leaflet, of the main stem. At its widest point

5. Pod length (mm): Mean of 10 mature pods
6. Pod width (mm): Mean of 10 mature pods measured at the widest point
7. Seed length (mm): Average of 10 mature seeds
8. Seed width (mm): Measured at the midpoint, average of 10 mature seeds
9. Yield/plant (g):

10.6.3. Genetic Diversity Analysis of Rice Landraces using SSR Markers

A total of 83 rice germplasm have been characterized at molecular level using SSR markers during February 2018 to November 2020. The molecular work was done at Molecular Laboratory of Plant Breeding Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh. Total genomic DNA was extracted from young leaves of three-week-old plants following the simple and modified protocol of Zheng *et al.*, 1995. PCR analysis was performed in 12.5 µl reaction sample containing 5-25 ng of DNA template, 1.25 µl of MgCl₂ free 10X PCR buffer (100 mM Tris-HCl pH 9.0 at 25°C, 500 mM KCl, 0.1% Triton® X-100 and H₂O), 1.5 µl of 25 mM MgCl₂, 0.25 µl of 10mM dNTP, 0.25 µl of 5 U/µl Taq polymerase enzyme, 0.625 µl each of 10 µM forward and reverse primers using a MJ Research single 96-well thermal cycler. The mixture was overlaid with one drop of mineral oil to prevent evaporation. After initial denaturation for five minutes at 94°C, each cycle comprised one min denaturation at 94°C, one min annealing at 55°C, and two min extension at 72°C with a final extension for seven min at 72°C at the end of 35 cycles. The PCR products were mixed with bromophenol blue gel loading dye and were analyzed by electrophoresis on 8% polyacrylamide gel using mini vertical polyacrylamide gels for high throughput manual genotyping (CBS Scientific Co. Inc., CA, USA). 2.5 µl of amplification products were resolved by running gel in 1×TBE buffer for 2-2.5 hrs depending upon the allele size at around 75 volts and 180 mA current. The gels were stained in 0.5 mg/ml ethidium bromide and were documented using UVPRO (Uvipro Platinum, EU) gel documentation unit. Microsatellite or simple sequence repeat (SSR) markers were used for DNA analysis (Temnykh *et al.*, 2001; McCouch *et al.*, 2002).

10.6.4. Conservation

BINA had collected 199 germplasm of different crops during 2018-2020. Collected germplasm were multiplied at BINA headquarter, Mymensingh in respective season (February 2018 to December 2020) and preserved in mid and short term storage room at BINA. After multiplication seeds of collected germplasm we carefully cleaned of each germplasm. Removal of any debris, and low quality, infested or infected seeds of a different species can also be considered. We processed collected or harvested germplasm material is as soon as possible to avoid unnecessary losses or decrease in longevity. For Safe conservation demands, we had determined the germination percentage. After a sufficient number of good qualities for a given accession have been cleaned, dried, tested, and weighed or counted, the seeds will be placed in a container and hermetically sealed for subsequent storage. All the seeds of a given accession are packaged in one container, especially when large glass or metal containers are used; alternatively sub-samples, each adequately representing the genetic diversity of that accession for later use, are packaged in separate containers. The latter procedure has the advantage that the removal of one sub-sample will not affect the other sub-samples, and its removal is quick and easy, thus facilitating the use of the germplasm. If sub-samples are used, it must be decided whether sub-samples of the same accession are stored in both the base and active collections, which might have different storage conditions and locations.

11. Results and Discussion:

11.3. Bangladesh Agricultural Research Institute

11.3.1. Exploration and Collection of Plant Genetic Resources during January 2018 - December 2020

A total of 600 germplasm of 66 crops were collected from 69 upazilas of 30 districts (Fig. 29 and Table 27). Among them, 14 germplasm from cereals (barley, foxtail millet and wheat), 39 pulses (black gram, black pea, cowpea, field pea, grass pea, lentil, mung bean, pigeon pea and white pea), 26 oilseeds (linseed, mustard, safflower and sesame), 36 spices (black cumin, chilli, coriander, fennel, fenugreek, garlic, onion and turmeric), 455 vegetables (amabashashak, amaranth, ash gourd, babar shak, bitter gourd, bottle gourd, brinjal, chinese mellow, country bean, cucumber, french bean, indian spinach, jute leaf, kang kong, kidney bean, okra, potato, pumpkin, radish, red amaranth, ridge gourd, roselle, snake gourd, spinach, sponge gourd, sword bean, teasel gourd, turnip, yam and yard-long bean), 14 fruits (banana, custard apple, musk melon and papaya), 12 medicinal and 04 other germplasm (indigo and sesbania) (Table 27). Details of passport data with photograph of collected germplasm are presented in Table 28.

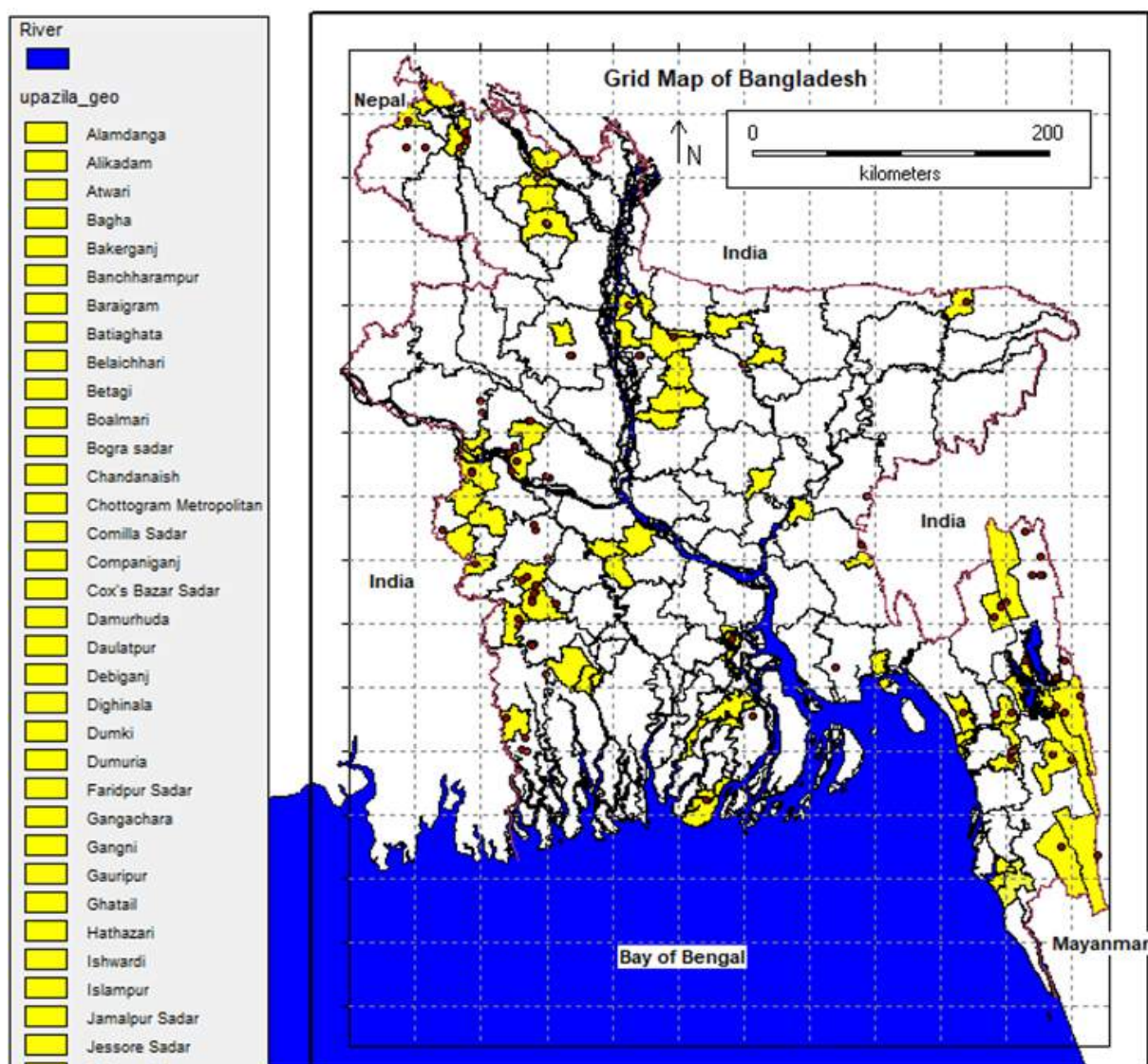


Fig. 29. Grid map of Bangladesh showing exploration sites

Table 27. Collection of germplasm from different districts in Bangladesh, January 2018 - December 2020

District*	No. of upazila explored	No. of germplasm collected							Total
		Cereal	Pulse	Oilseed	Vegetable	Spice	Fruit	Other	
Bandarban	3	5	2	2	48	5	4	2	68
Barishal	1		1		15			Medicinal =12 (from different locations)	16
Chattogram	6		1		61	3	4		69
Cox's Bazar	2		6		1				7
Cumilla	3				1				1
Faridpur	5	2	15	16	24	16	1	1	75
Jamalpur	3				36	1	2		39
Jashore	4				15				15
Jhinaidah	1				9		1		10
Khulna	5			1	16				17
Lalmonirhat	1				1				1
Mymensingh	1				1				1
Noakhali	2				3				3
Pabna	2			3	65		2		70
Panchagarh	2	2	1		24	3		1	31
Patuakhali	4		9	2	72	2			85
Satkhira	4	1	4		53	4			62
Thakurgao	2	4		2	10	2			18
Total	51	14	39	26	455	36	14	16	588+12

*Other explored districts but not mentioned in the table are: Borguna (1), Chuadanga (3), Khagrachari (2), Meherpur (2), Natore (2), Rangamati (3), Rangpur (2), Tangail (3).

Table 28. List of collected germplasm of different crops, January 2018 - December 2020

Sl. No.	Crop name	No. of germplasm	Sl. No.	Crop name	No. of germplasm
1	Different <i>shak</i>	6	18	Custard apple	2
2	Amaranth	30	19	Fennel	2
3	Ash gourd	19	20	Fenugreek	3
4	Taro	4	21	Field pea	5
5	Banana	1	22	Foxtail millet	6
6	Barley	1	23	French bean	6
7	Bitter gourd	12	24	Garlic	1
8	Black cumin	4	25	Grass pea	9
9	Black gram	2	26	Indian spinach	7
10	Black pea	1	27	Indigo	1
11	Bottle gourd	32	28	Jute leaf	4
12	Brinjal	76	29	Kangkong	4
13	Chinese mallow	5	30	Kidney bean	1
14	Coriander	11	31	Lentil	4
15	Country bean	75	32	Linseed	1
16	Cowpea	8	33	Mung bean	6
17	Cucumber	14	34	Musk melon	5

Table 28. Cont'd

Sl. No.	Crop name	No. of germplasm	Sl. No.	Crop name	No. of germplasm
35	Mustard	13	51	Spinach	14
36	Okra	16	52	Sponge gourd	16
37	Onion	2	53	Sword bean	3
38	Papaya	6	54	Teasle gourd	3
39	Pigeon pea	3	55	Turmeric	4
40	Potato	1	56	Turnip	1
41	Pumpkin	28	57	Wheat	1
42	Radish	6	58	White pea	1
43	Red amaranth	23	59	Yam	5
44	Red chilli	13	60	Yard long bean	24
45	Ridge gourd	13	61	Carrot	1
46	Roselle	1	62	Yam bean	1
47	Safflower	1	63	Broom corn	2
48	Sesame	7	64	Maize	3
49	Sesbania	1	65	Coffee	1
50	Snake gourd	7	66	Medicinal	12
Total = 600					

Table 29. Passport information of collected germplasm, January 2018 - December 2020

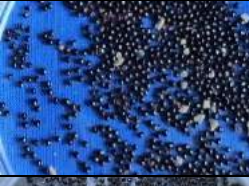
Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Field pea (<i>Pisum sativum</i>)					
1	NRI-100	Motor Kalai/ Rainfed/ Rabi season	Name: Idris Sheikh Village: Piarpur Union: Kojjuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	NRI-180	Motor Kalai/ Rainfed/ Rabi season	Name: Sumon Jomoddar Village: Duldi, Gobindopur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23°36'38.39" E-89°49'3.84" 12-04-2019	
3	NRI-204	Motor Kalai/ Rainfed/ Rabi season	Name: Md. Siddique Sheikh Village: Bahirdah Union: Macchor Upazila: Faridpur Sadar District: Faridpur	N-23°35'56.39" E-89°46'41.84" 12-04-2019	
4	SNQR-5	Deshi motor/ Irrigated/ Rabi	Name: Lovlu Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.36522 E-89.14153 13-10-2020	

Table 29 (Cont'd)

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
5	SNQR-60	Motorsuti/ Irrigated/ Rabi	Name: Gonesh Ch. Mondol Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.27883 E-89.11263 14-10-2020	
Amaranth (<i>Amaranthus gangeticus</i>)					
1	NRI-164	Danta/ Broadcast/ Thinning	Name: Md. Akter Mondol Village: Parchar Union: Pourosova, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23°35'21.34" E-89°46'48.02" 12-04-2019	
2	NRI-196	Danta/ Broadcast/ Thinning	Name: Md. Saidul Molla Village: Macchorkourpur Union: 6 no. Macchor Upazila: Faridpur Sadar District: Faridpur	N-23°36'33.49" E-89°46'37.84" 12-04-2019	
3	NRI-245	Danta Broadcast/ Irrigated	Name: Sahana Begum Village: Alipur Union: Hathazari pourosova Upazila: Hathazari District: Chattogram	N-22°30'05.9" E-91°047'27.9" 20-04-2019	
4	NRI-246	Lal maresh (Danta)/ Broadcast/ Irrigated	Name: Saymon Village: Dewan nagar Union: Hathazari pourosova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°048'25.2" 21-04-2019	
5	NRI-247	Sadamaresh (Danta)/ Broadcast/ Thinning	Name: Saymon Village: Dewan nagar Union: Hathazari pourosova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°048'25.2" 21-04-2019	
6	NRI-268	Danta/ Broadcast/ Irrigated	Name: Md. Palash Molla Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
7	NRI-269	Danta/ Broadcast/ Irrigated	Name: Md. Palash Molla Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
8	NRI-286	Danta/ Broadcast/ Irrigated	Name: Shelina Khatun Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	
9	NQR-15	Danta/ Broadcast/ Irrigated	Name: Nazimuddin Village: Sikdar para Union: Sonahar Upazila: Debiganj District: Panchagarh	N-26.05165 E-88.72736 13-11-2019	
10	NQR-22	Danta/ Broadcast/ Irrigated	Name: Abdus Salam Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
11	NQ-48	Datashak/ Broadcast/ Thinning	Name: Md. Abdur Rob Village: Giadhat Union: Haibatpur Upazila: Sadar District: Jashore	N-23°11'40.9" E-89°19'25.7" 02-10-2019	
12	NQ-77	Datashak/ Broadcast/ Thinning	Name: Md. Nazmul Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°44'54.2" E-89°49'41.8" 18-10-2019	
13	NQ-82	Datashak/ Broadcast/ Thinning	Name: Md. Nazmul Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°44'54.2" E-89°49'41.8" 18-10-2019	
14	MRI-11	Aman Daunga (Data)/ Aman season	Name: Nikhil Ch. Howlader Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
15	MRI-20	Aman Data/ Aman season	Name: Md. Belal Hossen Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
16	MRI-27	Data/ Broadcast/ Thinning	Name: Razvanu Village: Itbaria Union: Itbaria Upazila: Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
17	MRI-41	Data (Lal)/ Broadcast/ Thinning	Name: Md. Habibur Rahman Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
18	MRI-44	Data (Lal & Sada)/ Broadcast/ Thinning	Name: Md. Habibur Rahman Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
19	MRI-54	Then theinashak (Data)/ Broadcast/ Kharif-I & II	Name: Md. Al-Amin Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'23.79" E-90°7'12.54"	
20	MRI-88	Data (Daunga)/ In field/ Irrigated	Name: Mst. Sweety Village: Boro Laxmipur Union: Safipur Upazila: Muladi District: Barishal	14 October 2018 N-23°01'38.6" E-90°22'15.6"	
21	NRI-26	Data (Shada)/ Broadcast/ Thinning	Name: Sobita Mistri Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	
22	NRI-40	Data (Local)/ Broadcast/ Thinning	Name: Md. Moksed Fakir Village: Teligati Union: KUET (Aronggatha) Upazila: Aronggatha District: Khulna	13 September 2018 N-22°53'56.88" E-89°29'52.23"	
23	N-228	Sada Data Shak/ Broadcast/ Thinning	Name: Md. Shofi Village: Kobutorhat Union: Hathazari Upazila: Hathazari District: Chottogram	30 October 2018 N-22°50' E-91°85'	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
24	NSR-39	Data/ Broadcast/ Thinning	Name: Sujon Ali Village: Salgaria Union: Salgaria Upazila: Sadar District: Pabna	03 October 2018 N-23°59'50" E-89°15'19.7"	
25	SNQR-7	Chotrovogdanta / Irrigated/ Kharif I, II and Rabi	Name: Lovlu Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.36522 E-89.14153 13-10-2020	
26	SNQR-33	Patabahar data shak/ Irrigated/ Kharif I, II and Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
27	SNQR-37	Altabat damoshak/ Irrigated/ Kharif I, II and Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
28	SNQR-47	Chotrovongo data shak/ Irrigated/ Kharif I, II and Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
29	SNQR-55	Sada data/ Irrigated/ Kharif I, II and Rabi	Name: Gonesh Ch. Mondol Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.27883 E-89.11263 14-10-2020	
30	SN-2	Bashpata Data/ Irrigated/ Rabi, Kharif	Name: Dr. Sohikul Islam Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22.933543 E-89.166874 04-03-2020	
Ash gourd (<i>Benincasa hispida</i>)					
1	NRI-194	Chalkumra/ Roof top platform	Name: Md. Saidul Islam Village: Macchorkourpur Union: 6 no. Macchor Upazila: Faridpur Sadar District: Faridpur	N-23°36'33.39" E-89°46'37.84" 12-04-2019	
2	NRI-250	Chalkumra/ Roof top platform	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030°07.8" E-91048°25.2" 21-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
3	NRI-83	Chalkumra/ Roof top platform	Name: Promila Das Village: Velabaj Union: Krisnonagor Upazila: Faridpur-S District: Faridpur	N-23034'26.4" E-89045'44.1" 10-04-2019	
4	NRI-271	Chalkumra/ Roof top platform	Name: Md. Palash Molla Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
5	NRI-282	Chalkumra/ Roof top platform	Name: JoliAker Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
6	NQR-33	Chalkumra/ Roof top platform	Name: Prodip Chandra Ray Village: Danga para Union: Balrampur Upazila: Mulani District: Thakurgao	N-26.19113 E-88.51921 14-11-2019	
7	NQ-81	Chalkumra/ Roof top platform	Name: Md. Nazmul Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°44'54.2" E-89°49'41.8" 18-10-2019	
8	MRI-7	Chalkumra/ Roof top platform	Name: Chintahoron Hawlader Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
9	MRI-18	Chalkumra/ Roof top platform	Name: Md. Belal Hossen Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
10	MRI-21	Chalkumra/ Roof top platform	Name: A. Halim Matobbor Village: Itbaria Union: Itbaria Sadar Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
11	MRI-38	Chalkumra/ Roof top platform	Name: Md. Habibur Rahman Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
12	MRI-59	Chalkumra/ Roof top platform	Name: Md. Al-Amin Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'23.79" E-90°7'12.54"	
13	MRI-92	Chalkumra/ Roof top platform	Name: Yeasmin Village: Boro Laxmipur Union: Safipur Upazila: Muladi District: Barishal	14 October 2018 N-23°01'38.6" E-90°22'15.6"	
14	NRI-8	Deshi Chalkumra/ Roof top platform	Name: Ruidas Sordar Village: Mirzapur Union: Dumuria Upazila: Dumuria District: Khulna	12 September 2018 N-22°49'15.72" E-89°26'41.04"	
15	SNQR-42	Chalkumra/ Irrigated/ Kharif I, II	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
16	SNQR-62	Chalkumra/ Irrigated/ Kharif I	Name: Zakir Hossen Village: Varashimla Union: Varashimla Upazila: Kaliganj District: Satkhira	N-22.48083 E-89.01310 15-10-2020	
17	SAA-57	Jhum chalkumra/ Irrigated/ Kharif (Jhum)	Name: Sukiron Chakma Village: TUS (NGO) Union: Milonpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	
Banana (<i>Musa sapientum</i>)					
1	NRI-217	Rustom kola (Gera sundori)/ Annual plant	Name: Md. Kamal Hossen Village: Alipur Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'0" E-91°47'60" 20-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Barley (<i>Hordeum vulgare</i>)					
1	NRI-127	Job/ Field crop	Name: Jahid Sheikh Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
Bitter gourd (<i>Momordica charantia</i>)					
1	NRI-249	Tit Korolla/ In field platform	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°48'25.2" 21-04-2019	
2	NRI-69	Usta/ In field platform	Name: Morzina Begum Village: Fursa Union: Kanaipur Upazila: Faridpur Sadar District: Faridpur	N-23°43'26.4" E-89°28'44.1" 10-04-2019	
3	NRI-277	Korolla/ In field platform	Name: Mst. Fahima Khatun Village: Varoimari (Sordarpara) Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
4	NRI-285	Korolla/ In field platform	Name: Shelina Begum Village: Varoimari (Sordarpara) Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	
5	NQR-18	Korolla/ In field platform	Name: Abdus Salam Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
6	NQR-47	Korolla/ In field platform	Name: Nogen Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
7	NQ-79	Korolla/ In field platform	Name: Md. Nazmul Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°44'54.2" E-89°49'41.8" 18-10-2019	
8	SNQR-6	Ucche/ Irrigated/ Kharif I	Name: Lovlu Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.36522 E-89.14153 13-10-2020	
9	SNQR-43	Ucche/ Irrigated/ Kharif I	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
10	SNQR-58	Ucche/ Irrigated/ Kharif I	Name: Gonesh Ch. Mondol Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.27883 E-89.11263 14-10-2020	
11	SNQR-63	Korolla/ Irrigated/ Kharif I, II	Name: Shah Alam Village: Varashimla Union: Varashimla Upazila: Kaliganj District: Satkhira	N-22.48083 E-89.01310 15-10-2020	
12	SAA-54	Jhum korolla/ Irrigated/ Kharif (Jhum)	Name: Sukiron Chakma Village: TUS (NGO) Union: Milonpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	
Black cumin (<i>Nigella sativa</i>)					
1	NRI-125	Kalijira/ Field/ Rabi	Name: Jahid Sheikh Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
2	NRI-147	Kalijira/ Field/ Rabi	Name: M. A. Kader Sheikh Village: Gobindopur Union: Pourasava, ward-10 Upazila: Faridpur Sadar District: Faridpur	N-23036'55.08" E-89048'50.04" 12-04-2019	
3	NRI-165	Kalajira/ Field/ Rabi	Name: Md. Akter Mondol Village: Parchar Union: Pourasava, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23035'21.34" E-89046'48.02" 12-04-2019	
4	NRI-195	Kalijira/ Field/ Rabi	Name: Md. Saidul Molla Village: Mocchor Kourpur Union: 6 no. Macchor Upazila: Faridpur Sadar District: Faridpur	N-23036'33.39" E-89046'37.84" 12-04-2019	
Black gram (<i>Vigna mungo</i>)					
1	NRI-41	Mashkolair Dail/ Field/ Kharif-II	Name: Tara Sheikh Village: Beparidangi Union: Dingir Char Upazila: Faridpur-Sadar District: Faridpur	N-23°35'28.61" E-89°49'53.68" 10-04-2019	
2	NRI-42	Mash kalai/ Field/ Kharif-II	Name: Dilip Das Village: Velabaj Union: Krisnonagor Upazila: Faridpur-Sadar District: Faridpur	N-23°35'26.4" E-89°46'44.1" 10-04-2019	
Black pea (<i>Pisum sativum</i>)					
1	NRI-176	Kali motor/ Field	Name: Moslem Jomoddar Village: Duldi, Gobindopur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23°36'38.39" E-89°49'3.84" 12-04-2019	
Bottle gourd (<i>Lagenaria siceraria</i>)					
1	NRI-181	Lau/ In jhar	Name: Sonailaa Jomoddar Village: Duldi, Gobindopur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23°36'38.39" E-89°49'3.84" 12-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
2	NRI-228	Lau/ In field	Name: Nuruzzaman Village: Sujanagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	
3	NRI-236	Lau/ Field	Name: Abdul Mannan Village: Sujanagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	
4	NRI-254	Lau/ In jhar	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'07.8" E-91048'25.2" 21-04-2019	
5	NRI-280	Lau/ In jhar	Name: Joli Akter Village: Varoimari (Sordarpara) Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
6	NQR-13	Lau/ In jhar	Name: Rohima Begum Village: Sikdar para Union: Sonahar Upazila: Debiganj District: Panchagarh	N-26.05165 E-88.72736 13-11-2019	
7	NQR-31	Lau/ In jhar	Name: Abdul Malek Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
8	NQR-32	Lau/ In jhar	Name: Abdul Malek Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
9	NQR-46	Lau/ In jhar	Name: Nogen Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	
10	NQ-42	Lau/ In jhar	Name: Md. Billal Village: Kullapara Union: Haibatpur Upazila: Jashore Sadar District: Jashore	N-23°20'39.6" E-89°06'39.0" 02-10-2019	
11	NQ-66	Lau/ In jhar	Name: Md. Asfaq Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
12	MRI-35	Lau/ In jhar	Name: Mizanur Rahman Fakir Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
13	MRI-40	Lau/ In jhar	Name: Md. Habibur Rahman Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
14	MRI-64	Lau/ In jhar	Name: Md. Jahangir Hossen Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'24.54" E-90°7'11.79"	
15	MRI-70	Lau/ In jhar	Name: M. Joynal Abedin Kazi Village: Tarikata Union: Dulassor Upazila: Mohipur District: Patuakhali	12 October 2018 N-21°51'26.9" E-90°07'31.6"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
16	MRI-85	Lau/ In <i>jhar</i>	Name: Mst. Sabikunnahar Village: Chilmari Union: Nazirpur Upazila: Muladi District: Barishal	13 October 2018 N-22°57'39.65" E-90°21'54.47"	
17	MRI-86	Lau/ In <i>jhar</i>	Name: Aleya Khatun Village: Banimordon Union: Nazirpur Upazila: Muladi District: Barishal	13 October 2018 N-22°57'39.65" E-90°21'54.47"	
18	MRI-87	Lau (Kadu)/ In <i>jhar</i>	Name: Yeasmin Village: Boro Laxmipur Union: Safipur Upazila: Muladi District: Barishal	14 October 2018 N-23°01'38.6" E-90°22'15.6"	
19	NRI-3	Jharlau (Deshi)/ In <i>jhar</i>	Name: Purnandu Bishwas Village: Mirzapur Union: Dumuria Upazila: Dumuria District: Khulna	12 September 2018 N-22°44'15.72" E-89°26'41.04"	
20	NRI-19	Lau/ In <i>jhar</i>	Name: Kumkum Boiragi Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	
21	NRI-22	Deshikodu (Lomba)/ In <i>jhar</i>	Name: Bila Mondol Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	
22	NRI-37	Lau/ In <i>jhar</i>	Name: Palash Sardar Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
23	NSR-42	Lau/ In jhar	Name: Sujon Ali Village: Salgaria Union: Salgaria Upazila: Pabna Sadar District: Pabna	03 October 2018 N-23°59'50" E-89°15'19.7"	
24	NSR-50	Lau/ In jhar	Name: Babul Mir Village: Kochua Union: Dapunia Upazila: Pabna Sadar District: Pabna	03 October 2018 N-23°59'50.6" E-89°15'19.7"	
25	SNQR-39	Lau/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
26	SNQR-65	Lau/ Irrigated/ Rabi	Name: Zakir Hossen Village: Varashimla Union: Varashimla Upazila: Kaliganj District: Satkhira	N-22.48083 E-89.01310 15-10-2020	
27	SAA-14	Jhum lau/ Irrigated/ Jhum (Rabi)	Name: Tona Chakma Village: Kanglak Pahar Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°29'19" E-92°16'46" 22/12/2019	
28	SAA-27	Jhum lau/ Irrigated/ Rabi (Jhum)	Name: Bilas Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
29	SAA-42	Jhum lau/ Irrigated/ Rabi (Jhum)	Name: Dipali Tripura Village: 8 Mile Perachora Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°11'07" E-92°01'56" 23/12/2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Brinjal (<i>Solanum melongena</i>)					
1	NRI-130	Kata begun (sada)/ Home yard/ Year round	Name: Aklima Sheikh Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	NRI-221	Futa begun/ Field/ Year round	Name: Md. Hanif Village: Sujanagar Union: Hathazari pourosova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	
3	NRI-231	Futa begun (choto)/ Field/ Year round	Name: Nuruzzaman Village: Sujanagar Union: Hathazari pourosova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	
4	NRI-232	Begun (Islampuri)/ Field/ Year round	Name: Abdul Mannan Village: Sujanagar Union: Hathazari pourosova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	
5	NRI-264	Futa begun/ Field/ Year round	Name: Md. Sultan Village: Dewannagar (West) Union: Hathazaripourosova Upazila: Hathazari District: Chattogram	N-22029'58.58" E-91048'0.53" 20-04-2019	
6	NRI-281	Begun/ Home yard/ Year round	Name: Joli Akter Village: Varoimari (Sordarpara) Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
7	NRI-291	Begun/ Home yard/ Year round	Name: Ruma Village: Varoimari (Sordarpara) Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
8	NQR-39	Tit begun (<i>Solanum trilobatum</i>)/ Wild	Name: Abdul Gofur Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	
9	NQ-50	Begun/ Field/ Year round	Name: Huzaifa Rahman Village: Berapatahalia Union: Pourasaba Upazila: Jamalpur Sadar District: Jamalpur	N-24°51'55.4" E-90°02'19.4" 17-10-2019	
10	NQ-53	Begun/ Home yard/ Year round	Name: Md. Shahin Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
11	NQ-54	Begun/ Home yard/ Year round	Name: Md. Shahin Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
12	NQ-67	Begun/ Home yard/ Year round	Name: Hossain Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°45'14.7" E-89°49'50.3" 18-10-2019	
13	NQ-75	Begun/ Home yard/ Year round	Name: Hossain Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°45'14.7" E-89°49'50.3" 18-10-2019	
14	NQ-87	Begun/ Home yard/ Year round	Name: Md. Kamrul Village: Shankarpur Union: Noapara Upazila: Islampur District: Jamalpur	N-25°04'21.3" E-89°45'49.6" 19-10-2019	
15	MRI-22	Sada begun/ Home yard/ Year round	Name: Razvanu Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
16	MRI-100	Begun-(SMP-2)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
17	MRI-101	Begun-(SMP-3)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
18	MRI-102	Begun-(SMP-4)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
19	MRI-103	Begun-(SMP-5)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
20	MRI-104	Begun-(SMP-6)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
21	MRI-105	Begun-(SMP-9)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
22	MRI-106	Begun-(SMP-10)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
23	MRI-107	Begun-(SMP-12)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
24	MRI-108	Begun-(SMP-11)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
25	MRI-109	Begun-(SMP-14)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
26	MRI-110	Begun-(SMP-35)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
27	MRI-111	Begun-(SMP-43)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
28	MRI-112	Begun-(SMP-44)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
29	MRI-113	Begun-(SMP-47)/ Selected line	Name: Dr. M. M. Rahman Village: RHRS Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
30	MRI-114	Begun (Gol kata)/ Home yard	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	

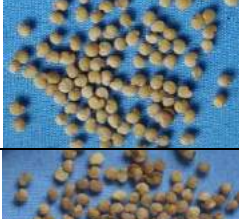
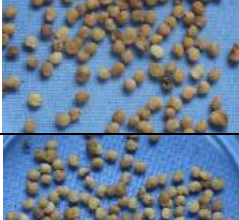
Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
31	MRI-115	Begun (2-16)/ Selected line	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
32	MRI-116	Begun (4-2)/ Selected line	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
33	MRI-117	Begun (4-3)/ Selected line	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
34	MRI-118	Begun (4-4)/ Selected line	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
35	MRI-119	Begun (6-1)/ Selected line	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
36	MRI-120	Begun (6-2)/ Selected line	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
37	MRI-121	Begun (6-3)/ Selected line	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
38	MRI-122	Begun (6-4)/ Selected line	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
39	MRI-123	Begun (7-3) Selected line	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
40	MRI-124	Begun (7-16)/ Selected line	Name: Md. Rezaul Karim Village: (SO, RHRS) Union: Lebukhali Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'50.62" E-90°20'19.52"	
41	N-215	Baigun/ Home yard/ Year round	Name: Md. Saiful Islam Village: Boiltoli bazar Union: Dohazari Upazila: Chandanaish District: Chattogram	29 October 2018 N-22°16' E-92°06'	
42	N-216	Begun (Deshi)/ Home yard/ Year round	Name: Azim Uddin Village: Dewan Nagar Union: Hathazari Upazila: Hathazari District: Chattogram	29 October 2018 N-22°50' E-91°85'	
43	N-217	Sada Tal Begun/ Home yard/ Year round	Name: Helal Uddin Village: Vatirtek Union: Sadar-6 Upazila: Choumohoni District: Noakhali	28 October 2018 N-22°94' E-91°11'	
44	N-218	Tal Begun Sobuj/ Home yard/ Year round	Name: Tofayel Ahamed Village: Purbo Solakia Sadar Union: Sadar-7 Upazila: Noakhali Sadar District: Noakhali	28 October 2018 N-22°94' E-91°11'	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
45	N-234	Owsodi Begun/Jhum	Name: Piplu Rakhiyan Village: Bolipara (Nilgiri) Union: Bolipara Upazila: Thanchi District: Bandarban	29 October 2018 N-21°81' E-92°43'	
46	N-235	Choto Begun/Jhum	Name: Piplu Rakhiyan Village: Bolipara (Nilgiri) Union: Bolipara Upazila: Thanchi District: Bandarban	29 October 2018 N-21°81' E-92°43'	
47	N-236	Begun/Jhum	Name: Piplu Rakhiyan Village: Bolipara (Nilgiri) Union: Bolipara Upazila: Thanchi District: Bandarban	30 October 2018 N-21°81' E-92°43'	
48	N-237	Begun/Jhum	Name: Sorot Marma Village: Laimipara (Nilgiri) Union: LaimiSadar Upazila: Thanchi District: Bandarban	29 October 2018 N-21°81' E-92°43'	
49	N-215	Baigun/Field/Year round	Name: Md. Saiful Islam Village: Boiltoli bazar Union: Dohazari Upazila: Chandanaish District: Chattogram	29 October 2018 N-22°16' E-92°06'	
50	NSR-2	Begun/Home yard/Year round	Name: Shopown Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
51	NSR-3	Begun/Home yard/Year round	Name: Shopown Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
52	NSR-4	Begun/Home yard/Year round	Name: Amirul Islam Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
53	NSR-5	Begun/ Home yard/ Year round	Name: Shopown Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
54	NSR-6	Begun/ Home yard/ Year round	Name: Amirul Islam Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
55	NSR-8	Begun/ Home yard/ Year round	Name: Shopown Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
56	NSR-9	Begun/ Home yard/ Year round	Name: Amirul Islam Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
57	NSR-10	Begun/ Home yard/ Year round	Name: Kiron Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
58	NSR-11	Begun/ Home yard/ Year round	Name: Kiron Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
59	NSR-12	Begun/ Home yard/ Year round	Name: Kiron Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
60	NSR-13	Begun/ Home yard/ Year round	Name: Kiron Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
61	NSR-14	Begun/ Home yard/ Year round	Name: Al-Amin Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
62	NSR-15	Begun/ Home yard/ Year round	Name: Al-Amin Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
63	NSR-17	Begun/ Home yard/ Year round	Name: Al-Amin Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
64	NSR-18	Begun/ Home yard/ Year round	Name: Al-Amin Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
65	NSR-19	Begun/ Home yard/ Year round	Name: Al-Amin Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
66	NSR-20	Begun/ Home yard/ Year round	Name: Fotik Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
67	NSR-21	Begun/ Home yard/ Year round	Name: Fotik Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
68	NSR-22	Begun/ Home yard/ Year round	Name: Fotik Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
69	NSR-23	Begun/ Home yard/ Year round	Name: Fotik Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
70	NSR-24	Begun/ Home yard/ Year round	Name: Shahanur Rahman Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
71	NSR-26	Begun/ Home yard/ Year round	Name: Shahanur Rahman Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
72	NSR-27	Begun/ Home yard/ Year round	Name: Shahanur Rahman Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
73	NSR-28	Begun/ Home yard/ Year round	Name: Shahanur Rahman Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
74	SNQR-10	Begun/ Irrigated/ Kharif I, II	Name: Mohon Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.48153 E-89.26292 13-10-2020	
75	SAA-66	Jhum begun/ Irrigated/ Kharif	Name: Sukiron Chakma Village: TUS (NGO) Union: Milenpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	
76	SAA-68	Laffa begun/ Irrigated/ Kharif	Name: Jamal Uddin Village: Mohamoni Union: Rai-Pouroshova Upazila: Ramghar District: Khagrachari	N-22.9565669 E-91.7763169 24-12-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
77	SN-1	Bagun/ Irrigated/ Kharif	Name: Dr. Sohikul Islam Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22.933543 E-89.166874 04-03-2020	
Chilli (<i>Capsicum frutescens</i>)					
1	NRI-220	Hathazari Morich/ Kharif	Name: Md. Salauddin Village: West Mirzapur Union: Mirzapur Upazila: Hathazari District: Chattogram	N-22°33'26.9" E-91°46'30.7" 20-04-2019	
2	NRI-225	Halda Morich/ kharif	Name: Md. Hasan Village: Sujanagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'12.5" E-91°47'42.0" 20-04-2019	
3	NRI-243	DhennaMorich/ Home yard/ kharif	Name: Sahana Begum Village: Alipur Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'05.9" E-91°47'27.9" 20-04-2019	
4	NQR-38	Jira morich/ Home yard	Name: Norul Islam Village: Danga para Union: Balrampur Upazila: Mulani District: Thakurgao	N-26.19113 E-88.51921 14-11-2019	
5	NQ-64	Morich/ Field	Name: Md. Asfaq Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
6	SNQR-31	Bombay morich/ Irrigated/ Biennial	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
7	SNQR-53	Bullet jhal/ Irrigated/ Annual	Name: Gonesh Ch. Mondol Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.27883 E-89.11263 14-10-2020	
8	SAA-02	Chikonmorich/ Rainfed/ Rabi	Name: Tona Chakma Village: Kanglak Pahar Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°29'19" E-92°16'46" 22/12/2019	
9	SAA-03	Chotomorich/ Rainfed/ Rabi	Name: Anil Tripura Village: Kanglak Pahar Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°29'19" E-92°16'46" 22/12/2019	
10	SAA-36	Jhum morich/ Irrigated/ Rabi (Jhum)	Name: Mokshedor Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
11	SN-4	Pola morich/ Irrigated/ Rabi	Name: Md. Ruhul Amin Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22.933543 E-89.166874 04-03-2020	
12	SN-5	Boltumorich/ Irrigated/ Rabi	Name: Dr. Sohidul Islam Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22°56'2.22" E-89°9'45.9" 04-03-2020	
13	SN-6	Patakandimorich/ Irrigated/ Rabi	Name: Dr. Sohidul Islam Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22.933543 E-89.166874 04-03-2020	
Coriander (<i>Coriandrum sativum</i>)					
1	NRI-104	Dhonia soz/ Field/ Rabi	Name: Idris Sheikh Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
2	NRI-158	Dhonia soz/ Field/ Rabi	Name: Md. Humayun Mondol Village: Parchar Union: Pourasava, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23035'21.34" E-89046'48.02" 12-04-2019	
3	NRI-159	Dhonia soz/ Field/ Rabi	Name: Md. Akter Mondol Village: Parchar Union: Pourasava, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23035'21.34" E-89046'48.02" 12-04-2019	
4	NRI-172	Dhonia soz/ Field/ Rabi	Name: Moslem Jomoddar Village: Duldi, Gobindopur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23036'38.39" E-89049'3.84" 12-04-2019	
5	NRI-188	Dhonia soz/ Field/ Rabi	Name: Ahmmed Ali Sheikh Village: Char Noshipur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23036'38.39" E-89049'3.84" 12-04-2019	
6	NRI-197	Dhonia soz/ Field/ Rabi	Name: Md. Saidul Molla Village: Macchorkourpur Union: 6 no. Macchor Upazila: Faridpur Sadar District: Faridpur	N-23036'33.49" E-89046'37.84" 12-04-2019	
7	NQR-8	Dhonia/ Field/ Rabi	Name: Aminul Islam Raju Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
8	NQR-28	Dhonia/ Field/ Rabi	Name: Abdul Malek Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
9	NQR-45	Dhonia/ Field/ Rabi	Name: Nogen Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
10	MRI-9	Dhonia/ Field/ Rabi	Name: Chintahoron Hawlader Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
11	MRI-65	Dhonia/ Field/ Rabi	Name: Md. Jahangir Hossen Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'24.54" E-90°7'11.79"	
Country bean (<i>Lablab purpureus</i>)					
1	NRI-132	Choita sim/ Hatikani sim/ <i>Jhar</i>	Name: Aklima Begum Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	NRI-133	Noladanga sim/ <i>Jhar</i>	Name: Aklima Begum Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
3	NRI-230	Jat sim/ <i>Jhar</i>	Name: Nuruzzaman Village: Sujanagar Union: Hathazari pourosova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	
4	NRI-235	Jat sim/ <i>Jhar</i>	Name: Abdul Mannan Village: Sujanagar Union: Hathazari pourosova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	
5	NRI-238	Putichoi/ <i>Jhar</i>	Name: Orchona Chowdhury Village: Alipur Union: Hathazari pourosova Upazila: Hathazari District: Chattogram	N-22030'05.9" E-91047'27.9" 20-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
6	NRI-239	Loittachoi/ <i>Jhar</i>	Name: Orchona Chowdhury Village: Alipur Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'05.9" E-91047'27.9" 20-04-2019	
7	NRI-253	Lal putichoi/ <i>Jhar</i>	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'07.8" E-91048'25.2" 21-04-2019	
8	NRI-214	Nolusshi/ <i>Jhar</i>	Name: Nazrul Matobbar Village: Aruakandi Union: Gatti Upazila: Nagar Kanda (Salta) District: Faridpur	N-23029'10.48" E-89048'57.5" 13-04-2019	
9	NRI-267	Seem/ <i>Jhar</i>	Name: Moriom Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
10	NRI-275	Seem/ <i>Jhar</i>	Name: Md. Afzal Village: PramanikVaroimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
11	NRI-283	Seem/ <i>Jhar</i>	Name: Jihad Village: Varoimari (Sordarpara) Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
12	NRI-284	Ghikanchon/ <i>Jhar</i>	Name: Shelina Begum Village: Varoimari (Sordarpara) Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
13	NQR-6	Seem/ Jhar	Name: Aminul Islam Raju Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
14	NQR-7	Seem/ Jhar	Name: Aminul Islam Raju Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
15	NQR-9	Seem/ Jhar	Name: Aminul Islam Raju Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
16	NQR-34	Seem/ Jhar	Name: Prodip Chandra Roy Village: Danga para Union: Balrampur Upazila: Mulani District: Thakurgao	N-26.19113 E-88.51921 14-11-2019	
17	NQR-48	Seem/ Jhar	Name: Nogen Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	
18	NQ-43	Sheem/ Jhar	Name: Md. Billal Village: Kullapara Union: Haibatpur Upazila: Jashore Sadar District: Jashore	N-23°20'39.6" E-89°06'39.0" 02-10-2019	
19	NQ-45	Shim/ Jhar	Name: Md. Billal Village: Kullapara Union: Haibatpur Upazila: Jashore Sadar District: Jashore	N-23°20'39.6" E-89°06'39.0" 02-10-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
20	NQ-46	Shim/ Jhar	Name: Md. Abdur Rob Village: Giadhat Union: Haibatpur Upazila: Jashore Sadar District: Jashore	N-23°11'40.9" E-89°19'25.7" 02-10-2019	
21	NQ-59	Sheem/ Jhar	Name: Md. Shahin Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
22	NQ-62	Sheem/ Jhar	Name: Md. Shahin Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
23	NQ-84	Sheem/ Jhar	Name: Md. Kamrul Village: Shankarpur Union: Noapara Upazila: Islampur District: Jamalpur	N-25°04'21.3" E-89°45'49.6" 19-10-2019	
24	MRI-1	Kartik jali sim/ Jhar	Name: Borun Hawlader Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.756" E-90°25'13.17"	
25	MRI-13	Sim (Soto)/ Jhar	Name: Md. Belal Hossen Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
26	MRI-14	Sim (Soto,Green)/ Jhar	Name: Md. Belal Hossen Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
27	MRI-15	Kartik sim/ <i>Jhar</i>	Name: Md. Belal Hossen Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
28	MRI-16	Tepa sim/ <i>Jhar</i>	Name: Md. Belal Hossen Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
29	MRI-32	Koromza (Chotoussi)/ <i>Jhar</i>	Name: Md. Ruhul Amin Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
30	MRI-34	Kartik sim (Utro)/ <i>Jhar</i>	Name: Mizanur Rahman Fakir Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
31	MRI-45	Kartik jal sim/ <i>Jhar</i>	Name: Md. Abdul Haque Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
32	MRI-60	Ussi/ <i>Jhar</i>	Name: Md. Al-Amin Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'23.79" E-90°7'12.54"	
33	MRI-78	Sim/ <i>Jhar</i>	Name: Feroza Begum Village: Banimordon Union: Nazirpur Upazila: Muladi District: Barishal	13 October 2018 N-22°57'39.65" E-90°21'54.47"	
34	MRI-79	Sim/ <i>Jhar</i>	Name: Feroza Begum Village: Banimordon Union: Nazirpur Upazila: Muladi District: Barishal	13 October 2018 N-22°57'39.65" E-90°21'54.47"	
35	MRI-99	Sim/ <i>Jhar</i>	Name: Md. Al-Amin Village: BoroLaxmipur Union: Safipur Upazila: Muladi District: Barishal	14 October 2018 N-23°01'38.6" E-90°22'15.6"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
36	NRI-5	Chepta sim/ <i>Jhar</i>	Name: Sonchoy Boiragi Village: Mirzapur Union: Dumuria Upazila: Dumuria District: Khulna	12 September 2018 N-22°49'15.72" E-89°26'41.04"	
37	NRI-18	Karthik shailchapta shim/ <i>Jhar</i>	Name: Monoronjon Ganguli Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	
38	NRI-33	Sim/ <i>Jhar</i>	Name: Md. Moktar Sheikh Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	
39	N-249	Sitakundo Sim/ <i>Jhum</i>	Name: Md. Samad Hossen Village: Kumira Union: Sitakunda Upazila: Sitatunga District: Chattogram	29 October 2018 N-22°50' E-91°71'	
40	N-252	Khaissa Sim/ <i>Jhum</i>	Name: Md. Nazim Uddin Village: Murgirhat Union: Hathazari Upazila: Hathazari District: Chattogram	29 October 2018 N-22°50' E-91°71'	
41	N-255	Sim (Khaissa)/ <i>Jhum</i>	Name: Abu Musa Village: Dewanhath Union: Dohazari Upazila: Chandanaish District: Chattogram	30 October 2018 N-22°17' E-92°07'	
42	NSR-31	Shim/ <i>Jhar</i>	Name: Shapon Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
43	NSR-32	Shim/ <i>Jhar</i>	Name: Shapon Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
44	NSR-33	Shim/ Jhar	Name: Shapon Ali Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
45	NSR-34	Shim/ Jhar	Name: Amirul Islam Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
46	NSR-35	Shim/ Jhar	Name: Amirul Islam Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
47	NSR-36	Shim/ Jhar	Name: Amirul Islam Village: Char Mir Kamal Union: Solimpur Upazila: Ishwardi District: Pabna	02 October 2018 N-24°4.4'65" E-89°4.10'34"	
48	NSR-45	Shim/ Jhar	Name: Rafique Sharker Village: Dashuria Union: Dashuria Upazila: Pabna Sadar District: Pabna	03 October 2018 N-23°59' E-89°16'20"	
49	SNQR-4	Rohimsheem/ Irrigated/ Rabi	Name: Lovlu Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.36522 E-89.14153 13-10-2020	
50	SNQR-14	Sadanoikoshsheem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
51	SNQR-15	Jamaikolisheem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
52	SNQR-16	Kori sheem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
53	SNQR-17	Borokoromjhas heem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
54	SNQR-18	Delpatsheem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
55	SNQR-19	Lal sheem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
56	SNQR-20	Sobuznolkoshsh eem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
57	SNQR-21	Sadanolkoshshe em/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
58	SNQR-22	Chotokorisheem / Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
59	SNQR-23	Ghitokanchansheem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
60	SNQR-24	Patra katrikasheem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
61	SNQR-25	Lal koromjhasheem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
62	SNQR-26	Motor sheem/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
63	SNQR-69	Ghee kanchonsheem/ Irrigated/ Rabi	Name: Shah Alam Village: Varashimla Union: Varashimla Upazila: Kaliganj District: Satkhira	N-22.48083 E-89.01310 15-10-2020	
64	SAA-45	Jhum sheem/ Irrigated/ Rabi (Jhum)	Name: Dipali Tripura Village: 8 Mile Perachora Union: Sajek Upazila: Baghaichari District: Rangamati	N-23°11'07" E-92°01.56" 23/12/2019	
65	SAA-61	Korenghasheem/ Irrigated/ Rabi	Name: Sukiron Chakma Village: TUS (NGO) Union: Milonpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
66	SAA-64	Jarkallosheem/ Irrigated/ Rabi	Name: Sukiron Chakma Village: TUS (NGO) Union: Milonpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	
67	SSQR-1	Lombu/Gochish eem/ Irrigated/ Rabi	Name: Md. Abdul Based Village: Daktarpara Union: Cupinagar Upazila: Sajahanpur District: Bogura	N-24.756514 E-89.413862 25-09-2020	
68	SSQR-2	Cotisheem/ Irrigated/ Rabi	Name: Md. Abdul Mojid Village: Brikushtia Union: Cupinagar Upazila: Sajahanpur District: Bogura	N-24.753970 E-89.406835 25-09-2020	
69	SSQR-3	China sheem/ Irrigated/ Rabi	Name: Md. Abdul Mojid Village: Brikushtia Union: Cupinagar Upazila: Sajahanpur District: Bogura	N-24.753970 E-89.406835 25-09-2020	
70	SSQR-4	Deshilalsheem/ Irrigated/ Rabi	Name: Md. Abdul Mojid Village: Brikushtia Union: Cupinagar Upazila: Sajahanpur District: Bogura	N-24.753970 E-89.406835 25-09-2020	
71	SSQR-5	Jossorisheem/ Irrigated/ Rabi	Name: Md. Romjan Ali Village: Doripara Union: Cupinagar Upazila: Sajahanpur District: Bogura	N-24.756514 E-89.413862 25-09-2020	
72	SSQR-6	Pantisheem/ Irrigated/ Rabi	Name: Md. Faridul Alam Village: Brikushtia Union: Cupinagar Upazila: Sajahanpur District: Bogura	N-24.753970 E-89.406835 25-09-2020	
73	SSQR-7	Tepa sheem/ Irrigated/ Rabi	Name: Md. Motahar Ali Village: Daktarpara Union: Cupinagar Upazila: Sajahanpur District: Bogura	N-24.756514 E-89.413862 25-09-2020	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Cucumber (<i>Cucumis sativus</i>)					
1	NRI-222	Kheera/ Macha/ Kharif	Name: Md. Hanif Village: Sujanagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'12.5" E-91°47'42.0" 20-04-2019	
2	NRI-223	Sosha/ Macha/ Kharif	Name: Md. Hanif Village: Sujanagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'12.5" E-91°47'42.0" 20-04-2019	
3	NRI-274	Sosha/ Macha/ Kharif	Name: Md. Afzal Pramanik Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
4	NRI-295	Sosha/ Macha/ Kharif	Name: Mojibor Rahman Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	
5	MRI-5	Borososha/ Macha/ Kharif	Name: Chintahoron Hawlader Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
6	MRI-29	Sosha/ Macha/ Kharif	Name: A. Halim Matobbor Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
7	MRI-56	Sosha/ Macha/ Kharif	Name: Md. Al-Amin Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'23.79" E-90°7'12.54"	
8	MRI-75	Morma/ Macha/ Kharif	Name: M. Joynal Abedin Kazi Village: Tarikata Union: Dulassor Upazila: Mohipur District: Patuakhali	12 October 2018 N-21°51'26.9" E-90°07'31.6"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
9	NSR-44	Sosha/ Macha/ Kharif	Name: Sujon Ali Village: Salgaria Union: Salgaria Upazila: Pabna Sadar District: Pabna	03 October 2018 N-23°59'50" E-89°15'19.7"	
10	SNQR-1	Deshikhira/ Irrigated/ Kharif I	Name: Lovlu Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.36522 E-89.14153 13-10-2020	
11	SNQR-30	Sosha/ Irrigated/ Kharif I, II	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
12	SAA-25	Marfa/ Irrigated/ Kharif	Name: Bibika Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
13	SAA-51	Jhum marfa/ Irrigated/ Kharif (Jhum)	Name: Chandrakishor Tripura Village: 6 Mile, Perachora Union: Baghaichori Upazila: Baghaichori District: Rangamati	N-23°10'34" E-92°01'38" 23/12/2019	
14	SAA-60	Marfa/ Irrigated/ Kharif	Name: Sukiron Chakma Village: TUS (NGO) Union: Milenpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	
Bullock's heart (<i>Annona reticulata</i>)					
1	NRI-216	Ata/ Perennial	Name: Enamul Kabir Village: Berbori Union: Fulhori Upazila: Shoilkupa District: Jhinaidha	N-23°41'0.83" E-89°14'45.4" 13-04-2019	
2	SAA-62	Sharifa (Atisamila)/ Rainfed/ Perennial	Name: Sukiron Chakma Village: TUS (NGO) Union: Milenpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Fennel (<i>Foeniculum vulgare</i>)					
1	NRI-117	Guemuri (Mouri)/ Field/ Rabi	Name: Moriam Akter Village: Piarpur Union: Kojjuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	NQR-19	Mouri/ Field/ Rabi	Name: Abdus Salam Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
Fenugreek (<i>Trigonella foenum-graecum</i>)					
1	NRI-108	Methi/ Field/ Rabi	Name: Shahid Sheikh Village: Piarpur Union: Kojjuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	NRI-167	Methi/ Field/ Rabi	Name: Md. Akter Mondol Village: Parchar Union: Pourasava, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23°35'21.34" E-89°46'48.02" 12-04-2019	
3	NRI-185	Methi/ Field/ Rabi	Name: Jalil Jomoddar Village: Duldi, Gobindopur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23°36'38.39" E-89°49'3.84" 12-04-2019	
Garlic (<i>Allium sativum</i>)					
1	NRI-135	Rosun/ Field/ Rabi	Name: Aklima Sheikh Village: Piarpur Union: Kojjuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
Grass pea (<i>Lathyrus sativus</i>)					
1	NRI-106	Khesari/ Rely crop with boro rice/ Rabi	Name: Idris Sheikh Village: Piarpur Union: Kojjuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
2	NRI-154	Khesari/ Rely crop with boro rice/ Rabi	Name: Razia Anwar Village: Gobindopur Union: Pourasava, ward-10 Upazila: Faridpur Sadar District: Faridpur	N-23036'55.08" E-89048'50.04" 12-04-2019	
3	NRI-156	Khesari/ Rely crop with boro rice/ Rabi	Name: M. Humayun Mondol Village: Parchar Union: Pourasava, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23035'21.34" E-89046'48.02" 12-04-2019	
4	NRI-207	Khesari/ Rely crop with boro rice/ Rabi	Name: Md. Siddique Sheikh Village: Bahirdah Union: Macchor Upazila: Faridpur Sadar District: Faridpur	N-23035'36.39" E-89046'41.84" 12-04-2019	
5	MRI-37	Khesari/ Rely crop with boro rice/ Rabi	Name: Mizanur Rahman Fakir Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
6	MRI-49	Khesari/ Rely crop with boro rice/ Rabi	Name: Md. Shanu Fakir Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
7	MRI-67	Khesari/ Rely crop with boro rice/ Rabi	Name: Israt Jahan Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'24.54" E-90°7'11.79"	
8	MRI-91	Khesari/ Rely crop with boro rice/ Rabi	Name: Yeamin Village: Boro Laxmipur Union: Safipur Upazila: Muladi District: Barishal	14 October 2018 N-23°01'38.6" E-90°22'15.6"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
9	SNQR-46	Kheshari/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
Indian spinach (<i>Basella alba</i>)					
1	NRI-103	Puishak/ <i>Macha</i>	Name: Idris Sheikh Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	NRI-206	Puishak/ <i>Macha</i>	Name: Md. Siddique Sheikh Village: Bahirdah Union: Macchor Upazila: Faridpur Sadar District: Faridpur	N-23°35'36.39" E-89°46'41.84" 12-04-2019	
3	NRI-261	Puishak/ <i>Macha</i>	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°48'25.2" 21-04-2019	
4	NQR-21	Puishak/ <i>Macha</i>	Name: Abdus Salam Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
5	NQ-88	Puishak/ <i>Macha</i>	Name: Md. Kamrul Village: Shankarpur Union: Noapara Upazila: Islampur District: Jamalpur	N-25°04'21.3" E-89°45'49.6" 19-10-2019	
6	SNQR-9	Puishak/ Irrigated/ Kharif I, II and Rabi	Name: Mohon Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.48153 E-89.26292 13-10-2020	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
7	SNQR-66	Puishak/ Irrigated/ Kharif I, II	Name: Zakir Hossen Village: Varashimla Union: Varashimla Upazila: Kaliganj District: Satkhira	N-22.48083 E-89.01310 15-10-2020	
Jute (<i>Corchorus olitorius</i>)					
1	NRI-137	Amoinnasada pat/ Aman season/ Field	Name: Rustom Khan Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	N-231	Pat shak/ Kharif-II	Name: Afsar Miah Village: Roktipara Union: Hathazari Upazila: Hathazari District: Chattogram	30 October 2018 N-22°50' E-91°85'	
3	SAA-59	Pat shak (Naris)/ Rainfed/ Kharif	Name: Sukiron Chakma Village: TUS (NGO) Union: Milonpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	
Kangkong (<i>Ipomoea aquatica</i>)					
1	NRI-262	Kolmishak/ Wetland	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°48'25.2" 21-04-2019	
2	NSR-75	Kolmishak/ Wetland	Name: Md. A. Aziz Village: Raddershar Union: Kakina Upazila: Kaligonj District: Lalmonirhat	14 January 2019 N-25°54'18.6" E-89°15'27.2"	
3	SNQR-40	Math kolmi/ Irrigated/ Kharif I, II and Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Lentil (<i>Lens esculenta</i>)					
1	NRI-118	Mosur dal/ Rabi/ Field	Name: Kaiyum Sheikh Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	NRI-166	Mosur dal/ Rabi/ Field	Name: Md. AkterMondol Village: Parchar Union: Pourosova, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23035'21.34" E-89046'48.02" 11-04-2019	
3	NRI-200	Mosur dal/ Rabi/ Field	Name: Md. Siddique Sheikh Village: Bahirdah Union: Macchor Upazila: Faridpur Sadar District: Faridpur	N-23036'38.39" E-89046'41.84" 11-04-2019	
4	NQR-17	Mosur dal/ Rabi/ Field	Name: Abdus Salam Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
Linseed (<i>Linum usitatissimum</i>)					
1	NRI-144	Moishna/ Kharif-II/ Field	Name: Md. Firoz Khan Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
Okra (<i>Abelmoschus esculentus</i>)					
1	NRI-161	Vendi/ Kharif/ Home yard	Name: Md. AkterMondol Village: Parchar Union: Pourosova, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23°35'21.34" E-89°46'48.02" 12-04-2019	
2	NRI-192	Vendi/ Kharif/ Home yard	Name: Ahmmmed Ali Sheikh Village: Char Noshipur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23038'34.39" E-89047'22.84" 12-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
3	NRI-240	Vendi/ Kharif/ Field	Name: Orchona Chowdhury Village: Alipur Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'05.9" E-91047'27.9" 20-04-2019	
4	NRI-259	Vendi/ Kharif/ Field	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'07.8" E-91048'25.2" 21-04-2019	
5	NRI-289	Vendi/ Kharif/ Home yard	Name: Shelina Begum Village: Varoimari (Sordarpara) Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	
6	NQR-20	Vendi/ Kharif/ Home yard	Name: Abdus Salam Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
7	NQR-40	Dherosh/ Kharif/ Home yard	Name: Munni Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	
8	NQ-52	Dherosh/ Kharif/ Home yard	Name: Huzaifa Rahman Village: Berapatahalia Union: Pourasaba Upazila: Jamalpur Sadar District: Jamalpur	N-24°51'55.4" E-90°02'19.4" 17-10-2019	
9	NQ-61	Dherosh/ Kharif/ Home yard	Name: Md. Shahin Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
10	NQ-80	Derosh/ Kharif/ Home yard	Name: Md. Nazmul Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°44'54.2" E-89°49'41.8" 18-10-2019	
11	MRI-69	Vandi (Derosh)/ Kharif/ Home yard	Name: Md. Kamal Hossen Village: Tarikata Union: Dulassor Upazila: Mohipur District: Patuakhali	12 October 2018 N-21°51'26.9" E-90°07'31.6"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
12	NRI-17	Vendi/ Kharif/ Home yard	Name: Shankar Mondol Village: Bosurabad Union: 2, No, Bosurabad Upazila: Botiaghata District: Khulna	13 September 2018 N-22°43'28.31" E-89°29'52.01"	
13	N-230	Vendi/ Kharif/ Home yard	Name: Saiful Alam Village: Boiltoli bazar Union: Dohazari Upazila: Chandanaih District: Chattogram	29 October 2018 N-22°31' E-92°06'	
14	SNQR-44	Dherosh/ Irrigated/ Kharif I, II	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
15	SAA-21	Jhum derosh/ Irrigated/ Kharif (Jhum)	Name: Sumon Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
16	SAA-52	Jhum dherosh/ Irrigated/ Kharif (Jhum)	Name: Chandrakishor Tripura Village: 6 Mile, Perachora Union: Baghaichori Upazila: Baghaichori District: Rangamati	N-23°10'34" E-92°01'38" 23/12/2019	
Onion (<i>Allium cepa</i>)					
1	NRI-153	Taherpuripeyaz/ Rabi/ Field	Name: Razia Anwar Village: Gobindopur Union: Pourosova, ward-10 Upazila: Faridpur Sadar District: Faridpur	N-23°36'55.08" E-89°48'50.04" 12-04-2019	
2	NRI-134	Taherpuripeyaz/ Rabi/ Field	Name: Aklima Sheikh Village: Piarpur Union: Kojjuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
Papaya (<i>Carica papaya</i>)					
1	NRI-234	Pepe/ Perennial/ Home yard	Name: Abdul Mannan Village: Sujanagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'12.5" E-91°47'42.0" 20-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
2	NRI-242	Pepe/ Perennial/ Home yard	Name: Orchona Chowdhury Village: Alipur Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'05.9" E-91047'27.9" 20-04-2019	
3	NRI-265	Pepe/ Perennial/ Home yard	Name: Md. Hasan Village: Sujanagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	
4	NRI-73	Pepe/ Perennial/ Home yard	Name: Shuvankar Das Village: Velabaj Union: Krisnonagor Upazila: Faridpur sadar District: Faridpur	N-23034'26.4" E-89045'44.1" 10-04-2019	
5	NRI-273	Pepe/ Perennial/ Home yard	Name: Hasem Ali Pramanik Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
6	SAA-46	Pepe/ Rainfed/ Annual	Name: Dipali Tripura Village: 8 Mile Perachora Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°11'07" E-92°01.56" 23/12/2019	
Pigeon pea (<i>Cajanus cajan</i>)					
1	NRI-257	Arol/ Perennial/ Road side	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°48'25.2" 21-04-2019	
2	NRI-57	Orol/ Perennial/ Home yard	Name: M. A. Rashid Khan Village: Fursa Union: Kanaipur Upazila: Faridpur-Sadar District: Faridpur	N-23043'26.4" E-89028'44.1" 10-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
3	SAA-40	Jhum Arhar/ Rainfed/ Annual	Name: Moten Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
Pumpkin (<i>Cucurbita moschata</i>)					
1	NRI-131	Misti kumra/ <i>Macha</i> / Rabi	Name: Aklima Begum Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	NRI-241	Misti kumra/ Field/ Rabi	Name: Orchona Chowdhury Village: Alipur Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'05.9" E-91047'27.9" 20-04-2019	
3	NRI-260	Misti kumra/ Field/ Rabi	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'07.8" E-91048'25.2" 21-04-2019	
4	NRI-272	Misti kumra/ <i>Macha</i> / Rabi	Name: Hasem Ali Pramanik Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
5	NRI-276	Misti kumra/ <i>Macha</i> / Rabi	Name: Mst. Fahima Khatun Village: Varoimari (Sordarpara) Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
6	NQ-44	Misti kumra/ <i>Macha</i> / Rabi	Name: Md. Billal Village: Kullapara Union: Haibatpur Upazila: Jashore Sadar District: Jashore	N-23°20'39.6" E-89°06'39.0" 02-10-2019	

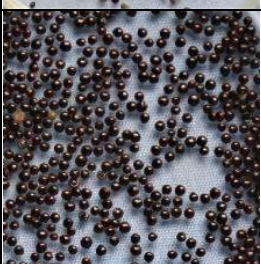
Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
7	NQ-58	Misti kumra/ Field/ Rabi	Name: Md. Shahin Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
8	NQ-71	Misti kumra/ Field/ Rabi	Name: Hossain Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°45'14.7" E-89°49'50.3" 18-10-2019	
9	MRI-6	Misti kumra/ <i>Macha</i> / Rabi	Name: Chintahoron Hawlader Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
10	MRI-39	Misti kumra/ <i>Macha</i> / Rabi	Name: Md. Habibur Rahman Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
11	MRI-51	Misti kumra/ <i>Macha</i> / Rabi	Name: Aleya Khatun Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
12	MRI-61	Misti kumra/ <i>Macha</i> / Rabi	Name: Md. Al-Amin Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'23.79" E-90°7'12.54"	
13	MRI-72	Misti kumra/ <i>Macha</i> / Rabi	Name: M. Joynal Abedin Kazi Village: Tarikata Union: Dulassor Upazila: Mohipur District: Patuakhali	12 October 2018 N-21°51'26.9" E-90°07'31.6"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
14	MRI-76	Misti kumra/ <i>Macha</i> / Rabi	Name: Feroza Begum Village: Banimordon Union: Nazirpur Upazila: Muladi District: Barishal	13 October 2018 N-22°57'39.65" E-90°21'54.47"	
15	MRI-80	Misti kumra/ <i>Macha</i> / Rabi	Name: Md. Rafiqul Islam Village: Banimordon Union: Nazirpur Upazila: Muladi District: Barishal	13 October 2018 N-22°57'39.65" E-90°21'54.47"	
16	MRI-83	Misti kumra/ <i>Macha</i> / Rabi	Name: Mst. Sabikunnahar Village: Chilmari Union: Nazirpur Upazila: Muladi District: Barishal	13 October 2018 N-22°57'39.65" E-90°21'54.47"	
17	MRI-89	Misti kumra/ <i>Macha</i> / Rabi	Name: Yeasmin Village: BoroLaxmipur Union: Safipur Upazila: Muladi District: Barishal	14 October 2018 N-23°01'38.6" E-90°22'15.6"	
18	NRI-38	Misti kumra (Majari)/ <i>Macha</i> / Rabi	Name: Palash Sardar Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	
19	NSR-38	Misti kumra/ <i>Macha</i> / Rabi	Name: Gazimia Village: Salgaria Union: Salgaria Upazila: Pabna Sadar District: Pabna	03 October 2018 N-23°59'50" E-89°15'19.7"	
20	SNQR-11	Deshimisti kumra/ Irrigated/ Rabi, Kharif I	Name: Mohon Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.48153 E-89.26292 13-10-2020	
21	SNQR-48	Misti kumra/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
22	SNQR-61	Misti kumra/ Irrigated/ Rabi	Name: Zakir Hossen Village: Varashimla Union: Varashimla Upazila: Kaliganj District: Satkhira	N-22.48083 E-89.01310 15-10-2020	
23	SAA-04	Jhum kumro/ Irrigated/ Jhum	Name: Anil Tripura Village: KanglakPahar Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°29'19" E-92°16'46" 22/12/2019	
24	SAA-05	Sumoroi (mistikumra)/ Rainfed	Name: Binoma Tripura Village: Kanglak Pahar Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°29'19" E-92°16'46" 22/12/2019	
25	SN-8	Misti kumra/ Irrigated/ Rabi	Name: Dr. Sohidul Islam Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22.933543 E-89.166874 04-03-2020	
Mustard (<i>Brassica rapa/juncea</i>)					
1	NRI-111	Choitasorisha (Rai)/ Rabi/ Field	Name: Shahid Sheikh Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	NRI-136	Choitasorisha (Rai)/ Rabi/ Field	Name: Rustom Khan Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
3	NRI-149	Choitasorisha (Rai)/ Rabi/ Field	Name: M. A. Kader Sheikh Village: Gobindopur Union: Pourosova, ward-10 Upazila: Faridpur Sadar District: Faridpur	N-23°36'55.08" E-89°48'50.04" 12-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
4	NRI-155	Choitasorisha (Rai)/ Rabi/ Field	Name: Md. Humayun Mondol Village: Parchar Union: Pourasava, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23035'21.34" E-89046'48.02" 12-04-2019	
5	NRI-174	Choitasorisha (Rai)/ Rabi/ Field	Name: Moslem Jomoddar Village: Duldi, Gobindopur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23036'38.39" E-89049'3.84" 12-04-2019	
6	NRI-184	Choitasorisha (Rai)/ Rabi/ Field	Name: Jalil Jomoddar Village: Duldi, Gobindopur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23036'38.39" E-89049'3.84" 12-04-2019	
7	NRI-190	Choitasorisha (Rai)/ Rabi/ Field	Name: Ahmmed Ali Sheikh Village: Char Noshipur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23038'34.39" E-89047'22.84" 12-04-2019	
8	NRI-199	Choitasorisha (Rai)/ Rabi/ Field	Name: Md. Siddique Sheikh Village: Bahirdah Union: Macchor Upazila: Faridpur Sadar District: Faridpur	N-23036'38.39" E-89046'41.84" 12-04-2019	
9	NQR-50	Sorisha/ Rabi/ Field	Name: Nogen Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	
10	MRI-30	Sorisha/ Rabi/ Field	Name: Md. Ruhul Amin Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
11	NSR-46	Sorisha/ Rabi/ Field	Name: Gazi Mia Village: Char Shahapur Union: Shahapur Upazila: Ishwardi District: Pabna	03 October 2018 N-24°4.4'72" E-89°4.13'34"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
12	NSR-54	Sorisha/ Rabi/ Field	Name: Hazrat Ali Village: Char Shahapur Union: Shahapur Upazila: Ishwardi District: Pabna	03 October 2018 N-24°4.4'72" E-89°4.13'34"	
13	NSR-55	Maghishorisha/ Rabi/ Field	Name: Samim Village: Char Shahapur Union: Shahapur Upazila: Ishwardi District: Pabna	03 October 2018 N-24°4.4'72" E-89°4.13'34"	
Red amaranth (<i>Amaranthus tricolor</i>)					
1	NRI-163	Lal shak/ Year round/ Home yard	Name: Md. AkterMondol Village: Parchar Union: Pourosova, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23°35'21.34" E-89°46'48.02" 12-04-2019	
2	NRI-202	Lal shak/ Year round/ Home yard	Name: Md. Siddique Sheikh Village: Bahirdah Union: Macchor Upazila: Faridpur Sadar District: Faridpur	N-23°35'56.39" E-89°46'41.84" 12-04-2019	
3	NRI-248	Lal shak/ Year round/ Home yard	Name: Saymon Village: Dewan nagar Union: Hathazari pourosova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°48'25.2" 21-04-2019	
4	NQR-11	Lal shak/ Year round/ Home yard	Name: Aminul Islam Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
5	NQR-25	Lal shak/ Year round/ Home yard	Name: Abdul Malek Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
6	NQ-47	Lal shak/ Year round/ Home yard	Name: Md. Abdur Rob Village: Giadhat Union: Haibatpur Upazila: Jashore Sadar District: Jashore	N-23°11'40.9" E-89°19'25.7" 02-10-2019	
7	NQ-55	Lal shak/ Year round/ Home yard	Name: Md. Shahin Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
8	NQ-57	Lal shak/ Year round/ Home yard	Name: Md. Shahin Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
9	NQ-63	Lal shak/ Year round/ Home yard	Name: Md. Asfaq Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
10	NQ-74	Lal shak/ Year round/ Home yard	Name: Hossain Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°45'14.7" E-89°49'50.3" 18-10-2019	
11	NQ-85	Lal shak/ Year round/ Home yard	Name: Md. Kamrul Village: Shankarpur Union: Noapara Upazila: Islampur District: Jamalpur	N-25°04'21.3" E-89°45'49.6" 19-10-2019	
12	MRI-2	Lal shak/ Year round/ Home yard	Name: BorunHawlader Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.756" E-90°25'13.17"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
13	MRI-10	Lal shak/ Year round/ Home yard	Name: Chintahoron Hawlader Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
14	MRI-33	Lal shak/ Year round/ Home yard	Name: Md. Ruhul Amin Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
15	MRI-36	Lal shak/ Year round/ Home yard	Name: Mizanur Rahman Fakir Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
16	MRI-42	Lal shak/ Year round/ Home yard	Name: Md. Habibur Rahman Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
17	MRI-46	Lal shak/ Year round/ Home yard	Name: Md. Abdul Haque Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
18	MRI-53	Lal shak/ Year round/ Home yard	Name: Md. Al-Amin Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'23.79" E-90°7'12.54"	
19	MRI-71	Lal shak/ Year round/ Home yard	Name: M. Joynal Abedin Kazi Village: Tarikata Union: Dulassor Upazila: Mohipur District: Patuakhali	12 October 2018 N-21°51'26.9" E-90°07'31.6"	

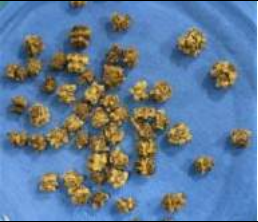
Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
20	NRI-23	Lal shak/ Year round/ Home yard	Name: Smiriti Mistri Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	
21	SNQR-49	Lal shak/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
22	SNQR-57	Lal shak/ Irrigated/ Kharif I, II and Rabi	Name: Gonesh Ch. Mondol Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.27883 E-89.11263 14-10-2020	
23	SN-3	Lal Taktok Shak/ Irrigated/ Rabi, Kharif	Name: Dr. Sohidul Islam Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22.933543 E-89.166874 04-03-2020	
Ridge gourd (<i>Luffa acutangula</i>)					
1	NRI-255	Jhinga/ Kharif/ Home yard-on other tree plants	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°48'25.2" 21-04-2019	
2	MRI-57	Jhinga/ Kharif/ Home yard-on other tree plants	Name: Md. Al-Amin Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'23.79" E-90°7'12.54"	
3	MRI-98	Jhinga/ Kharif/ Home yard-on other tree plants	Name: Yeasmin Village: Boro Laxmipur Union: Safipur Upazila: Muladi District: Barishal	14 October 2018 N-23°01'38.6" E-90°22'15.6"	
4	NRI-256	Jhinga (wild)	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°48'25.2" 21-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
5	NRI-294	Jhinga/ Kharif/ Home yard-on other tree plants	Name: M. Rahman Mollik Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	
6	NRI-301	Jhinga/ Kharif/ Home yard-on other tree plants	Name: Abdus Sattar Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	
7	NQR-5	Torui/ (wild type)	Name: Larzina Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
8	NQ-78	Zhinga/ Kharif/ Home yard-on other tree plants	Name: Md. Nazmul Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°44'54.2" E-89°49'41.8" 18-10-2019	
9	SNQR-8	Jhinga/ Rainfed/ Kharif I	Name: Lovlu Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.36522 E-89.14153 13-10-2020	
10	SNQR-41	Jhinga/ Irrigated/ Rabi, Kharif I	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
11	SAA-23	Jhum jinga/ Rainfed/ Kharif (Jhum)	Name: Bibika Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
12	SAA-43	Jhum jhinga/ Irrigated/ Kharif (Jhum)	Name: Gourangha Tripura Village: 8 Mile Perachora Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°11'07" E-92°01.56" 23/12/2019	
13	SN-7	Jhinga/ Rainfed/ Kharif	Name: Dr. Sohidul Islam Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22.933543 E-89.166874 04-03-2020	
Roselle (<i>Hibiscus sabdariffa</i>)					
1	NRI-252	Tok pata/ Year round/ Home yard	Name: Saymon Village: Dewan nagar Union: Hathazari purosava Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°48'25.2" 21-04-2019	
Safflower (<i>Carthamus tinctorius</i>)					
1	NRI-143	Kusumful/ Rabi/ Field	Name: Md. Firoz Khan Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
Sesame (<i>Sesamum indicum</i>)					
1	NRI-169	Kalotil/ Kharif/ Field	Name: Sohid Mondol Village: Parchar Union: Purosava, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23°35'21.34" E-89°46'48.02" 12-04-2019	
2	NRI-64	Kalotil/ Kharif/ Field	Name: Dilip Das Village: Velabaj Union: Krisnonagor Upazila: Faridpur Sadar District: Faridpur	N-23°34'26.4" E-89°45'44.1" 10-04-2019	
3	NQR-37	Krishnotil/ Kharif/ Field	Name: Md. Abdul Kadir Village: Danga para Union: Balrampur Upazila: Mulani District: Thakurgao	N-26.19113 E-88.51921 14-11-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
4	MRI-31	Til/ Kharif/ Field	Name: Md. Ruhul Amin Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
5	NRI-13	Lal til/ Kharif/ Field	Name: Shankar Mondol Village: Bosurabad Union: 2, No, Bosurabad Upazila: Botiaghata District: Khulna	13 September 2018 N-22°43'28.31" E-89°29'52.01"	
6	SAA-28	Gaichatil/ Rainfed/ Kharif	Name: Polmani Chakma Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
7	SAA-34	Til (sada)/ Rainfed/ Kharif	Name: Bibika Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
Sesbania (Sesbania sesban)					
1	NRI-193	Dhaincha/ Field/ Kharif-II	Name: Ahammed Ali Sheikh Village: Char Noshipur Union: Ambikapur Upazila: Faridpur Sadar District: Faridpur	N-23°38'34.39" E-89°47'22.84" 12-04-2019	
Snake gourd (Trichosanthes cucumerin)					
1	NRI-219	Chichinga/ Macha/ Kharif	Name: Md. Sultan Village: Dewannagar (West) Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°29'58.58" E-91°48'0.53" 20-04-2019	
2	NRI-258	Koinda/ Macha/ Kharif	Name: Saymon Village: Dewannagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°48'25.2" 21-04-2019	
3	NRI-270	Cicinga/ Macha/ Kharif	Name: Md. Palash Molla Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
4	NRI-287	Cicinga/ Macha/ Kharif	Name: Shelina Begum Village: Varoimari (Sordarpara) Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	
5	NRI-292	Cicinga/ Macha/ Kharif	Name: Nurjahan Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	
	SNQR-34	Kusicicinga/ Irrigated/ Kharif I, II	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
	SAA-41	Jhum cicinga/ Irrigated/ Kharif (jhum)	Name: Moten Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
Spinach (<i>Spinacia oleracea</i>)					
1	NRI-121	Palongshak/ Rabi/ Field	Name: Kaiyum Sheikh Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	
2	NRI-160	Palongshak/ Rabi/ Field	Name: Md. Akter Mondol Village: Parchar Union: Pourosova, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23°35'21.34" E-89°46'48.02" 12-04-2019	
3	NRI-205	Palongshak/ Rabi/ Field	Name: Md. Siddique Sheikh Village: Bahirdah Union: Macchor Upazila: Faridpur Sadar District: Faridpur	N-23°35'56.39" E-89°46'41.84" 11-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
4	NQR-26	Palongshak/ Rabi/ Field	Name: Abdul Malek Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
5	NQ-60	Palongshak/ Rabi/ Field	Name: Md. Shahin Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
6	NQ-68	Palongshak/ Rabi/ Field	Name: Hossain Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°45'14.7" E-89°49'50.3" 18-10-2019	
7	NRI-24	Palongshak (Shada)/ Rabi/ Field	Name: Smiriti Mistri Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	
8	NRI-29	Palongshak/ Rabi/ Field	Name: Ullasini Rai Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	
9	N-205	Palongshak/ Rabi/ Field	Name: Alamgir Hossen Village: Dhormopur Union: Sadar-7 Upazila: Choumohoni District: Noakhali	28 October 2018 N-22°94' E-91°11'	
10	N-247	Khor Palong/ Rabi/ Field	Name: Md. Shoti Village: Kobutorhat Union: Hathazari Upazila: Hathazari District: Chattogram	30 October 2018 N-22°50' E-91°85'	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
11	N-250	Palongshak/ Rabi/ Field	Name: Maruf Hossen Village: Haidgaon Union: Haidgaon Upazila: Potiya District: Chattogram	29 October 2018 N-22°31' E-91°97'	
12	N-251	Khor Palong/ Rabi/ Field	Name: Md. Naim Village: Foteabad Union: Hathazari Upazila: Hathazari District: Chattogram	30 October 2018 N-22°50' E-91°85'	
13	SNQR-28	Palongshak/ Irrigated/ Rabi, Kharif I	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
14	SNQR-56	Palongshak/ Irrigated/ Rabi	Name: Gonesh Ch. Mondol Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.27883 E-89.11263 14-10-2020	
Sponge gourd (<i>Luffa aegyptiaca</i>)					
1	NRI-208	Dhundul/ Kharif/ Home yard-on other tree plants	Name: Md. Siddique Sheikh Village: Bahirdah Union: Macchor Upazila: Faridpur Sadar District: Faridpur	N-23°35'36.39" E-89°46'41.84" 12-04-2019	
2	NRI-224	Dhundul/ Kharif/ Home yard-on other tree plants	Name: Md. Hasan Village: Sujanagar Union: Hathazari purosova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	
3	NRI-229	Dhundul/ Kharif/ Home yard-on other tree plants	Name: Nuruzzaman Village: Sujanagar Union: Hathazari purosova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
4	NRI-233	Dhundol/ Kharif/ Home yard-on other tree plants	Name: Abdul Mannan Village: Sujanagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'12.5" E-91047'42.0" 20-04-2019	
5	NRI-251	Dhundol/ Kharif/ Home yard-on other tree plants	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22030'07.8" E-91048'25.2" 21-04-2019	
6	NRI-88	Dhundul (Polla)/ Wild relatives	Name: Md. Abdur Rashid Village: Fursa Union: Kanaipur Upazila: Faridpur Sadar District: Faridpur	N-23043'26.4" E-89028'44.1" 10-04-2019	
7	NQR-4	Dhundol/ Kharif/ Home yard-on other tree plants	Name: Larzina Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
8	NQR-36	Dhundol/ Kharif/ Home yard-on other tree plants	Name: Prodip Chandra Ray Village: Danga para Union: Balrampur Upazila: Mulani District: Thakurgao	N-26.19113 E-88.51921 14-11-2019	
9	NQ-76	Dhundol/ Kharif/ Home yard-on other tree plants	Name: Md. Nazmul Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°44'54.2" E-89°49'41.8" 18-10-2019	
10	MRI-82	Dhundol/ Kharif/ Home yard-on other tree plants	Name: Imtiaz Begum Village: Chilmari Union: Nazirpur Upazila: Muladi District: Barishal	13 October 2018 N-22°57'39.65" E-90°21'54.47"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
11	NRI-20	Polla (Dhundul)/ Kharif	Name: Kumkum boiragi Village: Kochubunia (Jolma) Union: Chokrakhali Upazila: Botiaghata District: Khulna	13 September 2018 N-22°44'50.82" E-89°31'49.42"	
12	NSR-41	Dhundol/ Kharif/ Home yard-on other tree plants	Name: Sujon Ali Village: Salgaria Union: Salgaria Upazila: Pabna Sadar District: Pabna	03 October 2018 N-23°59'50" E-89°15'19.7"	
13	SU-27	Dhundol/ Kharif/ Home yard-on other tree plants	Name: Alamgir Village: Sutiakhali Union: Kawatkhali Upazila: Mymensingh Sadar District: Mymensingh	30 October 2018 N-24°41'51.5" E-90°27'14.1"	
14	SNQR-51	Monakobij (Dhundol)/ Irrigated/ Rabi, Kharif I	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
15	SNQR-64	Dhundol/ Irrigated/ Kharif I, II	Name: Zakir Hossen Village: Varashimla Union: Varashimla Upazila: Kaliganj District: Satkhira	N-22.48083 E-89.01310 15-10-2020	
16	SNQR-67	Dhundol/ Irrigated/ Kharif I	Name: Shah Alam Village: Varashimla Union: Varashimla Upazila: Kaliganj District: Satkhira	N-22.48083 E-89.01310 15-10-2020	
Teasle gourd (<i>Momordica dioica</i>)					
1	NRI-218	Korol (Kakrol)/ Field/ Vegetative reproduction	Name: Md. Ibrahim Village: Alipur Union: Hathazari purosova Upazila: Hathazari District: Chattogram	22°30'0" E-91°47'60" 20-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
2	NQ-70	Kakrol/ Kharif/ Home yard	Name: Hossain Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°45'14.7" E-89°49'50.3" 18-10-2019	
3	NQ-86	Kakrol/ Kharif/ Home yard	Name: Md. Kamrul Village: Shankarpur Union: Noapara Upazila: Islampur District: Jamalpur	N-25°04'21.3" E-89°45'49.6" 19-10-2019	
Turmeric (<i>Curcuma longa</i>)					
1	NRI-43	Holud/ Rabi/ Field	Name: Ajoy Das Village: Velabaj Union: Krisnonagor Upazila: Faridpur Sadar District: Faridpur	N-23°35'26.4" E-89°46'44.1" 10-04-2019	
2	NRI-44	Adagatiholud/ Rabi/ Field	Name: Dilip Das Village: Velabaj Union: Krisnonagor Upazila: Faridpur Sadar District: Faridpur	N-23°35'26.4" E-89°46'44.1" 10-04-2019	
3	NRI-138	Sonamukhholud/ Rabi/ Field	Name: Abdul Kader Khan Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'2.2" E-89°49'34.64" 11-04-2019	
4	SAA-31	Jhum halud/ Rainfed/ Annual (Jhum)	Name: Polmani Chakma Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
Wheat (<i>Triticum aestivum</i>)					
1	NRI-162	Gom/ Rabi/ Field	Name: Md. Akter Mondol Village: Parchar Union: Pourosaba, ward-03 Upazila: Faridpur Sadar District: Faridpur	N-23°35'21.34" E-89°46'48.02" 12-04-2019	
White pea (<i>Phaseolus vulgaris</i>)					
1	NRI-110	Dabri/ Rabi	Name: Shahid Sheikh Village: Piarpur Union: Koijuri Upazila: Faridpur Sadar District: Faridpur	N-23°33'35.41" E-89°50'1.33" 11-04-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Yard-long bean (<i>Vigna unguiculata</i>)					
1	NRI-226	Borboti (sada)/ Rabi/ <i>Macha</i>	Name: Nuruzzaman Village: Sujanagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'12.5" E-91°47'42.0" 20-04-2019	
2	NRI-227	Borboti (kalo)/ Rabi/ <i>Macha</i>	Name: Nuruzzaman Village: Sujanagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'12.5" E-91°47'42.0" 20-04-2019	
3	NRI-237	Borboti/ Rabi/ <i>Macha</i>	Name: Orchona Chowdhury Village: Alipur Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'05.9" E-91°47'27.9" 20-04-2019	
4	NRI-244	Borboti/ Rabi/ <i>Macha</i>	Name: Sahana Begum Village: Alipur Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'05.9" E-91°47'27.9" 20-04-2019	
5	NRI-263	Borboti/ Rabi/ <i>Macha</i>	Name: Saymon Village: Dewan nagar Union: Hathazari poursova Upazila: Hathazari District: Chattogram	N-22°30'07.8" E-91°48'25.2" 21-04-2019	
6	NRI-266	Borboti/ Rabi/ <i>Macha</i>	Name: Moriom Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	
7	NRI-278	Borboti/ Rabi/ <i>Macha</i>	Name: Mst. Fahima Khatun Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 11-07-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
8	NQR-30	Borboti/ Rabi/ <i>Macha</i>	Name: Abdul Malek Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
9	MRI-19	Borboti/ Rabi/ <i>Macha</i>	Name: Md. Belal Hossen Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
10	MRI-68	Borboti/ Rabi/ <i>Macha</i>	Name: Hasina Begum Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'24.54" E-90°7'11.79"	
11	MRI-73	Borboti/ Rabi/ <i>Macha</i>	Name: M. Joynal Abedin Kazi Village: Tarikata Union: Dulassor Upazila: Mohipur District: Patuakhali	12 October 2018 N-21°51'26.9" E-90°07'31.6"	
12	MRI-96	Barboti (Borkudi) Rabi/ <i>Macha</i>	Name: Yeasmin Village: Boro Laxmipur Union: Safipur Upazila: Muladi District: Barishal	14 October 2018 N-23°01'38.6" E-90°22'15.6"	
13	N-207	Lal Borboti/ Rabi/ <i>Macha</i>	Name: Asgar Chowdhury Village: Chowdhuri Hat Union: Hathazari Upazila: Hathazari District: Chottogram	29 October 2018 N-22°44' E-91°82'	
14	N-208	SobujBorboti/ Rabi/ <i>Macha</i>	Name: Md. Saiful Islam Village: Boiltoli Bazar Union: Dohazari Upazila: Chandanaish District: Chattogram	29 October 2018 N-22°16' E-92°06'	

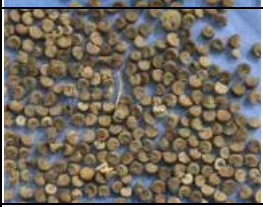
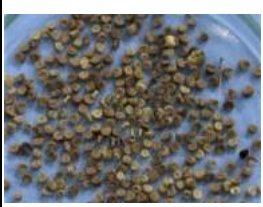
Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
15	N-209	SadaBorboti/ Rabi/ <i>Macha</i>	Name: Sozib Chowdhury Village: Chowdhuri Hat Union: Foteabad Upazila: Hathazari District: Chattogram	30 October 2018 N-22°44' E-91°81'	
16	N-243	Borboti/ Rabi/ <i>Macha</i>	Name: Piplu Rakhiyan Village: Khansama Chori Union: Khansama Upazila: Rowangchori District: Bandarban	30 October 2018 N-22°13' E-92°28'	
17	SNQR-59	Borboti/ Irrigated/ Rabi	Name: Gonesh Ch. Mondol Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.27883 E-89.11263 14-10-2020	
18	SNQR-68	Borboti (Sonai)/ Irrigated/ Rabi	Name: Shah Alam Village: Varashimla Union: Varashimla Upazila: Kaliganj District: Satkhira	N-22.48083 E-89.01310 15-10-2020	
19	SAA-22	Jhum borboti (lal)/ Irrigated/ Rabi (Jhum)	Name: Bibika Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
20	SAA-35	Jhum borboti/ Irrigated/ Rabi (Jhum)	Name: Moten Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
21	SAA-44	Jhum borboti/ Irrigated/ Rabi (Jhum)	Name: Dipali Tripura Village: 8 Mile Perachora Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°11'07" E-92°01.56" 23/12/2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
22	SAA-50	Jhum borboti/ Irrigated/ Rabi (Jhum)	Name: Chandrakishor Tripura Village: 6 Mile, Perachora Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°10'34" E-92°01'38" 23/12/2019	
Mung bean (<i>Vigna radiata</i>)					
1	MRI-3	Sona mug/ Kharif-I/ Field	Name: Chintahoron Hawlader Village: Uttor Muradia Union: Muradia Upazila: Dumki District: Patuakhali	08 October 2018 N-22°26'3.8" E-90°25'13.17"	
2	MRI-48	Sona mug (Chotodail)/ Kharif-I/ Field	Name: Md. Shanu Fakir Village: Itbaria Union: Itbaria Upazila: Patuakhali Sadar District: Patuakhali	09 October 2018 N-22°22'2.58" E-90°17'15.8"	
3	MRI-62	Mugdal/ Kharif-I/ Field	Name: Md. Al-Amin Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'23.79" E-90°7'12.54"	
4	MRI-66	Sonamug/ Kharif-I/ Field	Name: Israt Jahan Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'24.54" E-90°7'11.79"	
5	SU-22	Sona mug/ Kharif-I/ Field	Name: Sumon Village: Union: Tala Upazila: Tala District: Sathkhira	30 October 2018 N-22°45'02" E-89°15'29.1"	
6	SNQR-45	Choita mug dal/ Irrigated/ Kharif I	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
Cowpea (<i>Vigna unguiculata</i>)					
1	MRI-55	Feludal (Plane dail)/ Rabi/ Field	Name: Md. Al-Amin Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'23.79" E-90°7'12.54"	

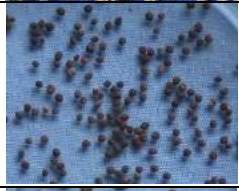
Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
2	MRI-63	Feludail/ Rabi/ Field	Name: Israt Jahan Village: Fashipara Union: Lotachapli Upazila: Kolapara District: Patuakhali	11 October 2018 N-21°50'24.54" E-90°7'11.79"	
3	SU-32	Felon/ Rabi/ Field	Name: Md. Azam Village: Tarabonna Union: Tarabonna Upazila: Cox's bazar Sadar District: Cox's bazaar	12 November 2018 N-22°30'46.0" E-91°47'47.4"	
4	SU-33	Felon/ Rabi/ Field	Name: Md. Azam Village: Tarabonna Union: Tarabonna Upazila: Cox's bazar Sadar District: Cox's bazaar	12 November 2018 N-22°30'46.0" E-91°47'47.4"	
5	SU-34	Felon/ Rabi/ Field	Name: Md. Kamrul Islam Village: Tarabonna Union: Tarabonna Upazila: Cox's bazar Sadar District: Cox's bazaar	12 November 2018 N-22°30'46.0" E-91°47'47.4"	
6	SU-35	Felon/ Rabi/ Field	Name: Md. Kamrul Islam Village: Tarabonna Union: Tarabonna Upazila: Cox's bazar Sadar District: Cox's bazaar	12 November 2018 N-22°30'46.0" E-91°47'47.4"	
7	SU-36	Felon/ Rabi/ Field	Name: Md. Kamrul Islam Village: Tarabonna Union: Tarabonna Upazila: Cox's bazar Sadar District: Cox's bazaar	12 November 2018 N-22°30'46.0" E-91°47'47.4"	
8	SU-37	Felon/ Rabi/ Field	Name: Md. Kamrul Islam Village: Tarabonna Union: Tarabonna Upazila: Cox's bazar Sadar District: Cox's bazaar	12 November 2018 N-22°30'46.0" E-91°47'47.4"	
French bean (<i>Phaseolus vulgaris</i>)					
1	N-212	Khaissa Sim/ Rabi/ Field	Name: Md. Shofi Village: Kobutorhat Union: Hathazari Upazila: Hathazari District: Chattogram	30 October 2018 N-22°50' E-91°85'	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
2	N-213	KhaissaForash Sim/ Rabi/ Field	Name: Azim Uddin Village: Dewan Nagar Union: Hathazari Upazila: Hathazari District: Chattogram	30 October 2018 N-22°50' E-91°85'	
3	N-245	Forasi Sim/ Rabi/ Field	Name: Rohim Mia Village: Hasan Dondi Union: Dohazari Upazila: Chandanaish District: Chattogram	30 October 2018 N-22°13' E-92°06'	
4	N-257	Forasi Sim (Golapi)/ Rabi/ Field	Name: Md. Shofi Village: Kobutorhat Union: Hathazari Upazila: Hathazari District: Chattogram	30 October 2018 N-22°50' E-92°85'	
5	N-258	Khassia Sim/ Rabi/ Field	Name: Ciru Mia Village: Foteabad Union: Chowdhrihat Upazila: Hathazari District: Chattogram	30 October 2018 N-22°50' E-92°85'	
6	N-259	ForasiKhassia/ Rabi/ Field	Name: Memaling Rakhiyan Village: Kodomtoli Union: Kodomtoli Upazila: Ali Kadam District: Bandarban	30 October 2018 N-22°33' E-91°82'	
7	N-195	Kidney bean/ Rabi/ Field	Name: Dr. Zakir Hossain Village: Doriadawlat Union: Doriadawlat Upazila: Bancharampur District: Cumilla	21 September 2018 N-23°48'43.2" E-90°47'52.8"	
Amaboshashak					
1	N-199	Amaboshashak/ Rabi/ Field	Name: Waser Hossain Village: Srirampur Union: Tripura Upazila: Shoilkupa District: Jhinaidha	29 November 2018 N-23°41'4.09" E-89°10'41.02"	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Sword bean (<i>Canavalia gladiata</i>)					
1	NSR-48	Katari shim/ Rabi/ Field yard-on other tree plants	Name: Sujon Ali Village: Salgaria Union: Salgaria Upazila: Pabna Sadar District: Pabna	03 October 2018 N-23°59'50" E-89°15'19.7"	
2	SNQR-2	Kola sheem/ Rainfed/ Rabi season	Name: Lovlu Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.36522 E-89.14153 13-10-2020	
3	SNQR-13	Borokola sim/ Irrigated/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
Potato (<i>Solanum tuberosum</i>)					
1	NSR-40	Kishor alu/ Rabi/ Field	Name: Sujon Ali Village: Salgaria Union: Salgaria Upazila: Pabna Sadar District: Pabna	03 October 2018 N-23°59'50" E-89°15'19.7"	
Musk melon (<i>Cucumis melo</i>)					
1	NRI-290	Bangi/ Kharif-I/ Field	Name: Ruma Village: Varoimari Union: Solimpur Upazila: Ishwardi District: Pabna	24°8'40.67"N 89°2'22.96"E 12-07-2019	
2	NQ-56	Bangi/ Kharif-I/ Field	Name: Md. Shahin Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
3	NQ-83	Bangi/ Kharif-I/ Field	Name: Md. Kamrul Village: Shankarpur Union: Noapara Upazila: Islampur District: Jamalpur	N-25°04'21.3" E-89°45'49.6" 19-10-2019	

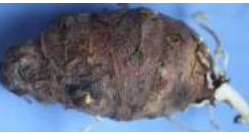
Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
4	SAA-47	Jhum cinal/ Irrigated/ Kharif	Name: Gouranga Tripura Village: 8 Mile Perachora Union: Sajek Upazila: Baghaichori District: Rangamati	N-23 ⁰ 11'07" E-92 ⁰ 01.56" 23/12/2019	
5	SAA-58	Jhum cinal/ Irrigated/ Kharif	Name: Sukiron Chakma Village: TUS (NGO) Union: Milonpur Upazila: Khagrachari Sadar District: Khagrachari	N-23 ⁰ 06'29" E-91 ⁰ 59'23" 24/12/2019	
Indigo (<i>Indigofera tinctoria</i>)					
1	NQR-1	Neel/ Rabi/ Field	Name: Dr. M. Mohi Uddin Village: BSPC Union: BSPC Upazila: Debiganj District: Panchagarh	N-26.09899 E-88.767254 12-11-2019	
Chinese mallow (<i>Malva verticillate</i>)					
1	NQR-2	Lafashak/ Year round/ Field/ Home yard	Name: Moniruzzaman Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
2	NQR-14	Lafashak/ Year round/ Field/ Home yard	Name: Rohima Begum Village: Sikdar para Union: Sonahar Upazila: Debiganj District: Panchagarh	N-26.05165 E-88.72736 13-11-2019	
3	NQR-16	Lafashak/ Year round/ Field/ Home yard	Name: Abdus Salam Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
4	NQR-41	Lafashak/ Year round/ Field/ Home yard	Name: Longkeshor Ray Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	
5	NQR-49	Lafashak/ Year round/ Field/ Home yard	Name: Nogen Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Foxtail Millet (<i>Setaria italica</i>)					
1	NQR-3	Kawoon/ Rabi/ Field	Name: Md. Fazal Haque Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
2	NQR-23	Kawoon/ Rabi/ Field	Name: Abdus Salam Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
3	NQR-35	Kawoon/ Rabi/ Field	Name: Prodip Ch. Day Village: Danga para Union: Balrampur Upazila: Mulani District: Thakurgao	N-26.19113 E-88.51921 14-11-2019	
4	NQR-42	Kawoon/ Rabi/ Field	Name: Md. Robiul Islam Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	
5	NQR-43	Kawoon/ Rabi/ Field	Name: Md. Probar Hossen Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	
6	NQR-44	Kawoon/ Rabi/ Field	Name: Nogen Village: Boal Danga Union: Rongian Bazar Upazila: Debipur District: Thakurgao	N-26.17937 E-88.51668 14-11-2019	
Different leafy vegetables					
1	NQR-10	Babar shak/ Year round/ Field/ Home yard	Name: Moniruzzaman Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
2	NQR-29	Babar shak/ Year round/ Field/ Home yard	Name: Abdul Malek Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
3	SNQR-3	Veto shak/ Irrigated/ Kharif II, Rabi	Name: Lovlu Village: Arpara Union: Shidnagar Upazila: Kaliganj District: Jhinaidah	N-23.36522 E-89.14153 13-10-2020	
4	SAA-63	Raishak/ Irrigated/ Year round	Name: Sukiron Chakma Village: TUS (NGO) Union: Milonpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	
5	SAA-69	Katarongshak/ Irrigated/ Year round	Name: BARI sub-station Village: HARS Union: Khagrachari Upazila: Khagrachari Sadar District: Khagrachari	N-23.10885 E-92.00031 24-12-2019	
Yam (<i>Dioscorea bulbifera</i>)					
1	NQR-12	Gozalu/ Annual/ Home yard-on other tree plants	Name: Lutu Village: Burujerdanga Union: 3 no. Debiganj Upazila: Debiganj District: Panchagarh	N-26.14964 E-88.75745 12-11-2019	
2	SAA-33	Jhum alu/ Irrigated/ Rabi	Name: Moten Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
3	SN-9	KhamoChupni (Mete alu)/ Rainfed/ Annual	Name: Saburon Nessa Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22.933543 E-89.166874 04-03-2020	
4	SN-10	Dil Alu (Mete alu)/ Rainfed/ Annual	Name: Saburon Nessa Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22.933543 E-89.166874 04-03-2020	
5	SN-11	Altapata (Mete alu)/ Rainfed/ Annual	Name: Saburon Nessa Village: Tripurapur Union: Chaluahati Upazila: Monirampur District: Jashore	N-22.933543 E-89.166874 04-03-2020	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Radish (<i>Raphanus sativus</i>)					
1	NQR-24	Mula/ Rabi/ Field/ Line sowing	Name: Abdul Malek Village: Atwari Bazar Union: Atwari Upazila: Atwari District: Panchagarh	N-26.24106 E-88.40820 13-11-2019	
2	NQ-51	Mula/ Rabi/ Field/ Line sowing	Name: Huzaifa Rahman Village: Berapatahalia Union: Poursaba Upazila: Jamalpur Sadar District: Jamalpur	N-24°51'55.4" E-90°02'19.4" 17-10-2019	
3	NQ-65	Mula/ Rabi/ Field/ Line sowing	Name: Md. Asfaq Village: Kharkaria Union: Rangachua Upazila: Jamalpur Sadar District: Jamalpur	N-24°52'06.7" E-90°02'17.8" 17-10-2019	
4	NQ-69	Mula/ Rabi/ Field/ Line sowing	Name: Hossain Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°45'14.7" E-89°49'50.3" 18-10-2019	
5	NQ-72	Mula/ Rabi/ Field/ Line sowing	Name: Hossain Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°45'14.7" E-89°49'50.3" 18-10-2019	
6	NQ-73	Mula/ Rabi/ Field/ Line sowing	Name: Hossain Village: Karnibari Union: Karnibari Upazila: Sarishabari District: Jamalpur	N-24°45'14.7" E-89°49'50.3" 18-10-2019	
German Turnip (<i>Brassica oleracea</i> L. var. <i>gongylodes</i>)					
1	NQ-48	Olkopi/ Rabi/ Field/ Line sowing	Name: Md. Abdur Rob Village: Giadhat Union: Haibatpur Upazila: Jashore Sadar District: Jashore	N-23°11'40.9" E-89°19'25.7" 02-10-2019	
Medicinal plants					
1	SNQR-27	Cakondo/ Rainfed/ Rabi	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
2	SNQR-29	Bishallakoroni/ Rainfed/ Perennial	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
3	SNQR-32	Bautulsi/ Rainfed/ Perennial	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
4	SAA-30	Tulsi/ Rainfed/ Annual	Name: Mayadhan Chakma Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
5	SNQR-35	Ombolmodhu/ Rainfed/ Perennial	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
6	SNQR-36	Tokma dana/ Rainfed/ Perennial	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
7	SNQR-38	Pithegorafol/ Rainfed/ Perennial	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
8	SNQR-50	Dupri ful/ Rainfed/ Annual	Name: Arpana Rani Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.272624 E-89.136888 14-10-2020	
9	SNQR-52	Bokful/ Rainfed/ Perennial	Name: Gonesh Ch. Mondol Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.27883 E-89.11263 14-10-2020	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
10	SAA-56	Tetfulgula/	Name: Sukiron Chakma Village: TUS (NGO) Union: Milonpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	
11	SAA-65	Hugibigol	Name: Sukiron Chakma Village: TUS (NGO) Union: Milonpur Upazila: Khagrachari Sadar District: Khagrachari	N-23°06'29" E-91°59'23" 24/12/2019	
Carrot (<i>Daucus carota</i>)					
1	SNQR-54	Gajhor/ Irrigated/ Rabi, Kharif I	Name: Gonesh Ch.Mondol Village: Dhumghat Union: Ishwaripur Upazila: Shamnagar District: Satkhira	N-22.27883 E-89.11263 14-10-2020	
Coffee (<i>Coffea arabica</i>)					
1	SAA-01	Coffee/ Perennial	Name: Tonachakma Village: Konglak Pahar Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°29'19" E-92°16'46" 22/12/2019	
Taro (<i>Colocasia esculenta</i>)					
1	SAA-06	Naricalkachu/ Rainfed/ Annual	Name: Raju Sinha Village: Konglak Pahar Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°29'19" E-92°16'46" 22/12/2019	
2	SAA-07	Mukhikachu/ Rainfed/ Annual	Name: Raju Sinha Village: Kanglak Pahar Union: Sajek Upazila: Baghaichori District: Rangamati	N-23°29'19" E-92°16'46" 22/12/2019	
3	SAA-29	Gurikachu/ Rainfed/ Kharif	Name: Mayadhan Chakma Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
4	SAA-38	Mukhikachu/ Rainfed/ Kharif	Name: Aben Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District: Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	

Sl. #	Collector's No.	Local/cultivar name/cultural practice	Donor's name and address	Geographic location and date	Photograph
Yam bean (<i>Pachyrrhizus tuberosa</i>)					
1	SAA-32	Shak alu/ Irrigated/ annual	Name: Polmani Chakma Village: Rashiknagar Union: Marung Upazila: Dighinala District Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
Broom corn (<i>Sorghum bicolor</i>)					
1	SAA-37	Sorghum (kalo)/ Irrigated/ Rabi	Name: Aben Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
2	SAA-39	Sorghum (sada)/ Irrigated/ Rabi	Name: Bibika Tripura Village: Rashiknagar Union: Marung Upazila: Dighinala District Khagrachari	N-23°12'10" E-92°03'58" 23/12/2019	
Maize (<i>Zea mays</i>)					
1	SAA-48	Jhum vutta (kalo)/ Irrigated/ Rabi (Jhum)	Name: Gourangha Tripura Village: 8 Mile Perachora Union: Sajek Upazila: Baghaichori District Rangamati	N-23°11'07" E-92°01'56" 23/12/2019	
2	SAA-49	Jhum vutta (sada)/ Irrigated/ Rabi (Jhum)	Name: Dipali Tripura Village: 8 Mile Perachora Union: Sajek Upazila: Bagharichori District Rangamati	N-23°11'07" E-92°01'56" 23/12/2019	
3	SAA-53	Jhum vutta / Irrigated/ Rabi (Jhum)	Name: Chandrakishor Tripura Village: 6 Mile, Perachora Union: Sajek Upazila: Baghaichori District Rangamati	N-23°10'34" E-92°01'38" 23/12/2019	

Conclusion

Primitive cultivars/landraces and wild relatives of agri-horticultural crops are still available in less accessible areas of the country, which are also endangered. Massive collection mission is essential to rescue these invaluable landraces and wild relatives.

11.3.2. Characterization of Pumpkin Germplasm

Qualitative character

Qualitative variations of different characters of pumpkin are presented below (Table 30). In plant character, early plant vigor and plant growth habit showed the variability among the germplasm. In vegetative stage 51.56% germplasm performed good for early plant vigor and 48.44% was very good. Good plant growth habit of 54.69% germplasm and 45.31% very good were observed. In leaf character, there are some variations observed on leaf size. Small, medium and large three types of leaf size were found, most of them (59.38%) were medium leaf size. Based on the fruit the variations (Fig. 31) were observed on mature fruit skin color, fruit skin pattern, stem end fruit shape, blossom end fruit shape, fruit ridge shape and matured fruit flesh color. The maximum variations were obtained on mature fruit skin color and fruit shape. Different types of fruit shape were found among the germplasm like globular (53.13%), flattened (21.88%), oblong blocky (10.94%) and elliptical (14.06%). The maximum variation of mature fruit skin color was observed creamish (4.69%) yellowish (4.69%) green (6.25%) deep brown (3.13%) brown (34.38%) brown with green (25.00%) yellow with green (21.88%) (Fig. 32). Most of the germplasm (82.81%) expressed mottled fruit skin pattern and rest of them (17.19%) uniform. Whereas 89.06% depressed and 9.38% flattened and 1.56% pointed both stem end fruit shape and blossom end fruit shape were observed. Superficial 4.69%, intermediate 70.31% and deep grooved 25% fruit ridge shape were found. Flesh color of mature fruits was orange in 70.31% germplasm and yellow in 29.69%. All germplasm showed dense stem pubescence density and angular stem shape. The tendril was present and coiled type tendril with branching for all germplasm. In case of leaf, undulated leaf margin, cordate leaf shape, silver color of leaf spot was found. Monoecious sex type and angular grooved peduncle shape were observed.

Table 30. Qualitative variation in different characters of pumpkin germplasm

Descriptor	Descriptor state	No. of acc.	Percent (%) of acc.
Early plant vigor	Good	33	51.56
	Very good	31	48.44
Plant growth habit	Good	35	54.69
	Very good	29	45.31
Stem pubescence density	Dense	64	100.00
Stem shape	Angular	64	100.00
Tendril	Present	64	100.00
Tendril type	Coiled	64	100.00
Tendril branching	Branched	64	100.00
Leaf margin	Undulated	70	109.38
Leaf shape	Cordate	64	100.00
Leaf size	Small	12	18.75
	Medium	38	59.38
	Large	14	21.88
Leaf pubescence density	Dense	64	100.00
Color of leaf spot	Silver	64	100.00
Sex type	Monoecious	64	100.00
Peduncle shape	Angular grooved	64	100.00
Fruit shape	Globular	34	53.13
	Flattened	14	21.88
	Oblong blocky	7	10.94
	Elliptical	9	14.06

Table 30. Cont'd

Descriptor	Descriptor state	No. of acc.	Percent (%) of acc.
Mature fruit skin color	Creamish	3	4.69
	Yellowish	3	4.69
	Green	4	6.25
	Deep brown	2	3.13
	Brown	22	34.38
	Brown with green	16	25.00
	Yellow with green	14	21.88
Fruit skin pattern	Uniform	11	17.19
	Mottled	53	82.81
Stem end fruit shape	Depressed	57	89.06
	Flattened	6	9.38
	Pointed	1	1.56
Blossom end fruit shape	Depressed	57	89.06
	Flattened	6	9.38
	Pointed	1	1.56
Fruit ridge shape	Superficial	3	4.69
	Intermediate	45	70.31
	Deep grooved	16	25.00
Mature flesh color	Yellow	19	29.69
	Orange	45	70.31

Quantitative character

Range, mean, standard deviation and coefficient of variation of different quantitative characters of pumpkin have been presented in Table 31. The range of number of primary branches was found 2 to 4 and average number of ridges per fruit 11.16. On an average, days to 1st male flower were 76.84 and days to 1st female flower were 80.66. The average flesh thickness 3.36 cm and number of fruits per plant 5.56 was observed. The range of fruit length 10 to 30.50 cm and fruit breadth 13.75 to 52.00 cm were identified. On an average, fruit weight was 2.99 kg. Among the germplasm average TSS (Brix) 5.92% was recorded. The maximum coefficient of variation was obtained for number of fruits per plant 41.25% followed by fruit weight in kg 34.53% and nodal position of 1st male flower 33.67%. The minimum CV was found for days to 1st male flower (10.38%). Percent of coefficient of variation indicated the variability among the germplasm comparing within the characters. The promising germplasm were selected based on sweetness of fruit on brix % like AHI-63 (10% TSS), RAI-87 (10% TSS), RAI-254 (10% TSS), RAI-279 (8% TSS) and AC-512 (8% TSS).

Table 31. Quantitative variation in different descriptors of pumpkin germplasm

Character	Range	Mean	SD	CV (%)
Number of primary branches	2.00- 4.00	2.70	0.61	22.53
Days to 1 st male flower	49.00-92.00	76.84	7.98	10.38
Days to 1 st female flower	56.00-94.00	80.66	8.73	10.82
Nodal position of 1st male flower	2.00-10.00	3.42	1.15	33.67
Nodal position of 1st female flower	2.00-19.00	12.42	3.97	31.97
Number of ridges per fruit	5.50-17.20	11.16	2.46	22.05
Flesh thickness (cm)	2.25-4.50	3.36	0.52	15.43
Fruit length (cm)	10.00-30.50	18.36	4.91	26.76
Fruit breadth (cm)	13.75-52.00	19.74	4.89	24.78
Fruit weight (kg)	1.14-5.43	2.99	1.03	34.53
Number of fruits per plant	2.00-12.00	5.56	2.29	41.25
TSS (Brix) %	4.00-10.00	5.92	1.48	25.07

Conclusion

The genetic variability of 64 germplasm of pumpkin was estimated using of qualitative and quantitative characters. Eight germplasm were selected based on the sweetness of fruit and yield per plant for future utilization.

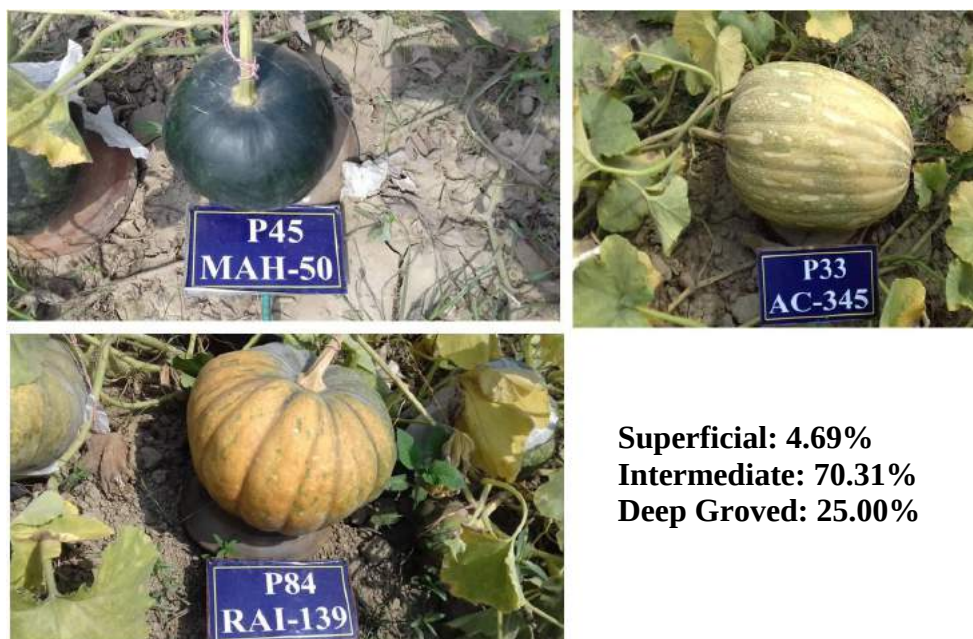


Fig. 30. Variation in pumpkin fruit ridge

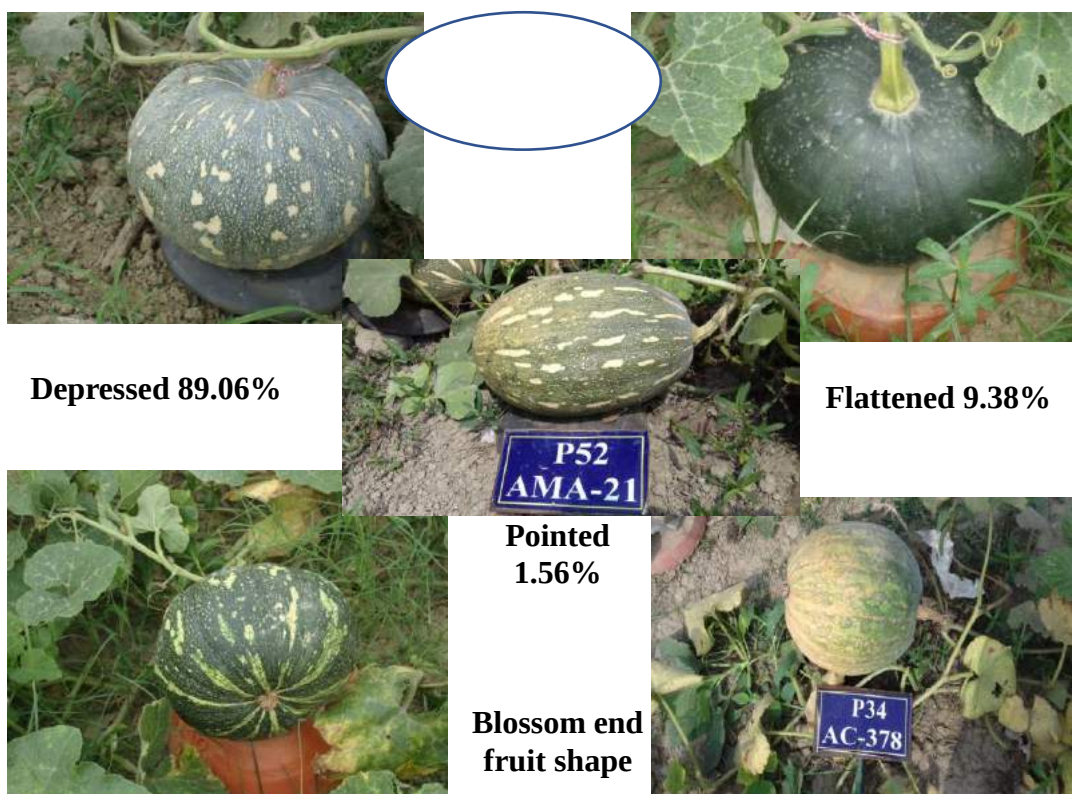


Fig. 31. Variation in pumpkin fruit shape



Globular



Flattened



Oblong blocky



Elliptical

Cont'd Fig. 31. variation in pumpkin fruit shape



Fig. 32. Variation in fruit skin pattern of pummkin



Fig. 33. Variation in leaf of pumpkin



Fig. 34. Peduncle shape of pumpkin



Fig. 35. Stem characters of pumpkin



Green 6.25%



Brown with green 25%



Creamish 4.69%



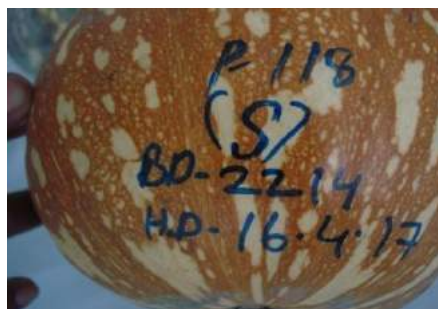
Yellow with green 21.88%



Deep Brown 30.13%



Yellow 4.69%



Brown 34.38%

Fig. 36. Variation in matured fruit skin color of pumpkin

Table 32. Qualitative characters of pumpkin germplasm

Coll. No.	Early plant vigor	Plant growth habit	Stem pubescence density	Stem shape	Tendrils	Tendrils type	Tendrils branching	Leaf margin	Leaf shape	Leaf size	Leaf pubescence density	Color of leaf spot	Sex type
1	2	3	4	5	6	7	8	9	10	11	12	13	14
AHI-63	7	7	2	2	1	1	2	4	1	5	7	3	1
AHI-121	5	5	2	2	1	1	2	4	1	5	7	3	1
RAI-87	5	5	2	2	1	1	2	4	1	5	7	3	1
RAI-139	3	5	2	2	1	1	2	4	1	5	7	3	1
RAI-151	3	5	2	2	1	1	2	4	1	5	7	3	1
RAI-178	5	7	2	2	1	1	2	4	1	5	7	3	1
RAI-195	5	5	2	2	1	1	2	4	1	5	7	3	1
RAI-196	7	7	2	2	1	1	2	4	1	7	7	3	1
RAI-211	5	5	2	2	1	1	2	4	1	5	7	3	1
RAI-254	5	5	2	2	1	1	2	4	1	5	7	3	1
RAI-268	5	5	2	2	1	1	2	4	1	5	7	3	1
RAI-278	5	5	2	2	1	1	2	4	1	5	7	3	1
RAI-279	3	5	2	2	1	1	2	4	1	5	7	3	1
SA-39	3	5	2	2	1	1	2	4	1	3	7	3	1
M-54	3	5	2	2	1	1	2	4	1	5	7	3	1
AR-182	3	3	2	2	1	1	2	4	1	3	7	3	1
AR-221	5	5	2	2	1	1	2	4	1	5	7	3	1
AR-238	5	3	2	2	1	1	2	4	1	3	7	3	1
AR-257	3	3	2	2	1	1	2	4	1	3	7	3	1
AC-13	7	7	2	2	1	1	2	4	1	7	7	3	1
AC-15	7	7	2	2	1	1	2	4	1	7	7	3	1
AC-22	5	5	2	2	1	1	2	4	1	5	7	3	1
AC-62	3	3	2	2	1	1	2	4	1	3	7	3	1
AC-73	5	5	2	2	1	1	2	4	1	5	7	3	1
AC-90	5	5	2	2	1	1	2	4	1	5	7	3	1
AC-107	3	3	2	2	1	1	2	4	1	3	7	3	1
AC-136	7	7	2	2	1	1	2	4	1	7	7	3	1
AC-192	5	5	2	2	1	1	2	4	1	5	7	3	1
AC-225	5	5	2	2	1	1	2	4	1	5	7	3	1
AC-253	5	5	2	2	1	1	2	4	1	5	7	3	1
AC-258	7	7	2	2	1	1	2	4	1	5	7	3	1
AC-263	7	5	2	2	1	1	2	4	1	5	7	3	1
AC-345	5	5	2	2	1	1	2	4	1	3	7	3	1
AC-378	5	5	2	2	1	1	2	4	1	7	7	3	1
AC-428	5	5	2	2	1	1	2	4	1	5	7	3	1
AC-447	5	5	2	2	1	1	2	4	1	5	7	3	1
AC-448	5	5	2	2	1	1	2	4	1	5	7	3	1
AC-465	7	7	2	2	1	1	2	4	1	5	7	3	1
AC-469	5	5	2	2	1	1	2	4	1	3	7	3	1
AC-512	7	7	2	2	1	1	2	4	1	5	7	3	1
RAI-224	7	7	2	2	1	1	2	4	1	7	7	3	1
MAH-10	7	3	2	2	1	1	2	4	1	5	7	3	1
MAH-24	5	3	2	2	1	1	2	4	1	3	7	3	1
MAH-44	7	5	2	2	1	1	2	4	1	3	7	3	1

Table 32. Cont'd

Coll. No.	Early plant vigor	Plant growth habit	Stem pubescence density	Stem shape	Tendrils	Tendrils type	Tendrils branching	Leaf margin	Leaf shape	Leaf size	Leaf pubescence density	Color of leaf spot	Sex type
MAH-50	5	5	2	2	1	1	2	4	1	7	7	3	1
MAH-60	5	5	2	2	1	1	2	4	1	7	7	3	1
ATR-1	7	7	2	2	1	1	2	4	1	7	7	3	1
ATR-2	3	3	2	2	1	1	2	4	1	5	7	3	1
ATR-7	3	3	2	2	1	1	2	4	1	5	7	3	1
ATR-28	5	5	2	2	1	1	2	4	1	7	7	3	1
ATR-45	7	7	2	2	1	1	2	4	1	5	7	3	1
AMA-21	7	7	2	2	1	1	2	4	1	5	7	3	1
AMA-24	5	5	2	2	1	1	2	4	1	3	7	3	1
AMA-33	5	5	2	2	1	1	2	4	1	3	7	3	1
AMA-42	5	5	2	2	1	1	2	4	1	5	7	3	1
AMA-47	7	7	2	2	1	1	2	4	1	7	7	3	1
AMA-76	5	5	2	2	1	1	2	4	1	5	7	3	1
AMA-84	7	7	2	2	1	1	2	4	1	7	7	3	1
AMA-85	5	5	2	2	1	1	2	4	1	5	7	3	1
AMA-106	5	5	2	2	1	1	2	4	1	5	7	3	1
AMA-124	5	5	2	2	1	1	2	4	1	5	7	3	1
AMA-146	7	7	2	2	1	1	2	4	1	7	7	3	1
AMA-160	7	7	2	2	1	1	2	4	1	7	7	3	1
AC-332	5	5	2	2	1	1	2	4	1	5	7	3	1

Table 32. Qualitative characters of pumpkin germplasm (cont'd)

Coll. No.	Peduncle shape	Fruit shape	Mature fruit skin color	Fruit skin pattern	Stem end fruit shape	Blossom end fruit shape	Fruit ridge shape	Mature flesh color
1	15	16	17	18	19	20	21	22
AHI-63	3	1	5	1	1	1	3	3
AHI-121	3	5	6	2	3	3	3	3
RAI-87	3	5	1	2	3	3	3	3
RAI-139	3	2	1	2	1	1	3	3
RAI-151	3	1	1	2	1	1	3	3
RAI-178	3	1	6	2	1	1	3	1
RAI-195	3	5	7	1	3	3	3	3
RAI-196	3	2	2	2	1	1	3	1
RAI-211	3	1	7	2	1	1	3	3
RAI-254	3	1	7	1	3	3	3	3
RAI-268	3	1	8	2	1	1	3	1
RAI-278	3	5	7	2	1	1	3	1
RAI-279	3	1	7	2	1	1	3	1
SA-39	3	1	5	2	1	1	3	3
M-54	3	1	6	2	1	1	3	3
AR-182	3	1	6	2	1	1	3	3
AR-221	3	1	6	2	1	1	3	3

Table 32. Cont'd

Coll. No.	Peduncle shape	Fruit shape	Mature fruit skin color	Fruit skin pattern	Stem end fruit shape	Blossom end fruit shape	Fruit ridge shape	Mature flesh color
AR-238	3	1	8	2	1	1	3	1
AR-257	3	1	6	1	3	3	3	1
AC-13	3	1	7	1	3	3	3	1
AC-15	3	1	6	2	3	3	1	1
AC-22	3	4	3	2	1	1	1	3
AC-62	3	1	7	2	1	1	3	3
AC-73	3	1	8	2	1	1	3	3
AC-90	3	1	7	2	1	1	3	1
AC-107	3	5	7	2	3	3	1	3
AC-136	3	2	3	2	1	1	4	1
AC-192	3	1	3	2	3	3	3	3
AC-225	3	5	7	2	3	3	3	1
AC-253	3	1	6	2	1	1	3	3
AC-258	3	1	6	2	1	1	3	3
AC-263	3	1	8	2	1	1	3	3
AC-345	3	1	6	2	1	1	1	3
AC-378	3	4	7	2	3	3	1	3
AC-428	3	1	6	2	3	3	1	3
AC-447	3	1	8	2	1	1	3	3
AC-448	3	2	6	2	1	1	3	3
AC-465	3	4	6	2	3	3	3	3
AC-469	3	1	3	2	1	1	3	3
AC-512	3	1	8	2	1	1	3	3
RAI-224	3	1	6	2	1	1	1	1
MAH-10	3	4	2	2	3	3	3	3
MAH-24	3	1	8	1	1	1	1	3
MAH-44	3	5	8	2	3	3	3	3
MAH-50	3	1	8	2	1	1	4	3
MAH-60	3	5	8	1	1	1	4	1
ATR-1	3	4	8	2	3	3	4	1
ATR-2	3	1	6	2	1	1	1	1
ATR-7	3	9	8	2	3	3	3	1
ATR-28	3	1	6	2	1	1	3	3
ATR-45	3	2	6	2	1	1	3	3
AMA-21	3	1	7	2	1	1	3	3
AMA-24	3	1	8	2	1	1	3	3
AMA-33	3	2	7	2	1	1	3	3
AMA-42	3	4	8	2	3	3	3	3
AMA-47	3	1	7	2	1	1	3	3
AMA-76	3	9	6	1	3	3	3	3
AMA-84	3	1	6	1	3	3	3	3
AMA-85	3	1	6	2	3	3	3	3
AMA-106	3	5	7	2	3	3	3	3
AMA-124	3	4	6	1	3	3	3	1
AMA-146	3	4	6	1	3	3	3	3
AMA-160	3	2	7	2	3	3	4	3
AC-332	3	2	2	2	1	1	3	1

Table 33. Quantitative characters of pumpkin germplasm

Coll. No.	No. of primary branches/ plant	Days to 1 st male flower	D/ 1 st Female flower	Nodal position of 1 st male flower	Nodal position of 1 st female flower	No. of ridges /fruit	Flesh thickness (cm)	Fruit length (cm)	Fruit breath (cm)	Fruit weight (kg)	No. of fruit /plant	TSS (Brix) %
1	2	3	4	5	6	7	8	9	10	11	12	13
AHI-63	3	73	71	3	18	15.60	4.00	11.00	22.80	2.82	11	10
AHI-121	3	78	71	4	13	9.80	3.50	10.00	17.20	1.81	5	9
RAI-87	2	71	74	4	16	11.80	3.20	15.00	20.60	2.69	8	10
RAI-139	3	72	74	4	15	11.00	3.75	15.00	21.20	3.15	5	7
RAI-151	3	71	75	4	15	12.00	2.88	13.80	19.20	2.52	6	7
RAI-178	3	62	59	4	12	10.60	2.25	10.20	13.80	1.14	3	9
RAI-195	3	72	69	2	17	11.60	4.00	19.80	21.80	4.08	5	5
RAI-196	2	70	72	2	2	12.40	3.00	16.20	18.40	2.63	7	5
RAI-211	2	73	73	3	16	12.40	3.67	19.80	17.60	2.92	3	6
RAI-254	3	70	73	2	16	7.80	3.70	17.00	20.60	3.36	6	10
RAI-268	4	64	73	3	13	9.00	3.60	18.20	22.60	4.17	4	7
RAI-278	2	59	56	4	16	14.80	2.40	14.20	19.80	2.20	4	7
RAI-279	3	72	75	5	13	17.20	3.60	12.40	21.20	2.77	6	8
SA-39	2	75	69	3	16	11.00	3.25	14.50	23.25	3.90	4	7
M-54	3	81	89	3	12	16.67	3.75	10.67	18.67	2.11	4	7
AR-182	2	76	79	3	16	10.80	3.50	20.80	20.40	3.84	3	5
AR-221	3	76	90	4	12	15.80	3.00	10.50	17.60	1.74	9	7
AR-238	2	86	84	3	13	12.80	3.30	22.40	18.00	3.45	6	6
AR-257	3	84	84	3	13	13.00	4.00	20.00	16.60	3.16	5	7
AC-13	3	82	78	4	14	8.00	3.66	26.60	13.75	3.35	3	4
AC-15	3	78	80	3	12	8.60	3.00	25.60	14.60	2.87	5	4
AC-22	2	77	85	3	14	11.60	3.00	19.80	16.20	2.84	6	5
AC-62	3	79	84	3	19	12.20	3.84	16.60	17.00	2.54	8	5
AC-73	3	85	75	4	15	11.40	2.80	14.80	17.40	2.27	10	5
AC-90	2	77	75	2	12	9.00	2.70	13.00	15.40	1.52	2	4
AC-107	2	83	75	3	4	9.00	3.25	25.75	19.75	4.04	6	5
AC-136	3	77	80	3	4	12.50	3.00	23.50	18.50	3.04	3	6
AC-192	3	81	86	3	17	12.80	2.88	12.60	16.80	2.02	9	5
AC-225	3	77	81	3	16	9.40	2.70	13.80	17.40	2.38	9	5
AC-253	3	76	78	4	10	11.00	3.75	23.00	19.60	4.27	3	7
AC-258	3	78	84	3	12	8.60	3.00	12.60	16.60	1.34	9	5
AC-263	2	92	86	3	13	13.75	2.50	19.50	19.25	3.47	7	7
AC-345	2	78	90	5	12	10.67	3.00	20.00	19.67	2.73	3	6
AC-378	2	75	75	3	8	9.00	3.00	18.10	21.00	3.60	5	5
AC-428	3	75	75	3	13	11.00	3.40	23.00	19.80	3.60	3	6
AC-447	3	77	80	4	18	11.00	4.00	16.40	24.00	3.64	3	6
AC-448	2	75	75	4	13	7.50	3.17	17.50	24.00	3.96	5	6
AC-465	2	82	82	4	12	10.25	3.00	16.80	22.40	3.96	5	7
AC-469	3	75	72	3	6	13.00	4.50	17.80	22.40	3.92	4	6
AC-512	2	78	92	4	16	14.00	2.50	15.00	20.50	2.60	6	8
RAI-224	4	49	75	4	9	11.67	4.00	28.00	22.67	5.43	4	5
MAH-10	2	78	93	2	11	16.00	3.33	20.80	22.80	3.75	4	5

Table 33. Cont'd

Coll. No.	No. of primary branches/ plant	Days to 1 st male flower	D/ 1 st Female flower	Nodal position of 1 st male flower	Nodal position of 1 st female flower	No. of ridges /fruit	Flesh thickness (cm)	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (kg)	No. of fruit /plant	TSS (Brix) %
MAH-24	2	78	80	3	18	10.40	2.33	21.60	19.20	2.88	7	5
MAH-44	2	78	79	3	14	9.20	3.67	15.20	16.20	1.66	12	4
MAH-50	3	71	91	3	13	8.20	3.20	16.80	18.80	2.36	8	5
MAH-60	3	78	91	4	12	5.50	4.20	30.50	22.50	4.90	7	5
ATR-1	2	74	81	3	14	9.25	3.50	22.75	18.25	3.94	4	5
ATR-2	2	71	77	4	12	10.20	4.50	23.80	15.60	3.07	6	6
ATR-7	3	71	75	2	13	10.67	3.25	16.33	18.33	2.52	4	7
ATR-28	2	71	77	6	7	15.00	3.00	14.50	23.00	3.77	4	5
ATR-45	3	71	75	3	15	11.20	3.60	14.40	17.60	2.39	11	5
AMA-21	3	91	90	10	8	9.60	3.00	27.20	16.60	3.00	7	5
AMA-24	3	92	92	5	12	10.20	2.75	15.40	17.00	2.15	5	4
AMA-33	4	73	91	3	12	8.40	3.40	20.00	16.20	2.59	7	5
AMA-42	3	78	91	3	14	10.20	3.60	22.00	18.00	3.04	8	4
AMA-47	4	76	91	3	13	7.00	4.00	27.50	20.50	4.56	7	5
AMA-76	2	72	77	3	16	14.60	3.25	16.40	22.00	3.28	6	5
AMA-84	3	72	76	3	10	14.00	3.25	20.50	16.50	3.42	5	5
AMA-85	2	77	93	3	12	10.40	3.33	24.80	16.20	2.85	4	6
AMA-106	3	91	93	3	13	8.40	4.50	15.80	19.60	2.96	3	6
AMA-124	3	91	94	2	3	10.00	3.56	16.54	18.53	3.24	4	6
AMA-146	3	91	94	3	3	10.60	3.54	25.00	52.00	3.25	3	5
AMA-160	3	91	94	3	3	10.20	3.67	15.00	23.40	4.07	5	5
AC-332	4	91	94	4	14	13.33	3.46	21.00	24.33	4.80	3	5

11.3.3. Characterization of Landraces of Cucumber

Qualitative descriptor

Plant growth was indeterminate type and tendril was present in all studied accessions (Table 34 and Fig. 35-38). Stem color was dark green in six accession but rest (12 accessions) showed light green color stem. Medium green colored leaves were present in 6 accessions, whereas light green colored leaves were showed in twelve accessions. No variation was found in leaf shape, tendril presence, leaf margin among all accessions. Stem end fruit shape was obtuse in most accessions (13) followed by acute (5) and blossom end fruit shape was flat among all accessions. Fruit skin texture at edible stage was smooth (18) in all accessions. Maximum number of accessions (14 accessions) showed oblong fruit shape while oval (4 accessions) fruit shape was also found among the accessions. Fruit skin color at edible stage was light green (13 accessions) followed by dark green (5 accessions). Maximum fruit skin color at fully ripening stage was brown (14) followed by yellow (4).

Table 34. Qualitative variation in different descriptors of Cucumber germplasm

Name of descriptor	Descriptor state	No. of germplasm
Plant growth type	Indeterminate	18
Stem color	Light green	12
	Dark green	06
Leaf intensity of green color	Light green	12
	Medium green	06
Leaf shape	Orbicular	18
Stem end fruit shape	Necked	0
	Acute	05
	Obtuse	13
Blossom end fruit shape	Flat	18
	Deep raised	0
	Blossom end tapered	0
Fruit shape	Oblong	14
	Oval	4
	Ellipsoid	0
	Blossom end tapered	0
Fruit skin color at table maturity	Light green	13
	Dark green	5
Fruit skin color at maturity	Brown	14
	Yellow	4
Seed color	Creamy	21

Quantitative descriptor

Range, mean, standard deviation and coefficient of variations are shown in Table 35. Low to medium variabilities among the germplasm was recorded for the quantitative characters studied. Highest variation (19.85%) was observed in fruit length closely followed by number of fruits per plant (18.71%). Internode length varied from 4.94 to 9.92 cm with an average of 7.816 cm with an average of 7.816 cm (CV- 16.01%). Variations among the germplasm in respect of length and width of leaves were medium (CV- 11.03 and 14.00, respectively). Fruit length ranged from 15.66 cm to 30.74 cm with an average of 20.33 cm. Number of fruits per plant showed medium variability, which ranged from 3.50 to 7.50 averaging 5.03. Days to staminate flower and pistillate flower ranged from 48 to 66 days and 56 to 73 days after sowing, respectively. The germplasm RAI -68 takes more duration to produce staminate and pistillate flower. Days to fruit at edible stage varied from 73 to 85 days after sowing. On an average, internode length, leaf blade length and leaf blade width were 7.81, 14.57 and 17.79 cm, respectively. Average fruit length and fruit width were 20.33 and 6.47 cm. The highest fruit length was recorded from RAI- 117 (30.74 cm) followed by RAI-116 (29.06 cm). The smallest fruit was obtained from AR-273 (15.66 cm). The highest fruit width was recorded from BD-4242 (8.42 cm) followed by RAI- 116 (8.12 cm) and the lowest fruit width was obtained from IAH-273 (5.08 cm). Number of fruit per plant at edible stage/ was ranged from 3.5 to 7.5. Maximum number fruits per plant were obtained from RAI- 209 and minimum number of fruits per plant was recorded from IAH-331. 100- Seed weight ranged from 2.96 to 3.48 gm. The highest coefficient of variation was found in fruit length (19.85 %) followed by fruit width (14.46%) and number of fruits per plant (18.71%). Coefficient of variation was also high in internode length (16.01). 100 seed weight showed the lowest (4.71%) coefficient of variation.



Fig. 37. Diversity in fruit shape of cucumber germplasm



Fig. 37. Diversity in fruit shape of cucumber germplasm (Cont'd)



Fig. 38. Shape of leaf (orbicular) and stem (angular) with pubescence



Fig. 39. Variation in fruit skin color at table maturity stage



Fig. 40. Variation in fruit skin color at matured stage

Table 35. Quantitative variation in different descriptors of cucumber germplasm

Descriptor	Range	Mean	Sd	CV (%)
Internode length	4.94-9.92	7.816	1.251	16.01
Leaf length (cm)	11.55-17.1	14.57	1.609	11.03
Leaf width (cm)	12.99-23.37	17.79	2.492	14.00
Fruit length	15.66-30.74	20.33	4.03	19.85
Fruit width (cm)	5.08-8.42	6.47	0.936	14.46
No. of fruit/pl	3.5-7.5	5.03	0.993	18.71
100 seed wt.	2.96-3.48	3.19	0.150	4.71
Days to staminate flower	48-66	56.76	5.048	8.89
Days to pistilate flower	56-73	65.09	5.356	8.22
Days to harvest	73-85	79.09	4.999	6.32

Conclusion

Variability showed in qualitative quantitative characters. It was shown that, although morphological diversity was found among the accession but would be necessary to investigate genetic diversity based on the molecular analysis using accessions collected more widely.

11.3.4. Characterization of Brinjal Germplasm

The brinjal germplasm collected districts and GIS position presented in Bangladesh map (Fig. 41), color filled polygon indicate collected districts and blue point indicate the collected sample GIS positions (Fig. 42). The collected germplasm covered 36 districts of the country. Maximum richness of brinjal germplasm was found in Pabna district followed by Chattogram and Gazipur.

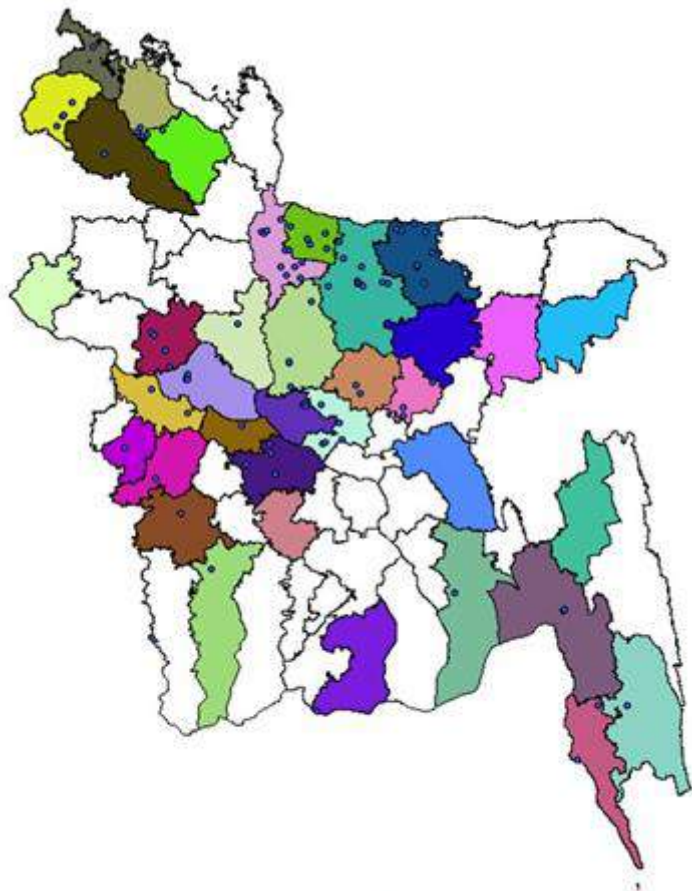


Fig. 41. GIS mapping of collected brinjal germplasm

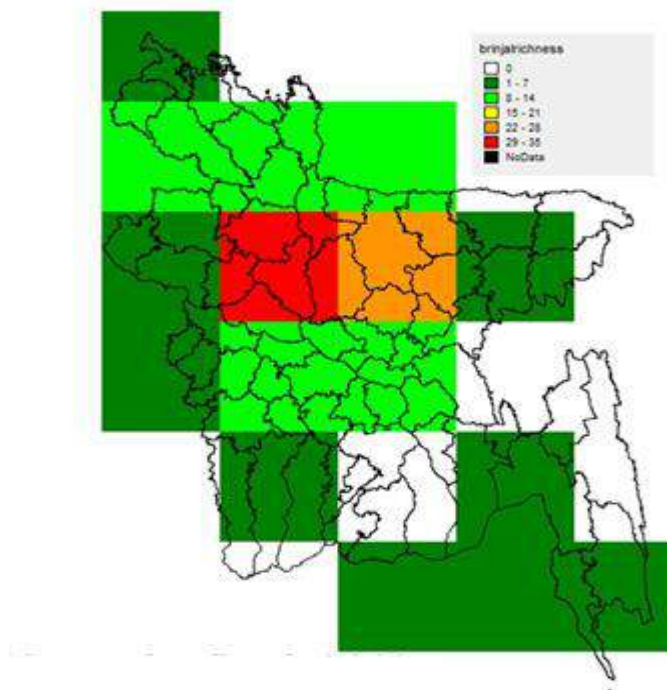


Fig. 42. Species richness of collected brinjal germplasm in Bangladesh map by using Shannon diversity index

A. Qualitative characters

A total of 18 qualitative characters were evaluated to know the variability of the studied germplasm (Table 36 & 37). All the characters showed distinct variation among the germplasm except leaf hairs, corolla color, fruit cross section and fruit position. The maximum variation observed in overall leaf prickles, fruit calyx prickles, fruit color at ripening and fruit flesh density.

Variability in growth and foliage

All the characters studied related to plant growth habit and foliage showed distinct variation among the germplasm except leaf hairs and corolla color (Table 35 & 36). Plant growth habit was observed in upright (67.6%), intermediate (10.2%) and prostrate only 22.1%). Leaf prickles were found in maximum variation such as very few (18.0%), few (33.6%), intermediate (42.6%), many (4.1%) and very many (1.6%) in studied germplasm. The Leaf blade tip angles were also exhibited as four categories such as Very acute (2.5%), Acute (23.8%), Intermediate (53.7%) and Obtuse (20.1%). Leaf hairs and corolla color showed no variation. Leaf blade lobing exhibited four categories such as Weak (60.2%), Intermediate (22.5%), Strong (16.4%), and Very strong (0.8%). All leaf hairs were observed as 'very many' type and corolla color was light violet (99.2%) and dark violet (0.8%).

Table 36. Variability in growth and foliage characters of brinjal germplasm

Name of descriptor	Descriptor state	No. of germplasm	Frequency (%)
Plant growth habit	Upright	165	67.6
	Intermediate	25	10.2
	Prostrate	54	22.1
Leaf blade lobing	Weak	147	60.2
	Intermediate	55	22.5
	Strong	40	16.4
	Very strong	2	0.8
Leaf blade tip angle	Very acute	6	2.5
	Acute	58	23.8
	Intermediate	131	53.7
	Obtuse	49	20.1
Leaf prickles	Very few	44	18.0
	Few	82	33.6
	Intermediate	104	42.6
	Many	10	4.1
	Very many	4	1.6
Leaf hairs	Very many	244	100.0
Corolla color	Light violet	242	99.2
	Dark violet	2	0.8
Leaf blade lobing	Weak	147	60.2
	Intermediate	55	22.5
	Strong	40	16.4
	Very strong	2	0.8

Variability in fruit characters

All the characters studied related to fruit of brinjal showed distinct variation among the germplasm (Fig. 43) except fruit position (Table 37). The maximum variation was found in 'fruit color at ripening stage'. Six categories fruit color at ripening such as milky white (0.4%), lilac grey (4.9%), Purple (19.7%), green with mottled at the distal end (29.5%), and Green with yellowish stripe (41.8%) and purple with light green at the distal end (3.7%) were observed. The next higher variation was found in 'fruit flesh density'. Very loose (spongy), loose (crumbly), average density, dense and very dense type of fruit flesh density was found where majority of the germplasm exhibited average density type. On the other hand, fruit calyx prickles were found as

very few (1.6%), few (13.9%), intermediate (36.5%), many (23.0%) and very many (25.0%). Fruit color distribution was exhibited as Uniform (50.8%), mottled (13.1%), netted (16.8%) and striped (27.9%). Fruit curvature was none (straight) in 50.8% of the germplasm 21.3% of the germplasm showed curved and 27.9% showed slightly curved fruit. Fruit apexes were exhibited as two categories such as rounded (40.28%) and depressed (59.72%).

Table 37. Variability in qualitative fruit characters of brinjal germplasm

Name of descriptor	Descriptor state	No. of germplasm	% of germplasm
Fruit calyx prickles	Very few	4	1.6
	Few	34	13.9
	Intermediate	89	36.5
	Many	56	23.0
	Very many	61	25.0
Fruit color distribution	Uniform	36	14.8
	Mottled	32	13.1
	Netted	41	16.8
	Striped	135	55.3
Fruit curvature	None (fruit straight)	124	50.8
	Slightly curved	68	27.9
	Curved	52	21.3
Fruit apex shape	Rounded	96	39.3
	Depressed	148	60.7
Fruit cross section	Circular (no groove)	72	29.5
Fruit color at ripening	Milky white	1	0.4
	Lilac grey	12	4.9
	Purple	48	19.7
	Green with mottled at the distal end	72	29.5
	Green with yellowish stripe	102	41.8
	Purple with light green at the distal end	9	3.7
Fruit flesh density	Very loose (spongy)	112	45.9
	Loose (Crumbly)	64	26.2
	Average density	43	17.6
	Dense	17	7.0
	Very dense	8	3.3
Fruit position	Pendant	244	100.0

Table 38. Quantitative descriptors of brinjal gerplasm

Coll./Acc. #	DFF	FD	FL	FW	LA	LACal	LDW
1	2	3	4	5	6	7	8
AC-172	73.56	3.77	14.76	75.76	444.2	375.69	2.29
AC-212	74.56	4.97	11.76	85.4	465.5	385.69	2.6
AC-240	72.56	4.87	11.42	71.74	480.1	496.99	2.07
AC-258	74.81	4.13	10.6	65.11	390.97	393.16	2.6
AC-285	73.56	6.63	12.09	168.4	435.3	342.39	2.62
AC-396	75.81	3.46	8.93	43.44	270.87	350.26	2.51
AC-47	77.81	5.13	7.6	86.44	476.87	390.26	2.26
AH-41	75.31	2.97	19.97	111.67	602.02	558.04	3.75
AHI-101	74.31	5.3	11.63	122.67	407.72	319.34	2.54
AHI-102	76.31	4.63	10.3	115	358.92	309.94	2.34
AHI-124	76.06	4.88	7.59	33.15	244.15	218.09	2.42
AM-10	75.81	5.67	5.55	84.07	285.9	337.29	1.9
AM-10111	77.06	6.88	7.59	11.15	367.05	236.29	2.9
AMA-294	75.06	5.75	16.55	97.07	308.37	378.09	2.48

Coll./Acc. #	DFF	FD	FL	FW	LA	LACal	LDW
1	2	3	4	5	6	7	8
AMA-302	75.31	4.92	9.39	91.15	438.75	401.49	2.27
AMA-312	77.06	3.42	13.89	56.4	388.37	219.79	2.65
AMA-368	74.81	4.84	10.55	96.41	437.5	465.29	3.44
AMA-410	73.31	3.63	13.63	89.33	301.12	250.94	1.92
ATR-12	74.81	3.51	10.22	81.74	544.8	211.39	0.89
BARI-1	75.06	4.42	9.22	50.4	352.97	234.49	2.54
BARI-10	74.06	3.75	9.22	58.73	201.17	309.39	2.49
BARI-4	73.81	3.34	10.22	96.07	380.9	267.09	1.1
BARI-5	73.81	6.34	8.55	138.07	325.1	274.69	1.58
BARI-6	75.81	6.67	8.22	95.74	534.4	439.99	1.9
BARI-7	73.81	2.44	10.55	50.41	563.3	564.29	2.29
BARI-8	73.81	3.01	15.89	70.74	577.8	444.19	1.94
BARI-9	74.81	5.01	6.22	109.07	357.6	303.29	1.72
BARI-BT-1	74.5	3.37	7.84	49.29	229.23	189.58	1.25
BARI-BT-2	74.75	3.53	9.37	50.98	246.15	217.35	1.37
BARI-BT-3	75	5.45	6.34	94.67	247.97	139.67	1.03
BARI-BT-4	75	7.5	8.17	142.66	365.05	327.75	2.21
BD—2705	74.06	2.62	7.07	31.96	450.25	288.14	2.99
BD-10154	73.56	3.03	14.76	57.07	390.3	324.59	1.73
BD-10156	74.56	2.97	12.42	48.73	297	225.69	1.43
BD-10157	74.81	5.18	8.51	46.67	239.05	337.14	2.86
BD-10158	74.81	3.51	20.18	41	209.15	213.14	1.28
BD-10171	74.56	5.23	6.09	113.07	640.8	501.39	4.29
BD-10176	73.56	3.3	7.42	34.07	317.9	283.49	1.44
BD-10178	75.81	3.51	11.85	63.34	292.25	319.24	1.85
BD-10187	74.81	3.35	8.51	41.67	310.05	319.94	2.74
BD-10188	74.81	4.18	8.18	72	309.15	334.94	2.16
BD-10190	74.56	3.75	9.8	69.77	592.57	458.66	4.47
BD-10191	74.56	4.75	10.13	112.1	464.67	446.26	3.89
BD-10192	74.56	6.42	9.13	137.1	380.87	403.96	2.06
BD-10193	74.56	2.42	5.47	18.1	525.27	547.16	3.18
BD-10194	74.56	4.09	6.47	42.44	427.97	403.26	2.92
BD-10195	74.56	4.42	10.8	78.44	410.47	446.26	2.35
BD-2645	75.06	3.55	14.8	82.41	509.45	342.34	3.06
BD-2646	74.06	5.22	6.3	83.86	505.35	494.74	3.28
BD-2649	76.06	4.21	7.26	59.15	392.25	355.39	4.09
BD-2650	75.56	5.33	4.72	94.48	380.32	425.99	2.08
BD-2651	75.56	3	10.05	75.15	328.12	282.39	2.06
BD-2652	75.06	2.88	12.59	33.48	379.05	397.79	2.69
BD-2653	73.06	3.55	8.13	46.6	228.45	229.04	1.13
BD-2657	74.06	3.55	6.63	40.52	365.45	203.64	2.16
BD-2658	75.06	2.89	3.97	37.66	394.55	267.04	2.29
BD-2662	75.56	2.77	10.05	45.81	621.42	411.09	1.78
BD-2663	76.06	4.55	8.63	66.75	92.15	30.34	0.47
BD-2664	75.56	3.17	10.39	86.81	222.22	239.19	2.88
BD-2665	75.06	2.89	9.63	70.95	404.95	285.34	2.38
BD-2669	74.56	7	6.05	85.15	219.32	321.09	2.88
BD-2672	76.56	3.67	12.05	82.48	380.42	319.09	2.49
BD-2673	75.56	3.67	8.05	50.15	225.92	333.79	1.77
BD-2674	76.06	4.55	12.63	88.44	250.95	195.64	1.39
BD-2675	75.06	2.52	11.47	67.29	230.65	156.54	1.37
BD-2677	75.56	5	7.05	75.48	382.02	282.39	1.14
BD-2678	74.06	3.55	6.97	40.66	352.45	250.14	1.76
BD-2680	74.56	3.67	5.05	54.81	362.92	245.79	1.33
BD-2681	74.81	2.68	8.51	32.67	207.05	130.94	3.66
BD-2682	74.06	2.89	7.3	43.88	259.05	127.64	0.99

Table 38. Cont'd

Coll./Acc. #	DFF	FD	FL	FW	LA	LACal	LDW
1	2	3	4	5	6	7	8
BD-2683	74.06	2.72	12.8	65.2	429.95	316.24	2.13
BD-2685	76.56	3	15.05	76.15	468.22	446.39	3.08
BD-2686	75.81	3.01	14.85	63	546.05	319.24	1.97
BD-2687	74.06	2.42	15.97	50.55	548.95	404.24	3.36
BD-2694	74.06	3.92	14.13	99.41	543.25	430.34	3.37
BD-2695	75.06	2.25	7.4	31.96	135.85	83.24	0.83
BD-2702	75.81	3.85	4.85	38	306.05	188.64	1.18
BD-2703	74.81	3.51	7.51	27.34	265.05	185.64	2.71
BD-2707	80.06	3.55	6.59	43.15	389.15	331.39	3.13
BD-2708	76.06	2.05	10.59	20.48	191.35	336.29	4.12
BD-2710	75.06	2.88	5.26	11.15	473.25	320.39	3.32
BD-2711	76.06	2.65	6.8	36.63	404.25	258.34	2.07
BD-2715	75.06	3.65	9.13	52.29	259.25	195.94	1.25
BD-2716	74.81	3.18	12.18	49.67	238.85	178.24	2.41
BD-2721	74.81	5.18	7.51	96.67	492.35	528.04	2
BD-2724	74.81	2.35	6.51	23.67	126.45	133.74	3.66
BD-2725	74.81	6.51	7.51	86.34	132.15	168.84	1.97
BD-2728	74.06	5.21	6.92	60.48	471.05	425.39	3.12
BD-2731	75.06	4.72	6.47	80.4	436.65	305.64	2.01
BD-2732	74.06	2.62	8.67	44.62	395.75	254.34	1.99
BD-2733	74.06	2.55	5.93	34.1	548.95	366.86	3.58
BD-2735	73.06	2.72	12.6	63.39	619.35	451.56	3.43
BD-2740	73.81	3.85	6.18	45	567.05	382.64	3.46
BD-2746	75.81	4.85	5.85	68	309.15	276.04	2.05
BD-2748	73.81	4.85	6.85	71.34	269.15	257.64	3.33
BD-2749	75.06	2.65	3.6	10.05	294.75	190.66	1.51
BD-2751	75.06	4.22	4.26	76.79	481.45	357.76	2.92
BD-2753	75.06	4.88	6.26	70.86	417.95	274.66	2.48
BD-2754	75.06	4.72	7.26	74.3	500.05	371.46	2.85
BD-2755	73.81	5.51	7.51	85.34	238.85	327.34	2.71
BD-2756	73.81	4.85	6.85	38.34	262.05	180.94	2.31
BD-2757	74.06	5.22	6.26	86.2	400.85	285.96	1.94
BD-2762	75.06	2.38	10.59	32.15	323.25	397.39	4.19
BD-2763	76.06	5.88	7.92	47.15	352.05	430.69	2.11
BD-2764	74.06	4.38	6.1	81.43	388.75	307.16	2.49
BD-2766	75.06	4.88	6.93	85.97	632.75	531.56	4.23
BD-2770	77.06	3.88	5.6	64.63	426.75	342.86	1.96
BD-2773	74.06	3.21	4.59	24.82	374.05	405.69	3.08
BD-2774	75.06	4.22	4.6	43.55	420.65	287.36	1.98
BD-2775	74.06	4.22	4.6	53.77	404.25	272.26	2.05
BD-2776	75.81	3.51	8.18	55.67	306.15	224.74	1.49
BD-2783	74.81	3.68	9.18	45	289.25	210.64	2.71
BD-2789	74.81	3.46	6.93	37.77	358.97	292.46	2.57
BD-2790	74.81	6.13	6.93	65.11	401.87	403.46	3.17
BD-2791	75.81	3.79	5.26	27.11	388.77	348.66	2.13
BD-2792	73.81	3.46	8.6	55.77	229.97	294.16	3
BD-2796	74.06	3.48	7.6	44.9	530.95	424.16	2.99
BD-2797	74.06	2.05	5.5	14.54	385.15	235.56	2.17
BD-2805	75.06	4.55	6.93	76.65	298.55	349.36	1.8
BD-2807	74.06	4.55	6.6	102.79	461.15	366.86	2.38
BD-2808	75.81	2.46	12.26	35.44	357.87	342.16	2.56
BD-2809	74.81	3.79	7.26	81.11	405.77	302.56	2.81
BD-2820	74.06	4.55	7.6	93.1	396.85	282.86	1.3
BD-2822	74.81	3.79	7.26	31.44	332.07	282.16	2.16

Table 38. Cont'd

Coll./Acc. #	DFF	FD	FL	FW	LA	LACal	LDW
1	2	3	4	5	6	7	8
BD-2825	74.81	4.13	6.6	42.44	222.97	352.36	2.33
BD-2826	79.06	5.88	7.92	38.15	348.55	368.09	3.4
BD-2827	80.06	4.88	7.92	33.15	400.05	336.29	2.99
BD-2830	74.06	3.88	6.46	76.43	467.75	426.56	2.52
BD-2832	73.06	3.88	13.26	67.1	594.55	446.66	3.15
BD-2840	73.81	2.46	6.26	37.77	232.07	322.96	1.84
BD-2842	75.06	3.55	8.26	88.43	437.15	313.76	2.56
BD-7314	74.56	5.3	7.76	68.74	306.5	302.39	1.86
BD-7319	74.56	4.3	8.76	74.4	390.7	316.59	2.62
BD-7320	74.81	2.46	22.93	57.44	242.87	307.66	2
BD-7321	74.81	3.46	10.93	70.77	262.77	255.46	1.78
BD-7324	73.81	2.39	14.26	38.44	357.07	274.16	2.68
BD-7327	74.81	4.89	7.6	66.44	696.07	323.96	2.57
BD-7328	74.56	2.03	13.52	26.76	307	271.69	2.02
BD-7332	72.56	2.57	9.42	27.4	340.1	268.69	2.17
BD-7333	73.56	4.73	7.69	40.74	392.4	290.39	2.04
BD-7335	73.56	4.3	13.76	103.07	575.7	537.49	2.97
BD-9530	72.56	3.97	3.76	26.07	216.2	142.89	1.27
BD-9531	77.06	4.71	8.26	78.15	422.75	335.19	2.91
BD-9532	73.56	3.3	3.09	25.4	116.3	93.49	0.75
BD-9535	74.56	4.3	5.09	35.07	166.4	140.09	1.08
BD-9537	75.06	3.88	5.26	30.82	265.85	260.99	2.54
BD-9538	75.06	3.55	3.92	13.48	397.15	264.09	2.26
BD-9540	74.81	2.29	12.93	39.11	298.97	348.66	2.51
BD-9542	73.81	4.79	6.26	44.77	397.97	372.86	3.11
BD-9543	74.81	2.79	8.93	81.44	332.87	363.26	4.03
BD-9545	75.81	2.29	7.93	26.11	367.97	288.36	2.29
BD-9546	74.56	3.4	11.76	73.07	402.5	279.69	2.43
BD-9547	74.56	3.07	4.69	22.74	146.1	105.59	0.72
BD-9548	73.56	2.73	16.26	53.26	279.8	216.09	1.25
BD-9549	75.31	4.25	5.39	87.79	499.95	342.79	2.05
IAH-39	75.31	6.63	8.63	103.67	415.32	378.54	2.93
K-10	75.31	4.92	10.72	56.82	552.25	530.09	3.63
K-11	76.06	4.42	7.55	57.4	415.07	257.19	1.68
K-12	76.31	7.25	8.39	125.49	511.85	476.99	2.99
K-13	74.06	5.75	7.55	103.07	434.37	215.59	1.76
K-15	74.06	3.75	10.89	58.07	384.77	268.09	1.82
K-16	75.06	6.42	7.55	95.07	308.77	279.79	1.91
K-17	75.06	5.75	7.72	119.4	348.07	299.19	2.64
K-18	74.31	4.25	16.05	115.49	574.95	502.39	3.8
K-19	75.31	4.92	5.39	118.15	468.95	406.49	2.88
K-20	75.31	6.59	7.39	149.49	411.15	292.39	2.11
K-21	75.06	4.75	9.22	68.73	399.47	217.79	3.43
K-22	77.06	3.42	21.89	74.4	410.17	286.59	2.65
K-23	75.06	3.42	8.22	61.07	329.27	281.39	2.29
K-26	76.06	5.09	6.55	51.07	351.37	265.79	2.34
K-27	75.31	6.25	6.05	124.82	522.65	471.79	3.17
K-28	74.31	5.59	7.05	95.49	615.75	388.49	3.73
K-29	73.31	5.92	8.05	77.82	656.75	535.69	4.45
K-30	75.31	5.25	9.05	118.32	579.15	443.39	3.47
K-32	75.06	5.42	8.22	72.73	308.37	244.49	2.35
K-33	74.31	5.59	7.05	127.82	472.95	406.69	2.67
K-34	75.31	3.59	10.05	53.15	661.15	563.49	4.33
K-35	73.31	4.59	9.05	76.82	500.95	393.49	3.04

Table 38. Cont'd

Coll./Acc. #	DFF	FD	FL	FW	LA	LACal	LDW
1	2	3	4	5	6	7	8
K-36	74.31	3.92	8.72	114.49	458.75	318.99	3.51
K-37	75.31	4.3	13.3	118	339.12	236.74	1.78
K-38	74.31	6.3	6.97	131.67	360.72	265.54	1.57
K-39	76.31	4.63	7.63	103	286.22	157.04	1.59
K-40	75.31	5.97	10.3	108.67	345.12	240.64	2.28
K-42	75.31	4.3	13.3	104.23	355.72	252.24	2.04
K-45	75.31	4.3	10.3	92.67	363.02	223.74	1.85
K-47	76.06	5.75	9.22	119.07	451.17	271.69	3.02
KASI-46	75.56	5.67	6.39	76.81	568.62	282.39	1.72
KASI-98	75.56	5.07	6.05	68.81	583.02	388.39	3.13
KASI-99	74.31	4.97	4.97	69.67	256.82	153.64	1.77
M-02	75.56	5.67	6.39	37.48	192.82	379.79	2.3
MTR-7	74.06	5.09	7.22	93.07	300.07	254.69	3.34
NIR-04	75.56	6.53	7.45	50.48	238.22	366.39	2.16
NIR-62	75.56	2.67	4.72	13.48	449.72	275.09	1.56
NSR-10	74.56	4.75	9.8	103.77	580.37	525.86	2.91
NSR-11	74.56	3.42	5.8	43.1	516.37	460.26	3.49
NSR-12	74.56	3.09	12.13	83.44	615.67	498.86	4.46
NSR-13	74.56	2.42	7.47	31.77	347.37	275.16	1.98
NSR-14	76.31	6.63	9.3	125	504.52	426.64	3.3
NSR-15	75.31	5.63	10.3	100.67	548.02	464.64	3.03
NSR-16	74.31	4.97	9.97	93	386.62	337.54	2.69
NSR-17	74.56	4.09	7.8	77.44	536.57	480.76	3.64
NSR-18	74.81	5.01	7.55	66.07	421.4	307.49	2.68
NSR-19	73.81	5.34	8.89	108.07	509.1	373.09	2.32
NSR-2	74.06	5.09	10.22	100.4	440.17	360.09	1.93
NSR-2.1	76.31	5.97	12.63	120.33	522.92	345.54	2.98
NSR-20	77.31	7.3	8.63	125	615.72	530.04	5.02
NSR-21	75.06	5.09	6.89	68.07	212.07	191.19	2.32
NSR-22	75.81	6.34	7.22	148.41	468.2	319.49	3.22
NSR-23	74.81	4.67	11.89	87.41	350.2	315.79	2.21
NSR-24	74.81	8.34	7.22	156.74	404.6	323.99	2.34
NSR-25	75.81	2.67	19.22	76.74	331.9	311.39	1.9
NSR-26	74.81	7.01	9.22	212.07	408.2	345.89	2.72
NSR-27	73.81	5.01	7.89	102.74	256	236.89	1.75
NSR-28	74.56	6	7.05	74.48	327.22	260.69	1.12
NSR-29	75.56	4.67	11.39	100.15	418.62	266.39	1.33
NSR-3	74.81	4.67	7.22	127.07	255.3	288.39	1.37
NSR-30	75.56	5.5	8.05	102.48	383.62	345.09	1.96
NSR-4	75.31	7.63	12.3	229.67	346.32	277.84	2.75
NSR-5	75.31	5.3	12.97	162.67	300.92	305.64	1.99
NSR-53	74.56	6.53	7.45	127.15	436.02	332.89	1.44
NSR-6	75.81	5.01	8.55	121.74	628.6	506.19	3.73
NSR-7	75.31	7.3	9.63	100.33	498.02	432.64	3.12
NSR-8	74.56	6.75	8.47	91.77	543.97	434.76	4.71
NSR-9	74.81	6.34	8.55	107.41	429.1	396.39	2.66
RAI-150	74.31	4.59	4.39	62.49	459.95	310.79	1.81
RAI-216	74.31	4.75	4.39	88.49	417.65	277.59	1.84
RAI-219	75.31	4.65	4.55	52.64	299.05	210.39	1.87
RAI-230	76.56	5	5.05	73.48	382.12	305.09	1.43
RAI-81	74.31	4.59	5.39	95.82	394.65	263.69	1.86
RAI-99	70.31	4.59	5.05	93.15	563.75	402.09	3.02
SU-1	80.06	3.88	4.26	11.82	422.15	372.39	2.64
SU-3	80.06	5.18	7.92	55.15	379.05	315.09	3.24

Table 38. Cont'd

Coll./Acc. #	DFF	FD	FL	FW	LA	LACal	LDW
1	2	3	4	5	6	7	8
SU-88	76.06	6.55	8.26	20.82	336.35	355.39	3.12
TRMR-102	74.56	2.42	21.8	57.77	487.57	425.86	3.04
TT-102	75.56	2.42	9.8	61.77	555.57	480.16	4.32
TT-103	74.56	3.09	5.13	14.77	371.57	446.26	3.33
TT-105	76.06	4.88	6.59	31.15	386.35	311.39	2.42
TT-136	75.56	4.42	7.8	99.77	771.37	656.16	5.28
TT-169	75.56	4.09	7.13	99.35	684.77	680.26	6.14
TT-176	75.56	4.42	6.47	65.1	730.17	694.06	5.86
TT-200	74.56	3.42	12.47	75.1	275.87	264.06	1.96
TT-27	75.06	3.92	9.89	69.4	449.37	181.39	2.34
TT-58	75.06	5.75	6.05	86.4	364.37	376.09	2.9
TT-64	74.56	3.42	9.47	28.1	392.87	470.76	3.08

Table 38. Quantitative descriptors of brinjal germplasm (Cont'd)

Coll. /Acc.#	LL	LW	PFI	PH	PSI	SPAD	TF	TS	YPP
1	9	10	11	12	13	14	15	16	17
AC-172	30.2	12.52	40.47	134.85	5	71.74	37.51	26.73	3.96
AC-212	30.2	12.85	34.67	139.85	5	65.44	24.79	26.73	2.83
AC-240	31.53	15.85	25.07	127.85	12.5	55.94	37.51	30.73	3.76
AC-258	26.29	15.09	9.14	99.35	2.17	49.21	19.07	87.73	2.18
AC-285	26.2	13.18	9.67	119.85	12	59.84	29.88	31.73	6.64
AC-396	25.62	13.76	50.84	101.35	2.6	48.31	6.36	77.73	0.55
AC-47	24.95	15.76	0.84	103.35	6	46.71	6.36	95.73	1.21
AH-41	37.29	13.85	7.59	108.35	8.89	54.79	6.36	37.23	1.21
AHI-101	25.62	11.85	32.59	113.35	14.29	58.89	6.36	20.23	1.38
AHI-102	25.62	11.51	74.29	113.35	22.22	54.49	3.81	37.23	0.85
AHI-124	23.2	9.35	59.67	87.1	4.35	56.44	14.62	49.73	1
AM-10	25.79	13.18	70.12	102.6	16.67	53.39	11.44	39.23	1.33
AM-10111	24.54	9.68	9.67	100.1	6.67	56.04	19.71	48.73	0.84
AMA-294	27.7	13.43	87.59	106.1	5	50.39	13.99	88.98	1.67
AMA-302	29.78	14.02	23.42	97.6	7.69	51.39	16.53	32.23	2.31
AMA-312	24.04	9.1	24.29	94.1	4.17	55.29	16.53	80.98	1.08
AMA-368	30.79	15.18	78.42	106.6	6.67	56.99	13.99	39.23	1.78
AMA-410	20.62	11.85	32.59	98.35	3.64	56.79	16.53	47.23	2.13
ATR-12	19.79	10.85	78.42	117.6	8	61.99	13.99	34.23	1.56
BARI-1	21.7	10.76	62.09	90.1	7.29	50.09	29.24	104.98	1.77
BARI-10	23.37	13.1	53.09	85.1	9.52	52.29	29.24	50.98	2.12
BARI-4	24.12	11.18	3.42	102.6	6.6e-14	50.79	16.53	64.23	2.09
BARI-5	22.79	12.18	17.72	93.6	12.5	56.49	21.62	49.23	3.84
BARI-6	30.45	14.52	53.42	99.6	5	54.29	13.99	49.23	1.77
BARI-7	36.45	15.52	3.42	101.6	5.2e-14	58.49	13.99	54.23	1.08
BARI-8	28.79	15.52	70.12	109.6	4.1e-14	55.19	19.07	44.23	1.83
BARI-9	24.45	12.52	78.42	101.6	-2.8e-14	54.39	13.99	49.23	1.98
BARI-BT-1	18.5	10.17	5.35	96.67	8.9e-15	57	16.53	63	1.43
BARI-BT-2	21.08	10.17	22.22	72	-3.8e-14	56.03	17.8	31.75	1.32
BARI-BT-3	17.56	7.89	11.1	114.92	4e-14	52.87	22.89	23.67	3.22
BARI-BT-4	24.67	13.17	1.7e-13	109.83	1.6e-14	57.15	19.07	28.5	3.87
BD-2705	23.7	11.93	20.12	116.6	3	56.99	29.24	92.48	1.01
BD-10154	26.87	12.18	36.97	109.85	5.56	52.44	32.42	78.73	2.6
BD-10156	23.2	9.85	71.17	117.85	10.71	56.34	37.51	34.73	2.62
BD-10157	24.78	13.27	29.67	99.85	16	51.74	24.79	39.98	1.65
BD-10158	18.12	11.93	91.47	114.85	5.81	58.84	27.34	75.98	1.58
BD-10171	37.2	13.52	38.27	109.85	8.33	60.04	22.25	30.73	3.24
BD-10176	24.87	11.52	55.17	106.85	20.83	55.84	32.42	30.73	1.64

Table 38. Cont'd

Coll. /Acc.#	LL	LW	PFI	PH	PSI	SPAD	TF	TS	YPP
1	9	10	11	12	13	14	15	16	17
BD-10178	26.78	11.6	36.37	117.85	-2.3e-14	56.74	37.51	69.98	3.48
BD-10187	25.45	12.27	42.97	111.85	13.16	53.94	29.88	27.98	1.77
BD-10188	22.45	14.6	36.37	99.85	-2.3e-14	53.34	37.51	73.98	3.98
BD-10190	32.37	14.43	22.09	99.6	8	53.76	9.54	18.23	1.19
BD-10191	30.03	15.09	24.99	109.6	4.44	54.86	14.62	38.23	2.97
BD-10192	28.37	14.43	-17.91	103.6	7.5	62.06	9.54	33.23	2.48
BD-10193	34.7	16.09	2.09	113.6	7.14	49.46	9.54	35.23	0.21
BD-10194	27.03	15.09	15.39	102.6	9.09	58.76	4.45	15.23	0.23
BD-10195	29.37	15.43	2.09	118.6	5	60.96	9.54	33.23	1.36
BD-2645	26.37	12.6	15.92	101.6	4.49	54.09	19.07	81.48	2.27
BD-2646	31.04	15.27	3.42	99.6	6.06	51.99	13.99	25.48	1.28
BD-2649	29.87	12.35	20.77	110.1	2.44	54.84	27.34	85.73	2.75
BD-2650	35.7	12.26	57.59	99.1	-4.3e-14	57.79	11.44	55.98	1.56
BD-2651	23.7	11.93	82.59	99.1	-2.6e-14	48.49	11.44	55.98	1.26
BD-2652	29.54	14.02	42.97	104.1	2.63	51.94	12.08	79.73	0.83
BD-2653	20.37	11.27	92.32	111.6	3.08	55.79	21.62	57.48	1.3
BD-2657	23.7	8.6	14.52	111.6	4.44	57.89	21.62	37.48	1.09
BD-2658	23.37	11.27	3.42	116.6	2.22	51.19	16.53	37.48	0.81
BD-2662	28.03	14.93	67.59	115.1	11.9	48.99	13.99	47.98	1.01
BD-2663	10.37	5.27	15.92	87.6	2.3e-14	54.49	19.07	34.48	1.79
BD-2664	18.7	12.6	27.59	99.1	10	65.99	26.7	45.98	3.56
BD-2665	20.7	13.6	103.42	116.6	8.9e-15	57.79	6.36	52.48	0.82
BD-2669	19.03	16.93	7.59	97.1	6	52.99	31.79	55.98	4.19
BD-2672	23.03	13.93	24.29	109.1	6.12	54.19	16.53	54.98	2.05
BD-2673	23.03	14.6	36.19	109.1	4.44	51.89	19.07	95.98	1.52
BD-2674	21.37	9.27	3.42	121.6	1.61	52.89	6.36	54.48	1.02
BD-2675	17.7	9.27	83.42	104.6	2.5e-14	59.99	11.44	52.48	1.19
BD-2677	23.03	12.26	47.59	99.1	10	53.39	13.99	55.98	1.58
BD-2678	22.04	11.27	86.72	111.6	-1.1e-14	51.29	13.99	57.48	0.79
BD-2680	20.36	11.93	74.29	105.1	22.22	51.19	16.53	50.98	1.41
BD-2681	13.45	10.6	67.97	113.85	8.89	63.54	29.88	34.98	1.36
BD-2682	17.37	7.93	103.42	106.6	4.6e-14	56.79	6.36	32.48	0.51
BD-2683	28.04	10.93	46.32	151.6	4.44	55.19	16.53	37.48	1.55
BD-2685	32.03	14.26	32.59	119.1	6.67	51.89	11.44	35.98	1.28
BD-2686	26.78	11.6	9.67	117.85	3.85	57.54	32.42	41.98	2.99
BD-2687	30.04	12.93	83.42	171.6	7.27	51.19	24.16	47.48	1.58
BD-2694	28.37	14.6	28.42	116.6	-1.9e-14	58.39	29.24	20.48	4.11
BD-2695	15.7	6.27	25.62	91.6	8.8e-14	59.79	21.62	69.48	0.8
BD-2702	21.45	8.93	9.67	99.85	5.26	57.04	14.62	27.98	0.75
BD-2703	20.45	9.27	9.67	85.85	8	52.84	14.62	39.98	0.5
BD-2707	25.54	13.35	9.67	110.1	3.33	59.04	19.71	63.73	1.57
BD-2708	23.54	14.68	42.97	98.1	2.22	48.74	19.71	93.73	1.05
BD-2710	22.87	14.35	23.97	103.1	3.33	45.04	22.25	93.73	0.93
BD-2711	24.04	10.6	40.92	131.6	2.11	47.29	39.42	87.48	1.58
BD-2715	20.04	9.93	103.42	121.6	16.3	56.69	6.36	84.48	0.61
BD-2716	20.45	8.93	38.27	97.85	3.23	56.64	17.17	51.98	1.2
BD-2721	33.78	14.93	42.97	99.85	8.89	50.74	14.62	34.98	2.09
BD-2724	14.12	10.27	84.67	103.85	3.33	52.54	9.54	49.98	0.24
BD-2725	16.12	10.93	9.67	109.85	3.03	58.44	17.17	55.98	2.18
BD-2728	28.87	15.35	38.27	100.1	2.44	51.24	22.25	85.73	2.24
BD-2731	25.7	11.6	78.42	101.6	2.4e-14	63.39	8.9	62.48	1.18
BD-2732	22.37	11.27	103.42	94.6	5	50.39	39.42	92.48	2.07
BD-2733	25.87	14.02	-19.98	99.85	-1.4e-14	52.31	6.36	51.48	0.49
BD-2735	29.87	15.02	80.02	112.85	6.25	55.61	6.36	43.48	0.67

Table 38. Cont'd

Coll. /Acc.#	LL	LW	PFI	PH	PSI	SPAD	TF	TS	YPP
1	9	10	11	12	13	14	15	16	17
BD-2740	35.45	10.27	59.67	101.85	5.77	56.94	9.54	41.98	0.57
BD-2746	24.12	11.27	9.67	99.85	7.27	53.04	6.99	44.98	0.66
BD-2748	21.45	11.93	69.67	99.85	6.35	48.44	12.08	52.98	1.24
BD-2749	20.54	9.02	80.02	101.85	1.6e-14	52.31	3.81	58.48	-0.42
BD-2751	25.2	14.02	80.02	112.85	-2.9e-14	64.81	-1.27	37.48	-0.06
BD-2753	24.54	11.02	-19.98	104.85	2.63	52.31	6.36	33.48	0.81
BD-2754	26.2	14.02	40.02	109.85	2.7e-14	60.51	6.36	27.48	0.88
BD-2755	24.12	13.27	69.67	99.85	4.35	52.84	12.08	35.98	1.51
BD-2756	21.45	8.6	9.67	103.85	3.17	57.64	12.08	52.98	0.61
BD-2757	21.54	13.02	0.02	122.85	5.3e-15	50.81	19.07	30.48	2.92
BD-2762	25.2	16.35	59.67	110.1	3.57	48.44	14.62	59.73	0.98
BD-2763	26.87	16.68	89.67	99.1	2	55.64	17.17	103.73	1.44
BD-2764	23.2	13.02	-19.98	132.85	4.3e-14	50.21	19.07	30.48	2.74
BD-2766	34.54	15.35	80.02	117.85	10	54.71	-1.27	15.48	0.01
BD-2770	23.54	14.35	60.02	132.85	5.56	61.31	6.36	31.48	0.69
BD-2773	26.87	15.68	42.97	94.1	2.38	48.74	27.34	87.73	1.57
BD-2774	24.2	11.68	0.02	98.85	7.14	48.31	31.79	37.48	2.3
BD-2775	22.87	11.68	25.52	132.85	14.29	54.91	21.62	30.48	1.92
BD-2776	24.12	9.27	76.37	106.85	5.26	52.64	6.99	27.98	0.52
BD-2783	17.45	12.27	9.67	103.85	3.08	50.24	4.45	54.98	0.23
BD-2789	22.29	13.09	42.54	101.35	2.7e-15	51.01	11.44	58.73	0.77
BD-2790	25.29	16.09	25.84	97.35	8	49.01	6.36	45.73	0.88
BD-2791	24.29	14.43	0.84	101.35	5.56	47.01	6.36	49.73	0.3
BD-2792	18.95	15.43	18.74	103.35	-1.6e-14	56.41	13.99	47.73	1.41
BD-2796	26.2	16.02	-4.58	117.85	2.38	56.21	26.7	37.48	1.96
BD-2797	20.87	11.02	60.02	92.85	2.9e-14	52.11	6.36	37.48	-0.26
BD-2805	25.2	13.68	17.52	98.85	5.71	56.31	13.99	30.48	1.9
BD-2807	27.2	13.35	55.02	96.85	10	55.51	13.99	15.48	2.7
BD-2808	21.29	16.09	9.14	113.35	5.45	53.11	11.44	50.73	0.72
BD-2809	21.95	13.76	31.44	105.35	12.31	52.21	19.07	60.73	2.73
BD-2820	24.54	11.35	63.32	112.85	8	48.71	8.9	20.48	1.63
BD-2822	23.29	12.09	31.44	101.35	7.69	54.61	19.07	60.73	1.02
BD-2825	21.95	16.09	39.44	100.35	5.26	52.21	24.16	71.73	1.74
BD-2826	26.54	14.35	59.67	97.1	2.7	53.24	14.62	77.73	1.07
BD-2827	23.54	14.68	59.67	100.1	4.29	54.74	19.71	73.73	1.34
BD-2830	27.54	15.35	40.02	107.85	16	53.81	19.07	20.48	2.55
BD-2832	29.54	15.02	46.72	122.85	15	50.31	8.9	15.48	1.03
BD-2840	19.62	16.43	5.84	94.35	12.5	54.21	21.62	43.73	1.39
BD-2842	22.54	13.68	24.42	97.85	10	55.31	16.53	15.48	2.64
BD-7314	23.2	13.18	92.97	96.85	6.25	56.84	19.71	38.73	1.8
BD-7319	25.53	12.52	87.47	104.85	12	61.04	27.34	31.73	2.77
BD-7320	21.29	14.43	-24.16	104.35	-4.4e-15	56.51	16.53	93.73	1.68
BD-7321	19.29	13.09	9.14	107.35	2.5e-14	59.01	19.07	55.73	2.37
BD-7324	21.95	12.43	25.84	114.35	1.2e-14	51.71	16.53	65.73	1.1
BD-7327	28.62	11.43	21.34	103.35	1.9e-14	49.11	24.16	57.73	2.75
BD-7328	23.2	11.85	101.37	99.85	4.6e-14	58.44	34.97	22.73	1.43
BD-7332	21.2	12.85	92.97	101.85	8.9e-15	52.74	34.97	31.73	1.46
BD-7333	26.2	11.18	98.57	89.85	4	51.94	27.34	31.73	1.61
BD-7335	35.53	15.18	76.37	99.85	11.11	72.14	12.08	42.73	1.42
BD-9530	17.87	8.18	59.67	85.85	14.29	53.74	19.71	27.73	0.82
BD-9531	25.2	13.68	76.37	103.1	2.86	51.64	19.71	73.73	2.37
BD-9532	13.53	7.18	82.37	59.85	10	51.14	32.42	26.73	1.27
BD-9535	17.53	8.18	98.57	114.85	12.5	59.54	27.34	30.73	1.42
BD-9537	22.54	11.68	76.37	98.1	2.22	57.04	19.71	93.73	1.29

Table 38. Cont'd

Coll. /Acc.#	LL	LW	PFI	PH	PSI	SPAD	TF	TS	YPP
1	9	10	11	12	13	14	15	16	17
BD-9538	23.54	11.35	59.67	88.1	2.38	51.04	14.62	87.73	0.7
BD-9540	24.29	14.43	65.84	101.35	1.52	53.21	21.62	61.73	1.44
BD-9542	23.29	16.09	-24.16	96.35	16.67	49.01	34.33	55.73	2.56
BD-9543	26.62	13.76	59.14	99.35	13.85	55.21	26.7	60.73	3.7
BD-9545	21.95	13.09	-1.96	100.35	15.91	52.21	19.07	39.73	0.84
BD-9546	23.87	11.85	109.67	109.85	5.56	62.34	19.71	42.73	1.9
BD-9547	14.53	7.52	82.37	89.85	4.17	64.44	32.42	30.73	1.16
BD-9548	21.53	10.18	17.97	118.85	8.33	56.94	34.97	30.73	2.64
BD-9549	25.78	13.68	26.52	119.6	8.33	48.59	36.87	42.23	4.9
IAH-39	29.95	11.85	47.59	104.35	8.33	47.39	8.9	16.23	1.46
K-10	30.78	18.02	3.42	109.6	6.67	56.69	31.79	21.23	2.93
K-11	23.7	10.76	37.59	98.1	13.33	61.59	26.7	53.98	1.87
K-12	31.11	16.02	3.42	114.6	30	60.59	34.33	26.23	6.29
K-13	22.04	9.76	49.29	97.1	2.88	53.29	31.79	112.98	4.35
K-15	28.04	9.43	7.59	108.1	4	53.89	26.7	108.98	1.9
K-16	25.7	10.76	24.29	98.1	7.14	56.89	16.53	64.98	1.97
K-17	21.04	14.1	47.59	96.1	4.84	53.29	13.99	70.98	2.1
K-18	29.11	18.02	3.42	107.6	24	50.99	34.33	31.23	5.84
K-19	29.45	14.35	3.42	116.6	15	52.49	31.79	26.23	5.51
K-20	23.45	12.68	3.42	125.6	5	54.69	39.42	26.23	6.53
K-21	18.04	12.1	34.89	98.1	3.13	55.79	29.24	104.98	2.54
K-22	21.7	13.1	32.59	101.1	5	57.89	21.62	68.98	2.01
K-23	19.37	14.43	90.89	95.1	5.45	58.29	31.79	63.98	2.42
K-26	20.7	12.76	7.59	102.1	4.55	56.49	13.99	52.98	0.79
K-27	30.11	16.35	3.42	106.6	15	57.59	26.7	26.23	4.84
K-28	26.78	15.02	23.42	109.6	15	54.89	41.96	26.23	6
K-29	31.11	18.02	3.42	111.6	22.22	62.29	34.33	24.23	4.11
K-30	29.45	15.68	20.12	118.6	15	53.99	34.33	26.23	5.97
K-32	24.04	10.1	7.59	108.1	3.23	56.59	26.7	70.98	2.46
K-33	28.11	15.02	13.42	119.6	15.38	54.89	29.24	32.23	5.43
K-34	32.78	18.02	16.72	114.6	8	57.09	41.96	31.23	3.58
K-35	27.78	14.68	3.42	106.6	10.71	57.39	31.79	34.23	3.77
K-36	25.11	13.02	36.72	98.6	11.43	62.69	11.44	41.23	1.88
K-37	21.95	10.51	7.59	108.35	13.64	48.69	26.7	14.23	4.7
K-38	22.29	11.51	32.59	101.35	10.71	55.29	6.36	20.23	1.51
K-39	18.29	8.85	7.59	108.35	15	53.39	1.27	12.23	0.34
K-40	21.62	10.85	7.59	104.35	14.29	61.39	3.81	13.23	0.78
K-42	21.29	11.51	7.59	101.35	10	51.49	3.81	22.23	0.72
K-45	20.29	10.85	7.59	113.35	9.52	49.99	8.9	13.23	1.25
K-47	21.7	12.43	54.29	108.1	1.52	55.59	39.42	74.98	6.36
KASI-46	23.03	12.26	37.59	99.1	13.33	49.09	26.7	35.98	3.18
KASI-98	27.03	14.6	32.59	93.1	16	58.79	11.44	30.98	1.17
KASI-99	18.62	8.51	27.59	88.35	15	53.99	8.9	12.23	0.81
M-02	27.7	13.93	20.09	107.1	8	48.99	21.62	30.98	1.34
MTR-7	26.7	9.43	24.29	87.1	8.33	51.69	31.79	68.98	3.89
NIR-04	26.03	14.26	7.59	94.1	12	54.59	24.16	30.98	1.96
NIR-62	23.03	11.93	47.59	85.1	7.14	58.39	13.99	33.98	0.39
NSR-10	30.7	17.43	-17.91	99.6	5	57.96	17.17	33.23	3.21
NSR-11	29.03	16.09	2.09	87.6	10	51.96	9.54	13.23	0.68
NSR-12	33.7	15.09	48.79	115.6	8	58.76	4.45	18.23	0.7
NSR-13	22.7	12.09	2.09	86.6	5.26	61.96	9.54	31.23	0.47
NSR-14	27.62	14.51	47.59	98.35	11.43	61.39	8.9	27.23	1.86
NSR-15	30.62	14.18	40.89	116.35	6.67	56.69	11.44	22.23	1.76
NSR-16	24.95	12.85	24.29	138.35	7.5	57.39	11.44	32.23	1.58

Table 38. Cont'd

Coll. /Acc.#	LL	LW	PFI	PH	PSI	SPAD	TF	TS	YPP
1	9	10	11	12	13	14	15	16	17
NSR-17	30.37	16.09	2.09	97.6	8	52.46	9.54	18.23	1.34
NSR-18	25.45	12.18	70.12	99.6	5.26	53.59	11.44	47.23	1.12
NSR-19	27.12	13.85	28.42	95.6	6.67	55.99	24.16	39.23	3.4
NSR-2	23.04	15.43	90.89	98.1	-1.6e-14	49.09	16.53	48.98	2.09
NSR-2.1	28.29	11.51	67.59	96.35	5	53.49	8.9	52.23	1.77
NSR-20	33.95	14.51	27.59	126.35	4.17	55.69	8.9	40.23	1.86
NSR-21	19.04	10.1	70.09	94.1	7.14	59.49	21.62	78.98	1.81
NSR-22	24.45	13.18	3.42	102.6	7.14	56.49	29.24	37.23	5.66
NSR-23	24.79	12.85	3.42	109.6	5.71	59.49	34.33	44.23	3.9
NSR-24	24.79	13.18	13.42	109.6	8	49.49	29.24	34.23	5.98
NSR-25	24.45	12.85	3.42	106.6	4	51.79	24.16	34.23	2.45
NSR-26	25.79	13.52	3.42	95.6	3.57	59.09	24.16	37.23	6.58
NSR-27	22.79	10.52	3.42	99.6	2.86	57.49	19.07	44.23	2.56
NSR-28	22.36	11.6	24.29	93.1	6.67	52.89	16.53	35.98	1.86
NSR-29	21.03	12.6	7.59	115.1	6.67	52.99	21.62	35.98	3.26
NSR-3	22.12	13.18	23.42	107.6	6.25	61.29	16.53	41.23	2.68
NSR-30	25.03	13.93	7.59	107.1	5.71	55.89	13.99	40.98	2.09
NSR-4	25.29	10.51	107.59	98.35	9.38	58.29	8.9	24.23	3.86
NSR-5	24.62	11.85	47.59	90.35	8	58.69	8.9	17.23	2.58
NSR-53	24.7	13.6	21.89	99.1	2.5	48.99	19.07	45.98	3.58
NSR-6	33.45	15.18	36.72	103.6	5.71	52.39	19.07	44.23	3
NSR-7	28.62	14.18	27.59	96.35	12	52.59	8.9	17.23	1.39
NSR-8	31.37	14.09	-3.61	103.6	14.29	49.46	14.62	21.23	2.43
NSR-9	28.79	13.85	3.42	97.6	4.44	65.29	24.16	54.23	3.38
RAI-150	25.78	12.35	24.82	99.6	12	56.69	39.42	31.23	3.88
RAI-216	24.11	11.68	11.72	124.6	20	52.49	34.33	21.23	4.6
RAI-219	17.11	12.02	23.42	118.6	8.9e-15	57.69	29.24	34.23	2.56
RAI-230	25.03	12.26	7.59	87.1	-8.9e-15	56.39	11.44	50.98	1.24
RAI-81	22.11	12.02	3.42	114.6	16.67	50.59	26.7	30.23	3.85
RAI-99	29.11	14.35	24.82	104.6	20	51.49	39.42	26.23	5.52
SU-1	23.54	16.35	9.67	100.1	4	57.14	14.62	53.73	0.67
SU-3	26.2	12.35	26.37	102.1	3.7	57.34	19.71	57.73	1.85
SU-88	27.54	13.35	9.67	100.1	6	50.14	24.79	53.73	1.31
TRMR-102	30.7	14.09	15.39	104.6	2.2e-14	53.36	12.08	11.23	1.24
TT-102	29.7	16.43	2.09	101.6	8.57	56.76	9.54	28.23	1.04
TT-103	29.37	15.43	32.09	95.6	3.33	58.16	6.99	23.23	0.03
TT-105	23.87	13.35	69.67	100.1	7.5	44.64	17.17	43.73	1.13
TT-136	31.7	21.09	-1.21	109.6	9.52	59.06	12.08	14.23	2.21
TT-169	32.37	21.43	2.09	106.6	11.11	55.26	9.54	11.23	1.76
TT-176	33.03	21.43	48.79	85.6	11.54	51.56	4.45	19.23	0.49
TT-200	23.03	11.43	-17.91	89.6	3.08	48.16	9.54	58.23	1.3
TT-27	19.37	9.43	35.39	104.1	3.33	58.59	47.05	68.98	4.22
TT-58	24.04	15.43	40.89	101.1	-8e-15	51.29	24.16	73.98	2.68
TT-64	31.03	15.43	-1.21	105.6	11.54	58.06	12.08	19.23	0.56

Table 39. Qualitative traits of brinjal germplasm

Coll./Acc. #	Plant Growth Habit	Corolla Color	Calyx Color	Calyx Spininess	NSUL	NSDL	Fruit Color	Fruit Color Dist.	Fruit Curvature	Fruit Flesh Density	Fruit Shape	Fruits Apex shape	fruit color at maturity	Fruit calyx prickles	Leaf blade lobing	leaf blade tip angle	relative fruit calyx length
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
AC-172	3	5	3	3	0	0	9	1	1	5	5	3	2	0	5	3	5
AC-212	3	5	3	3	0	0	9	1	5	5	5	3	1	0	7	5	5
AC-240	3	5	3	3	0	0	1	3	1	5	5	5	3	0	7	5	5
AC-258	3	5	3	3	0	0	1	1	1	5	5	5	3	0	7	5	5
AC-285	3	5	3	3	0	0	1	1	1	5	5	5	3	0	7	5	5
AC-396	3	5	3	3	0	0	9	5	1	7	5	5	2	0	5	3	3
AC-47	3	5	3	3	0	0	9	1	1	5	5	3	2	0	5	7	5
AH-41	3	5	3	3	0	0	1	1	1	5	5	5	3	0	7	3	5
AHI-101	5	5	3	3	0	0	1	3	1	5	5	5	3	0	5	3	5
AHI-102	5	5	1	3	0	0	9	5	7	5	5	5	9	0	5	3	5
AHI-124	5	5	3	3	0	0				5	5	5	9	0	5	3	5
AM-10	7	5	3	3	0	0	1	5	3	5	5	3	3	0	5	5	5
AM-10111	3	5	3	3	0	0				5	5	3	4	0	5	7	5
AMA-294	3	5	3	5	0	0	9	3	1	5	5	3	4	0	5	7	5
AMA-302	3	5	3	3	0	0	1	3	1	5	5	3	3	0	7	7	5
AMA-312	3	5	3	3	0	0	1	3	1	7	5	3	1	0	5	3	5
AMA-368	3	5	3	3	0	0	1	1	1	7	5	5	3	0	7	5	5
AMA-410	7	5	3	3	0	0	1	3	1	5	5	5	2	0	7	5	5
ATR-12	3	5	3	3	0	0	1	7	5	5	5	3	3	0	5	5	5
BARI-1	3	5	3	3	9	7				5	5	3	3	0	7	5	
BARI-10	3	5	1	3	0	0	1	3	1	7	5	5	3	0	5	5	5
BARI-4	7	5	3	3	0	0	8	1	1	7	5	5	9	0	7	5	7
BARI-5	3	5	3	3	0	0	1	1	1	7	5	5	3	0	3	3	3
BARI-6	3	5	1	3	0	0	9	1	5	5	5	3	2	0	5	5	5
BARI-7	3	5	3	3	0	0				5	5	5	3	0	5	5	
BARI-8	3	5	3	3	0	0	1	1	1	5	5	5	3	0	3	3	5
BARI-9	5	5	3	3	0	0				5	5	3	3	0	7	5	5
BARI-BT-1	5	7	3	3	0	0	1	1	1	5	5	3	3	0	5	3	3
BARI-BT-2	5	5	3	3	0	0	6	1	1	7	5	3	3	0	3	3	5
BARI-BT-3	3	5	3	3	0	0	1	1	1	7	5	5	3	0	5	3	5
BARI-BT-4	3	5	1	3	0	0	1	7	1	5	5	5	3	0	7	5	7
BD—2705	3	5	3	3	0	0	6	7	3	7	5	3	3	0	5	3	5
BD-10154	3	5	3	3	0	0	1	1	1	5	5	7	3	0	5	3	5
BD-10156	3	5	3	3	0	0	9	1	7	5	5	5	2	0	7	5	5
BD-10157	3	5	3	3	0	0	1	3	1	5	5	3	3	0	5	5	3
BD-10158	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	5	5
BD-10171	5	5	3	3	0	0	1	5	1	5	5	7	3	0	5	5	3
BD-10176	3	5	3	3	0	0	1	1	1	5	5	3	3	0	5	5	5
BD-10178	7	5	3	3	0	0	9	5	1	5	5	5	3	0	7	5	5
BD-10187	3	5	3	3	0	0	1	3	1	7	5	5	3	0	5	5	5
BD-10188	7	5	3	3	0	0	9	1	1	7	5	5	2	0	5	5	5
BD-10190	3	1	1	3	0	0	1	5	1	7	5	5	3	0	7	5	5
BD-10191	7	5	1	7	7	9	1	5	5	5	5	3	3	5	7	5	3
BD-10192	3	5	3	3	0	0	1	3	1	5	5	5	4	0	7	5	7
BD-10193	5	5	3	3	0	0	9	1	3	5	5	3	9	0	5	5	3
BD-10194	3	5	3	3	0	0	6	1	1	7	5	5	2	0	5	7	5
BD-10195	3	7	3	3	0	0	1	1	2	5	5	3	2	0	5	5	3
BD-2645	3	5	1	5	10	9	1	1	2	5	5	3	3	0			

Table 39. Cont'd

Coll./Acc. #	Plant Growth Habit	Corolla Color	Calyx Color	Calyx Spininess	NSUL	NSDL	Fruit Color	Fruit Color Dist.	Fruit Curvature	Fruit Flesh Density	Fruit Shape	Fruits Apex shape	fruit color at maturity	Fruit calyx prickles	Leaf blade lobing	leaf blade tip angle	relative fruit calyx length
BD-2646	3	5	3	3	0	0	1	5	3	5	5	3	3	0	5	5	5
BD-2649	3	5	1	3	0	0	1	5	3	7	5	3	3	0	7	5	
BD-2650	3	5	3	3	0	0	1	1	3	5	5	3	3	0	5	5	5
BD-2651	3	5	3	3	0	0	9	1	1	5	5	5	3	0	5	5	3
BD-2652	7	5	3	3	0	0		1						0	5	1	5
BD-2653	3	5	3	3	9	8	1		1	5	5	7	2	0	7	1	
BD-2657	3	5	1	3	0	0	6	1	1	5	1	3	2	0	5	1	5
BD-2658	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	7	5
BD-2662	7	5	3	3	0	0	6	7	1	5	5	3	1	0	5	3	5
BD-2663	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	5	7
BD-2664	3	7	3	3	0	0	1	7	3	7	5	3	2	0	7	3	3
BD-2665	5	5	3	3	0	0	9	5	1	5	5	3	2	0	5	5	5
BD-2669	3	5	1	3	0	0	9	1	1	5	5	3	3	0	5	5	5
BD-2672	3	5	3	3	0	0	9	1	8	5	5	3	2	0	7	5	5
BD-2673	3	5	1	3	0	0	1	1	1	5	5	5	2	0	3	5	7
BD-2674	7	5	3	3	0	0	1	5	1	7	5	3	2	0	5	5	5
BD-2675	3	5	3	3	0	0	1	1	1	7	5	5	3	0	5	5	5
BD-2677	3	5	3	3	0	0	9	5	1	7	5	3	2	0	5	3	5
BD-2678	5	5	3	3	0	0	6	5	1	5	5	5	2	0	5	5	5
BD-2680	7	5	3	3	0	0	1	1	5	5	5	3	2		5	5	7
BD-2681	7	5	3	3	0	0	1	7	5	5	5	3	2	0	5	3	5
BD-2682	3	5	3	3	0	0	9	3	3	5	5	3		0	7	7	5
BD-2683	3	5	3	3	0	0	1	1	1	5	5	3	3	0	7	5	7
BD-2685	3	5	3	3	0	0	6	1	3	5	5	5	1	0	5	7	5
BD-2686	3	7	3	3	0	0	1	3	5	5	5	3	1	0	7	5	5
BD-2687	3	5	1	3	0	0	6	3	1	7	5	3	2	0	5	3	3
BD-2694	7	5	3	3	0	0	1	7	3	5	1	5	3	0	5	3	5
BD-2695	3	5	3	3	0	0	6	1	1	7	5	5	2	0	7	5	5
BD-2702	7	5	3	3	0	0	9	1	1	5	5	3	2	0	5	5	7
BD-2703	7	5	3	3	0	0	1	3	1	5	5	3	3	0	5	1	7
BD-2707	3	5	3	3	0	0	9	3	5	5	5	3	2	0	5	5	7
BD-2708	3	5	3	3	0	0	1	3	1	5	5	3	3	0	5	3	5
BD-2710	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	7	5
BD-2711	7	5	3	3	0	0	9	3	3	5	5	3	2	0	7	7	5
BD-2715	3	5	3	3	0	0	1	3	1	7	5	5	2	0	5	3	5
BD-2716	3	5	3	3	0	0	1	1	1	7	5	5	3	0	5	5	5
BD-2721	7	5	1	3	0	0	1	5	1	5	5	5	3	0	5	5	5
BD-2724	7	5	3	3	0	0	1	1	1	7	5	5	3	0	5	5	5
BD-2725	3	5	1	5	0	0	1	5	1	5	5	5	3	1	7	7	3
BD-2728	7	5	1	3	0	0	1	7	1	7	5	5	3	0	5	5	5
BD-2731	3	5	1	5	0	0	1	7	5	5	5	5	3	0	5	5	5
BD-2732	7	5	3	3	0	0	1	1			5			0	5	5	5
BD-2733	3	5	1	7	10	9							3		7	5	
BD-2735	3	5	2	3	0	0	9	1	1	7	5	5	3	0	3	3	5
BD-2740	3	5	3	3	0	0	1	5	1	5	5	5	3	0	5	7	5
BD-2746	3	5	1	3	0	0	1	5	1	5	5	5	3	0	5	9	5
BD-2748	5	5	3	3	0	0	1	1	1	5	5	5	3	0	5	5	5
BD-2749	3	5	2	3	0	0	1	7	1	7	5	5	3	0	1	1	3
BD-2751	3	5	3	3	0	0	1	1		7	5	7	2	0	3	1	5

Table 39. Cont'd

Coll./Acc. #	Plant Growth Habit	Corolla Color	Calyx Color	Calyx Spininess	NSUL	NSDL	Fruit Color	Fruit Color Dist.	Fruit Curvature	Fruit Flesh Density	Fruit Shape	Fruits Apex shape	fruit color at maturity	Fruit calyx prickles	Leaf blade lobing	leaf blade tip angle	relative fruit calyx length
BD-2753	3	5	3	3	0	0				7	5	7	2	0	5	1	
BD-2754	3	5	3	3	0	0	1	7	1	7	5	7	2	0	5	3	5
BD-2755	5	5	3	3	0	0	1	5	1	5	5	5	3	0	5	5	5
BD-2756	3	5	3	3	0	0	1	5	1	7	5	5	3	0	7	3	5
BD-2757	3	5	3	3	0	0	1	5	1	7	5	5	3	0	7	5	3
BD-2762	3	5	3	3	0	0				7	5	5	3	0	5	5	5
BD-2763	3	5	3	3	0	0	1	5	1	7	5	5	3	0	5	5	5
BD-2764	3	5	3	3	0	0	1	5	1	7	5	5	3	0	3	3	5
BD-2766	3	5	1	5	0	0	1	7	1	5	5	5	3	0	5	5	5
BD-2770	5	5	2	3	0	0	1	5	1	5	5	5	3	0	5	5	7
BD-2773	5	5	3	3	0	0	6	5	1	7	5	5	2	0	3	3	3
BD-2774	7	5	3	3	0	0	1	5	1	5	5	5	3	0	7	5	5
BD-2775	3	5	2	3	0	0	6	5	1	7	5	5	9	0	5	3	5
BD-2776	3	5	3	3	0	0	1	7	1	5	5	3	3	0	7	5	5
BD-2783	3	5	1	5	4	2	6	5	1	5	5	5	3	0	5	3	5
BD-2789	7	5	3	3	0	0	1	3	1	5	5	7	3	0	5	3	5
BD-2790	3	5	3	3	0	0	2	1	1	5	5	5	3	0	7	5	5
BD-2791	3	5	1	7	12	10	9	1	1	5	5	5	3	3	7	5	5
BD-2792	7	5	3	3	0	0	1	1	5	7	5	3	3	0	5	5	7
BD-2796	3	5	3	3	0	0	6	1	1	7	5	3	2	0	7	3	5
BD-2797	7	5	3	3	0	0	1	1	5	5	5	3	3	0	5	7	5
BD-2805	7	7	3	3	0	0	1	7	1	7	5	5	3	0	3	3	5
BD-2807	3	5	3	3	0	0	1	5	1	7	5	5	3	0	7	5	5
BD-2808	3	5	3	3	0	0	1	7	1	5	5	5	3	0	5	5	5
BD-2809	3	5	3	3	0	0	9	5	1	5	5	5	2	0	5	3	5
BD-2820	3	5	3	3	0	0	6	7	1	7	5	3	2	0	3	3	5
BD-2822	3	5	1	7	14	10				5	5	5	2	0	7	7	5
BD-2825	3	5	3	5	0	0	9	3	1	5	5	5	2	0	5	5	5
BD-2826	3	5	3	3	0	0				5	5	3	3	0	5	5	
BD-2827	3	5	1	5	4	3				5	5	3	3	0	7	3	
BD-2830	7	5	2	3	0	0	1	5	3	5	5	3	3	0	7	5	5
BD-2832	3	5	3	7	10	7	1	3	1	5	5	5	3	0	7	5	5
BD-2840	7	5	3	3	0	0	9	1	8	5	5	3	2	0	5	5	5
BD-2842	3	5	3	3	0	0	1	1	1	5	5	5	2	0	5	3	5
BD-7314	3	5	3	3	0	0	1	5	1	5	5	5	3	0	5	5	5
BD-7319	3	5	1	3	0	0	1	7	8	5	5	3	3	0	7	3	5
BD-7320	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	5	7
BD-7321	7	5	3	3	0	0	1	5	1	5	5	3	3	0	5	5	5
BD-7324	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	3	5
BD-7327	3	5	3	3	0	0	9	3	3	5	5	3	3	0	7	5	5
BD-7328	7	5	3	3	0	0	1	7	1	5	5	5	3	0	5	3	5
BD-7332	7	5	3	3	0	0	1	1	1	5	5	3	3	0	3	1	5
BD-7333	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	3	5
BD-7335	3	5	3	5	0	0	1	1	1	7	5	5	3	0	7	1	5
BD-9530	7	5	3	3	0	0	1	5	1	7	5	5	4	0	5	5	3
BD-9531	3	5	3	3	0	0	1	5	1	5	5	5	3	0	5	5	5
BD-9532	7	5	3	3	0	0	1	5	1	5	5	5	3	0	3	3	3
BD-9535	3	5	3	3	0	0	9	5	1	7	5	5	9	0	5	5	3
BD-9537	7	5	3	3	0	0	1	5	1	5	5	5	3	0	5	5	3
BD-9538	7	5	3	3	0	0	1	5	3	5	5	3	1	0	5	5	3
BD-9540	3	5	3	3	0	0	1	3	1	5	5	5	3	0	5	5	7

Table 39. Cont'd

Coll./Acc. #	Plant Growth Habit	Corolla Color	Calyx Color	Calyx Spininess	NSUL	NSDL	Fruit Color	Fruit Color Dist.	Fruit Curvature	Fruit Flesh Density	Fruit Shape	Fruits Apex shape	fruit color at maturity	Fruit calyx prickles	Leaf blade lobing	leaf blade tip angle	relative fruit calyx length
BD-9542	3	5	3	3	0	0	1	5	1	5	5	5	3	0	7	7	5
BD-9543	3	5	3	3	0	0	1	5	1	5	5	5	3	0	5	5	5
BD-9545	3	5	3	3	0	0	1	1	1	5	5	3	3	0	3	3	5
BD-9546	3	5	3	3	0	0	1	7	5	5	5	3	3	0	7	5	5
BD-9547	7	5	2	3	0	0	1	1	1	7	5	5	3	0	5	5	5
BD-9548	3	5	3	3	0	0	1	7	1	7	5	5	3	0	5	3	5
BD-9549	5	5	3	3	0	0	1	1	8	5	5	3	3	0	3	5	3
IAH-39	3	5	3	3	0	0	1	7	1	5	5	5	3	0	7	3	
K-10	3	5	1	5	10	9	1	7	1	5	5	5	3	0	7	3	
K-11	3	5	1	3	0	0	1	7	1	5	5	5	3	0	7	5	
K-12	3	5	1	3	0	0	1	7	1	5	5	5	3	0	7	3	7
K-13	3	5	3	5	0	0	1	5	1	5	5	5	3	1	5	5	3
K-15	5	5	1	3	0	0	1	1	1	5	5	5	3	0	3	3	5
K-16	3	5	1	3	0	0	1	5	1	5	5	3	3	0	7	5	3
K-17	3	5	1	3	0	0	1	5	1	7	5	5	3	0	7	5	3
K-18	3	5	3	3	4	3	1	1	1	5	5	5	3	0	7	5	5
K-19	7	5	1	3	0	0	9	1	5	7	5	3	2	3	7	3	5
K-20	3	5	3	3	0	0	1	1	1	7	5	5	3	0	7	3	5
K-21	3	5	3	3	0	0	1	1	1	7	5	7	3	0	5	5	7
K-22	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	5	5
K-23	7	5	3	3	0	0	1	1	8	7	5	3	9	0	5	5	5
K-26	3	5	3	3	0	0				5	5	5	3	0	5	5	5
K-27	7	5	3	3	0	0	1	5	1	5	5	5	3	0	5	3	3
K-28	5	5	3	3	0	0	1	1	1	5	5	5	3	0	5	5	5
K-29	3	5	1	5	0	0	1	7	1	7	5	5	3	0	7	5	5
K-30	3	5	2	5	0	0	1	1	1	5	5	5	3	0	5	5	5
K-32	3	5	3	3	0	0	6	1	1	7	5	5	2	0	5	7	5
K-33	3	5	1	3	0	0	6	7	1	7	5	3	3	0	5	3	5
K-34	7	5	1	3	0	0								0	5	5	
K-35	3	5	1	7	0	0	1	3	1	5	5	5	1	0	7	5	5
K-36	3	5	1	3	0	0	9	7	1	5	5	3	3	0	5	3	7
K-37	3	5	2	3	0	0	1	3	1	7	5	5	3	0	5	3	7
K-38	5	5	1	7	11	10	1	5	1	5	5	5	3	3	5	3	5
K-39	3	5	3	3	0	0	9	1	1	5	5	5	3	0	5	3	5
K-40	3	5	3	3	0	0								0	7	5	
K-42	3	5	3	3	0	0	9	3	1	7	5	3	2	0	7	5	5
K-45	3	5	3	3	0	0	9	1	1	5	5	5	9	0	5	5	7
K-47	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	5	5
KASI-46	7	5	1	3	0	0	2	5	1	5	5	5	3	0	5	7	5
KASI-98	3	5	1	7	12	9	1	1	1	5	5	3	3	3	7	5	5
KASI-99	3	5	3	5	0	0	9	3	1	5	5	3	4	0	7	5	3
M-02	3	5	1	3	0	0	6	1	1	7	5	5	8		3	3	5
MTR-7	3	5	3	3	0	0								0	7	5	
NIR-04	3	5	1	3	0	0	1	5	1	5	5	5	3		7	5	5
NIR-62	7	5	3	3	0	0	2	5	1	5	5	5	3	0	3	3	5
NSR-10	7	5	1	3	0	0	1	1	1	5	5	5	2	0	7	3	5
NSR-11	7	5	3	3	0	0	1	3	1	5	5	3	3	0	7	5	5
NSR-12	3	5	3	3	0	0	6	1	1	7	5	5	2	0	5	5	7
NSR-13	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	5	7
NSR-14	3	5	1	7	6	2								0	7	5	
NSR-15	3	5	3	3	0	0	1	1	3	5	5	5	3	0	5	7	5

Table 39. Cont'd

Coll./Acc. #	Plant Growth Habit	Corolla Color	Calyx Color	Calyx Spininess	NSUL	NSDL	Fruit Color	Fruit Color Dist.	Fruit Curvature	Fruit Flesh Density	Fruit Shape	Fruits Apex shape	fruit color at maturity	Fruit calyx prickles	Leaf blade lobing	leaf blade tip angle	relative fruit calyx length
NSR-16	3	5	1	3	0	0	1	7	1	5	5	5	3	0	7	3	5
NSR-17	7	5	3	3	0	0	6	7	1	7	5	5	2	0	5	5	5
NSR-18	3	5	3	3	0	0	1	1	1	5	5	5	3	0	7	7	5
NSR-19	3	5	1	3	0	0	1	5	1	5	5	5	3	0	7	5	5
NSR-2	7	5	3	3	0	0	1	7	1	5	5	7	3	0	5	5	5
NSR-2.1	3	5	1	3	0	0	1	1	1	5	5	5	3	0	5	3	5
NSR-20	3	5	1	3	0	0	1	5	1	7	5	5	3	0	5	5	5
NSR-21	3	5	3	5	3	2	1	1	1	7	5	7	3	3	7	5	5
NSR-22	7	5	1	3	0	0	9	5	1	5	5	5	2	0	5	5	3
NSR-23	5	5	3	3	0	0	9	3	1	7	5	3	9	0	5	5	5
NSR-24	5	5	3	3	0	0	9	1	1	7	5	3	9	0	7	7	7
NSR-25	3	5	3	3	0	0	1	1	1	5	5	5	3	0	7	5	7
NSR-26	7	7	1	7	18	10	9	5	1	5	5	5	2	5	7	5	5
NSR-27	3	5	3	3	0	0	1	3	1	5	5	5	3	0	5	7	5
NSR-28	3	5	3	3	0	0	1	5	1	5	5	5	3	0	7	5	3
NSR-29	3	5	3	3	0	0	1	1	1	7	5	5	3	0	5	3	5
NSR-3	3	5	3	3	0	0	1	3	1	7	5	5	3	0	7	7	5
NSR-30	3	5	1	3	0	0	1	5	1	5	5	5	3	0	5	5	5
NSR-4	3	5	1	3	0	0	1	5	1	5	5	5	3	0	7	5	3
NSR-5	7	5	3	3	0	0	6	1	1	7	5	5	3	0	7	5	5
NSR-53	7	5	1	5	0	0	1	5	1	5	5	5	3	0	5	5	5
NSR-6	3	5	3	3	0	0	1	1	1	5	5	5	3	0	7	5	5
NSR-7	3	5	1	3	0	0	6	1	1	5	5	5	2	0	5	3	5
NSR-8	7	5	1	5	15	12				5	5	5	2	0	7	5	
NSR-9	3	5	1	7	14	13	1	5	1	5	5	5	3	0	5	5	5
RAI-150	5	5	2	3	0	0	9	5	1	7	5	5	9	0	3	3	3
RAI-216	3	5	2	3	0	0	1	5	1	5	5	5	3	0	5	5	5
RAI-219	5	5	2	3	0	0	9	5	1	5	5	3	9	0	7	7	5
RAI-230	3	5	3	3	0	0	8	5	1	5	5	3	2	0	5	3	3
RAI-81	7	5	3	3	0	0	1	1	1	7	5	5	3	0	7	5	3
RAI-99	3	5	2	3	0	0	1	5	1	7	5	5	3	0	5	3	3
SU-1	5	5	3	3	0	0				5	5	5	2	0	5	5	
SU-3	3	5	3	3	0	0	9	3	1	5	5	5	2	0	7	5	5
SU-88	3	5	3	3	0	0	9	3	1	5	5	5	2	0	5	5	5
TRMR-102	3	5	3	3	0	0	9	1	1	5	5	5	1	0	5	3	5
TT-102	3	5	3	3	0	0	2	3	1	5	5	5	3	0	7	3	5
TT-103	3	5	3	7	14	9	6	1	1	7	5	5	3	0	3	3	7
TT-105	3	5	3	3	0	0				7	5	5	3	0	3	3	7
TT-136	5	5	3	3	0	0	1	3	1	5	5	5	3	0	7	7	5
TT-169	3	5	3	3	0	0	1	1	1	5	5	5	3	0	5	5	5
TT-176	3	5	3	3	0	0	6	1	1	7	5	5	3	0	5	5	5
TT-200	7	5	3	3	0	0	9	1	3	5	5	3	9	0	5	3	7
TT-27	3	5	3	3	0	0	1	3	1	7	5	5	3	0	5	3	5
TT-58	5	5	3	3	0	0	1	5	1	5	5	5	3	0	5	5	3
TT-64	3	5	1	3	0	0	9	1	5	5	5	3	1	0	7	3	5



Fig. 43. Distinctness among test brinjal germplasm

Conclusion

A wide variation was observed in the collected brinjal germplasm. Most of the qualitative characters showed distinct variation among the germplasm. Qualitatively the maximum variation was observed in leaf prickles, fruit calyx prickles, fruit color at ripening and fruit flesh density. Quantitatively highest variation was observed in fruit length which was followed by 100 seed weight and yield per plant. The overall performance of the genotypes indicated that the genotypes NSR-10, NSR-8 and AH-101 had higher yield potentiality. Therefore, selection of these genotypes might play a significant role for future breeding program.

11.3.5. Characterization of Landraces of Bitter Gourd Germplasm

A. Qualitative Descriptors

Qualitative characters of different germplasm of bitter gourd are presented in Table 40. All germplasm was classified as *Korolla* (100%) (Table 40). Poor (15.22%), good (23.91%) and very good (60.87%) early plant vigor were observed among the germplasm. Short viny (6.52%), medium viny (36.96%) and long viny (56.52%) plant growth habit were found (Fig. 44). Stem pubescence was present in 45 germplasm (97.83%) and absent in only 1 germplasm (2.17%). Moreover, all germplasm has angular stem shape. Twining tendency of studied germplasm was intermediate (52.17%) and pronounced (47.83%). Maximum (80.43%) germplasm showed unifid and only (19.57%) germplasm showed bifid tendril branching (Fig. 44). However, all germplasm showed serrate leaf margin. In case of leaf shape, ovate and cordate shape was found in 4.35% germplasm of each, and supreme percentage of germplasm (91.30%) showed reniform leaf shape. Small (2.17%), medium (52.17%) and large 45.65%) leaf size was found among the germplasm (Fig. 46). Leaf pubescence was sparse, intermediate and dense in 21.74%, 30.43% and 47.83% germplasm respectively. Nevertheless, Monoecious sex type was found in entire germplasm. Among the germplasm 23.91%, 45.65% and 30.43% showed correspondingly light yellow, yellow and deep yellow color flower. While considering fruit shape, spindle shaped was highest in 40 germplasm (86.96%), long cylindrical, top shaped and globular (4.35%) each fruit shape (Fig. 47) along with smooth only 2.17%, light tubercle 34.78% and deep tubercle 63.04% fruit surface occurred among the germplasm. Nature of tubercles were observed as sparse (17.39%), medium and dense (41.30%) each (Fig. 48). Blunt (39.13%) and acute (60.87%) blossom-end fruit shape were found (Fig. 49). Fruit skin color such as white was found in least number of germplasm (2.17%), while maximum germplasm has light green (34.78%) skin, as well green (39.13%) and dark green (23.91%) were exhibited among the germplasm. Fruit skin luster showed intermediate (45.65%), followed by glossy (36.96%) and matt in (17.39%) germplasm. Amid the germplasm fruit bitterness was mild in 26.09%, moderate in 45.65% and strong in 28.26%. Twenty-five (54.35%) germplasm had glossy seed luster, while intermediate and matt was in 13 (28.26%) and 8 (17.39%) germplasm singly (Fig. 50). Low (17.39%), medium and high (41.30%) seediness occurred among the germplasm. The qualitative descriptors for individual germplasm are presented in Table 41.

Table 40. Qualitative variations in bitter gourd germplasm

Name of Descriptor	Descriptor state	No. of germplasm	Percentage (%)
Classes	Uchche	0	0
	Korolla	46	100
Early plant vigor	Poor	7	15.22
	Good	11	23.91
	Very good	28	60.87
Plant growth habit	Short viny	3	6.52
	Medium viny	17	36.96
	Long viny	26	56.52
Stem pubescence	Absent	1	2.17
	Present	45	97.83
Stem shape	Angular	46	100
Twining tendency	Slight	0	0
	Intermediate	24	52.17
	Pronounced	22	47.83
Tendril branching	Unifid	37	80.43
	Bifid	9	19.57
Leaf margin	Serrate	46	100
Leaf shape	Ovate	2	4.35
	Cordate	2	4.35
	Orbicular	42	91.30

Table 40. Cont'd

Name of Descriptor	Descriptor state	No. of germplasm	Percentage (%)
Leaf size	Small	1	2.17
	Medium	24	52.17
	Large	21	45.65
Leaf pubescence	Sparse	10	21.74
	Intermediate	14	30.43
	Dense	22	47.83
Sex type	Monoecious	46	100
Flower color	Light yellow	11	23.91
	Yellow	21	45.65
	Deep yellow	14	30.43
Fruit shape	Spindle	40	86.96
	Long cylindrical	2	4.35
	Top shaped	2	4.35
	Globular	2	4.35
Fruit surface	Smooth	1	2.17
	Light tubercle	16	34.78
	Deep tubercle	29	63.04
Nature of tubercles	Sparse	8	17.39
	Medium	19	41.30
	Dense	19	41.30
Blossom-end fruit shape	Blunt	18	39.13
	Acute	28	60.87
Fruit skin color	White	1	2.17
	Light green	16	34.78
	Green	18	39.13
	Dark green	11	23.91
Fruit skin luster	Matt	8	17.39
	Intermediate	21	45.65
	Glossy	17	36.96
Fruit bitterness	Mild	12	26.09
	Moderate	21	45.65
	Strong	13	28.26
Seediness	Low	8	17.39
	Medium	19	41.30
	High	19	41.30
Seed luster	Matt	8	17.39
	Intermediate	13	28.26
	Glossy	25	54.35

**Fig. 44. Plant growth habit of test bitter gourd germplasm**

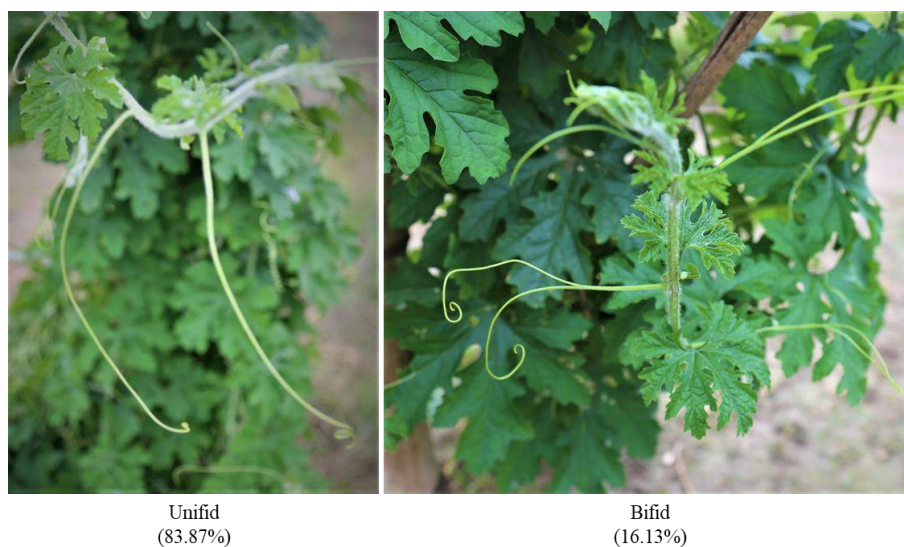


Fig. 45. Tendril branching habit of test bitter gourd germplasm



Fig. 46. Leaf size of bitter gourd germplasm.



Fig. 47. Fruit shape of bitter gourd germplasm



Fig. 48. Nature of tubercles and fruit surface of test bitter gourd germplasm



Fig. 49. Blossom-end fruit shape of bitter gourd germplasm

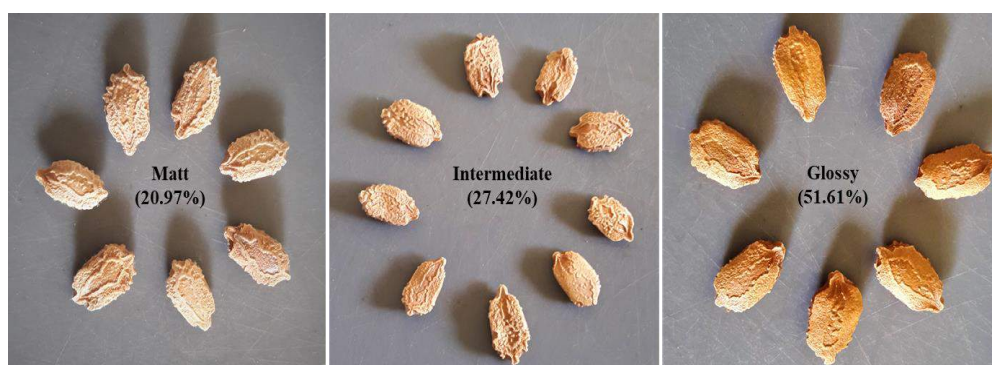


Fig. 50. Seed skin luster of bitter gourd germplasm.

B. Quantitative Descriptor

Range, mean, standard deviation and coefficient of variation for quantitative characters are shown in Table 41. Days to germinations varied from 4 to 15 days with mean 6.04. Internode length ranged from 4.44 to 9.4 cm. On an average, petiole length was 5.73 cm. Days to 50% plant flowering female flower ranged from 40 to 61. Moreover, Peduncle length ranged from 2.1 to 9.2 cm. Vine length showed an average of 250 cm, which oscillated from 170-342 cm. However, number of primary branches ranged from 20-45. On an average, days to first fruit harvest and last fruit harvest was 56.48 and 88.15 accordingly. Number of fruits per plant fluctuated from 9-38 with mean 20.85. Besides, weight of 5 marketable fruits ranged from 15-950 g. However, fruit length and fruit width ranged from 4 to 23.3 and 2.96 to 6.62 cm respectively. Averagely, number of seeds per fruit was 12.59. 100-seed weight ranged from 9.2 to 23.24 g. The highest CV was found in fruit weight (53.21%) and the lowest CV was found in days to last fruit harvest (5.35%). The quantitative descriptors for individual germplasm are presented in Table 43. Hereafter, some promising bitter gourd germplasm were selected based on two different criteria. Firstly, while considering total fruiting period AC-204 showed the

longest duration (49 days), followed by, AC-282 (43 days), AC-502 (42 days), AHI-85 (40 days) and AHI-30 (39 days). Secondly, taking the yield factor in mind AHI-85 was the best performer, about 5.5 kg/plant. Subsequent best yielders were, TRMR-13 (5.4 kg/plant), IA-13 (about 4.4 kg/plant), AHI-28 (3.6 kg/plant) and TRMR-63 (about 3.4 kg/plant). Overall, linking both factor AHI-85 is the most latent one among studied germplasm.

Table 41. Quantitative variations in bitter gourd germplasm

Parameter	Range	Mean	SD	CV (%)
Days to germination	4-15	6.04	2.56	42.29
Internode length (cm)	4.44-9.4	7.10	1.36	19.15
Petiole length (cm)	2.56-9.9	5.73	1.78	31.13
Days to 50% flowering	40-61	49.67	3.72	7.50
Peduncle length (cm)	2.1-9.2	4.89	1.41	28.85
Vine length (cm)	170-342	250.00	38.24	15.30
Number of primary branches	20-45	32.57	5.56	17.06
Days to first fruit harvest	42-70	56.48	5.68	10.06
Days to last fruit harvest	78-97	88.15	4.71	5.35
No. of fruits per plant	9-38	20.85	8.08	38.76
Fruit weight (g) (5)	15-950	413.17	219.83	53.21
Fruit length (cm)	4-23.3	14.30	3.86	26.98
Fruit width (cm)	2.96-6.62	5.12	0.80	15.62
No. of seed(s) per fruit	5.2-19.4	12.59	3.35	26.65
100 seed weight (g)	9.2-23.24	17.24	2.57	14.93

Table 42. Qualitative characters of bitter gourd germplasm

Coll. No.	Class	Early plant vigor	Plant growth habit	Stem pubescence	Stem shape	Twining tendency	Tendrils branching	Leaf margin	Leaf shape	Leaf size	Leaf pubescence
1	2	3	4	5	6	7	8	9	10	11	12
AC-204	2	7	7	1	2	7	1	2	5	5	5
AC-255	2	5	5	1	2	5	2	2	1	7	3
AC-282	2	3	3	1	2	5	2	2	5	5	5
AC-287	2	7	7	1	2	7	1	2	5	5	7
AC-296	2	5	7	1	2	5	1	2	5	7	5
AC-301	2	7	7	1	2	7	1	2	5	5	3
AC-307	2	7	5	1	2	5	1	2	5	5	7
AC-346	2	7	7	1	2	7	1	2	5	5	7
AC-404	2	7	5	1	2	5	2	2	5	5	7
AC-476	2	7	7	1	2	5	1	2	1	5	7
AC-502	2	7	5	1	2	7	2	2	5	5	3
AR-18	2	3	5	1	2	7	1	2	5	5	3
AR-181	2	7	7	1	2	7	1	2	5	5	7
AR-263	2	3	5	1	2	7	1	2	5	5	3
RC-18	2	7	7	1	2	7	2	2	5	7	7
RC-26	2	7	7	1	2	5	1	2	5	5	3
RC-96	2	5	7	1	2	5	1	2	5	7	7
RC-143	2	7	7	1	2	5	1	2	5	5	7
AHM-138	2	3	5	1	2	7	1	2	5	7	5
RAI-12	2	5	5	1	2	5	1	2	5	7	5
RAI-32	2	7	7	1	2	5	1	2	5	5	5
RAI-173	2	7	7	1	2	7	2	2	5	7	7
ZA-02	2	5	3	0	2	5	1	2	5	3	3

Table 42. Cont'd

Coll. No.	Class	Early plant vigor	Plant growth habit	Stem pubescence	Stem shape	Twining tendency	Tendrils branching	Leaf margin	Leaf shape	Leaf size	Leaf pubescence
ZS-24	2	5	5	1	2	7	1	2	5	7	7
TT-40	2	7	7	1	2	5	1	2	5	7	5
N-23	2	7	5	1	2	7	1	2	5	7	7
N-98	2	7	7	1	2	7	1	2	5	7	7
N-112	2	7	5	1	2	7	1	2	5	5	5
N-130	2	7	7	1	2	7	1	2	3	5	3
IA-13	2	5	5	1	2	5	1	2	5	5	7
IA-55	2	7	7	1	2	7	1	2	5	5	5
AHI-28	2	7	7	1	2	5	1	2	5	7	7
AHI-30	2	5	7	1	2	5	1	2	5	5	7
AHI-85	2	7	7	1	2	7	1	2	5	7	7
AHI-98	2	7	7	1	2	7	1	2	5	7	7
AHI-112	2	3	5	1	2	5	1	2	3	7	7
AHI-115	2	3	5	1	2	7	1	2	5	5	5
AHI-122	2	5	5	1	2	7	1	2	5	7	7
ATR-42	2	3	5	1	2	5	1	2	5	5	5
TRMR-13	2	7	7	1	2	5	1	2	5	5	3
TRMR-63	2	7	7	1	2	5	1	2	5	7	5
NRI-36	2	5	5	1	2	7	1	2	5	7	3
AC-18	2	5	5	1	2	5	1	2	5	5	3
AC-185	2	5	5	1	2	5	2	2	5	7	5
MRI-26	2	7	7	1	2	5	2	2	5	7	7
A-05	2	7	7	1	2	5	2	2	5	7	7
BARI Korolla-2	2	7	5	1	2	5	1	2	5	5	5
BARI Korolla-3	2	7	5	1	2	5	1	2	5	5	5

Table 42. Qualitative characters of bitter melon germplasm (Cont'd)

Collector's No.	Sex type	Flower color	Fruit shape	Fruit surface	Nature of tubercles	Blossom-end fruit shape	Fruit skin color	Fruit skin luster	Fruit bitterness	Seediness	Seed luster
1	13	14	15	16	17	18	19	20	21	22	23
AC-204	1	4	1	3	7	2	5	5	5	7	3
AC-255	1	4	1	2	7	2	6	5	5	7	7
AC-282	1	4	1	3	7	2	5	3	7	5	7
AC-287	1	2	1	3	7	1	5	5	3	5	7
AC-296	1	2	1	3	5	2	4	5	5	7	7
AC-301	1	4	1	3	7	1	5	7	5	3	7
AC-307	1	2	1	3	5	2	4	5	3	5	5
AC-346	1	2	1	3	7	2	5	7	3	5	5
AC-404	1	4	1	3	5	1	4	7	5	5	7
AC-476	1	2	1	3	7	2	6	5	5	5	7
AC-502	1	2	1	3	5	2	6	5	7	3	3
AR-18	1	3	1	3	7	2	5	7	5	3	5
AR-181	1	2	1	3	5	2	5	7	5	3	3
AR-263	1	2	4	2	5	2	4	5	5	5	7
RC-18	1	4	1	2	5	2	4	7	3	5	3
RC-26	1	3	1	3	5	2	5	5	7	7	5
RC-96	1	4	1	3	7	2	5	7	5	5	7

Table 42. Cont'd

Collector's No.	Sex type	Flower color	Fruit shape	Fruit surface	Nature of tubercles	Blossom-end fruit shape	Fruit skin color	Fruit skin luster	Fruit bitterness	Seediness	Seed luster
RC-143	1	3	1	3	3	2	5	7	5	5	7
AHM-138	1	3	1	3	7	1	6	3	7	7	7
RAI-12	1	4	1	2	7	2	6	3	5	5	5
RAI-32	1	4	1	3	7	2	4	3	5	7	5
RAI-173	1	3	1	3	5	1	6	5	5	7	5
ZA-02	1	3	5	2	3	2	5	3	7	3	7
ZS-24	1	4	1	3	7	1	5	5	3	5	3
TT-40	1	3	1	3	7	2	5	3	5	7	3
N-23	1	2	4	1	5	1	4	7	3	5	3
N-98	1	4	1	2	5	2	5	5	5	7	7
N-112	1	2	1	3	5	1	5	5	3	7	5
N-130	1	4	5	2	5	1	4	5	7	7	7
IA-13	1	3	1	3	7	1	6	5	3	7	7
IA-55	1	3	1	3	5	2	5	5	5	5	5
AHI-28	1	3	1	3	7	2	4	5	3	7	7
AHI-30	1	3	1	3	7	2	5	7	3	7	5
AHI-85	1	3	1	3	7	1	6	7	5	7	7
AHI-98	1	4	1	3	3	2	1	7	7	5	5
AHI-112	1	4	1	3	5	2	4	7	5	7	7
AHI-115	1	2	1	2	5	1	4	5	5	3	7
AHI-122	1	3	1	2	5	2	6	5	5	5	7
ATR-42	1	3	1	2	5	1	4	5	7	5	7
TRMR-13	1	3	1	2	5	1	4	7	3	7	7
TRMR-63	1	3	1	3	7	1	6	7	5	7	5
NRI-36	1	3	1	2	3	2	4	3	7	5	7
AC-18	1	2	1	3	3	2	4	5	7	5	7
AC-185	1	3	1	2	5	1	4	3	7	5	7
MRI-26	1	3	4	2	3	1	4	7	7	3	7
A-05	1	3	1	2	3	1	5	5	3	7	3
BARI Korolla-2	1	3	1	2	5	2	5	5	5	3	5
BARI Korolla-3	1	2	1	2	7	1	4	5	5	3	7

Table 43. Quantitative characters of different germplasm of bitter gourd

Collector's No.	Days to germination	Internode length (cm)	Petiole length (cm)	Days to 50% flowering	Sex ratio (M/F)	Peduncle length (cm)	Vine length (cm)	No. of primary branches	Days to first fruit harvest	Days to last fruit harvest	No. of fruits/plant	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	No. of seeds/fruit	100 seed wt (g)
AC-204	5	6.8	8.54	54	10/7	6.5	225	30	44	93	28	580	16.2	4.9	16	18.1
AC-255	4	7.76	7.2	55	10/5	6.9	226	29	55	89	18	500	9.84	4.64	9.6	20.5
AC-282	5	6.12	6.3	58	10/2	3.1	225	40	50	93	9	100	6.1	3.5	12.8	13.2
AC-287	5	7.2	5.3	50	10/8	4.8	250	37	52	88	21	173	13.6	5.2	11.2	19.1
AC-296	4	8.9	7.804	51	10/8	4.1	230	35	55	91	28	290	12.5	4.7	9	16.8
AC-301	5	8.9	6.2	50	10/7	4.6	265	30	56	93	26	460	14.3	5.7	8.8	18.42
AC-307	4	7.2	5.7	51	10/2	3.9	210	35	52	89	18	160	10.9	4.8	14	15.47
AC-346	5	7.2	6.5	50	10/8	5	265	32	63	88	26	172	12.7	4.4	10.6	13.82
AC-404	4	6.48	4.58	51	10/10	4.4	260	30	61	86	27	500	13.8	5.26	11	18.2
AC-476	5	8.02	5.46	50	7/10	5	170	20	59	84	17	370	12.8	4.3	9.8	21.6
AC-502	5	7.22	5.96	50	10/5	4.4	220	35	51	93	18	252	9.1	4	8.8	14.7
AR-18	10	6.06	2.66	43	10/10	4	225	35	59	83	16	300	14.4	4.7	9.6	22.32
AR-181	10	6.26	5.98	45	10/5	6.4	170	25	49	79	21	399	18.7	4.8	9.6	17.5

Collector's No.	Days to germination	Internode length (cm)	Petiole length (cm)	Days to 50% flowering	Sex ratio (M/F)	Peduncle length (cm)	Vine length (cm)	No. of primary branches	Days to first fruit harvest	Days to last fruit harvest	No. of fruits/plant	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	No. of seeds/fruit	100 seed wt (g)
AR-263	6	8.12	4.26	49	5/10	3.6	220	30	51	83	9	420	19.7	5.9	10.4	14.9
RC-18	5	9.28	3.74	50	10/5	3.5	240	25	59	84	12	210	14.9	4.8	18.6	16.91
RC-26	4	6.54	4.18	49	5/10	3.8	250	27	55	89	31	147	16.06	6.18	15	16.9
RC-96	5	7.68	5.54	50	10/5	4.5	230	35	59	88	14	260	18.2	5.9	8.6	19.5
RC-143	5	7.44	5.6	50	5/10	5.8	235	25	51	88	22	680	14.6	5.6	10	15.3
AHM-138	6	4.54	4.7	49	10/10	4.2	227	26	53	87	13	730	12.8	6	16	19.2
RAI-12	5	7.7	9.3	50	10/10	5.6	290	39	59	93	12	410	17.3	5.5	11.2	16.2
RAI-32	5	7.4	9.7	50	10/7	5	288	28	58	84	14	157	22	5.96	10	16.2
RAI-173	5	8.4	7.5	48	10/5	3.9	247	36	54	89	36	450	17.82	5.76	15.4	17.5
ZA-02	6	4.4	6.8	47	10/10	2.1	170	24	51	88	20	15	4	2.96	5.2	9.2
ZS-24	4	4.7	5.04	51	10/5	4.4	220	32	62	97	13	820	15.3	5.5	9.6	18.2
TT-40	10	6.04	5.46	43	10/10	3	247	34	57	79	28	64	15.12	6.14	19.2	17.5
N-23	5	8.7	8.56	50	10/10	3.64	325	30	59	93	21	602	18.8	5.2	9.2	16.2
N-98	4	4.86	7.06	51	10/5	3.9	290	29	55	92	23	520	15.9	4.9	16.2	18.8
N-112	5	6.26	9.9	46	5/10	2.3	240	25	55	92	17	147	11.4	4.6	12.8	16.36
N-130	4	6.6	3.6	49	5/10	3.8	260	35	52	86	11	147	9	3.5	13.2	14.2
IA-13	15	7.84	6.9	40	10/5	9.2	325	44	42	78	21	950	15.3	4.6	15.4	17.8
IA-55	6	6.06	5.36	49	10/5	6	245	33	62	92	27	84	13.5	5.3	11.2	18.3
AHI-28	4	5.88	3.86	51	10/5	5.6	280	45	62	94	36	500	13.5	5.4	19.4	18.1
AHI-30	5	7.76	3.88	50	5/10	4.9	255	37	54	93	32	352	12.4	5.3	15	14.4
AHI-85	10	6.44	6.44	45	10/10	6.5	342	45	48	88	38	720	13.1	5.7	19	18.5
AHI-98	5	9.04	6.68	49	10/5	6.3	325	38	59	81	30	320	11.3	5.1	12.4	19.2
AHI-112	4	8.98	5	61	10/5	7.3	315	32	59	92	26	600	16.1	6.1	18.2	17.2
AHI-115	10	7.82	5.08	55	10/2	3.4	240	35	58	79	12	590	10.5	4.2	11.4	17.27
AHI-122	4	8.12	4.76	55	10/10	5.9	250	32	64	94	9	550	13.7	4.7	10.6	15.8
ATR-42	10	4.46	3.24	49	10/10	6.6	235	36	59	88	15	510	14.74	6.62	13.6	17.3
TRMR-13	4	9.4	4.02	51	7/10	3.9	255	33	66	89	36	750	16.5	6.44	15.4	15.75
TRMR-63	10	8.58	5.8	45	10/10	5	290	34	66	83	28	590	11.5	4.9	14.6	21.4
NRI-36	10	5.32	2.56	45	5/10	4.2	253	32	58	88	14	500	19.2	6.1	11.2	15.1
AC-18	6	6.72	3.44	53	5/10	5.8	242	35	63	87	22	512	12.1	5.24	14.8	18.1
AC-185	4	7.96	4.22	49	5/10	5.3	240	28	70	94	14	420	21.5	4.5	8.8	19.5
MRI-26	10	7.92	7.5	49	5/10	5.8	238	27	59	83	11	523	23.3	5.5	12	13.4
A-05	6	5.6	5.5	49	10/10	7	250	39	53	91	19	500	11.9	4.3	14.6	23.24
BARI Korolla-2	7	4.1	7.6	44	7/10	8.6	225	28	67	72	32	700	14.3	5.9	7.8	17.6
BARI Korolla-3	7	4.9	6.2	44	10/4	3.9	260	30	68	84	27	705	12.7	5.9	10.2	26.6

Conclusion

Forty-six bitter melon germplasm showed variation in qualitative and quantitative characters. The maximum coefficient of variations was in fruit weight and minimum in days to last fruit harvest. Also, among all few germplasm were selected based on total fruiting period and yield, where AHI-85 was certainly a good one.

11.3.6. Regeneration of Black Cumin and Fenugreek Germplasm

Black cumin

The qualitative and quantitative characters of thirty-two germplasm of black cumin carried out in this program have been shown in Table 44. Green color leaves with lobed margin were noticed in all germplasm. The flower color was violet mixed with white. All the germplasm exhibited straw

color fruit and black color seeds at matured stage (Fig. 42). Hundred seed weight ranged from 0.34 to 0.60 g and the maximum seed weights 175.19 g obtained by BD-10864.



Fig. 51. Flowering stage and different plant parts of black cumin

Table 44. Qualitative and quantitative characters of black cumin

Coll. No.	Leaf color	Leaf margin	Petal color	Mature fruit color	Seed color	100 seed weight(g)	Total seed weight (g)
AC-19	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.34	41.37
AC-25	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.60	66.32
AC-115	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.322	103.3
AC-266	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.32	100.55
AC-318	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.28	140.08
AC-327	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.291	45.53
AC-377	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.28	150.16
AC-77	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.34	152.44
AC-99	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.27	90.4
AC-115	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.38	70.33
SA-20	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.36	47.29
SA-32	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.34	160.52
AHM-119	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.39	88.88
AHM-167	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.41	120.76
AHM-350	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.43	68.32
AHM-364	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.42	85.2
IA-33	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.38	59.3
RAI-34	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.44	160.2
IAH-93	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.42	150.11

Coll. No.	Leaf color	Leaf margin	Petal color	Mature fruit color	Seed color	100 seed weight(g)	Total seed weight (g)
AR-210	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.43	64.64
BD-4516	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.41	18.5
BD-10320	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.37	104.8
BD-10861	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.36	130.8
BD-10862	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.35	115.16
BD-10863	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.42	77.32
BD-10864	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.29	175.19
BD-11211	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.44	95.53
BD-11212	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.42	68.57
BD-11213	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.32	42.06
BD-11214	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.28	23.52
BD-11215	Green	Lobed	Mixed (Violet with white and light green color)	Straw color	Black	0.39	49.69
BD-11216	Green	Lobed	Mixed	Straw color	Black	0.45	47.62

Fenugreek

The qualitative and quantitative characters of thirty-nine germplasm of fenugreek carried out under this program have been shown in Table 45. Green color leaves noticed in all germplasm. All the germplasm exhibited green color fruit and brown color seeds at matured stage (Fig. 43). The maximum seed weight 5000 g obtained by AC-122.

Table 45. Qualitative and quantitative characters of fenugreek

Acc. No.	Leaflet color	Leaf pubescence	Immature pod color	Matured pod color	Seed coat color	Total seed weight (g)
BD-8521	Green	Absent	Green	Straw	Brown	80.2
BD-8538	Green	Absent	Green	Straw	Brown	120
BD-8539	Green	Absent	Green	Straw	Brown	2000
AHM-137	Green	Absent	Green	Straw	Brown	45
AHM-135	Green	Absent	Green	Straw	Brown	105
AC--265	Green	Absent	Green	Straw	Brown	82
AC-330	Green	Absent	Green	Straw	Brown	260
RAI-250	Green	Absent	Green	Straw	Brown	95
AC-122	Green	Absent	Green	Straw	Brown	5000



Fig. 52. Different plant parts of fenugreek

11.3.7. Characterization of Brinjal Germplasm (Set-II)

Qualitative characteristics

Qualitative characteristics of 36 brinjal accessions are presented in Table 46. Cotyledon color was green for 22 accessions (61.11%), light violet for 9 accessions (25.00%), purple for 5 accessions (13.89%). Plant growth habit was upright for 20 accessions, intermediate for 5 accessions (17.94%) and strong for 11 accessions (30.56%). Leaf blade lobing was weak for 4 accessions (11.11%), intermediate for 12 accessions (33.33%) and strong for 17 accessions (47.22%) and very strong for 3 accessions (8.33%). Leaf blade tip angle was very acute for 5 accessions (13.89%), acute for 12 accessions (33.33%), intermediate for 18 accessions (50.00%) and obtuse for 1 accession (2.78%). Number of leaf prickles was none for 27 accessions (75.00%), intermediate for 3 accessions (8.33%), many for 5 accessions (13.89%) and very many for 1 accession (2.78%). Number of leaf hairs was very few for 17 accessions (47.22%), few for 15 accessions (41.67%) and intermediate for 4 accessions (11.11%). Corolla color was pale violet for 12 accessions (33.33%), light violet for 14 accessions (38.89%) and bluish violet for 10 accessions (27.78%). Fruit curvature was straight for 26 accessions (72.22%), slightly curved for 2 accessions (5.56%), curved for 5 accessions (13.89%) and snake shaped for 3 accessions (8.33%). Fruit shape was about half way from base to tip for 6 accessions (16.67%) and about three-quarter way from base to tip for 30 accessions (83.33%). Fruit apex shape was protruded for 23 accessions (63.89%), rounded for 12 accessions (33.33%) and depressed for 1 accession (2.78%). Fruit color was Green for 13 accessions (36.11%), milk white for 5 accessions (13.89%), scarlet red for 2 accessions (5.56%), lilac grey for 3 accessions (8.33%), purple for 8 accessions (22.22%), purple black for 3 accessions (8.33%) and black for 2 accessions (5.56%). Fruit color distribution was uniform for 8 accessions (22.22%), mottled for 3 accessions (8.33%), netted for 8 accessions (22.22%) and striped for 17 accessions (47.22%) were observed. The individual data of each accession is shown in Table 49.

Table 46. Qualitative variations in brinjal germplasm

Sl.#	Descriptor	Descriptor state	No. acc.	% of acc.
1	Cotyledon color	Green	22	61.11
		Light violet	9	25.00
		Violet	5	13.89
2	Plant growth habit	Upright	20	55.56
		Intermediate	5	13.89
		Strong	11	30.56
3	Leaf blade lobing	Weak	4	11.11
		Intermediate	12	33.33
		Strong	17	47.22
		Very strong	3	8.33
4	Leaf blade tip angle	Very acute	5	13.89
		Acute	12	33.33
		Intermediate	18	50.00
		Obtuse	1	2.78
5	Number of leaf prickles	None	27	75.00
		Intermediate	3	8.33
		Many	5	13.89
		Very many	1	2.78
6	Number of leaf hairs	Very few	17	47.22
		Few	15	41.67
		Intermediate	4	11.11
7	Corolla color	Pale violet	12	33.33
		Light violet	14	38.89
		Bluish violet	10	27.78

Sl.#	Descriptor	Descriptor state	No. acc.	% of acc.
8	Fruit curvature	Straight	26	72.22
		Slightly curved	2	5.56
		Curved	5	13.89
		Snake shaped	3	8.33
9	Fruit shape	About half way from base to tip	6	16.67
		About three quarter way from base to tip	30	83.33
10	Fruit apex shape	Protruded	23	63.89
		Rounded	12	33.33
		Depressed	1	2.78
11	Fruit color	Green	13	36.11
		Milk white	5	13.89
		Scarlet red	2	5.56
		Lilac grey	3	8.33
		Purple	8	22.22
		Purple Back	3	8.33
		Black	2	5.56
12	Fruit color distribution	Uniform	8	22.22
		Mottled	3	8.33
		Netted	8	22.22
		Striped	17	47.22

Quantitative characteristics

Quantitative characteristics of 36 brinjal accessions are presented in the Table 47. Days to first flowering, days to first edible fruiting stage, number of fruits per plant, 100-seed weight, seed yield per plant differed among the accessions. The first flower initiation was noticed in SM Ish-017 (82 days). Days to first flowering varied from 82.00 to 101.00, 17 accessions were early (82.00 to 87 days) and rest 19 accessions were optimum (91.00 to 101.00 days). Five accessions attained first edible fruiting stage within 100 to 115 days while 18 accessions first edible fruiting stage were within 116 to 120 days and the rest accessions 1st edible fruiting stage were within 125 to 132 days. Plant height varied from 62.50 cm to 106.50 cm, 18 accessions were short (62.50 to 79 cm), the 14 accessions were intermediate (80.50 to 99.50 cm) and rest 3 accessions were tall (102.50 to 106.50 cm). Plant breadth varied from 47.50 to 133.50 cm, 17 accessions were broad (47.50 to 90 cm) and rest 19 accessions were very broad (90.50 to 133.50 cm). Number of primary branches varied from 3.40 to 8.70cm, 21 accessions were weak (3.40 to 5.60 cm) and rest 15 accessions were intermediate (6.40 to 8.70cm). Leaf blade length varied from 12.30 to 24.20 cm, 22 accessions were intermediate (12.30 to 18.60 cm) and rest 14 accessions were long (21.20 to 24.20 cm). Leaf blade width varied from 7.40 to 13.60 cm, 16 accessions were intermediate (7.40 to 10.50 cm) and rest 20 accessions were wide (11.10 to 13.60 cm). Fruit length varied from 9.30 to 29.10 cm, 4 accessions were intermediate (9.30 to 10.75 cm), 25 accessions were long (11.25 to 19.60 cm) and rest 7 accessions were very long (20.30 to 29.10 cm) were observed. Number of fruits per plant varied from 9.00 to 46.00, 3 accessions were low (9.00 to 11.20), 9 accessions were intermediate (15.20 to 18.20), 8 accessions were high (19.00 to 23.00.) and rest 16 accessions were very high (24.10 to 46.00) were observed. Fruit weight per fruit varied from 77.65 to 266.38 g, the accessions were produced high fruit weight (>60g). The highest fruit weight per plant was found from SM Ish-015 (5.38 kg per plant) and lowest was found from SM Ish-032 (2.09 kg per plant). 100 seed weight varied from 1.10 to 4.30 g, the 100 seed weight of all the brinjal accessions were observed high. The individual data of each accession is shown in Table 48.

Table 47. Quantitative variations in brinjal germplasm

Characteristics	Range	Mean	SD	CV (%)
Days to first flowering	82.00-101.00	89.33	5.12	5.71
Days to first edible fruiting stage	102.00-132.00	114.86	7.73	6.73
Plant height (cm)	62.50-106.50	82.47	11.59	14.05
Plant breadth (cm)	47.50-133.50	92.50	14.81	16.02
Number of primary branches	3.40-8.70	5.87	1.22	20.90
Leaf blade length (cm)	12.30-24.20	18.43	3.60	19.56
Leaf blade width (cm)	7.40-13.60	11.18	1.72	15.45
Fruit length (cm)	9.30-29.10	17.34	7.89	45.53
Fruit breadth (cm)	2.80-10.55	7.31	1.59	21.84
Number of fruits per plant	9.00-46.00	21.56	7.40	34.35
Fruit weight (g)	77.65-266.38	190	41.78	21.97
Fruit weight per plant (kg)	2.06-5.38	3.87	0.83	21.56
100-seed weight (g)	1.10-4.30	3.10	1.18	38.30

Conclusion

Variations among 36 brinjal accessions were observed in different qualitative characteristics. The accessions SM Ish-001, SM Ish-015, SM Ish-018, SM Ish-010, SM Ish-011, SM Ish-012, SM Ish-024 and SM Ish-027 germplasm gave high edible fruit weight per fruit and per plant (4.77 to 5.38 kg) and it may be considered as better accessions. These accessions may be used in brinjal improvement program.

Table 48. Quantitative characters of brinjal germplasm

Acc. No.	Days to first flowering	Days to 1st edible fruiting stage	Plant height (cm)	Plant breadth (cm)	Number of primary branches	Leaf blade length (cm)	Leaf blade width (cm)	Fruit length (cm)	Fruit breadth (cm)	Number of fruits per plant	Fruit weight (g)	Fruit weight /plant (kg)	100 seed weight (g)
SM Ish-001	87	120	94.50	119.00	4.40	23.40	13.10	11.60	9.10	9.40	266.38	2.50	4.10
SM Ish-002	91	116	78.50	92.50	5.50	17.50	11.50	16.80	8.50	17.40	185.17	3.22	3.20
SM Ish-003	85	125	83.00	93.00	5.40	16.90	10.50	17.85	6.75	22.20	182.07	4.04	3.10
SM Ish-004	92	132	97.00	90.50	5.60	22.40	13.10	11.25	7.70	9.00	228.44	2.06	4.30
SM Ish-005	87	107	74.00	99.50	4.40	16.70	10.20	15.00	7.65	18.20	189.01	3.44	2.10
SM Ish-006	92	120	83.50	97.00	4.50	23.10	12.60	10.75	7.60	21.00	164.00	3.44	2.10
SM Ish-007	92	115	78.50	89.50	4.50	17.60	12.20	10.20	7.35	25.60	178.05	4.56	2.20
SM Ish-008	93	114	106.50	96.00	4.40	15.60	11.10	21.20	5.45	25.00	166.48	4.16	4.10
SM Ish-009	91	120	91.50	96.00	4.60	14.90	9.52	15.30	8.90	17.40	258.74	4.50	4.30
SM Ish-010	101	120	99.50	83.00	6.60	18.20	10.50	13.90	10.55	22.00	226.36	4.98	2.10
SM Ish-011	84	105	90.00	90.50	6.50	23.30	13.20	12.25	8.30	29.20	167.12	4.88	3.30
SM Ish-012	85	118	87.50	99.00	5.60	18.60	10.30	18.25	6.15	27.80	171.80	4.78	1.40
SM Ish-013	93	125	105.00	123.50	6.70	22.60	13.30	13.50	4.60	22.80	169.47	3.86	4.10
SM Ish-014	85	106	91.00	88.00	7.80	17.80	12.10	29.10	2.80	46.00	77.65	3.57	4.30
SM Ish-015	86	105	90.00	90.00	4.60	21.90	12.40	16.75	6.00	24.20	222.31	5.38	5.20
SM Ish-016	84	105	71.00	90.00	5.60	17.60	12.30	12.25	7.25	23.00	170.61	3.92	1.20
SM Ish-017	82	102	80.50	133.50	5.40	16.30	10.20	10.70	9.90	19.40	174.74	3.39	2.00
SM Ish-018	91	111	72.50	86.00	6.50	16.40	10.30	9.30	7.20	19.00	251.05	4.77	4.10
SM Ish-019	84	115	98.50	87.50	4.50	14.30	9.50	12.40	8.30	29.60	147.64	4.37	2.20
SM Ish-020	93	119	70.00	81.50	6.70	22.10	13.10	17.50	8.00	16.40	239.51	3.93	4.10
SM Ish-021	85	102	78.00	104.50	6.40	21.30	12.90	23.70	3.40	19.40	183.71	3.56	4.30

Acc. No.	Days to first flowering	Days to 1st edible fruiting stage	Plant height (cm)	Plant breadth (cm)	Number of primary branches	Leaf blade length (cm)	Leaf blade width (cm)	Fruit length (cm)	Fruit breadth (cm)	Number of fruits per plant	Fruit weight (g)	Fruit weight /plant (kg)	100 seed weight (g)
SM Ish-022	87	105	102.50	114.00	6.50	23.40	13.20	12.20	8.15	40.80	105.78	4.32	4.10
SM Ish-023	91	120	78.50	81.50	5.60	24.20	13.60	17.70	6.70	24.40	185.41	4.52	3.30
SM Ish-024	86	115	79.00	95.00	8.70	16.50	10.10	18.75	6.25	27.60	131.45	3.63	4.20
SM Ish-025	93	116	81.50	91.00	6.50	21.60	12.40	16.90	8.10	26.00	194.23	5.05	4.10
SM Ish-026	84	119	62.50	90.00	8.60	16.30	10.10	20.70	8.00	15.80	198.23	3.13	4.30
SM Ish-027	97	120	88.50	100.00	5.50	21.20	11.90	21.10	6.30	21.20	233.49	4.95	3.20
SM Ish-028	96	120	66.00	86.50	5.60	22.30	11.50	11.65	9.15	24.40	168.44	4.11	2.10
SM Ish-029	92	119	79.00	85.50	5.60	12.30	7.50	19.60	7.85	15.20	231.58	3.52	4.10
SM Ish-030	93	120	78.50	99.00	6.60	15.60	11.20	17.25	7.85	16.40	235.37	3.86	2.20
SM Ish-031	84	103	75.00	81.00	7.60	22.10	13.20	13.80	6.70	19.20	248.96	4.78	2.30
SM Ish-032	101	120	66.00	47.50	7.50	14.30	9.20	20.30	6.60	11.20	186.43	2.09	2.10
SM Ish-033	87	100	75.50	86.00	5.40	12.30	7.40	22.45	6.60	18.20	181.76	3.31	1.20
SM Ish-034	87	116	77.00	85.50	5.50	14.50	8.90	17.25	6.95	19.40	150.82	2.93	1.10
SM Ish-035	100	120	69.00	66.00	6.70	15.20	10.20	14.60	8.00	17.20	165.70	2.85	1.20
BARI Begun-6	93	120	70.80	91.50	3.40	13.40	8.20	16.30	8.80	15.40	206.49	3.18	4.30
SD	5.13	7.73	11.59	14.82	1.23	3.61	1.73	7.90	1.60	7.41	41.78	0.84	1.19
CV%	5.71	6.73	14.05	16.02	20.90	19.56	15.46	45.54	21.85	34.36	21.97	21.56	38.31

Table 49. Qualitative characters of brinjal germplasm

Acc. No.	Cotyledon color	Plant growth habit	Leaf blade lobing	Leaf blade tip angle	Number of leaf prickles	Number of leaf hairs	Corolla color	Fruit curvature	Fruit shape	Fruit apex shape	Fruit color	Fruit color distribution
SM Ish-001	5	7	5	5	7	5	5	1	7	5	2	1
SM Ish-002	7	3	3	3	9	5	9	1	7	7	6	7
SM Ish-003	3	5	5	5	0	1	9	1	7	3	1	7
SM Ish-004	3	3	7	5	0	1	7	1	7	5	1	7
SM Ish-005	7	3	3	3	0	1	9	1	7	5	7	5
SM Ish-006	7	3	5	5	7	5	5	1	7	3	8	7
SM Ish-007	5	5	9	5	7	3	5	1	7	5	7	1
SM Ish-008	3	3	5	3	7	3	7	7	7	5	9	1
SM Ish-009	3	7	7	5	5	1	5	5	7	3	2	1
SM Ish-010	3	7	7	3	0	1	5	1	7	3	1	7
SM Ish-011	5	5	3	1	5	3	9	1	7	5	2	7
SM Ish-012	3	7	5	3	0	3	7	1	7	5	2	5
SM Ish-013	5	3	7	1	0	3	9	3	7	3	2	5
SM Ish-014	5	3	5	1	0	3	9	7	7	3	7	1
SM Ish-015	5	3	7	1	0	1	9	5	7	3	9	5
SM Ish-016	7	5	3	3	0	1	7	1	7	3	7	7
SM Ish-017	3	3	5	3	0	1	7	1	7	3	5	5
SM Ish-018	3	3	7	5	0	3	5	1	7	3	1	7
SM Ish-019	3	7	5	5	5	3	7	1	7	5	1	7
SM Ish-020	3	7	7	5	0	3	7	1	7	5	1	7
SM Ish-021	7	3	5	3	0	3	5	1	7	3	5	5
SM Ish-022	5	3	7	1	0	3	9	7	7	3	7	1

Acc. No.	Cotyledon color	Plant growth habit	Leaf blade lobing	Leaf blade tip angle	Number of leaf prickles	Number of leaf hairs	Corolla color	Fruit curvature	Fruit shape	Fruit apex shape	Fruit color	Fruit color distribution
SM Ish-023	3	7	7	5	0	3	7	1	7	5	1	7
SM Ish-024	3	5	5	5	0	3	7	5	5	3	6	5
SM Ish-025	3	7	7	5	0	1	9	1	7	5	1	7
SM Ish-026	5	3	7	3	0	1	7	1	5	3	7	3
SM Ish-027	3	3	7	7	0	1	5	5	5	3	1	7
SM Ish-028	3	3	7	5	0	3	5	1	7	3	8	1
SM Ish-029	3	3	5	5	7	5	7	1	7	5	1	3
SM Ish-030	3	3	7	5	0	1	5	1	5	3	1	7
SM Ish-031	3	7	9	5	0	1	9	1	7	3	1	7
SM Ish-032	3	3	7	5	0	1	7	1	7	3	1	7
SM Ish-033	3	7	7	3	0	1	7	5	7	3	7	1
SM Ish-034	3	7	7	3	0	1	7	3	5	3	8	3
SM Ish-035	5	3	9	5	0	3	5	1	7	3	6	7
BARI Begun-6	3	3	5	3	0	1	5	1	5	3	7	5

11.3.8. Characterization of Mungbean Germplasm

A. Qualitative character

The data were recorded of ninety-one germplasm and six check varieties of mung bean which are presented in Table 50. The germplasm under study did not vary for hypocotyle colour, epicotyle colour, growth habit, growth pattern, terminal leaflet length, leaf pubescence, leaf colour, petiole colour, calyx colour, corolla colour, pod colour at immature stage, and pod colour at mature stage. Hundred percent germplasm exhibited same states for respective descriptors. Among the 97 germplasm, variation was found for terminal leaflet shape, petiole length, raceme position, leafiness, and seed color. Terminal leaflet shape was deltoid in 63.92% and ovate in 36.08% germplasm. Short (<12cm) petiole length was observed in 58.76% germplasm while rest of the germplasm (41.24% had medium petiole length (12-18 cm). Raceme position such as mostly above canopy (50.82%) and intermediate (49.48%) were observed. Sparse (43.96%), medium (58.56%) and abundant (8.79%) leafiness were exhibited among the germplasm.

Table 50. Qualitative variation in mungbean germplasm

Character	Descriptor state	No. of acc.	Frequency (%)
Hypocotyl color	Green	97	100
Epicotyl color	Light green	97	100
Growth habit	Erect	97	100
Growth pattern	Determinate	97	100
Terminal leaflet shape	Deltoid	62	63.92
	Ovate	35	36.08
Terminal leaflet length	Small (<10cm)	97	100
Leaf pubescence	Glabrous	97	100
Leaf color	Green	97	100
Petiole color	Greenish purple	97	100
Petiole length	Short (<12cm)	57	58.76
	Medium (12-18cm)	40	41.24
Raceme position	Mostly above canopy	49	50.82
	Intermediate	48	49.48
Calyx color	Green	97	100
Corolla color	Yellow	97	100

Character	Descriptor state	No. of acc.	Frequency (%)
Pod color at immature stage	Deep green	97	100
Pod color at mature stage	Black	97	100
Leafiness	Sparse	40	43.96
	Medium	57	58.76
	Abundant	8	8.79
Seed color	Deep green	93	95.88
	Deep brown	4	4.12



Fig. 53. Terminal leaflet shape (Deltoid and ovate)



**Fig. 54. Calyx and corolla color of mungbean
(Calyx: green and corolla: yellow)**



Fig. 55. Seed color of mungbean (Deep green and deep brown)

B. Quantitative characters

The variable data were recorded as per IBPGR descriptor. Means and standard error (SE), standard deviations (SD), minimum (Min), maximum (Max), skewness and kurtosis are summarized in Table 51. The maximum range of yield/plant was 5.75 to 338.24 g followed by number of pods per plant was 3.24 to 85.46 and mean 24. 25. In plant height, mean was 40.97 cm and range, 22.50 to 73.70 cm, in number of seed per pod range 10.52 to 35.30 and mean 22.37. The maximum coefficient of variation 92.68% was obtained from yield per plant followed 69.91% no. of pod/plant 26.69%, no. of primary branches/plant, 25.40% 100 seed weight. The frequency distribution observed higher on number of seed per pod and medium on days to 1st flowering and yield per plant.

Table 51. Quantitative variation in mungbean germplasm

Trait	Range		Mean	SE	SD	CV (%)
	Min	Max				
Days to germination	1.75	5.17	3.64	0.08	0.74	12.36
Days to 5 leaves	10.47	16.31	13.27	0.14	1.33	6.29
No. of primary branches/plant	0.56	5.09	2.16	0.06	0.63	13.81
Days to 1 st flowering	14.81	19.97	17.03	0.13	1.25	4.08
Days to 50% flowering	4.25	64.25	49.76	0.76	7.48	5.81
Plant height (cm)	22.5	73.7	40.97	0.99	9.69	5.97
Pod length (cm)	5.59	8.43	6.97	0.06	0.57	0.76
Pod breath (cm)	0.36	0.66	0.49	0.01	0.06	10.05
No. of pod /plant	3.24	85.46	24.25	1.74	17.09	5.36
No. of seed /pod	10.52	35.3	22.37	0.51	4.99	0.09
100 seed wt. (g)	1.24	5.48	2.78	0.08	0.76	7.36
Yield /plant (g)	5.75	338.24	103.36	9.57	93.73	23.53

Table 52. Qualitative information of mungbean germplasm

Acc. No.	Hypocotyl color	Epicotyl color	Growth habit	Growth Pattern	Terminal leaflet shape	Terminal leaflet length	Leaf pubescence	Leaf color	Petiole color	Petiole length	Raceme position	Calyx color	Corolla color	pod color at immature stage	Pod color at mature stage	Leafiness	Seed color
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
BD-6874	1	1	1	2	2	1	1	2	2	2	2	1	1	2	4	5	1
BD-6875	1	1	1	2	1	1	1	2	2	2	1	1	1	2	4	5	1
BD-6876	1	1	1	2	2	1	1	2	2	2	1	1	1	2	4	5	1
BD-6877	1	1	1	2	2	1	1	2	2	2	2	1	1	2	4	5	1
BD-6878	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	5	1
BD-6879	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	5	1
BD-6880	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-6881	1	1	1	2	2	1	1	2	2	1	2	1	1	2	4	5	1
BD-6882	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	1	1
BD-6884	1	1	1	2	2	1	1	2	2	2	2	1	1	2	4	1	1
BD-6885	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	1	1
BD-6886	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	1	1
BD-6887	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	5	1
BD-6888	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1

Table 52. Cont'd

Acc. No.	Hypocotyl color	Epicotyl color	Growth habit	Growth Pattern	Terminal leaflet shape	Terminal leaflet length	Leaf pubescence	Leaf color	Petiole color	Petiole length	Raceme position	Calyx color	Corolla color	pod color at immature stage	Pod color at mature stage	Leafiness	Seed color
BD-6889	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	1	1
BD-6890	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-6891	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	1	1
BD-6892	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	5	1
BD-6893	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	1	1
BD-6894	1	1	1	2	1	1	1	2	2	2	1	1	1	2	4	1	1
BD-6896	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	1	1
BD-6897	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	1	1
BD-6898	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	1	1
BD-6899	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-6900	1	1	1	2	2	1	1	2	2	2	2	1	1	2	4	1	1
BD-6902	1	1	1	2	2	1	1	2	2	1	2	1	1	2	4	1	1
BD-6903	1	1	1	2	2	1	1	2	2	1	2	1	1	2	4	5	1
BD-6904	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	1	1
BD-6905	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	5	1
BD-6907	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	5	1
BD-6908	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-6909	1	1	1	2	2	1	1	2	2	1	1	1	1	2	4	5	1
BD-6910	1	1	1	2	2	1	1	2	2	2	1	1	1	2	4	9	1
BD-6911	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	5	1
BD-6912	1	1	1	2	1	1	1	2	2	2	1	1	1	2	4	1	1
BD-6916	1	1	1	2	2	1	1	2	2	1	1	1	1	2	4	9	1
BD-6917	1	1	1	2	2	1	1	2	2	2	1	1	1	2	4	5	1
BD-6918	1	1	1	2	1	1	1	2	2	2	1	1	1	2	4	5	1
BD-6920	1	1	1	2	2	1	1	2	2	2	1	1	1	2	4	1	1
BD-6922	1	1	1	2	2	1	1	2	2	1	2	1	1	2	4	5	2
BD-6923	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	1	1
BD-6924	1	1	1	2	2	1	1	2	2	2	2	1	1	2	4	1	2
BD-6925	1	1	1	2	2	1	1	2	2	1	2	1	1	2	4	1	1
BD-6926	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	1	1
BD-6927	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	5	1
BD-6928	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-6934	1	1	1	2	2	1	1	2	2	2	1	1	1	2	4	1	1
BD-6935	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	1	1
BD-6936	1	1	1	2	2	1	1	2	2	1	1	1	1	2	4	1	1
BD-6937	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	1	1
BD-6941	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-9743	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	1	1
BD-9706	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	5	1
BD-9707	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-9835	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-9836	1	1	1	2	1	1	1	2	2	2	1	1	1	2	4	9	1
BD-9837	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	5	1
BD-10022	1	1	1	2	1	1	1	2	2	2	1	1	1	2	4	1	1
BD-10023	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	9	1
BD-10024	1	1	1	2	1	1	1	2	2	2	1	1	1	2	4	9	1
BD-10026	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	9	1
BD-10028	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	5	1
BD-10029	1	1	1	2	1	1	1	2	2	2	1	1	1	2	4	5	1

Table 52. Cont'd

Acc. No.	Hypocotyl color	Epicotyl color	Growth habit	Growth Pattern	Terminal leaflet shape	Terminal leaflet length	Leaf pubescence	Leaf color	Petiole color	Petiole length	Raceme position	Calyx color	Corolla color	pod color at immature stage	Pod color at mature stage	Leafiness	Seed color
BD-10030	1	1	1	2	2	1	1	2	2	2	1	1	1	2	4	1	1
BD-10031	1	1	1	2	2	1	1	2	2	2	2	1	1	2	4	5	1
BD-10032	1	1	1	2	2	1	1	2	2	2	2	1	1	2	4	5	1
BD-10324	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	5	1
BD-10353	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-10503	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	5	1
BD-10504	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	1	1
BD-10584	1	1	1	2	2	1	1	2	2	2	2	1	1	2	4	1	1
BD-10585	1	1	1	2	2	1	1	2	2	1	2	1	1	2	4	1	1
BD-10586	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	1	1
BD-10587	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	5	1
BD-10588	1	1	1	2	2	1	1	2	2	1	1	1	1	2	4	5	1
BD-10589	1	1	1	2	2	1	1	2	2	1	1	1	1	2	4	1	1
BD-10590	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-10591	1	1	1	2	2	1	1	2	2	1	2	1	1	2	4	1	1
BD-10733	1	1	1	2	2	1	1	2	2	2	2	1	1	2	4	5	1
BD-10734	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	1	1
BD-10735	1	1	1	2	2	1	1	2	2	2	1	1	1	2	4	1	1
BD-10736	1	1	1	2	2	1	1	2	2	1	1	1	1	2	4	1	1
BD-10739	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BD-10740	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	1	2
BD-10741	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	1	2
BD-10742	1	1	1	2	2	1	1	2	2	1	2	1	1	2	4	5	1
BD-10743	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	5	1
BD-10744	1	1	1	2	2	1	1	2	2	1	1	1	1	2	4	1	1
BD-10745	1	1	1	2	1	1	1	2	2	1	2	1	1	2	4	5	1
BD-10746	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	5	1
BD-10747	1	1	1	2	1	1	1	2	2	1	1	1	1	2	4	5	1
BARI-2	1	1	1	2	2	1	1	2	2	1	1	1	1	2	4	5	1
BARI-3	1	1	1	2	2	1	1	2	2	2	1	1	1	2	4	9	1
BARI-4	1	1	1	2	1	1	1	2	2	2	2	1	1	2	4	5	1
BARI-5	1	1	1	2	2	1	1	2	2	2	1	1	1	2	4	1	1
BARI-6	1	1	1	2	2	1	1	2	2	1	1	1	1	2	4	9	1
BARI-7	1	1	1	2	1	1	1	2	2	2	1	1	1	2	4	5	1

Table 53. Quantitative information of mungbean germplasm

Acc. No.	Days to germination	Days to 5 leaves	No. of Primary branch/plants	Days to 1 st flower	Days to 50 % flowering	Plant height (cm)	Pod length (cm)	Pod breadth (cm)	Pod per plant	No. of seed/pod	100 seed wt. (g)	Yield per plant (g)
1	2	3	4	5	6	7	8	9	10	11	12	13
BD-6874	3	12	5.0	15	4	38.8	6.42	0.42	21.36	14.3	2.34	74.88
BD-6875	4	12	3.2	16	51	31.2	6.44	0.44	21.52	21.1	2.05	74.06
BD-6876	3	14	2.6	17	59	37.2	7.06	0.48	10.88	21.9	2.36	65.58
BD-6877	3	13	2.4	16	51	31.8	5.80	0.44	13.33	19.7	2.53	22.98
BD-6878	4	14	3.0	18	45	35.0	6.86	0.42	8.71	19.0	2.14	13.04
BD-6879	3	14	2.8	17	53	34.0	6.72	0.44	15.00	21.0	2.14	34.37

Acc. No.	Days to germination	Days to 5 leaves	No. of Primary branch/plants	Days to 1 st flower	Days to 50 % flowering	Plant height (cm)	Pod length (cm)	Pod breath (cm)	Pod per plant	No. of seed/pod	100 seed wt. (g)	Yield per plant (g)
1	2	3	4	5	6	7	8	9	10	11	12	13
BD-6880	4	15	2.6	19	51	32.6	6.66	0.42	19.33	21.5	2.30	32.44
BD-6881	4	13	3.0	17	61	31.6	6.16	0.44	11.21	21.2	2.26	24.79
BD-6882	4	14	2.6	18	50	36.4	6.24	0.36	11.54	20.4	2.29	49.15
BD-6884	3	12	2.6	15	51	43.2	7.20	0.46	18.92	22.6	3.12	57.13
BD-6885	4	15	2.2	19	51	31.0	6.54	0.42	35.40	23.9	2.60	27.98
BD-6886	5	14	2.6	19	51	37.0	6.74	0.42	18.25	22.1	1.92	70.69
BD-6887	4	14	2.6	18	51	37.0	6.66	0.46	19.47	22.1	2.23	67.70
BD-6888	3	13	2.4	16	51	41.4	7.94	0.64	13.13	21.7	4.81	36.02
BD-6889	3	15	2.6	18	51	33.2	6.76	0.50	6.47	19.3	3.27	24.76
BD-6890	3	14	1.6	17	51	33.4	6.26	0.46	12.35	20.1	2.77	43.90
BD-6891	4	12	2.0	16	50	35.6	7.34	0.48	18.75	21.4	3.90	36.39
BD-6892	3	12	1.8	15	48	39.8	7.14	0.46	19.72	21.7	2.78	81.88
BD-6893	4	14	2.2	18	48	42.4	6.48	0.42	30.00	24.2	2.37	111.82
BD-6894	3	15	1.8	18	48	37.0	6.92	0.42	13.89	20.7	2.64	65.92
BD-6896	4	12	1.6	16	50	34.8	7.14	0.44	7.92	22.2	2.82	21.73
BD-6897	3	15	2.0	18	57	42.6	7.82	0.48	9.29	23.7	2.98	40.09
BD-6898	3	14	2.8	17	59	48.6	6.96	0.44	20.71	23.2	2.49	54.61
BD-6899	4	16	2.4	20	45	46.0	6.72	0.42	20.53	23.3	2.72	63.75
BD-6900	4	12	2.2	16	48	48.4	7.40	0.46	21.18	26.4	2.84	105.83
BD-6902	4	13	3.0	17	58	54.6	7.26	0.48	9.73	21.5	2.91	27.02
BD-6903	3	12	2.8	15	55	54.2	7.42	0.46	9.00	22.7	3.14	32.62
BD-6904	3	12	1.6	15	52	44.4	7.50	0.44	6.64	19.2	2.35	42.52
BD-6905	3	14	3.2	17	59	43.6	7.50	0.48	12.86	23.4	3.26	54.73
BD-6907	4	12	2.4	16	51	33.6	6.78	0.44	19.14	22.7	1.98	76.33
BD-6908	4	14	2.4	18	57	29.4	7.30	0.46	14.00	21.8	2.05	43.95
BD-6909	4	12	2.0	16	59	44.8	7.16	0.44	12.94	22.6	2.06	38.86
BD-6910	4	13	2.0	17	54	39.0	6.52	0.46	22.56	23.2	3.29	65.72
BD-6911	3	14	2.2	17	57	35.0	6.58	0.44	27.00	24.9	1.89	38.32
BD-6912	4	15	2.2	19	61	35.2	6.70	0.46	10.55	19.1	2.60	36.47
BD-6916	3	12	3.0	15	58	36.8	6.18	0.52	3.75	19.0	2.58	32.54
BD-6917	4	13	2.2	17	57	41.4	6.36	0.54	19.23	21.2	3.78	26.53
BD-6918	3	12	2.4	15	51	30.8	6.94	0.38	18.89	21.7	2.38	44.97
BD-6920	3	12	2.0	15	55	33.4	6.72	0.44	8.44	19.3	2.55	32.12
BD-6922	4	12	2.0	16	56	36.6	7.22	0.50	10.42	20.1	2.70	29.55
BD-6923	4	13	2.0	17	64	39.8	7.00	0.54	25.65	21.8	2.90	41.25
BD-6924	4	12	2.0	16	59	28.8	6.80	0.44	4.29	16.4	2.53	48.57
BD-6925	3	13	2.0	16	47	37.8	7.22	0.58	14.00	17.2	3.40	43.48
BD-6926	3	13	2.2	16	51	37.2	6.46	0.58	41.52	10.55	3.32	340.56
BD-6927	3	12	2.2	15	49	36.0	6.55	0.60	38.06	10.54	3.51	345.30
BD-6928	3	13	2.6	16	55	29.0	6.53	0.59	40.45	10.55	3.38	289.98
BD-6934	3	13	2.0	16	49	31.0	6.42	0.42	21.36	14.3	2.34	74.88
BD-6935	3	15	2.0	18	56	28.6	6.44	0.44	21.52	21.1	2.05	74.06
BD-6936	4	12	1.6	16	59	22.8	7.06	0.48	10.88	21.9	2.36	65.58
BD-6937	4	13	2.0	17	41	28.6	5.80	0.44	13.33	19.7	2.53	22.98
BD-6941	3	12	2.4	15	33	33.2	6.86	0.42	8.71	19.0	2.14	13.04
BD-9743	4	13	1.6	17	40	29.4	6.72	0.44	15.00	21.0	2.14	34.37
BD-9706	3	14	1.4	17	41	29.2	6.66	0.42	19.33	21.5	2.30	32.44
BD-9707	4	13	1.4	17	51	36.2	6.16	0.44	11.21	21.2	2.26	24.79
BD-9835	4	13	1.8	17	45	28.6	6.24	0.36	11.54	20.4	2.29	49.15
BD-9836	4	12	1.8	16	46	32.4	7.20	0.46	18.92	22.6	3.12	57.13

Table 53. Cont'd

Acc. No.	Days to germination	Days to 5 leaves	No. of Primary branch/plants	Days to 1 st flower	Days to 50 % flowering	Plant height (cm)	Pod length (cm)	Pod breadth (cm)	Pod per plant	No. of seed/pod	100 seed wt. (g)	Yield per plant (g)
BD-9837	3	12	2.6	15	45	43.6	6.54	0.42	35.40	23.9	2.60	27.98
BD-10022	3	12	2.6	15	52	44.2	6.74	0.42	18.25	22.1	1.92	70.69
BD-10023	4	13	1.8	17	46	37.6	6.66	0.46	19.47	22.1	2.23	67.70
BD-10024	4	13	1.4	17	47	41.4	7.94	0.64	13.13	21.7	4.81	36.02
BD-10026	4	13	2.6	17	48	40.0	6.76	0.50	6.47	19.3	3.27	24.76
BD-10028	4	14	1.4	18	49	36.6	6.26	0.46	12.35	20.1	2.77	43.90
BD-10029	3	14	1.2	17	45	74.0	7.34	0.48	18.75	21.4	3.90	36.39
BD-10030	4	13	2.6	17	45	57.8	7.14	0.46	19.72	21.7	2.78	81.88
BD-10031	4	14	1.6	18	61	65.0	6.48	0.42	30.00	24.2	2.37	111.82
BD-10032	4	15	3.2	19	48.2	62.8	6.92	0.42	13.89	20.7	2.64	65.92
BD-10324	4	15	2.0	19	48	56.6	6.62	0.46	23.53	21.9	2.82	89.67
BD-10353	3	14	1.8	17	50	52.2	7.14	0.44	7.92	22.2	2.82	21.73
BD-10503	4	12	1.4	16	41	47.2	7.82	0.48	9.29	23.7	2.98	40.09
BD-10504	4	15	1.6	19	56	46.2	6.96	0.44	20.71	23.2	2.49	54.61
BD-10584	3	14	1.8	17	49	51.6	6.72	0.42	20.53	23.3	2.72	63.75
BD-10585	4	12	1.4	16	42	50.2	7.40	0.46	21.18	26.4	2.84	105.83
BD-10586	4	13	1.2	17	40	47.0	6.74	0.48	12.95	24.1	2.81	40.89
BD-10587	4	14	2.2	18	42	59.4	7.26	0.48	9.73	21.5	2.91	27.02
BD-10588	4	14	1.4	18	40	58.4	7.42	0.46	9.00	22.7	3.14	32.62
BD-10589	3	15	1.8	18	40	49.0	7.50	0.44	6.64	19.2	2.35	42.52
BD-10590	4	13	1.0	17	41	51.4	7.42	0.44	10.64	20.5	2.19	34.56
BD-10591	4	14	1.8	18	45	60.4	7.50	0.48	12.86	23.4	3.26	54.73
BD-10733	3	15	1.4	18	45	52.2	6.78	0.44	19.14	22.7	1.98	76.33
BD-10734	4	13	2.2	17	47	45.2	7.30	0.46	14.00	21.8	2.05	43.95
BD-10735	4	12	1.4	16	48	45.4	7.16	0.44	12.94	22.6	2.06	38.86
BD-10736	4	13	1.6	17	50	52.6	6.52	0.46	22.56	23.2	3.29	65.72
BD-10739	4	13	2.6	17	57	43.4	6.58	0.44	27.00	24.9	1.89	38.32
BD-10740	3	14	2.8	17	47	53.2	6.70	0.46	10.55	19.1	2.60	36.47
BD-10741	3	14	2.6	17	56	43.6	6.78	0.48	13.33	20.7	2.60	28.65
BD-10742	4	14	2.4	18	55	46.8	6.74	0.42	24.40	23.4	2.32	38.97
BD-10743	4	13	2.2	17	53	43.0	6.88	0.44	10.23	23.1	3.07	21.70
BD-10744	4	13	2.4	17	50	41.4	6.18	0.52	3.75	19.0	2.58	32.54
BD-10745	4	14	2.0	18	47	36.4	6.36	0.54	19.23	21.2	3.78	26.53
BD-10746	4	15	2.8	19	53	53.6	6.94	0.38	18.89	21.7	2.38	44.97
BD-10747	4	15	2.4	19	53	46.8	6.90	0.50	19.75	21.2	2.40	33.44
BARI-2	5	12	2.2	18	53	31.35	6.72	0.44	8.44	19.3	2.55	32.12
BARI-3	4	14	2.4	19	50	29.7	6.86	0.52	24.50	21.3	2.55	85.24
BARI-4	4	13	1.8	17	47	34.71	7.22	0.50	10.42	20.1	2.70	29.55
BARI-5	5	12	2.0	18	45	36.49	7.00	0.54	25.65	21.8	2.90	41.25
BARI-6	4	14	1.6	19	51	33.06	6.80	0.44	4.29	16.4	2.53	48.57
BARI-7	5	14	2.4	18	45	33.49	7.22	0.58	14.00	17.2	3.40	43.48

11.9. Characterization of Bottle Gourd Germplasm

In bottle gourd, qualitative and quantitative traits were studied. Some characters showed pronounced variability as described below:

A. Qualitative Characters

Nineteen (19) qualitative characters were studied for 223 germplasm of bottle gourd (Table 54). These accessions showed variations under individual character. The Maximum variation was observed in fruit shape such as Globular, Oblong blocky, Pyriform, Dumbbell, Elongate form, Curved and Crooked neck. Among the total germplasm (223 acc.) 8.97% globular (20

acc.), 4.04% Oblong blocky (9 acc.), 62.78% pyriform (140 acc.), 0.456% Dumbbell (1 acc.), 15.70% elongate form (35 acc.), 0.456% curved (1 acc.) and 7.62% crooked neck (17 acc) followed by matured fruit skin color such as creamish, yellowish and green. These were 39.46% creamish (88 acc.), 56.95% yellowish (127 acc.), 3.59% green (8 acc.). Early plant vigor viz. poor 23.32% in 52 acc., good 46.19% in 103 acc. and very good 30.49% in 68 acc. were found. Variation was observed on leaf margin, 93.29% germplasm showed entire margin and 6.73% germplasm showed serrate leaf margin. No variability was observed on plant growth habit, stem pubescence, stem shape, tendril, tendril type, tendril branching, leaf shape, leaf pubescence density, calyx color, leaf pubescence density, sex type, flower color, fruit pubescence and fruit pubescence density (Table 54).

Table 54. Qualitative variation in bottle gourd germplasm

Character	Descriptor state	No. of germplasm	Variation (%)
Early plant vigor	Poor	52	23.32
	Good	103	46.19
	Very good	68	30.49
Plant growth habit	Light green	223	100
Stem pubescence	Dense	223	100
Stem shape	Angular	223	100
Tendril	Present	223	100
Tendril type	Coiled	223	100
Tendril branching	Branched	223	100
Leaf margin	Entire	208	93.27
	Serrate	15	6.73
Leaf shape	Cordate	223	100
Leaf size	Small	16	7.17
	Medium	142	63.68
	Large	65	100
Leaf pubescence nature	Intermediate	223	100
Calyx color	Green	223	100
Leaf pubescence density	Dense	223	100
Sex type	Monoecious	223	100
Corolla color	White	223	100
Fruit shape	Globular	20	8.97
	Oblong blocky	9	4.04
	Pyriform	140	62.78
	Dumbbell	1	0.45
	Elongate form	35	15.70
	Curved	1	0.45
	Crooked neck	17	7.62
Matured fruit skin color	Creamish	88	39.46
	Yellowish	127	56.95
	Green	8	3.59
Fruit pubescence	Present	223	100
Fruit pubescence density	Intermediate	223	100



Stem pubescence and shape



Variation in calyx



Variation in leaf margin and shape



Ovary shape and flower color of bottle gourd

Fig. 56. Stem pubescence and stem shape, leaf margin and leaf shape and variation in calyx, ovary and flower color of bottle gourd



Globular



Oblong blocky shape



Pyriform shape



Dumb bell shape



Curved shape

Fig. 57. Fruit shape of bottle gourd



Elongate form shape



Crooked neck shape

Cont'd Fig. 57. Friut shape of bottle gourd



Creamish



Yellowish



Green

Fig. 58. Matured friut skin color of bottle gourd

B. Quantitative Characters

All (223 germplasm) germplasm relating to fifteen (15) important quantitative traits showed variations on different traits. Range, mean, standard deviation (SD) and percent of coefficient of variation (CV %) indicated their comparative performances on different characters. The mean value was observed in case of yield per plant was 26.26 kg, days to edible fruit was 125.73 days, days to 1st male flower was 96.00 days, days to 1st female flower was 98.35 days. The range of number of fruits per plant was 1 to 7, fruit weight at matured stage was 1.28 to 15.64 kg, days to edible fruit was 108.77 to 140.17 days and yield per plant was 1.92 to 55.98 kg. The highest standard deviation (SD) was found in 1000 seed weight (49.49) and the lowest in number of fruits per plant (1.75). The maximum coefficient of variation was obtained on petiole length (84.38%) followed by yield per plant (41.40%) (Table 55). Percent of coefficient of variation indicated the variability among the germplasm comparing within the characters. The frequency distribution was high for days to edible fruit and yield per plant.

Table 55. Quantitative variation in bottle gourd germplasm

Trait	Range		Mean	SE	SD	CV (%)
	Min	Max				
Days to seed germination	7.2	19	11.67	0.18	2.72	24.58
Internode length (cm)	6.4	19.2	11.98	0.15	2.26	19.11
Petiole length (cm)	7.86	190.86	14.30	0.81	12.02	84.38
Days to 1 st female flowering	80.67	111.67	98.35	0.44	6.5	6.72
Nodal position of 1st female flower	3.72	17.34	10.08	0.18	2.68	26.63
Days to 1st male flower	80.3	127.3	96.00	0.75	11.21	11.31
Nodal position of 1st male flower	3.37	28.37	13.92	0.28	4.12	29.92
Peduncle length (cm)	7.55	20.42	13.22	0.16	2.38	17.33
Days to edible fruit	108.77	140.17	125.73	0.45	6.71	5.31
Fruit length (cm)	13.84	96.84	41.57	0.83	12.32	29.75
Fruit width (cm)	11.44	33.09	17.89	0.25	3.79	21.12
Fruit weight at matured stage (kg)	1.28	15.64	8.75	0.16	2.44	28.19
1000 seed wt. (g)	51.24	431.24	252.29	3.33	49.49	19.57
Number of fruits per plant	1.00	7.00	3.23	0.12	1.75	30.98
Yield per plant (kg)	1.92	55.98	26.26	0.73	10.78	41.40

Table 56. Qualitative information of bottle gourd germplasm

Acc. No.	Early plant vigor	Plant growth habit	Stem Pubescence	Stem shape	Tendrils	Tendrils type	Tendrils branching	Leaf margin	Leaf shape	leaf size	Leaf pubescence nature	Leaf pubescence density	Sex type	Flower color	Fruit shape	Fruit skin Color	Fruit pubescence	Fruit pubescence density
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
BD-375	3	3	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-376	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	3	1	5
BD-380	7	5	7	2	1	1	2	1	1	3	5	7	1	1	13	1	1	5
BD-382	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-383	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-384	7	3	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-389	7	5	7	2	1	1	2	1	1	7	5	7	1	1	1	2	1	5
BD-390	5	7	7	2	1	1	2	1	1	7	5	7	1	1	1	1	1	5
BD-391	5	5	7	2	1	1	2	1	1	5	5	7	1	1	1	1	1	5
BD-394	5	7	7	2	1	1	2	1	1	5	5	7	1	1	1	1	1	5
BD-397	3	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-398	3	7	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-403	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-404	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-405	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-407	3	5	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-408	7	7	7	2	1	1	2	1	1	5	5	7	1	1	9	1	1	5
BD-412	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-416	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-419	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-423	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-424	5	7	7	2	1	1	2	1	1	3	5	7	1	1	9	1	1	5
BD-425	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-426	5	7	7	2	1	1	2	1	1	7	5	7	1	1	9	1	1	5
BD-428	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-432	3	5	7	2	1	1	2	1	1	5	5	7	1	1	14	2	1	5
BD-435	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-438	5	5	7	2	1	1	2	1	1	5	5	7	1	1	14	2	1	5
BD-441	5	7	7	2	1	1	2	1	1	5	5	7	1	1	4	1	1	5
BD-442	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-445	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-448	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-449	7	7	7	2	1	1	2	1	1	5	5	7	1	1	8	2	1	5
BD-450	3	7	7	2	1	1	2	1	1	5	5	7	1	1	9	G	1	5
BD-452	7	7	7	2	1	1	2	1	1	5	5	7	1	1	9	G	1	5
BD-453	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	G	1	5
BD-454	5	5	7	2	1	1	2	1	1	3	5	7	1	1	7	G	1	5
BD-455	5	5	7	2	1	1	2	1	1	5	5	7	1	1	9	G	1	5
BD-456	5	5	7	2	1	1	2	1	1	5	5	7	1	1	14	1	1	5
BD-457	3	7	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-458	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-459	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-460	5	5	7	2	1	1	2	2	1	5	5	7	1	1	7	2	1	5
BD-463	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-4525	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4527	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4528	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5

Table 56. Cont'd

Acc. No.	Early plant vigor	Plant growth habit	Stem Pubescence	Stem shape	Tendrils	Tendrils type	Tendrils branching	Leaf margin	Leaf shape	leaf size	Leaf pubescence nature	Leaf pubescence density	Sex type	Flower color	Fruit shape	Fruit skin Color	Fruit pubescence	Fruit pubescence density
BD-4531	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4533	7	7	7	2	1	1	2	1	1	5	5	7	1	1	4	1	1	5
BD-4537	5	3	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4539	5	3	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-4540	3	3	7	2	1	1	2	1	1	5	5	7	1	1	7	3	1	5
BD-4542	3	7	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-4543	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4548	3	3	7	2	1	1	2	1	1	5	5	7	1	1	9	2	1	5
BD-4549	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4550	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4551	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-4552	7	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-4553	3	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-4554	7	5	7	2	1	1	2	1	1	5	5	7	1	1	1	1	1	5
BD-4555	5	7	7	2	1	1	2	1	2	5	5	7	1	1	7	2	1	5
BD-4556	7	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-4557	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4558	5	5	7	2	1	1	2	1	1	7	5	7	1	1	1	2	1	5
BD-4561	5	5	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-4562	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-4563	5	3	7	2	1	1	2	1	1	5	5	7	1	1	1	1	1	5
BD-4564	5	7	7	2	1	1	2	1	1	5	5	7	1	1	1	1	1	5
BD-4565	5	5	7	2	1	1	2	1	2	5	5	7	1	1	9	1	1	5
BD-4566	3	3	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-4567	3	3	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4568	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4569	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-4570	3	7	7	2	1	1	2	1	1	7	5	7	1	1	14	1	1	5
BD-4571	5	7	7	2	1	1	2	1	1	7	5	7	1	1	1	1	1	5
BD-4572	3	7	7	2	1	1	2	1	1	7	5	7	1	1	14	2	1	5
BD-4573	5	7	7	2	1	1	2	2	1	5	5	7	1	1	4	2	1	5
BD-4574	5	3	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-4575	3	3	7	2	1	1	2	1	1	7	5	7	1	1	1	1	1	5
BD-4576	7	5	7	2	1	1	2	1	1	5	5	7	1	1	1	1	1	5
BD-4577	7	7	7	2	1	1	2	1	1	7	5	7	1	1	4	1	1	5
BD-4578	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-4579	5	5	7	2	1	1	2	2	1	5	5	7	1	1	1	1	1	5
BD-4580	3	3	7	2	1	1	2	2	1	5	5	7	1	1	7	2	1	5
BD-4581	5	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-4582	5	7	7	2	1	1	2	2	1	5	5	7	1	1	14	2	1	5
BD-4583	7	7	7	2	1	1	2	1	1	7	5	7	1	1	14	2	1	5
BD-4584	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-4585	3	7	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-4597	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-4598	5	7	7	2	1	1	2	2	1	7	5	7	1	1	7	2	1	5
BD-4599	3	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-4600	5	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-4602	5	5	7	2	1	1	2	1	1	7	5	7	1	1	4	2	1	5
BD-4603	5	5	7	2	1	1	2	1	1	5	5	7	1	1	1	1	1	5

Table 56. Cont'd

Acc. No.	Early plant vigor	Plant growth habit	Stem Pubescence	Stem shape	Tendrils	Tendrils type	Tendrils branching	Leaf margin	Leaf shape	leaf size	Leaf pubescence nature	Leaf pubescence density	Sex type	Flower color	Fruit shape	Fruit skin Color	Fruit pubescence	Fruit pubescence density
BD-4604	3	3	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-8935	5	3	7	2	1	1	2	1	1	7	5	7	1	1	4	1	1	5
BD-8936	3	3	7	2	1	1	2	1	1	3	5	7	1	1	4	2	1	5
BD-8939	3	5	7	2	1	1	2	2	1	5	5	7	1	1	7	2	1	5
BD-8940	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-8942	7	7	7	2	1	1	2	1	1	3	5	7	1	1	9	1	1	5
BD-8943	5	7	7	2	1	1	2	1	1	5	5	7	1	1	1	1	1	5
BD-8944	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-8945	5	5	7	2	1	1	2	1	1	5	5	7	1	1	14	2	1	5
BD-8946	3	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-8947	5	7	7	2	1	1	2	1	1	5	5	7	1	1	14	2	1	5
BD-8949	3	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-8950	3	7	7	2	1	1	2	2	1	5	5	7	1	1	7	2	1	5
BD-8952	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-8954	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-8955	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-8956	7	5	7	2	1	1	2	1	1	5	5	7	1	1	14	2	1	5
BD-8957	7	5	7	2	1	1	2	1	1	3	5	7	1	1	9	1	1	5
BD-8958	7	3	7	2	1	1	2	1	1	3	5	7	1	1	9	2	1	5
BD-8959	7	5	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-8960	7	7	7	2	1	1	2	2	1	5	5	7	1	1	14	2	1	5
BD-8961	7	7	7	2	1	1	2	2	1	5	5	7	1	1	7	1	1	5
BD-8962	7	7	7	2	1	1	2	2	1	5	5	7	1	1	1	1	1	5
BD-8963	7	7	7	2	1	1	2	2	1	5	5	7	1	1	7	1	1	5
BD-8964	7	5	7	2	1	1	2	1	1	5	5	7	1	1	9	2	1	5
BD-8965	5	7	7	2	1	1	2	1	1	7	5	7	1	1	9	1	1	5
BD-8966	5	5	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-8968	7	7	7	2	1	1	2	2	1	7	5	7	1	1	7	1	1	5
BD-8971	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-8972	7	5	7	2	1	1	2	2	1	5	5	7	1	1	14	1	1	5
BD-8973	5	7	7	2	1	1	2	1	1	7	5	7	1	1	9	1	1	5
BD-8974	7	7	7	2	1	1	2	1	1	3	5	7	1	1	4	2	1	5
BD-8975	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-8976	5	5	7	2	1	1	2	1	1	5	5	7	1	1	9	2	1	5
BD-8977	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-8978	5	5	7	2	1	1	2	1	1	7	5	7	1	1	9	2	1	5
BD-8985	7	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-8988	3	7	7	2	1	1	2	1	1	5	5	7	1	1	1	1	1	5
BD-9617	3	7	7	2	1	1	2	1	1	7	5	7	1	1	9	2	1	5
BD-9618	5	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-9620	7	5	7	2	1	1	2	1	1	5	5	7	1	1	9	2	1	5
BD-9621	5	5	7	2	1	1	2	1	1	3	5	7	1	1	7	1	1	5
BD-9624	3	7	7	2	1	1	2	1	1	3	5	7	1	1	7	2	1	5
BD-9625	5	7	7	2	1	1	2	1	1	5	5	7	1	1	9	1	1	5
BD-9630	7	5	7	2	1	1	2	1	1	5	5	7	1	1	1	2	1	5
BD-9635	5	7	7	2	1	1	2	1	1	5	5	7	1	1	14	1	1	5
BD-9637	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-9638	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-9641	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5

Table 56. Cont'd

Acc. No.	Early plant vigor	Plant growth habit	Stem Pubescence	Stem shape	Tendrils	Tendrils type	Tendrils branching	Leaf margin	Leaf shape	leaf size	Leaf pubescence nature	Leaf pubescence density	Sex type	Flower color	Fruit shape	Fruit skin Color	Fruit pubescence	Fruit pubescence density
BD-9648	5	5	7	2	1	1	2	1	1	7	5	7	1	1	7	1	1	5
BD-9740	3	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
BD-9844	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-10327	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-10545	5	5	7	2	1	1	2	1	1	5	5	7	1	1	1	2	1	5
BD-10547	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-10548	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-10549	7	7	7	2	1	1	2	2	1	7	5	7	1	1	7	2	1	5
BD-10556	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BD-11453	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
BD-11454	5	5	7	2	1	1	2	1	1	3	5	7	1	1	7	2	1	5
BD-9958	5	3	7	2	1	1	2	1	1	5	5	7	1	1	14	2	1	5
BARI-1	7	5	7	2	1	1	2	1	1	3	5	7	1	1	9	2	1	5
BARI-2	7	5	7	2	1	1	2	1	1	5	5	7	1	1	4	1	1	5
BARI-3	7	5	7	2	1	1	2	1	1	5	5	7	1	1	9	2	1	5
BARI-4	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
BARI-5	7	5	7	2	1	1	2	1	1	5	5	7	1	1	14	3	1	5
AC-16	5	3	7	2	1	1	2	1	1	3	5	7	1	1	1	1	1	5
AC-34	5	5	7	2	1	1	2	1	1	3	5	7	1	1	7	2	1	5
AC-41	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	3	1	5
AC-76	7	5	7	2	1	1	2	1	1	5	5	7	1	1	14	2	1	5
AC-93	7	3	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
AC-101	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
AC-106	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
AC-121	3	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
AC-139	7	3	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
AC-216	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
AC-246	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
AC-297	5	5	7	2	1	1	2	1	1	5	5	7	1	1	9	3	1	5
AC-302	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
AC-334	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
AC-349	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
AC-405	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
AC-414	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
AC-494	5	3	7	2	1	1	2	1	1	3	5	7	1	1	7	2	1	5
AHM-01	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
AHM-23	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
AHM-157	7	5	7	2	1	1	2	1	1	5	5	7	1	1	7	3	1	5
AHM-168	7	5	7	2	1	1	2	1	1	7	5	7	1	1	9	2	1	5
RAI-01	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
RAI-11	3	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
RAI-15	5	3	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
RAI-62	7	5	7	2	1	1	2	1	1	5	5	7	1	1	9	1	1	5
AH-16	7	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
AH-23	3	7	7	2	1	1	2	1	1	5	5	7	1	1	7	3	1	5
IA-02	7	5	7	2	1	1	2	1	1	7	5	7	1	1	9	3	1	5
IA-03	7	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
IA-04	3	7	7	2	1	1	2	1	1	7	5	7	1	1	9	2	1	5
IA-26	3	5	7	2	1	1	2	1	1	7	5	7	1	1	9	2	1	5

Table 56. Cont'd

Acc. No.	Early plant vigor	Plant growth habit	Stem Pubescence	Stem shape	Tendrils	Tendrils type	Tendrils branching	Leaf margin	Leaf shape	leaf size	Leaf pubescence nature	Leaf pubescence density	Sex type	Flower color	Fruit shape	Fruit skin Color	Fruit pubescence	Fruit pubescence density
IA-45	3	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
IA-54	5	5	7	2	1	1	2	1	1	5	5	7	1	1	9	2	1	5
IA-61	7	5	7	2	1	1	2	1	1	5	5	7	1	1	9	2	1	5
IA-73	7	5	7	2	1	1	2	1	1	5	5	7	1	1	9	2	1	5
IA-74	5	5	7	2	1	1	2	1	1	5	5	7	1	1	9	1	1	5
AMA-319	5	7	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
AMA-340	3	5	7	2	1	1	2	1	1	5	5	7	1	1	9	1	1	5
AMA-387	3	5	7	2	1	1	2	1	1	5	5	7	1	1	9	1	1	5
AMA-418	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
AM-13	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
AM-14	3	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
AM-51	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
MAH-31	3	5	7	2	1	1	2	1	1	7	5	7	1	1	9	2	1	5
MAH-111	3	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
RC-25	3	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
RC-91	5	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
RC-141	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
RC-147	5	7	7	2	1	1	2	1	1	5	5	7	1	1	14	2	1	5
RC-158	5	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
MTR-82	5	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
RC-58	3	3	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
KMR-300	5	3	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
M-49	5	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
RC-163	7	5	7	2	1	1	2	1	1	7	5	7	1	1	7	2	1	5
R-246	5	5	7	2	1	1	2	1	1	5	5	7	1	1	9	1	1	5
KASI-54	5	5	7	2	1	1	2	1	1	5	5	7	1	1	1	2	1	5
TR-11	5	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5
ZS-09	5	5	7	2	1	1	2	1	1	5	5	7	1	1	7	1	1	5
B-33	7	7	7	2	1	1	2	1	1	5	5	7	1	1	7	2	1	5

Table 57. Quantitative information of bottle gourd germplasm

Acc. no.	Days to seed germination	Internode length (cm)	Petiole length (cm)	Days to 1 st female flower	Nodal position of 1 st female flower	Days to 1 st male flower	Nodal position of 1 st male flower	Peduncle length (cm)	Days to seed germination	Fruit length (cm)	Fruit width (cm)	Fruit weight at matured stage (kg)	1000 seed wt. (g)	Number of fruits per plant	Yield per plant (kg)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
BD-375	10	15.4	7.8	99	6	119	10	13.80	132	30.50	20.50	10.23	220.0	4	40.93
BD-376	10	13.6	8.2	94	9	109	11	11.00	124	56.50	19.00	12.73	290.0	4	50.93
BD-380	11	11.8	8	111	5	90	5	12.80	112	96.50	14.00	8.20	217.5	3	24.60
BD-382	11	12	11.2	102	8	84	11	12.00	140	35.50	17.00	8.43	320.0	4	33.73
BD-383	12	15.6	10.8	101	7	109	13	16.80	132	36.67	14.00	5.98	222.5	4	23.90
BD-384	10	10.4	11.8	88	9	103	18	10.50	120	35.00	23.50	13.03	250.0	4	52.13
BD-389	10	14.6	12	94	9	103	9	9.25	125	21.20	22.00	7.37	300.0	4	29.47
BD-390	12	14.8	14.2	103	15	112	22	16.80	125	23.50	27.50	13.67	275.0	3	41.00
BD-391	10	12.6	14.2	106	11	127	28	14.25	140	19.67	19.00	7.20	101.0	4	28.80
BD-394	9	14.8	14.2	96	10	109	14	12.20	125	23.50	21.50	10.20	280.0	3	30.60
BD-397	12	12.2	14.2	99	11	109	19	15.25	132	23.00	25.00	11.33	240.0	4	45.33
BD-398	11	12	15.2	96	12	109	16	14.00	126	24.67	24.33	10.38	265.0	2	20.77
BD-403	11	11.8	14	96	11	104	16	17.00	119	26.33	27.67	12.09	265.0	3	36.28
BD-404	13	11	13.4	99	11	112	9	16.67	127	17.87	18.55	6.61	267.5	4	26.44
BD-405	11	11.6	13.8	99	10	112	16	13.67	132	17.87	18.33	6.51	85.0	2	13.02
BD-407	11	11.6	13.2	96	12	84	17	16.50	127	50.50	17.50	10.83	295.0	3	32.50
BD-408	9	12	13.8	94	14	106	14	14.00	125	42.20	15.20	6.83	282.5	4	27.33
BD-412	12	14.8	14.2	109	11	109	17	20.00	140	36.67	14.00	5.98	235.0	4	23.90
BD-416	12	13.2	13.2	99	14	107	21	15.00	129	33.00	26.67	11.47	235.0	3	34.40
BD-419	12	14	13.2	94	7	107	16	13.33	140	27.00	19.00	12.05	215.0	3	36.15
BD-423	14	13	14.4	94	8	104	13	9.60	125	33.25	19.00	7.38	285.0	3	22.14
BD-424	9	11.2	14.2	91	6	104	14	11.00	121	36.00	13.50	6.27	252.5	2	12.53
BD-425	11	16	16	105	8	117	15	14.50	134	39.00	18.00	10.07	330.0	2	20.13
BD-426	15	13.4	13.6	96	9	110	16	16.67	127	53.50	14.00	7.87	216.0	4	31.47
BD-428	10	13.4	12.6	103	13	119	14	13.50	132	32.00	26.67	11.67	225.0	3	35.01
BD-432	15	10.6	12.6	98	4	108	13	10.75	132	42.00	16.00	10.20	185.0	4	40.80
BD-435	12	12	12.6	98	5	110	15	12.50	134	33.00	18.00	9.17	215.0	2	18.33
BD-438	15	12	10	95	7	112	16	16.00	130	33.00	26.77	11.67	235.0	4	46.68
BD-441	11	14	190.4	94	9	105	13	14.50	131	33.00	17.00	10.20	257.5	1	10.20
BD-442	15	14.6	9.2	94	8	104	11	10.40	132	34.00	26.78	11.68	278.0	4	46.72
BD-445	11	10.2	8.6	93	8	107	10	19.00	132	46.50	18.00	10.33	287.5	3	31.00
BD-448	12	15.6	7.4	92	8	81	11	13.25	132	33.00	25.00	15.20	215.0	3	45.60
BD-449	12	14.4	12.2	95	14	104	8	13.40	117	46.40	16.40	7.60	275.0	3	22.80
BD-450	9	10	12.4	95	9	83	10	12.80	131	44.50	15.00	8.13	277.5	2	16.27
BD-452	12	9.8	10.4	92	9	83	13	13.00	138	46.67	15.33	6.96	282.5	2	13.92
BD-453	15	13.8	11.2	99	9	83	21	12.75	132	39.67	15.00	7.79	275.0	1	7.79
BD-454	13	18.8	10	107	8	95	23	14.25	132	54.22	15.50	6.65	218.0	3	19.95
BD-455	11	8.2	8.4	105	9	83	18	11.00	134	53.25	14.50	6.48	266.5	2	12.96
BD-456	14	13	11.4	91	5	83	14	13.25	123	42.00	17.00	10.52	200.0	4	42.08
BD-457	12	8.4	13.2	96	10	81	13	17.50	127	48.50	17.50	10.57	271.0	3	31.70
BD-458	16	12	11.4	99	11	83	14	13.67	129	40.00	16.00	10.20	50.00	2	20.40
BD-459	12	12.8	11.6	95	8	82	11	10.33	140	51.67	15.67	7.97	210.0	4	31.87
BD-460	12	11.8	10.8	99	7	84	16	16.00	129	32.67	15.47	6.84	229.0	4	27.36
BD-463	18	11.6	13.2	109	15	84	18	14.50	131	40.50	14.50	7.67	285.0	4	30.67
BD-4525	10	14.2	12.2	87	8	102	23	11.00	124	39.00	18.00	12.35	270.0	4	49.40
BD-4527	12	15.6	12	95	14	83	16	8.60	131	34.67	16.33	7.06	275.0	4	28.23

Table 57. Cont'd

Acc. no.	Days to seed germination	Internode length (cm)	Petiole length (cm)	Days to 1 st female flower	Nodal position of 1 st female flower	Days to 1 st male flower	Nodal position of 1 st male flower	Peduncle length (cm)	Days to seed germination	Fruit length (cm)	Fruit width (cm)	Fruit weight at matured stage (kg)	1000 seed wt. (g)	Number of fruits per plant	Yield per plant (kg)
BD-4528	10	8.6	10.2	96	13	81	17	13.25	131	45.33	15.33	6.83	237.5	3	20.50
BD-4531	12	12.4	12.4	92	11	81	18	14.00	131	48.33	16.33	8.31	320.0	3	24.93
BD-4533	9	11.8	12.6	94	10	103	23	12.00	115	51.00	17.00	11.65	270.0	1	11.65
BD-4537	10	11.8	13.4	102	14	111	13	12.50	131	32.67	15.33	6.96	211.0	1	6.96
BD-4539	11	10.6	12.4	95	11	81	17	13.50	128	39.67	19.33	8.51	255.0	3	25.53
BD-4540	12	14	11.4	99	9	81	19	13.25	128	39.67	15.00	7.79	225.0	4	31.15
BD-4542	11	9.4	11	99	16	82	14	14.50	129	54.00	18.00	10.60	285.0	5	53.00
BD-4543	9	11.2	13.2	106	11	109	9	15.00	130	49.00	16.00	9.00	330.0	3	27.00
BD-4548	9	14.2	12	94	10	104	15	11.33	128	52.00	18.00	9.45	235.0	4	37.80
BD-4549	12	7.6	12.2	106	13	109	21	10.40	130	51.00	17.00	9.30	225.0	4	37.20
BD-4550	11	7.8	12.6	100	13	81	10	13.50	131	41.50	14.00	7.03	230.0	3	21.10
BD-4551	12	13.4	13.4	92	10	104	14	13.25	119	41.00	11.50	5.47	252.5	4	21.87
BD-4552	13	11.2	12.6	93	10	104	14	13.50	118	21.67	14.33	5.03	221.5	3	15.10
BD-4553	12	12.6	13	106	12	107	16	12.00	134	25.67	32.00	13.43	267.5	4	53.70
BD-4554	12	10.6	10.6	96	17	108	15	9.67	121	31.00	14.00	8.40	197.5	4	33.60
BD-4555	12	11.4	13.6	91	9	81	10	10.33	123	42.33	18.00	10.43	320.0	3	31.28
BD-4556	9	11.8	13.8	94	15	104	20	15.00	127	49.33	17.00	9.13	277.5	2	18.25
BD-4557	12	11.8	12.8	105	14	105	17	12.67	127	51.67	15.67	7.97	272.5	2	15.93
BD-4558	9	10.6	14	102	15	104	15	12.60	128	20.33	20.67	7.97	270.0	3	23.90
BD-4561	12	8.4	14	95	14	82	7	13.00	125	38.00	21.50	12.27	430.0	2	24.53
BD-4562	11	10.8	14	102	13	81	11	11.00	129	45.00	17.75	8.05	325.0	4	32.20
BD-4563	11	10.8	13.6	104	9	84	10	16.33	125	25.00	25.00	11.73	275.0	2	23.47
BD-4564	10	11.2	13.8	96	11	81	12	10.67	126	22.33	22.33	10.21	247.5	4	40.83
BD-4565	10	8.6	13.8	106	10	81	8	12.00	121	40.50	12.50	6.03	269.0	3	18.10
BD-4566	11	11.4	12	95	9	81	16	8.33	123	55.67	18.67	9.32	270.0	3	27.95
BD-4567	15	13	14	105	13	82	16	12.75	129	31.00	18.50	8.70	210.0	2	17.40
BD-4568	11	14.4	14.8	103	14	109	13	10.50	124	54.00	15.00	6.42	365.0	2	12.84
BD-4569	13	11	13.6	104	11	111	10	9.75	129	40.67	17.33	7.43	249.0	3	22.30
BD-4570	15	15.8	14.2	83	12	94	23	10.00	139	51.00	20.00	11.97	66.00	3	35.90
BD-4571	13	11.2	12.8	102	9	81	12	10.00	129	30.00	19.50	9.17	262.5	4	36.67
BD-4572	15	12.8	15	105	9	81	10	10.33	131	42.50	13.50	6.57	250.0	4	26.27
BD-4573	12	12.2	16	103	10	105	6	13.00	129	31.00	18.50	8.70	242.5	4	34.80
BD-4574	18	8.8	14.4	94	11	103	13	14.00	122	51.00	20.00	11.97	257.5	4	47.87
BD-4575	12	10.6	14	105	10	82	14	11.00	129	18.50	20.50	9.57	240.0	3	28.70
BD-4576	12	14.6	14	90	7	103	16	16.25	118	19.50	23.50	7.96	270.0	2	15.92
BD-4577	17	13.8	10.8	93	9	81	18	13.00	127	35.50	17.50	9.53	235.0	4	38.13
BD-4578	12	12.6	13.6	95	9	105	14	9.50	121	28.00	20.00	10.63	250.0	4	42.53
BD-4579	16	12.2	14	105	10	82	8	13.50	117	21.50	24.50	11.83	305.0	2	23.67
BD-4580	14	10.4	13.2	88	6	105	14	12.00	132	25.00	25.00	12.47	260.0	2	24.93
BD-4581	14	9.8	13	95	11	104	21	12.50	123	46.00	22.00	14.23	320.0	3	42.70
BD-4582	15	12.2	12.2	103	18	108	8	11.00	125	55.00	16.00	10.15	242.0	3	30.45
BD-4583	12	11.2	14.2	94	11	104	18	13.00	132	57.00	17.00	10.13	345.0	3	30.40
BD-4584	15	10.6	14	104	13	106	15	11.50	125	51.00	20.00	11.97	287.5	3	35.90
BD-4585	12	9.4	15.2	102	11	108	12	14.50	132	34.00	26.50	12.40	260.0	3	37.20
BD-4597	8	7	14.2	95	13	105	7	14.33	117	58.00	18.00	10.40	290.0	2	20.80
BD-4598	11	11.6	13.6	103	11	83	16	10.00	129	47.00	15.00	7.97	290.0	2	15.93
BD-4599	11	14.4	14	106	8	83	16	12.00	127	44.50	20.50	12.60	340.0	1	12.60
BD-4600	9	11.8	14.6	102	14	82	9	12.00	132	46.00	17.00	9.33	290.0	4	37.33

Table 57. Cont'd

Acc. no.	Days to seed germination	Internode length (cm)	Petiole length (cm)	Days to 1 st female flower	Nodal position of 1 st female flower	Days to 1 st male flower	Nodal position of 1 st male flower	Peduncle length (cm)	Days to seed germination	Fruit length (cm)	Fruit width (cm)	Fruit weight at matured stage (kg)	1000 seed wt. (g)	Number of fruits per plant	Yield per plant (kg)
BD-4602	11	10.6	14.4	92	11	105	17	11.75	118	43.67	17.67	8.57	255.0	5	42.83
BD-4603	11	8.4	14	94	8	106	15	15.00	120	20.33	21.33	8.76	280.0	2	17.52
BD-4604	11	15	14	98	5	111	16	11.00	132	54.50	13.50	8.60	270.0	1	8.60
BD-8935	12	11	13.6	87	5	104	4	13.00	119	25.00	18.50	7.47	190.0	3	22.40
BD-8936	16	10	15	104	8	91	16	10.50	119	42.00	15.00	9.00	222.0	3	27.00
BD-8939	16	14.4	14.6	105	6	95	22	12.67	119	43.00	14.00	8.45	242.0	3	25.35
BD-8940	16	9.4	15	95	11	105	14	13.50	119	22.67	24.67	10.57	257.5	3	31.70
BD-8942	9	12	15.4	88	6	103	14	12.00	118	89.33	17.67	10.97	300.0	2	21.93
BD-8943	11	11.8	15.4	98	11	103	8	12.00	128	16.50	29.00	14.00	330.0	2	28.00
BD-8944	9	9.8	15	105	9	82	15	10.67	129	14.50	18.00	7.47	215.0	3	22.40
BD-8945	9	13.2	15	95	11	104	16	12.25	131	49.50	16.00	8.33	224.0	2	16.67
BD-8946	12	13.8	15.2	100	10	81	15	12.33	130	57.00	16.00	9.67	347.5	3	29.00
BD-8947	9	13.8	15.4	95	11	102	7	13.50	116	53.50	13.00	6.57	277.5	2	13.13
BD-8949	11	8.6	14	94	9	82	16	10.33	130	44.67	15.33	7.21	257.5	3	21.63
BD-8950	16	12	13.2	100	11	105	10	13.67	124	42.50	21.50	12.00	250.0	2	24.00
BD-8952	11	13.4	14.6	95	10	81	16	12.50	122	46.50	15.00	8.63	240.0	3	25.90
BD-8954	9	16.8	15.6	95	11	104	7	15.67	123	50.67	19.00	9.70	295.0	2	19.40
BD-8955	14	11.8	15.8	95	13	104	11	10.00	124	44.00	14.50	7.20	60.00	3	21.60
BD-8956	9	13.2	16.2	87	7	102	9	16.00	138	50.00	17.50	11.07	260.0	1	11.07
BD-8957	9	13.2	14	81	9	105	21	11.67	119	40.50	16.00	8.57	340.0	3	25.70
BD-8958	12	14.2	16.2	83	10	91	13	13.00	138	34.00	16.00	5.60	280.0	4	22.40
BD-8959	8	15	14.4	91	11	91	12	11.75	136	43.00	14.00	8.45	216.0	2	16.90
BD-8960	9	12.6	12	94	12	81	13	10.33	125	42.00	12.50	6.00	195.0	5	30.00
BD-8961	12	12.4	13.6	95	15	81	12	14.00	130	69.35	14.45	8.73	235.0	2	17.47
BD-8962	8	11.6	16	92	10	100	14	11.75	114	21.50	22.00	10.20	275.0	4	40.80
BD-8963	8	10.2	16.2	94	13	104	18	12.25	123	19.50	18.50	8.23	220.0	3	24.70
BD-8964	9	9.4	17	94	11	104	19	13.50	128	69.33	14.33	8.73	290.0	3	26.20
BD-8965	9	13	16	91	7	82	12	15.50	127	52.00	20.00	10.93	310.0	3	32.80
BD-8966	10	11.2	13.6	93	11	103	15	11.00	117	54.50	15.50	6.80	300.0	4	27.20
BD-8968	9	7	14.6	98	12	82	13	13.33	131	43.00	18.50	8.57	200.0	4	34.27
BD-8971	12	12.4	14.6	95	8	104	14	14.00	121	48.00	18.00	10.80	330.0	4	43.20
BD-8972	9	9	14.6	88	7	104	15	13.75	118	55.33	19.67	10.84	345.0	4	43.37
BD-8973	9	8.4	14.6	95	10	103	7	12.33	118	47.50	17.50	10.40	270.0	2	20.80
BD-8974	9	8.6	13.8	92	11	104	11	13.25	111	38.33	15.67	8.27	240.0	1	8.27
BD-8975	8	11.2	14.2	84	6	90	10	13.25	119	42.60	17.60	7.46	272.5	3	22.38
BD-8976	8	10.4	13	92	11	103	17	14.20	119	43.50	17.50	9.00	160.0	1	9.00
BD-8977	12	8	13.4	96	8	81	19	15.33	130	53.25	18.50	9.16	285.0	1	9.16
BD-8978	12	9	14.2	92	9	105	14	9.25	121	42.50	19.50	9.90	267.5	4	39.60
BD-8985	16	8.2	13.6	95	10	106	11	14.00	121	65.00	16.33	9.18	285.0	2	18.37
BD-8988	16	11.8	13.6	99	11	91	17	14.75	130	16.50	18.50	7.67	230.0	2	15.33
BD-9617	11	13	13	90	7	105	19	14.75	122	50.00	21.50	13.10	257.5	2	26.20
BD-9618	12	6.2	14	95	9	103	10	13.20	127	39.00	20.50	8.30	285.0	3	24.90
BD-9620	9	8.8	13.2	94	12	104	16	13.00	124	62.00	17.50	10.00	280.0	3	30.00
BD-9621	12	13	13.8	103	14	84	21	13.00	130	47.00	20.50	11.13	285.0	3	33.40
BD-9624	12	13.4	12.4	106	12	107	17	11.50	121	41.50	11.50	5.27	142.0	4	21.07
BD-9625	9	8.6	13.6	87	8	97	13	11.75	112	42.60	15.20	6.27	265.0	4	25.07
BD-9630	9	9.2	12	92	9	95	9	17.50	131	33.00	32.00	4.20	242.0	4	16.80
BD-9635	11	9	12.4	92	10	106	17	14.25	124	40.00	11.00	6.65	245.0	4	26.60

Table 57. Cont'd

Acc. no.	Days to seed germination	Internode length (cm)	Petiole length (cm)	Days to 1 st female flower	Nodal position of 1 st female flower	Days to 1 st male flower	Nodal position of 1 st male flower	Peduncle length (cm)	Days to seed germination	Fruit length (cm)	Fruit width (cm)	Fruit weight at matured stage (kg)	1000 seed wt. (g)	Number of fruits per plant	Yield per plant (kg)
BD-9637	15	14.4	13	104	11	108	18	14.00	132	46.00	16.50	9.03	235.0	2	18.07
BD-9638	11	13.4	13	95	10	108	14	17.67	129	22.50	19.50	6.46	277.5	2	12.92
BD-9641	11	15	14.2	83	4	106	14	13.75	123	38.33	15.00	6.35	145.0	3	19.05
BD-9648	14	12.8	11.4	92	8	104	16	11.50	125	55.00	12.00	8.00	218.0	3	24.00
BD-9740	18	12.2	12.8	106	7	107	15	13.25	127	32.33	12.00	4.30	152.0	4	17.20
BD-9844	7	13.4	13.6	95	11	106	10	15.00	134	43.00	14.00	6.93	222.5	4	27.73
BD-10327	12	10.2	14	86	5	86	4	12.67	110	22.00	21.00	11.55	265.0	4	46.20
BD-10545	8	12.8	12.4	103	14	104	12	15.00	132	29.00	13.00	7.25	252.0	4	29.00
BD-10547	8	12.6	14.4	94	9	105	10	16.25	125	45.00	17.00	2.45	232.0	4	9.80
BD-10548	11	12.6	14.2	94	10	104	8	12.25	122	51.00	20.00	3.21	257.5	4	12.84
BD-10549	7	11.8	13.6	94	9	106	11	14.75	123	45.75	16.00	6.10	230.0	4	24.40
BD-10556	11	12.6	13.4	94	10	105	14	16.25	123	42.00	15.50	8.20	335.0	2	16.40
BD-11453	8	10.6	13.2	95	8	105	10	12.20	129	59.00	20.50	13.23	232.5	3	39.70
BD-11454	8	7.4	13	86	6	87	8	13.75	117	34.00	18.50	8.17	240.0	2	16.33
BD-9958	8	14.6	14.8	95	9	105	11	9.60	129	39.75	12.50	4.54	220.0	4	18.16
BARI-1	8	10.6	13.6	92	6	104	9	9.00	129	41.00	12.00	5.03	227.5	2	10.07
BARI-2	8	10.2	14.4	95	9	83	10	11.40	129	21.00	16.50	7.63	202.5	4	30.53
BARI-3	11	10.4	15.2	99	10	104	16	12.80	127	43.00	16.00	10.75	290.0	3	32.25
BARI-4	14	13.8	17	94	7	100	6	13.80	127	55.00	15.00	6.44	290.0	4	25.76
BARI-5	12	7.8	12.4	96	7	82	9	12.60	126	42.00	15.00	9.20	266.0	2	18.40
AC-16	10	10.8	14	92	9	105	11	9.60	119	21.00	21.00	7.93	275.0	4	31.70
AC-34	11	12.6	10.4	91	9	102	10	7.75	129	44.33	13.67	6.39	300.0	2	12.78
AC-41	9	7.8	12.8	86	10	100	7	12.40	119	42.50	17.50	9.73	285.0	4	38.93
AC-76	16	13.8	13.2	94	12	106	23	19.00	126	44.25	13.50	4.82	220.0	2	9.64
AC-93	9	14.6	13.4	87	8	88	9	14.00	109	31.67	20.33	8.56	227.5	4	34.23
AC-101	11	12.8	13.2	94	9	95	12	16.00	135	50.00	19.00	3.50	217.5	2	7.00
AC-106	17	12.2	12.4	103	11	106	13	13.00	123	36.67	17.67	8.74	287.5	4	34.97
AC-121	18	12.4	13	95	7	105	16	16.25	123	44.00	18.00	9.20	272.5	4	36.80
AC-139	11	12.4	13.2	87	7	107	10	14.00	125	49.50	18.50	9.83	245.0	1	9.83
AC-216	18	12.8	13	95	8	109	16	16.00	135	55.00	18.50	11.97	275.0	4	47.87
AC-246	10	10.4	13.2	86	6	106	9	12.50	120	32.67	16.67	6.62	267.0	2	13.23
AC-297	18	7	13.4	92	9	100	14	9.60	116	60.00	12.00	1.24	195.0	2	2.48
AC-302	10	14.4	14	95	11	109	21	16.00	124	31.00	19.33	7.88	255.0	2	15.77
AC-334	14	9.4	14.2	91	10	87	7	10.00	116	39.00	14.00	6.15	205.0	3	18.45
AC-349	9	11.4	14.2	92	11	102	9	16.00	116	45.00	17.50	9.00	220.0	3	27.00
AC-405	16	14.6	14.2	107	9	83	14	10.00	127	40.00	15.00	2.45	212.0	1	2.45
AC-414	11	17.4	14.2	89	9	106	10	11.00	116	38.25	16.00	8.60	280.0	3	25.80
AC-494	8	13	13.8	106	4	84	8	12.00	114	45.75	15.75	5.95	215.0	3	17.85
AHM-01	8	12	13.2	87	9	95	12	12.75	111	46.00	15.50	7.63	260.0	3	22.90
AHM-23	8	10.6	14	96	12	104	17	16.50	120	46.00	20.00	8.00	200.0	4	32.00
AHM-157	8	13	13.6	86	7	87	6	13.75	109	29.80	20.00	6.87	250.0	3	20.60
AHM-168	8	15	13.4	87	8	109	18	12.00	127	51.33	18.00	8.25	320.0	3	24.75
RAI-01	8	13.2	14.2	94	13	104	14	11.33	116	41.00	12.00	5.97	190.0	4	23.87
RAI-11	8	9	13.8	104	11	106	13	9.00	127	52.00	15.50	7.67	232.5	3	23.00
RAI-15	8	12.6	13	86	7	91	7	11.00	119	55.50	18.50	9.80	230.0	5	49.00
RAI-62	8	12.2	13.2	82	6	91	11	14.00	109	39.67	16.33	8.98	285.0	4	35.93
AH-16	8	13.2	13.8	92	13	106	13	19.00	121	60.50	18.50	10.37	275.0	3	31.10
AH-23	8	8.2	14	94	7	102	9	13.00	120	42.00	19.00	7.00	315.0	4	28.00

Table 57. Cont'd

Acc. no.	Days to seed germination	Internode length (cm)	Petiole length (cm)	Days to 1 st female flower	Nodal position of 1 st female flower	Days to 1 st male flower	Nodal position of 1 st male flower	Peduncle length (cm)	Days to seed germination	Fruit length (cm)	Fruit width (cm)	Fruit weight at matured stage (kg)	1000 seed wt. (g)	Number of fruits per plant	Yield per plant (kg)
IA-02	8	9.2	13.2	92	15	106	14	14.00	119	57.00	17.00	9.83	265.0	4	39.33
IA-03	8	12.2	14	82	8	91	12	14.00	109	33.50	18.00	8.90	322.5	2	17.80
IA-04	8	7.6	12.8	95	9	106	13	13.33	119	40.00	17.00	9.47	252.5	4	37.87
IA-26	7	11.2	14.6	92	12	105	12	9.20	116	44.50	16.50	8.17	225.0	2	16.33
IA-45	8	7.8	14.2	92	11	106	20	12.75	131	42.00	17.00	4.00	257.5	4	16.00
IA-54	8	12.8	14	93	7	106	17	16.33	127	48.00	19.00	5.00	250.0	4	20.00
IA-61	7	13.6	13.6	81	6	91	11	13.25	110	61.00	16.25	8.03	290.0	4	32.12
IA-73	8	9	12	84	11	92	13	16.00	117	38.50	17.00	7.83	200.0	2	15.67
IA-74	8	9.4	13.2	92	8	104	17	17.20	134	29.67	15.00	6.18	185.0	4	24.70
AMA-319	8	14.8	14.6	84	10	107	16	14.00	119	49.67	14.75	6.87	185.0	4	27.48
AMA-340	9	9.2	14.6	106	9	83	14	14.75	134	50.33	17.00	8.95	260.0	2	17.90
AMA-387	9	12.4	14	107	11	104	13	11.80	120	40.33	16.00	6.95	275.0	4	27.80
AMA-418	14	13.2	13.6	107	13	83	16	17.00	132	28.33	24.33	9.78	290.0	2	19.57
AM-13	12	12.6	14.6	97	13	107	16	11.00	127	35.00	11.67	4.07	205.0	4	16.27
AM-14	12	12	14.6	104	13	108	16	12.00	128	52.00	13.00	3.20	292.5	4	12.80
AM-51	16	14.8	14.2	97	13	109	13	11.33	129	50.00	14.00	8.95	200.0	2	17.90
MAH-31	12	9.4	11.2	106	11	83	18	11.67	130	35.00	19.00	6.00	260.0	4	24.00
MAH-111	15	15.2	15.6	104	15	82	14	12.00	129	47.67	14.00	5.60	225.0	3	16.80
RC-25	15	10.4	13.6	106	7	90	19	13.00	135	59.00	15.00	10.05	210.0	2	20.10
RC-91	16	12.4	11	106	11	83	14	9.50	129	41.00	17.00	9.07	235.0	3	27.20
RC-141	16	12	12.8	96	11	82	15	8.75	129	40.00	12.67	5.09	190.0	3	15.28
RC-147	14	10.8	13.2	106	13	83	11	11.00	129	32.00	17.33	7.38	285.0	2	14.77
RC-158	17	10.2	13.8	95	10	82	17	12.00	120	53.50	18.00	10.30	210.0	3	30.90
MTR-82	14	16.4	13.8	95	8	84	11	13.00	122	42.00	18.00	4.00	200.0	3	12.00
RC-58	18	14.4	14	104	10	104	13	11.00	130	53.50	16.50	8.33	220.0	4	33.33
KMR-300	18	13	13.8	107	11	89	21	12.50	124	38.67	13.67	5.67	265.0	3	17.00
M-49	18	13	13.8	109	16	91	18	16.00	136	39.67	17.00	8.15	240.0	3	24.45
RC-163	14	14	14.8	95	10	108	16	15.60	123	44.50	16.50	8.77	257.5	2	17.53
R-246	11	13.8	14	96	8	105	14	17.00	123	42.50	18.50	10.80	240.0	3	32.40
KASI-54	18	15	12.2	104	11	109	9	16.00	129	22.00	23.67	14.43	225.0	4	57.73
TR-11	15	7.8	13.6	106	9	83	14	15.67	121	27.00	26.33	12.46	300.0	3	37.38
ZS-09	12	10.2	13.4	96	7	108	14	15.50	124	52.25	17.75	8.61	280.0	3	25.83
B-33	9	8.8	14.4	87	5	88	10	14.67	129	61.33	14.33	7.03	215.0	3	21.10

Conclusion

Based on the study, characterization and identification of 34 qualitative and quantitative traits of 218 germplasm and 5 check varieties were performed a wide variation. Finally, the seeds are preserved as active and base collections for future utilization.

11.3.9. Characterization of Amaranth Germplasm

A. Qualitative Descriptors

Qualitative characters of different accessions of amaranth are presented in Table 58. After sowing, plants were emerged at varied speed of growth as poor (31.25% accessions), good (37.5%) and very good (31.25%) (Fig. 59). On the basis of leaf, stem and grain quality, the whole accessions were classified as leaf, stem and grain amaranth. Among them, 57.5% accessions were identified as leaf amaranth, 26.25% accessions were identified as stem amaranth and the rest 16.25% were classified as grain amaranth.. Most of the accessions grew up erectly (77.5%), some showed spreading (21.25%) type of growth habit and only one accession with drooping attitude (1.25%) (Fig. 60). Among the accessions, 17.5% had green colored leaves, 16.25% had reddish green leaves, 6.25% had red colored leaves and 60% had dark red colored leaves. Furthermore, the accessions were flashed with different colored inflorescence such as yellowish orange (1.25%), purple (5%), red (3.75%), reddish green (61.25%) and green (28.75%) (Fig. 61). However, inflorescence compactness was more or less equally intermediate (52.5%) and dense (47.5%) type. Whereas, maximum (72.5%) accessions showed red color stem, only a few (6.25%) exhibited reddish green color stem and rest (21.25%) of the accessions showed green color stem (Fig. 62C). Nevertheless, all (98.75%) but one accessions demonstrated ridged stem surface and one (1.25%) had smooth stem surface (Fig. 62B). Globose (6.25%), semi drooping (28.75%), completely drooping (15%) and straight (50%) shaped inflorescence was observed among the accessions (Fig. 63). Where, inflorescence spininess attitude was smooth (65%), prickly (22.5%) and spiny (12.5%) (Fig. 62A). Low seed shattering character was found in 30% accession, intermediate type was observed in 13.75%, but more than half (56.25%) accessions had high seed shattering character. Finally, half of the accessions (50%) showed black colored seed, red colored seed was observed in 48.75% accessions and only one (1.25%) gave greenish colored seed. The qualitative descriptors for individual germplasm are presented in Table 58.



Fig. 59. Early vigor of amaranth germplasm



Fig. 60. Growth habit of amaranth germplasm



Fig. 61. Inflorescence color of test amaranth germplasm

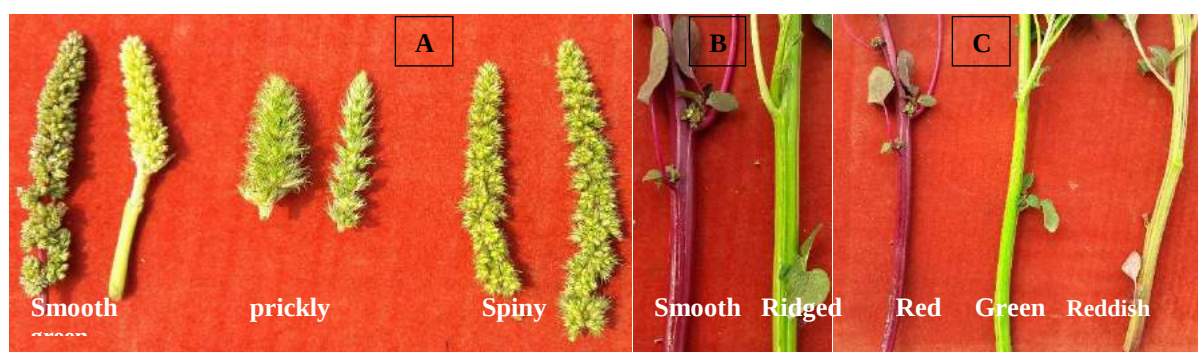


Fig. 62. Inflorescence spininess (A), stem shape (B) and stem color (C) of test amaranth germplasm



Fig. 63. Inflorescence shape of test amaranth germplasm

Table 58. Qualitative variations in amaranth germplasm

Name of Descriptor	Descriptor state	No. of germplasm	Percentage (%)
Classes	1 Leaf amaranth	46	57.5
	2 Stem amaranth	21	26.25
	3 Grain amaranth	13	16.25
Early plant vigor	1 Poor	25	31.25
	2 Good	30	37.5
	3 Very good	25	31.25
Plant growth habit	1 Erect	62	77.5
	2 Spreading	17	21.25
	3 Drooping	1	1.25
Leaf color	5 Green	14	17.5
	10 Reddish green	13	16.25
	11 Red	5	6.25
	12 Dark red	48	60
Inflorescence color	3 Yellowish orange	1	1.25
	8 Purple	4	5
	9 Red	3	3.75
	10 Reddish green	49	61.25
	11 Green	23	28.75
Inflorescence compactness	3 Lax	0	0
	5 Intermediate	42	52.5
	7 Dense	38	47.5
Stem color	5 Red	58	72.5
	6 Reddish green	5	6.25
	8 Green	17	21.25
Stem surface	1 Smooth	1	1.25
	2 Ridged	79	98.75
Inflorescence shape	1 Globose	5	6.25
	2 Semi drooping	23	28.75
	3 Completely drooping	12	15
	4 Straight	40	50
Inflorescence spininess	1 Smooth	52	65
	2 Glabrous	0	0
	3 Prickly	18	22.5
	4 Spiny	10	12.5
Seed shattering	3 Low (%)	24	30
	5 Intermediate (10-50%)	11	13.75
	7 High (>50%)	45	56.25
Seed color	2 Greenish	1	1.25
	5 Red	39	48.75
	7 Black	40	50

Table 59. Qualitative characters of amaranth germplasm

Accession no.	Class	Early plant vigor	Plant growth habit	Leaf color	Inflorescence color	Inflorescence compactness	Stem color	Stem surface	Inflorescence shape	Inflorescence spininess	Seed shattering	Seed color
1	2	3	4	5	6	7	8	9	10	11	12	13
BD-2461	2	1	1	10	9	5	5	1	4	3	3	7
BD-2466	2	1	1	10	9	7	5	2	4	3	3	7
BD-2470	1	1	1	12	9	7	5	2	4	3	3	7
BD-2510	1	2	1	12	10	5	5	2	4	3	3	7
BD-2923	1	1	2	12	10	5	5	2	4	3	3	7
BD-2925	1	2	1	10	10	5	5	2	4	1	7	5
BD-2926	3	1	2	5	11	7	8	2	3	3	5	7
BD-2928	1	3	1	12	11	5	5	2	4	1	7	5
BD-2930	1	1	1	12	10	5	5	2	4	1	7	5
BD-2931	1	1	1	12	10	5	5	2	4	1	7	5
BD-2932	1	2	1	12	10	5	5	2	4	1	7	5
BD-2933	1	2	1	12	10	5	5	2	4	1	7	5
BD-2934	1	1	1	12	10	5	5	2	4	1	7	5
BD-2935	1	2	1	10	10	5	5	2	4	1	7	5
BD-2936	1	1	1	12	10	5	5	2	4	1	7	5
BD-2940	1	1	1	12	10	5	5	2	4	1	3	7
BD-2942	1	2	1	12	10	5	5	2	4	1	7	5
BD-2944	1	1	1	12	10	5	5	2	4	1	3	7
BD-2946	1	1	1	12	10	5	5	2	4	1	3	7
BD-2947	1	3	1	12	10	5	5	2	4	1	3	7
BD-2951	3	3	1	5	11	7	8	2	4	3	5	7
BD-2952	2	2	2	12	10	5	5	2	4	1	7	5
BD-2953	1	2	1	12	10	5	5	2	4	1	3	7
BD-2956	1	1	1	12	10	5	5	2	4	1	7	5
BD-2957	1	1	1	12	10	5	5	2	4	1	7	5
BD-2958	1	1	1	12	10	5	5	2	4	1	7	5
BD-2959	1	1	1	12	10	5	5	2	4	1	7	5
BD-2961	1	3	1	12	10	5	5	2	4	1	7	5
BD-2964	1	2	1	12	10	5	5	2	4	1	7	5
BD-2966	1	1	1	12	10	5	5	2	4	1	7	5
BD-2968	2	1	2	10	11	7	8	2	4	3	3	7
BD-2969	1	1	1	12	10	5	5	2	2	1	7	5
BD-7382	3	2	1	10	11	7	8	2	3	4	7	7
BD-7383	3	2	1	10	11	7	8	2	3	4	7	7
BD-7385	3	2	1	10	11	7	8	2	3	4	5	7
BD-7389	3	2	1	10	11	7	8	2	3	4	7	7
BD-7392	2	2	1	5	11	5	8	2	4	4	5	7
BD-7400	1	3	1	12	10	5	5	2	2	1	7	5
BD-7403	1	2	1	12	10	7	5	2	2	1	7	5
BD-7406	2	2	3	12	10	5	5	2	2	1	7	5
BD-7411	2	2	2	12	10	5	5	2	2	1	3	5
BD-8066	3	2	1	5	11	7	8	2	4	3	5	7
BD-8069	3	2	1	5	3	5	8	2	1	1	7	2
BD-8260	2	2	1	10	11	7	8	2	3	4	5	7
BD-8263	2	3	1	12	10	7	5	2	4	4	3	7
BD-8303	2	3	2	5	10	7	5	2	4	4	3	7
BD-8312	2	3	1	5	11	7	8	2	2	3	5	7
BD-8313	2	3	1	5	11	7	8	2	2	3	3	7
BD-8316	2	2	2	5	10	7	5	2	4	4	5	7

Table 59. Cont'd

Accession no.	Class	Early plant vigor	Plant growth habit	Leaf color	Inflorescence color	Inflorescence compactness	Stem color	Stem surface	Inflorescence shape	Inflorescence spininess	Seed shattering	Seed color
BD-8322	1	1	1	12	10	5	5	2	3	1	7	5
BD-8325	3	1	1	12	11	7	8	2	2	3	7	7
BD-8326	3	3	1	10	11	7	8	2	3	3	7	7
BD-8482	3	3	1	11	8	7	6	2	1	3	3	7
BD-9004	1	2	1	12	11	5	5	2	4	1	7	5
BD-9789	2	2	2	5	10	7	5	2	4	4	7	7
BD-9790	1	3	1	12	10	5	5	2	3	1	7	5
BD-9795	1	3	1	12	10	5	5	2	2	1	7	5
BD-9797	1	2	1	12	10	7	5	2	3	1	7	5
BD-9802	1	1	2	11	8	7	6	2	1	3	7	7
BD-9806	1	3	1	12	10	7	5	2	2	1	7	5
BD-9811	2	2	2	5	10	7	5	2	2	1	3	7
BD-9812	2	2	2	5	10	7	5	2	2	1	5	7
BD-9815	1	2	1	12	10	5	5	2	2	1	7	5
BD-9820	3	2	2	5	11	7	8	2	4	3	5	7
BD-9822	2	1	2	12	10	7	5	2	2	1	3	7
BD-9825	1	3	1	12	10	5	5	2	4	1	7	5
BD-9826	3	1	2	5	11	7	8	2	3	1	3	7
BD-9941	2	3	2	11	8	7	6	2	1	3	5	7
BD-9942	2	3	2	11	8	7	6	2	1	3	3	7
BD-10206	1	2	1	12	10	7	5	2	3	1	7	5
BD-10207	1	3	1	12	11	7	5	2	2	1	7	5
BD-10212	2	3	2	10	10	7	5	2	2	1	7	7
BD-10215	1	3	1	12	11	7	5	2	2	1	7	7
BD-10223	1	1	1	12	10	7	5	2	2	1	7	5
BD-10463	1	2	1	11	11	5	5	2	2	1	3	5
BD-10465	1	3	1	12	10	5	5	2	2	1	3	5
BD-10466	1	3	1	12	11	5	5	2	2	1	7	5
BD-10470	1	3	1	12	10	7	5	2	2	1	3	5
BD-11539	1	3	1	12	11	7	5	2	4	1	7	5
BARI Danta-1	2	3	1	10	10	5	6	2	2	1	3	7

B. Quantitative Descriptor

Range, mean, standard deviation and coefficient of variation of different quantitative characters of amaranth have been summarized in Table 60. Where, days to germination varied from 6 to 31 with a mean value of 14.94. On an average, leaf length and petiole length were 11.40 and 6.06 cm, respectively. Number of days to 50% flowering ranged from 50 to 79. In addition, number of branches per plant ranged from 3 to 15 with an average of 8.90. Mean plant height was 98.45 cm, where it ranged from 26 to 153 cm. Moreover, lateral spikelet length and inflorescence length ranged from 2.5 to 22.6 cm and 4.3 to 28.6 cm, correspondingly. On the one hand, average seed yield per plant was 9.11 g, on the other hand, mean of 1000 seed weight was 0.83 g. However, highest standard deviation (SD) was found 23.22 for plant height and lowest was 0.14 for 1000 seed weight. Finally, CV% was highest in case of seed yield per plant (68.21%), which indicates wide distinction amid accessions regarding this character, and the lowest was found in number of days to 50% flowering (13.41%), suggesting lower dispersion from mean value. The quantitative descriptors for specific germplasm are shown in Table 61.

Table 60. Quantitative variations in amaranth germplasm

Character	Range		Mean	SD	CV (%)
	Minimum	Maximum			
Days to germination	6	31	14.94	6.52	43.62
Leaf length (cm)	3.5	19.34	11.40	2.89	25.36
Petiole length (cm)	2.3	10.2	6.06	1.66	27.39
Number of days to 50% flowering	50	79	60.05	8.05	13.41
Number of branches per plant	3	15	8.90	2.71	30.41
Plant height (cm)	26	153	98.45	23.22	23.58
Lateral spikelet length (cm)	2.5	22.6	8.24	4.34	52.66
Inflorescence length (cm)	4.3	28.6	13.53	4.69	34.68
Seed yield per plant (g)	1	35	9.11	6.22	68.21
1000 seed weight (g)	0.61	1.2	0.83	0.14	16.67

Table 61. Quantitative characters of amaranth germplasm

Accession no.	Days to germination	Leaf length (cm)	Petiole length (cm)	Number of days to 50% flowering	Number of branches per plant	Plant height (cm)	Lateral spikelet length (cm)	Inflorescence length (cm)	Seed yield per plant (g)	1000 seed weight (g)
BD-2461	8	15.22	4.22	72	8	90	5.6	17.5	4	0.77
BD-2466	31	4.52	2.44	77	5	91	3.2	7.6	3	0.91
BD-2470	11	12.2	4.9	76	3	85	5	9	8	1
BD-2510	12	9.24	5.8	77	8	85	4.5	11.3	1	0.96
BD-2923	17	11.46	5.14	55	7	95	13.5	19.2	4	0.91
BD-2925	17	11.5	7	55	9	95	3.5	13.5	5	1
BD-2926	12	9.8	5.1	58	12	94	7.5	14.5	5	0.65
BD-2928	12	12.7	6.7	55	9	107	8.2	11.5	6	0.81
BD-2930	19	13.3	7	55	6	112	4.2	12.5	8	1
BD-2931	19	9.6	5.6	55	8	83	5.1	13.5	9	0.81
BD-2932	19	13.6	7.3	55	9	113	5.6	13.5	4	0.76
BD-2933	17	13.2	7.3	55	10	107	5.3	12.9	4	0.92
BD-2934	27	19.34	5.02	62	10	121	6.5	9.5	20	0.83
BD-2935	19	13.5	8.5	55	8	119	7.2	9.1	4	0.64
BD-2936	25	11.8	5.7	55	12	100	7.5	7.2	10	0.77
BD-2940	19	13.5	8.5	55	12	130	9.6	10.2	3	0.67
BD-2942	12	10.5	6	55	8	97	7.5	17.8	7	1
BD-2944	23	16.1	6.5	55	11	103	10.5	10.5	4	0.91
BD-2946	17	10.6	7.5	55	8	100	3.8	11.7	6	0.63
BD-2947	7	8.4	5.6	55	9	111	8.3	12.1	15	1
BD-2951	7	9.5	5.4	76	5	62	6	12	8	0.66
BD-2952	19	10.4	7.3	62	3	70	6.5	13	3	1
BD-2953	12	10.3	7.1	55	9	97	8.9	15.3	4	0.71
BD-2956	23	18.4	7	58	8	128	7.3	14.3	7	0.73
BD-2957	17	13.6	7	58	10	114	6.2	13.5	10	0.96
BD-2958	27	11.7	6.4	58	8	107	7.2	14.3	12	0.87
BD-2959	27	14.2	6.7	58	11	86	5.4	17.5	3	0.67
BD-2961	12	11.5	6	55	4	106	9.5	14.5	10	0.61

Table 61. Cont'd

Accession no.	Days to germination	Leaf length (cm)	Petiole length (cm)	Number of days to 50% flowering	Number of branches per plant	Plant height (cm)	Lateral spikelet length (cm)	Inflorescence length (cm)	Seed yield per plant (g)	1000 seed weight (g)
BD-2964	12	12.4	7.8	58	8	99	3.5	11.2	4	0.72
BD-2966	27	14.3	4.1	64	11	94	5.6	13.9	14	0.83
BD-2968	20	9.84	4.18	78	8	85	4.5	10.5	4	0.66
BD-2969	27	10.8	7.4	62	13	70	9.5	15.6	2	0.71
BD-7382	12	7.2	5.2	52	8	84	5.2	19.9	16	0.91
BD-7383	12	8	5.2	52	7	67	13.2	17.6	19	1.2
BD-7385	12	10	6.4	52	9	94	6.3	18.3	12	1
BD-7389	12	7.2	5	52	10	77	8.2	15.2	10	1
BD-7392	7	14.54	4.28	79	10	130	18.5	16.5	15	1
BD-7400	7	10.9	7.1	55	8	96	9.3	13.5	9	1
BD-7403	20	9	6	55	15	96	5.4	12.5	10	0.69
BD-7406	12	16.64	5.16	55	11	132	22.6	12.3	12	1
BD-7411	12	15.26	5.08	62	5	127	4.5	21.2	10	1
BD-8066	12	6.34	4.24	62	14	153	14.2	17.1	14	1
BD-8069	7	16.8	10.2	66	7	130	5.3	4.3	20	1.2
BD-8260	7	15.24	3.36	78	8	123	7.5	23.2	20	0.83
BD-8263	7	12	3.88	78	8	112	14.5	11.5	5	0.75
BD-8303	7	11.28	3.28	78	10	73	7.6	17.4	4	0.82
BD-8312	7	11.1	3.42	78	8	117	12.5	15.5	12	0.92
BD-8313	7	8.76	3.36	78	9	135	7.8	8.5	10	0.69
BD-8316	13	11.92	3.02	55	15	98	2.5	15.5	25	0.96
BD-8322	16	11	7.4	62	13	82	14.5	17.3	3	0.76
BD-8325	16	8.84	4.026	58	7	53	10.5	28.6	35	0.84
BD-8326	7	7.3	5.7	51	10	64	22.4	6.9	10	0.63
BD-8482	17	16.9	8.2	58	10	105	13.5	22.9	3	0.76
BD-9004	17	11.2	7.6	55	15	85	4.5	10.5	7	0.71
BD-9789	19	9.4	5.62	55	12	105	18.6	20.2	9	0.79
BD-9790	12	11.4	8.1	58	13	107	6.5	7.5	7	0.82
BD-9795	13	11.1	7.6	55	8	111	4.5	21.5	15	0.69
BD-9797	19	11	7.1	55	10	113	7.6	16.9	10	0.71
BD-9802	27	6.9	3.42	62	9	98	18.6	16.5	6	0.76
BD-9806	12	9	6.3	55	8	103	5.7	15.5	7	0.72
BD-9811	27	11.9	5.02	66	8	126	8.2	12.2	25	0.92
BD-9812	13	12.9	8.3	66	7	65	6	14	11	0.63
BD-9815	19	13.7	9	55	6	94	4.5	17.5	9	0.92
BD-9820	17	10.6	6.58	66	8	75	7	8	3	1
BD-9822	19	9.5	4.5	55	5	79	8.5	7.5	10	0.73
BD-9825	17	10.5	7.5	58	12	108	8.5	12.3	16	0.89
BD-9826	27	10.5	7.5	62	6	114	17.5	21.5	6	1

Table 61. Cont'd

Accession no.	Days to germination	Leaf length (cm)	Petiole length (cm)	Number of days to 50% flowering	Number of branches per plant	Plant height (cm)	Lateral spikelet length (cm)	Inflorescence length (cm)	Seed yield per plant (g)	1000 seed weight (g)
BD-9941	7	9.5	5.4	55	4	54	8.5	12.5	8	0.74
BD-9942	7	11.5	6.8	55	10	32	6.5	10	5	0.91
BD-10206	7	12.3	9	55	11	97	11	14.5	9	0.63
BD-10207	12	10	6.2	55	7	103	8	19	14	0.81
BD-10212	12	14	7.5	62	11	102	13	10	13	0.63
BD-10215	13	10.5	8	62	12	92	5	9.5	12	0.9
BD-10223	24	8.5	5	55	10	96	4	5.2	3	0.83
BD-10463	12	3.5	2.3	62	4	26	7.5	9.5	3	0.69
BD-10465	9	12.5	6.5	55	5	127	6	6.2	7	0.81
BD-10466	9	11.5	7.5	55	7	135	4	5.4	3	0.72
BD-10470	10	9.5	5.5	55	9	130	5	5.2	4	0.89
BD-11539	7	10.6	8	55	11	115	8.5	16.6	20	0.9
BARI Danta-1	6	15.6	5.4	50	10	80	7.5	11	2	1

Conclusion

Based on the phenotypic appearance and performance in the field condition few accessions can be recommended as top-notch genotypes for future study. For instance, leaf amaranth: BD-2961, BD-9790, BD-9795 and BD-9825; stem amaranth: BD-9822, BD-9941 and BD-9942.

11.3.10. Characterization of Guava Germplasm

Qualitative character

Qualitative traits of guava are presented in Table 62. Leaf shape varied from oblong lanceolate (2) to elliptical (3). Among the accession 50% was found oblong lanceolate and 50% was found elliptical leaf shape guava germplasm. The maximum variation was observed in pulp color and seediness in guava fruits. Four types of pulp color were found among the germplasm. White colored guava was found 31.81%, creamy white 45.45%, greenish white 18.18% and light red 4.54%. Fruit seediness was found in four types in among the germplasm. Seedless guava was found 4.54%, which our desired trait and high seed also found 4.54%, low seed was observed 36.36% and 54.54% was observed medium number of seed. If crossed low seeded or seedless guava genotypes with high seed containing genotypes got maximum variation in seediness for selection good quality guava variety.

Quantitative character

The pattern of 10 quantitative traits of guava is presented in Table 62a. The highest coefficient variation (%) was observed in yield per plant (94.04%) followed by individual fruit weight (68.59%). Plant height ranged from 2.38 to 6.20 m with an average 3.58 m. Base girth ranged from 28.00 to 81.00 cm with an average of 47.79 cm. Fruit weight ranged from 55.0-362.0 g with average 101.92 g and yield per plant ranged from 12.53 to 126.70 kg with average 26.54 kg (Table 62). The genotypes BARI Peyara 4 (126.70 kg per plant), BARI Peyara 2 (66.00 kg per plant), PG Pah 07 (34.65 kg per plant), PG Hat 012 (27.50 kg per plant) and PG Hat 017 (26.25 kg per plant) selected as a higher yielder than other genotypes.

Table 62. Qualitative characters of guava gerplasm

Acc.	Leaf shape	Mature leaf Color	Fruit shape	Fruit surface	Fruit skin color	Pulp color	Pulp flavor	Fruit taste	Pulp flavor	Seed hardness	Seediness
BARI Peyara 2	2	1	2	1	4	1	5	3	3	7	5
BARI Peyara 4	2	1	4	2	4	1	5	3	3	0	0
PG Pah 01	3	2	2	1	3	3	3	3	5	3	3
PG Pah 02	3	2	2	1	3	2	1	5	5	7	5
PG Pah 03	2	1	2	1	3	2	3	3	5	7	3
PG Pah 04	2	1	2	2	4	2	3	3	3	5	5
PG Pah 05	3	2	3	2	4	6	5	3	5	7	7
PG Pah 06	2	1	2	2	4	2	3	3	5	5	5
PG Pah 07	2	1	3	3	4	1	3	3	5	5	5
PG Hat 004	2	1	3	1	3	1	3	3	5	3	3
PG Hat 009	2	2	2	2	4	2	3	3	7	3	5
PG Hat 010	3	2	3	3	3	1	3	3	5	3	5
PG Hat 011	2	1	2	2	3	1	5	3	7	5	5
PG Hat 012	2	1	2	2	3	1	5	3	7	5	5
PG Hat 013	3	2	2	2	3	2	5	3	7	5	5
PG Hat 014	3	1	4	3	4	2	3	3	7	5	3
PG Hat 015	3	2	3	2	4	2	3	3	7	5	3
PG Hat 016	3	2	4	1	4	2	3	3	7	7	3
PG Hat 017	3	2	2	1	4	3	5	3	7	3	5
PG Hat 018	3	2	3	2	3	3	3	3	5	3	5
PG Hat 019	2	1	4	2	3	2	5	5	7	5	3
PG Hat 020	3	1	2	3	4	3	3	3	7	3	3

Table 62a. Quantitative characters of guava gerplasm

Acc.	Plant height (m)	Base girth (cm)	No. of branch	Canopy (N-S)	Canopy (E-W)	Fruit dia. (cm)	Fruit length (cm)	TSS (%)	Fruit weight (g)	Yield/plant (kg)
BARI Peyara 2	5.3	44.0	2.3	6.1	6.6	7.4	7.8	5.4	250.0	66.0
BARI Peyara 4	3.6	37.3	3.0	4.1	4.6	8.6	10.3	4.5	362.0	126.7
PG Pah 01	4.0	35.0	4.0	4.7	7.1	6.1	4.9	8.9	79.0	15.8
PG Pah 02	3.5	28.0	4.0	5.1	4.9	6.6	5.5	9.4	89.0	22.3
PG Pah 03	3.6	35.0	4.0	5.3	4.9	6.8	4.8	6.5	87.0	21.8
PG Pah 04	2.9	38.0	3.0	4.2	3.6	6.4	5.3	9.9	84.0	16.8
PG Pah 05	2.9	30.0	2.0	2.8	3.4	5.5	6.0	8.7	89.5	12.5
PG Pah 06	4.2	28.0	3.0	3.1	6.3	5.2	5.5	8.7	83.3	16.7
PG Pah 07	3.9	70.0	5.0	6.1	4.6	6.0	6.7	10.0	115.5	34.7
PG Hat 004	4.2	67.0	3.0	6.2	5.9	4.8	5.5	10.1	60.0	15.0
PG Hat 009	5.2	28.0	5.0	5.0	5.1	6.5	4.5	12.4	75.0	18.8
PG Hat 010	4.7	35.0	5.0	5.2	5.0	6.0	5.0	10.7	80.0	20.0
PG Hat 011	3.3	49.0	6.0	5.0	4.7	5.3	5.0	10.9	80.0	20.0
PG Hat 012	4.9	48.0	4.0	6.1	5.9	5.7	5.9	11.6	110.0	27.5
PG Hat 013	3.2	45.0	5.0	5.5	5.2	5.0	5.5	12.3	85.0	21.3
PG Hat 014	2.9	55.0	5.0	4.2	4.0	4.8	5.5	12.0	70.0	17.5
PG Hat 015	2.6	65.0	6.0	4.0	4.3	5.2	4.8	13.0	75.0	18.8

Acc.	Plant height (m)	Base girth (cm)	No. of branch	Canopy (N-S)	Canopy (E-W)	Fruit dia. (cm)	Fruit length (cm)	TSS (%)	Fruit weight (g)	Yield/plant (kg)
PG Hat 016	2.9	81.0	7.0	3.3	3.5	5.3	5.2	13.6	80.0	20.0
PG Hat 017	3.1	70.0	5.0	4.2	4.4	5.6	5.8	11.8	105.0	26.3
PG Hat 018	5.2	65.0	3.0	4.5	4.3	4.9	4.0	10.1	60.0	15.0
PG Hat 019	2.4	50.0	4.0	3.0	3.1	5.0	4.3	11.1	68.0	17.0
PG Hat 020	6.2	48.0	5.0	7.0	6.5	4.0	4.4	11.4	55.0	13.8
Mean	3.85	47.79	4.24	4.75	4.89	5.75	5.54	10.13	101.92	26.54
S. Error	0.22	3.39	0.27	0.24	0.24	0.22	0.29	0.50	14.90	5.32
Minimum	2.38	28.00	2.00	2.80	3.10	4.00	4.00	4.52	55.00	12.53
Maximum	6.20	81.00	7.00	7.00	7.10	8.63	10.30	13.60	362.00	126.70
CV (%)	26.82	33.30	30.21	24.15	22.55	17.72	24.33	68.59	23.21	94.04

Molecular Characterization of Germplasm and Landraces

11.3.11. Molecular Characterization of Rapeseed-Mustard Germplasm using SSR Marker

According to DNA amplification patterns, all ten SSR markers used in this analysis were found to be polymorphic. Two typical SSR profiles are shown in Fig. 64. After studying 10 SSR loci for the 25 rapeseed-mustard genotypes, 34 alleles were amplified with an average 3.40 allele per locus, which is higher than that of effective number of alleles (2.50). Among the primers, the highest rates were produced by Na10-D03 and Na12-A02, which produced 5 bands, whereas the least number of bands (2) were generated by primers Ra2E07, Na12D04 and Ni3G04b. Variation of allele sizes ranged from 98 to 293 bp for the locus Ni3G04b and Na12D04, respectively. The locus Ni3G04b had the smallest (98-108 bp) and Na12D04 had the largest fragments (275-293 bp). Thus, markers with different fragment length (for example, Na12D04 versus Ni2-B02) can be used concurrently (Turi *et al.*, 2012).

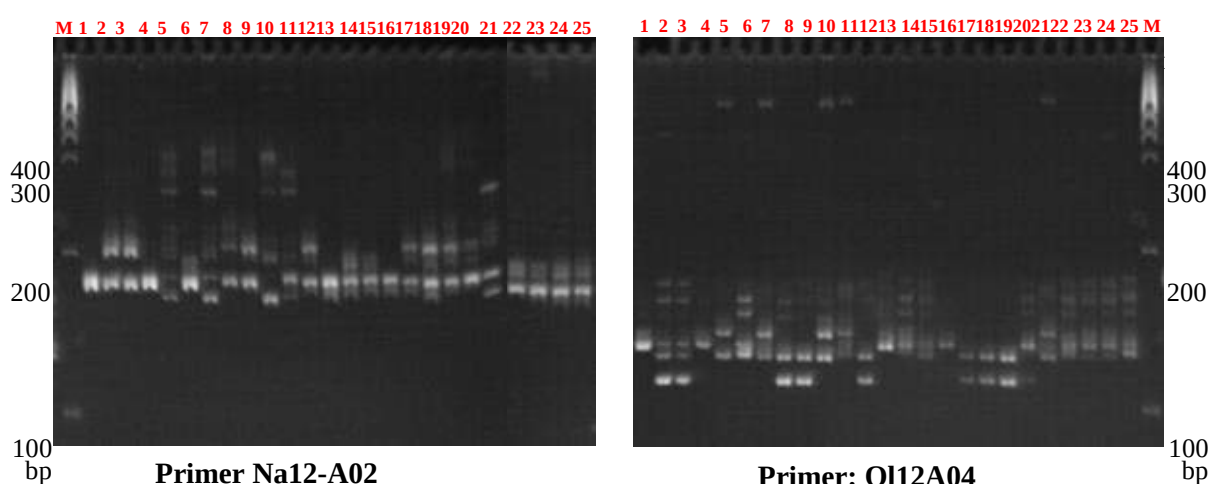


Fig. 64. Microsatellite profiles of 25 rapeseed-mustard genotypes; primer Na12-A02 and OI12A04

Average observed heterozygosity of SSR markers is 0.321, ranging between 0.000 and 0.522. The second locus of the marker 12-E01 showed the highest heterozygosity (0.522). Markers Ni3G04b was not heterozygote (Table 63). The values of expected heterozygosity (H_e) for each SSR locus, considering all test genotypes, are always higher than the observed heterozygosity (average $H_e=0.575$), indicating high of homozygosity.

Polymorphic information content (PIC) is regarded as one of the important features of the molecular markers used to evaluate the differentiation ability of the markers (Junjian *et al.*, 2002). We have PIC values ranging from 0.211 (Ra2E07) to 0.737 (Na10-D03) (Table 63). The di-nucleotide marker, Na10-D03 with GT/CA and Ol12A04 with GA/CT repeated sequence showed higher PIC as compared to other di-nucleotide makers (Ra2E07, Na12D04 and Ni3G04b). This may be attributed to the higher mutation rate of di-nucleotide repeated sequence (Molla *et al.* 2010 and Vigoruroux *et al.*, 2005). Similar results have been reported by some researchers (Heckenberger *et al.*, 2002; Agrama and Tuinstra, 2003; Vaz Patto *et al.*, 2004; Moghaddam *et al.* 2009). The amount of PIC is a function of allele number and frequency. Thus, markers with more alleles had larger PIC. For example, Na10-D03 representing largest number of alleles (5) had the highest PIC (0.735). Average PIC of all SSR markers was 0.560 indicating the ability of utilized markers to differentiate the mustard genotypes. SSR markers with *B. rapa* origin showed lower PIC (0.439) as compared to the rest (0.594). Turi *et al.* (2012) also obtained lower PIC with markers from *B. rapa* origin. This is probably is an the indication of lower genetic variation existing in the A genome.

Genetic differentiation (F_{st}) values were found ranging from 0.532 to 1.000 with an average of 0.752 and gene flow (N_m) values ranged from 0.000 to 0.228 with an average of 0.082 (Table 63). It is observed comparatively that higher level of genetic differentiation and lower level of gene flow values in 25 rapeseed-mustard genotypes, an indicative of diverse genotypes. The loci Ra2E07 and Ol12A04 have highest (0.88) and lowest (0.36) frequency of the predominant allele, respectively. The average frequency of the predominant allele was 0.561 (Table 63). Low frequency of the predominant allele reveals suitable allelic distribution among the rapeseed genotypes (Priolli *et al.*, 2002). Furthermore, SSR markers with the higher number of alleles per locus, showed the lowest frequency of the predominant allele. Thus, markers with lower frequency of the predominant allele have more differentiating ability than others (Moghaddam *et al.*, 2009).

A similarity matrix based on the proportion of shared SSR fragments was used to establish the level of relatedness among the various collected mustard genotypes. Pair-wise estimates of similarity ranged from 0.069 to 1.000 and the average similarity among all 25 accessions was 0.45. Genotypes BD-10111 and Nap-0564; Jun-536 and BJDH-12 and BARI Sarisha-10 and BARI Sarisha-16 had the highest similarity index of 100%. This was followed by 96% similarity between two genotypes BD-7114 and BD-9343. The lowest similarity (6.90%) was observed between BD-10111 and BD-9343; Nap-0564 and BD-9343 and BARI Sarisha-13 and BD-9343 (Fig.64b). These results were further strengthened by the earlier findings Das *et al.*, 1999; Cansian and Echeverrigaray, 2000 and Turi *et al.*, 2012.

Table 63. Variability of simple sequence repeat marker used for rapeseed-mustard genotypes genetic analysis

Locus	na	Allele sizes (bp)	ne	MAF	Ho	He	Fst	Nm*	PIC
Ol11-C02	3	116, 126, 1133	2.000	0.667	0.333	0.522	0.910	0.025	0.500
Ra2E07	2	104, 1115	1.268	0.880	0.160	0.216	0.621	0.152	0.211
Ra2-F11	4	188, 207, 237, 263	2.998	0.480	0.240	0.680	0.820	0.055	0.666
Na12D04	2	275, 293	1.950	0.580	0.200	0.497	0.795	0.065	0.487
Ni3G04b	2	98, 108	1.899	0.615	0.000	0.492	1.000	0.000	0.473
Ol12A04	4	118, 126, 136, 138	3.342	0.360	0.480	0.715	0.658	0.130	0.701
Na10-D03	5	119, 129, 133, 137, 145	3.799	0.400	0.520	0.752	0.647	0.136	0.737
Na12-A02	5	161, 172, 178, 189, 201	2.197	0.640	0.520	0.556	0.523	0.228	0.545
Na12-E01	4	198, 209, 229, 244	3.067	0.457	0.522	0.689	0.669	0.124	0.674
Ni4-B10	3	163, 172, 180	2.558	0.529	0.235	0.628	0.902	0.027	0.609
Mean	3.40	-	2.508	0.561	0.321	0.575	0.752	0.082	0.560

Na: Observed number of alleles, ne: Effective number of alleles, MAF: Major allele frequency Ho: Observed Heterozygosity, He Expected heterozygosity, Fst: Genetic differentiation, Nm: Gene flow estimated from Fst = $0.25(1 - Fst)/Fst$, PIC: Polymorphic Information Content

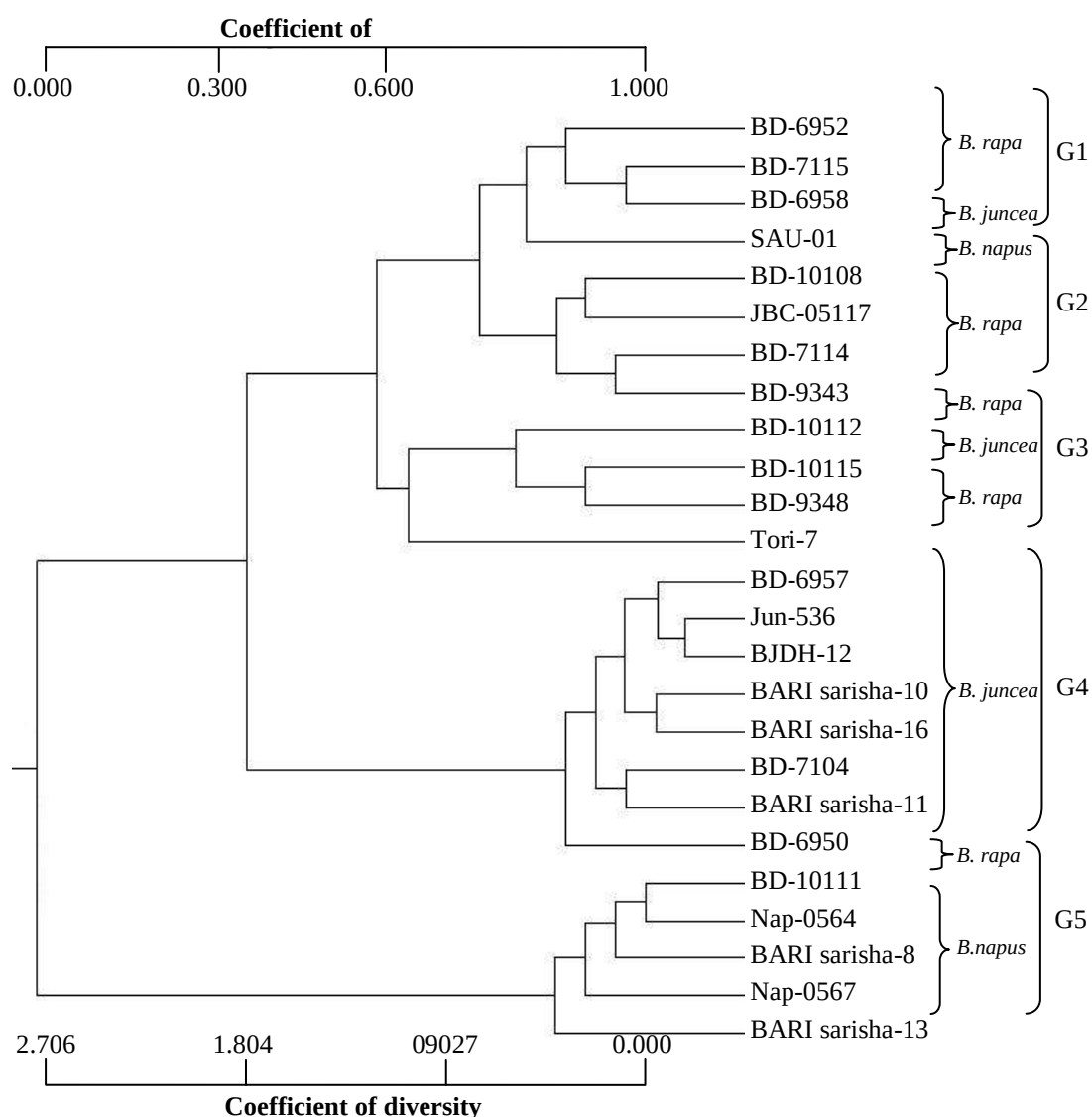


Fig. 64a. UPGMA cluster analysis and relationship among 25 mustard germplasm based on alleles generated by SSR markers.

On the basis of cluster study, the total genotypes were distributed into two main clusters (I and II). Main cluster I was further sub-divided into four sub-groups (Fig. 64a) comprising *B. rapa* and *B. juncea* and also one genotype of *B. napus*, while in cluster II four among the five genotypes belongs to *B. napus* and one (BD-10111) to *B. rapa*. These findings suggested that there is less variations among *B. napus* and *B. juncea* genotypes and also some kind of similarity among *B. rapa* genotypes. The genotypes of *B. rapa* have a distinct status in the dendrogram, because there might have effect of geographical variaation.

As discussed above, genotypes belonging to different subspecies but were collected from the same region were more similar to each other than genotypes of the same species but of different location. Zhao *et al.*, (2005) made the same observation as they studied various morphotypes of *B. rapa* using AFLP markers. This confirms that geographic affinity would contribute to the similarity between genotypes (Ren *et al.*, 1995).

Conclusion

Genetic diversity was found among the test rapeseed-mustard genotypes. Higher ratio of genetic diversity was obtained in *B. rapa* accessions than in *B. napus* and *B. juncea* genotyppes. The possible reason for high genetic variation in *B. rapa* is the local adaptability desireable. Information on genetic distances based on microsatellite markers shall be employed in creating variation using disting genotypes.

11.4. Bangladesh Jute Research Institute

11.4.1. Germplasm collection

The collection mission was made to Rangpur, Kurigram, Nilphamari, Panchagarh and Dinajpur districts of Rangpur Division; Bogura district of Rajshahi division; Cumilla district of Chattogram division and Patuakhali, Barguna and Barishal districts of Barishal division during February 2018 to November 2020 (Fig. 65, 66 & 67). A total of 35 germplasm were collected from farmers' field, road side, stores and market place (Table 64). Samples were collected as seeds and fruits from individual plant or population along with sufficient passport information. The collected samples were registered and conserved in active collection for further activities (Mostofa, 2001). Out of 35 germplasm 23 *Corchorus capsularis*, 9 *C. olitorius* and 3 were *Hibiscus sabdariffa* (Table 65). Passport information of collected germplasm of jute (*Corchorus spp.*) with photographs is shown in table 66.

Table 64. List of collected jute germplasm, November 2018 to December 2020

Sl. no.	Crops name	Scientific name	Deshi pat	Tossa pat	Kenaf	Mesta
1	Pat	<i>Corchorus capsularis</i>	23	-	-	-
2	Pat	<i>Corchorus olitorius</i>		9	-	-
3	Kenaf	<i>Hibiscus cannabinus</i>	-	-	-	-
4	Mesta	<i>Hibiscus sabdariffa</i>	-	-	-	3
Sub Total			23	9	0	3
Grand Total			35			

Table 65. District wise jute germplasm collection status

Name of District	No. of Upazilas explored	Number of germplasm collected				
		Deshi pat	Tossa pat	Kenaf	Mesta	Total
Kurigram	3	4	-	-	-	4
Nilphamari	2	2	2	-	-	4
Panchagarh	2	4	-	-	-	4
Dinajpur	5	4	2	-	-	6
Bogura	1	4	1	-	-	5
Rangpur	3	3	-	-	-	3
Patuakhali	1	2	2	-	1	5
Barisal	2	-	2	-	-	2
Cumilla	1	-	-	-	2	2
Total	20	23	9	-	3	35

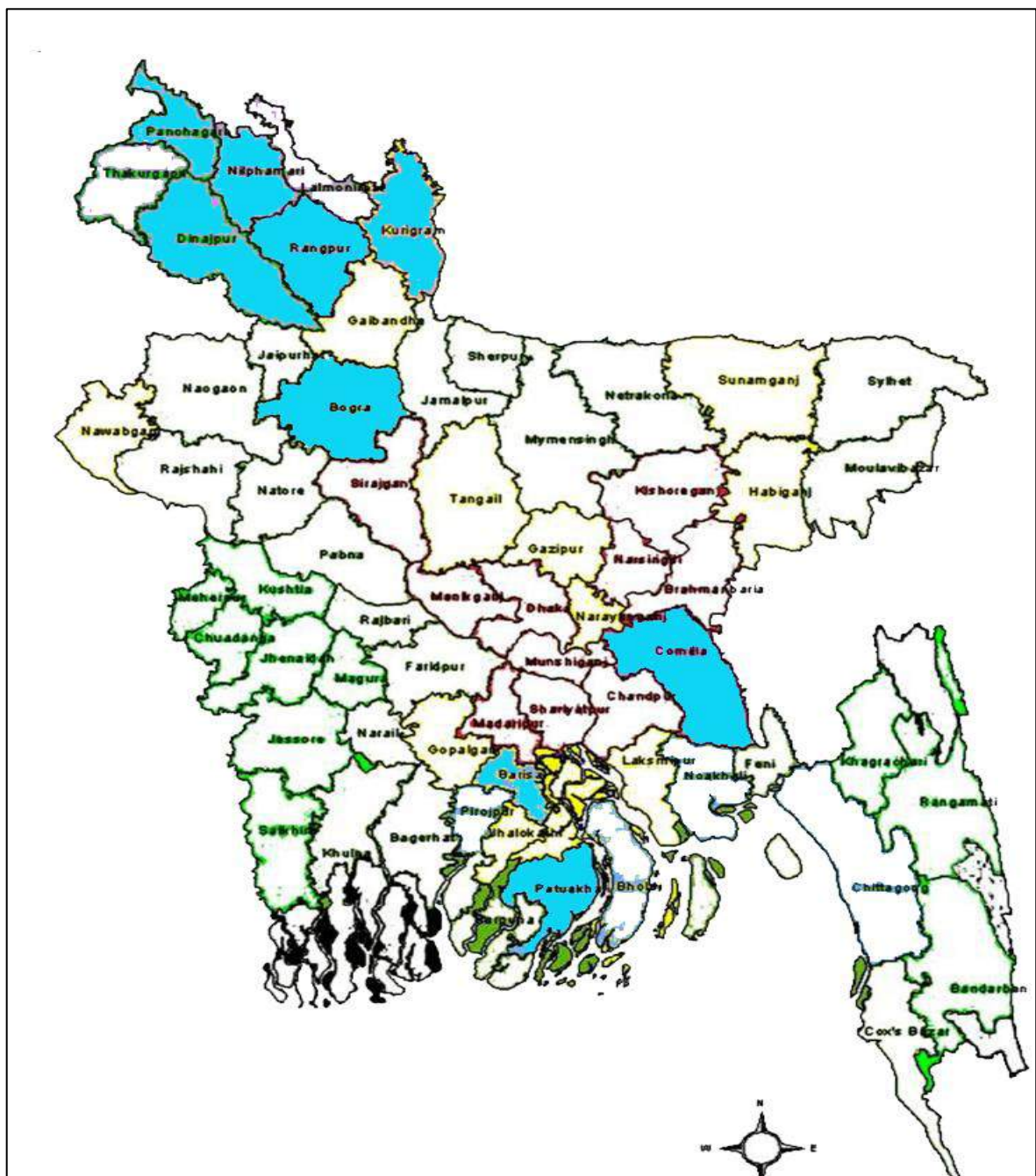


Fig. 65. Bangladesh GIS map demonstrating explored areas

Table 66. Passport information of jute germplasm

Sl. no.	Collector's no.	Local/Cultivar name/cultural practice	Donor's Name & address	Geographic location and date	Photograph
1	RS-1	Mera Shak Used as vegetable	Md. Moksedul Village: Kabir Mahmud Thana: Fulbari District: Kurigram	N-25°57.210 E-89°33.518 15-11-2018	
2	RS-2	Mera Shak	Abdul Malek Village: Rash mela Thana: Fulbari District: Kurigram	N-25°57.210 E-89°33.518 15-11-2018	
3	RS-3	Chera Pat	Haji Guljar Hossain Village: Tookar Bazar Thana: Fulbari District: Kurigram	N-25°57.210 E-89°33.518 15-11-2018	
4	RS-4	Mera Shak Vegetable type	Md. Abed Ali Village: Japurvita Thana: Kurigram Sadar District: Kurigram	N-23°51.916 E-90°16.213 15-11-2018	
5	AS-2	Deshi pat	Md. Mahbubur Rahman Village: Domarrailget Thana: Domer District: Nilphamari	N-26°6.620 E-88°49.682 16-11-2018	
6	AS-4	DeshiSada	Md. Aminul Islam Village: Domar railgate Thana: Domer District: Nilphamari	N-26°6.620 E-88°49.682 16-11-2018	
7	ACK-1	Jati pat	Shonali Rani Village: Kazi Para Thana: Boda District: Panchagarh	N-25°44.088 E-89°15.104 16-11-2018	

Sl. no.	Collector's no.	Local/Cultivar name/cultural practice	Donor's Name & address	Geographic location and date	Photograph
8	ACK-2	Jati pat	Shree Omapatho Village: Shahed Para Thana: Boda District: Panchagarh	N-25°44.088 E-89°15.104 16-11-2018	
9	ACK-3	Jati pat	AbdusShamad Thana: Panchagarh Sadar District: Panchagarh	N-26°20.357 E-89°15.104 16-11-2018	
10	FM-1	Jati pat	Julfikar Ali Vhutto Thana: Panchagarh Sadar District: Panchagarh	N-26°20.357 E-89°15.104 16-11-2018	
11	AS-5	Deshi pat	Sree Birendro Nath Goash Village: Pannagor Thana: Birgonj District: Dinajpur	N-26°2.447 E-89°36.793 16-11-2018	
12	AS-6	Deshi pat	Sree Birendro Nath Goash Village: Pannagor Thana: Birgonj District: Dinajpur	N-26°2.447 E-89°36.793 16-11-2018	
13	AS-7	Deshi pat	Md. Amirul Islam Village: Doshmile Thana: Kaharul District: Dinajpur	N-25°48.182 E-88°39.37 16-11-2018	
14	AS-9	Tita pat	Md. Aynul Village: Ranir Bandor Thana: Chirirbandar District: Dinajpur	N-25°39.622 E-88°46.794 16-11-2018	

Sl. no.	Collector's no.	Local/Cultivar name/cultural practice	Donor's Name & address	Geographic location and date	Photograph
15	RS-5	Mera	Md. Zablul Tareq Village: Dhawakola Thana: Bogura Sadar District: Bogura	N-24°50.561 E-89°22.596 17-11-2018	
16	RS-6	Birol	Md. Zablul Tareq Village: Dhawakola Thana: Bogura Sadar District: Bogura	N-24°50.561 E-89°22.596 17-11-2018	
17	RS-7	Birol	Md. Zablul Tareq Village: Dhawakola Thana: Bogura Sadar District: Bogura	N-24°50.561 E-89°22.596 17-11-2018	
18	RS-8	Birol Vegetable type	Md. Zablul Tareq Village: Dhawakola Thana: Bogura Sadar District: Bogura	N-24°50.561 E-89°22.596 17-11-2018	
19	FMN-1	Megnal	Mir Hasan Mithu Village: Ubragir Kuthir Thana: Mithapukur District: Rangpur	N-25°34.133 E-89°16.413 23-11-2018	
20	FMN-2	Cherashak	Abdus Salam Village: Muradpur Thana: Nobabgong District: Rangpur	N-25°25.386 E-89°16.413 23-11-2018	
21	FZ-1	Deshi pat	Abul Fazal Mollah Village: Kamal kashna Thana: Rangpur Sadar District: Rangpur	N-25°45.410 E-89°4.283 23-11-2018	

Sl. no.	Collector's no.	Local/Cultivar name/cultural practice	Donor's Name & address	Geographic location and date	Photograph
22	RS-11	Pat	Md. Mosharrof Phokir Village: Umedpur Thana: Kolapara District: Patuakhali	N-21°59.985 E-90°13.524 17-12-2019	
23	RS-12	Deshi pat	Md. Mosharrof Phokir Village: Umedpur Thana: Kolapara District: Patuakhali	N-21°59.985 E-90°13.524 17-12-2019	
24	AS-1	Naila	Md. Mishudul Islam Village: Chiraviza Thana: Joldaka District: Nilphamari	N-23°51.916 E-90°16.213 16-11-2018	
25	AS-3	Naila	Md. Mahbubur Rahman Village: Domar railget Thana: Domer District: Nilphamari	N-26°6.620 E-88°49.682 16-11-2018	
26	AS-8	Mitha pat	Md. Aynul Village: Ranir Bandor Thana: Chirirbandar District: Dinajpur	N-25°39.622 E-88°46.794 16-11-2018	
27	AS-10	Mitha pat	Md. Aynul Village: Ranir Bandor Thana: Chirirbandar District: Dinajpur	N-25°39.622 E-88°46.794 16-11-2018	
28	TZ-1	Nobin pat	Moshrrrof Hossain Thana: Borguna Sadar District: Borguna	N-22°9.254 E-90°7.022	

Sl. no.	Collector's no.	Local/Cultivar name/cultural practice	Donor's Name & address	Geographic location and date	Photograph
29	TP-1	Tossa pat	Moshrrrof Hossain Village: Gutia Bazar Thana: Uzirpur District: Barishal	N-22°49.364 E-90°15.248 17-12-2019	
30	TP-2	Tossa pat	Md. Nuruzzaman Village: Chakhar Bazar Thana: Banari Para District: Barishal	N-22°47.164 E-90°9.902 18-12-2019	
31	TP-3	Tossa pat	Shohraf Farazi Village: Kolapara Bazar Thana: Kolapara District: Patuakhali	N-22°47.164 E-90°9.902 18-12-2019	
32	RS-13	Pat	Md. Alom Shordar Village: Mowdubi Thana: Kolapara District: Patuakhali	N -22°47.164 E-90°9.902 18-12-2019	
33	RS-9	Chukur	A.K.M. Shahadat Village: Gangkanda Thana: Daudkandi District: Cumilla	N-23°31.106 E-90°42.654 17-11-2018	
34	RS-10		A.K.M. Shahadat Village: Gangkanda Thana: Daudkandi District: Cumilla	N-23°31.106 E-90°42.654 17-11-2018	
35	RS-14	Mesta	DulalKazi (Seed Dealer) Village: Baintola Thana: Kolapara District: Patuakhali	N-22°47.164 E-90°9.902 18-12-2019	



Fig. 66. Germplasm collection from Dashiachora Sitmohol, Phulbari, Kurigram



Fig. 67. Germplasm collection from different places of Bangladesh

11.4.2. Conservation of collected germplasm

Global initiative for collection and conservation of plant genetic resources (PGR) are focused for ensuring the future adaptability of cultivars and wild populations by preserving data and traits. Plant genetic resources can be conserved both *in-situ* and *ex-situ*. Jute & allied fibre (JAF) germplasm are conserved by *ex-situ* in BJRI. This sub-project has to conserve 35 jute and allied fibre germplasm collected from target areas and seed received from different sources (Table 64). The collected JAF germplasm samples were registered in conservation book by specific registration number. Among them, 32% germplasm found in respect of 20-30% germination rate. Same 32% germplasm also showed 40-60% germination rate. 70-80% germination rate covered for 8% of total conserved germplasm. 90% and 100% germination rate measured in the 17% and 11% conserved material respectively. Moisture content 7-9% was found among the conserved germplasm. The conserved seed quantity varied sharply 3-120 g of different collected genetic materials. The collected germplasm have so far been conserved in short-term storage as an active collection is shown in table 67.

Table 67. Conservation status of jute and allied fibre (JAF) germplasm collected under PBRG-PGR sub-project

Sl.no	Local/cultivar name	Collector's No.	Quantity of seeds conserved (g)	Moisture content (%)	Germination rate (%)	Date of conservation	Acc. No.
Deshi Jute							
1.	Mera Shak	RS-1	112	8	90	05.08.2020	5317
2.	Mera Shak	RS-2	90	8	90	05.08.2020	5318
3.	Chera Pat	RS-3	48	7	100	05.08.2020	5319
4.	Mera Shak vegetable	RS-4	52	7	60	05.08.2020	5320
5.	Deshi pat	AS-2	03	8	50	05.08.2020	5321
6.	Deshi Sada	AS-4	90	8	80	05.08.2020	5322
7.	Jati pat	ACK-1	06	7	90	05.08.2020	5323
8.	Jati pat	ACK-2	09	8	20	05.08.2020	5324
9.	Jati pat	ACK-3	86	7	90	05.08.2020	5325
10.	Jati pat	FM-1	22	7	20	05.08.2020	5326
11.	Deshi pat	AS-5	62	8	40	05.08.2020	5327
12.	Deshi pat	AS-6	05	7	50	05.08.2020	5328
13.	Deshi pat	AS-7	33	8	30	05.08.2020	5329
14.	Tita pat	AS-9	29	7	40	05.08.2020	5330
15.	Mera	RS-5	13	8	90	05.08.2020	5331
16.	Birol	RS-6	20	7	100	05.08.2020	5332
17.	Birol	RS-7	20	8	60	05.08.2020	5333
18.	Birol Vegetable type	RS-8	03	8	100	05.08.2020	5334
19.	Megnal	FMN-1	67	7	60	05.08.2020	5335
20.	Cherashak	FMN-2	103	8	100	05.08.2020	5336
21.	Deshi pat	FZ-1	57	7	90	05.08.2020	5337
22.	Pat	RS-11	46	8	70	05.08.2020	5338
23.	Deshi pat	RS-12	36	8	60	05.08.2020	5339
Tossa Jute							
24.	Naila	AS-1	45	7	30	06.08.2020	5340
25.	Naila	AS-3	46	7	20	06.08.2020	5341
26.	Mitha pat	AS-8	25	7	30	06.08.2020	5342
27.	Mitha pat	AS-10	30	8	40	06.08.2020	5343
28.	Nobin pat	TZ-1	29	7	80	06.08.2020	5344
29.	Tossa pat	TP-1	05	8	50	06.08.2020	5345
30.	Tossa pat	TP-2	07	8	30	06.08.2020	5356
31.	Tossa pat	TP-3	12	7	20	06.08.2020	5347
32.	Pat	RS-13	24	8	40	06.08.2020	5348
Mesta (<i>Hibiscus Subdarifa</i>)							
33.	Chukur	RS-9	10	9	30	06.08.2020	5349
34.	Mesta	RS-10	12	9	25	06.08.2020	5350
35.	Mesta	RS-14	120	9	30	06.08.2020	5351

11.4.3. Characterization of Deshi Jute (*Corchorus capsularis*) germplasm during 2018 season

Qualitative variations of different characters in 27 deshi jute germplasm are shown in table 68 & 70. Wide range of variation was found in plant stem color. Green stem (44%), red (30%) and light red (26%) stem color were found among the germplasm. Green leaf color was found in most of the germplasm except two (Collector's no RS-6 & RS-7), which were light red in color. Leaf vein color was green in 16 genotypes and rest was light red in color. Light red (48%), green (26%) and red color (26%) petiole were found among the germplasm. Stipule was present in all germplasm with green (52%), light red (37%) and 11% red in color. 48% germplasm were non-branched habit with lanceolate leaves, 30% germplasm have same percentage for weak and intermediate branching habit and the other 22% germplasm were equally considered for very weak and strong in branching habit.

Quantitative variations of 15 characters were shown in table 69. Range, mean, standard deviation and co-efficient of variations of quantitative characters were calculated (Table 71). The highest leaf length was found in acc. no. 742 (17.76 cm) followed by Collector's no. ACK-3 (16.34 cm) and Acc. no. 4894 (16.26 cm). In case of leaf width the highest was 11.28 cm in acc. no. 3311. Leaf area ranged from 13.94 cm²-75.11cm² with an average 42.10 cm². Petiole length was highest in Collector's no. AS-4 (12.38 cm) followed by acc. no. 890 (11.78 cm). The technical height was found highest in Collector's no. AS-6 (352.5 cm) while the lowest was 120 cm in Collector's no. AS-9. Number of nodes per plant ranged from 35-74 with an average 54.85. The highest base diameter (39.30 mm) was observed in Collector's no. AS-5 followed by 23.05 mm in Collector's no. AS-6 and 21.81 mm (acc. no. 742 and Collector's no. AS-4). Germplasm stem mid diameter ranged from 5.23 mm to 20.58 mm in Collector's no. RS-2 and Collector's no. RS-5, respectively. The highest top diameter (5.09 mm) was found in acc. no. 4894 whereas the lowest was in Collector's no. RS-2 (3.18 mm). Basal core diameter was highest (19.45 mm) in Collector's no. AS-6 followed by Collector's no. AS-4 (18.20 mm) and acc. no. 742 (17.89 mm). Dry fibre and stick weight was highest in acc. no. 742 which was 21.8 g and 53.4 g, respectively. Merha red (Collector's no. RS-4) and Birol red (Collector's no. RS-8) two wild germplasm collected from Kurigram and Bogura are used as vegetable in that region round the year though their fibre yield is low (5.1 g, 5.8 g). These two germplasm contained more vitamins, minerals and indicated their importance for vegetable (Tareq *et al.* 2019). Therefore, Merha red and Birol red can be identified for vegetable purpose and acc. no. 742 for fibre and stick purpose.

Table 68. Qualitative variation in different characters of jute germplasm, 2018

Character	Descriptor state	No. of germplasm	Frequency (%)
Stem color	Green	12	44
	Red	8	30
	Light red	7	26
Leaf color	Green	25	93
	Light red	2	7
Vein color	Green	16	59
	Light red	11	41
Petiole color	Green	7	26
	Red	7	26
	Light red	13	48
Stipule color	Green	14	52
	Red	3	11
	Light red	10	37

Table 69. Quantitative variation in different descriptors of deshi jute germplasm, 2018

Name of descriptor	Range	Mean	SD	CV (%)
Technical height (cm)	120-352.5	231.77	67.66	29.19
Node number (no.)	35-74	54.85	12.20	22.24
Plant base diameter (mm)	8.8-39.3	15.66	6.47	41.32
Mid-diameter (mm)	5.23-20.58	9.61	3.25	33.86
Top diameter (mm)	3.18-5.09	4.03	0.60	14.86
Basal core diameter(mm)	7-19.45	12.04	3.98	33.10
Dry fibre weight (g)	1.3-21.8	8.41	6.35	75.58
Dry stick weight (g)	7.9-53.4	24.34	14.22	58.43
Leaf length (cm)	9.6-17.76	13.62	2.27	16.72
Leaf width(cm)	2.62-11.28	5.37	1.87	34.96
Petiole length (mm)	2.78-12.38	6.00	2.01	33.61
Leaf area (cm ²)	13.94-75.11	42.10	18.25	43.34

Table 70. Qualitative characters of deshi jute germplasm, 2018

Collector's no.	Stem Color (1) (g/lr/r)	Stem Color (2) (g/lr/r)	Leaf lemma Color (g/lr/r)	Leaf vein Color (g/lr/r)	Petiole Color (g/lr/r)	Stipule (+ / 0)	Stipule Color (g/lr/r)
RS-1	2	2	1	99	2	1	2
RS-2	1	1	1	1	99	1	1
RS-3	2	2	1	99	2	1	2
RS-4	2	2	1	99	2	1	99
Acc. 841	1	1	1	1	1	1	1
AS-2	1	1	1	1	1	1	1
Acc. 742	1	1	1	1	1	1	1
AS-4	99	99	1	1	99	1	1
ACK-1	99	99	1	1	99	1	1
ACK-2	2	2	1	1	2	1	99
ACK-3	1	1	1	1	99	1	1
FM-1	2	2	1	99	2	1	99
AS-5	99	99	1	1	99	1	1
AS-6	99	99	1	1	99	1	1
AS-7	1	1	1	1	1	1	1
Acc.890	1	1	1	1	1	1	1
AS-9	1	1	1	1	1	1	1
Acc. 4894	1	1	1	1	1	1	1
RS-5	99	99	1	99	99	1	99
RS-6	1	1	99	99	99	1	99
RS-7	1	1	99	99	99	1	99
RS-8	2	2	1	99	2	1	2
Acc. 3311	99	99	1	99	99	1	1
Acc. 5134	99	99	1	99	99	1	99
FMN-1	1	1	1	1	99	1	99
FMN-2	2	2	1	99	2	1	99
FZ-1	2	2	1	1	99	1	99

Table 71. Quantitative characters of deshi jute germplasm, 2018

Collector's no.	Tech ht (cm)	Nodes (no.)	Base dia. (mm)	Mid dia. (mm)	Top dia. (mm)	Basal Core dia.(mm)	Dry fibre wt/plant. (g)	Dry stick wt./plant (g)	Branchabit(0-9)	Leafangle(1-9)	Leaflength(cm)	Leaf width(cm)	Petiolelength(mm)	Leaf area (cm ²)	Leaf shape (1-6)
RS-1	204.0	48	14.41	9.45	4.10	11.97	5.0	11.42	5	5	12.90	3.90	4.48	30.10	3
RS-2	167.2	42	9.68	5.23	3.18	7.65	5.1	11.4	1	5	11.48	4.58	5.54	33.75	3
RS-3	207.5	52	15.48	9.70	4.10	12.77	5.6	28.2	5	5	12.14	4.06	4.92	30.10	3
RS-4	174.0	40	9.80	6.75	3.49	7.50	1.8	8.9	0	5	9.60	4.00	4.78	29.34	2
Acc. 841	235.5	55	14.40	9.05	5.08	10.50	8.4	16.4	0	5	14.88	5.82	6.04	55.98	2
AS-2	170.0	35	8.80	6.00	4.00	7.00	5.0	12.5	3	5	10.00	4.50	5.00	25.80	2
Acc. 742	340.0	70	21.81	11.58	5.09	17.89	21.8	53.4	0	5	17.76	7.36	6.70	75.07	2
AS-4	334.0	72	21.81	12.98	4.97	18.20	21.0	47.8	0	5	15.38	6.26	12.38	52.30	2
ACK-1	264.1	68	21.38	12.95	4.51	16.64	11.5	31.1	0	5	14.36	6.16	6.14	57.80	2
ACK-2	231.0	45	12.54	9.34	4.16	8.71	5.0	21.4	5	5	12.80	4.36	5.02	24.81	3
ACK-3	315.0	66	20.52	12.62	5.04	16.81	14.3	39.6	0	5	16.34	6.94	6.52	70.77	2
FM-1	217.5	46	12.69	8.31	4.16	10.47	4.1	17.2	5	5	12.54	4.62	4.96	28.24	3
AS-5	327.5	69	39.30	11.94	3.99	16.67	13.0	35.2	0	5	15.52	6.38	6.50	57.40	2
AS-6	352.5	74	23.05	12.88	4.83	19.45	19.4	51.2	0	5	15.70	6.40	6.66	63.84	2
AS-7	173.0	39	8.80	6.00	3.40	7.00	2.0	9.00	0	5	11.00	4.50	5.00	32.00	3
Acc.890	247.0	66	12.08	8.30	3.20	9.73	7.4	15.2	0	5	13.46	8.20	11.78	75.11	2
AS-9	120.0	38	10.00	8.00	4.00	8.00	1.5	8.0	3	5	11.50	2.62	6.5	28.5	3
Acc. 4894	231.0	74	11.00	7.02	3.45	8.89	6.2	14.0	0	5	16.26	7.46	5.96	63.54	2
RS-5	298.5	63	18.58	20.58	3.98	16.05	13.3	38.8	0	5	15.68	5.34	5.48	54.79	2
RS-6	148.5	44	10.13	6.10	3.21	7.92	1.3	7.9	7	5	11.88	2.62	2.78	14.75	3
RS-7	162.5	43	11.23	7.74	3.35	8.77	1.9	11.6	7	5	11.82	2.82	3.20	13.94	3
RS-8	200.0	52	14.36	9.05	3.74	11.35	5.8	23.0	7	5	14.20	4.08	5.00	28.62	3
Acc. 3311	125.6	47	13.60	8.22	4.20	10.25	1.7	12.2	3	5	9.62	11.28	6.80	41.98	6
Acc. 5134	282.0	70	16.78	8.20	3.90	13.28	19.10	31.0	0	5	14.30	5.22	5.34	30.50	3
FMN-1	244.0	45	17.04	12.44	4.44	14.20	9.5	37.0	3	5	16.14	5.68	6.56	37.55	3
FMN-2	194.5	57	13.60	7.42	3.36	10.34	4.2	25.0	1	5	14.68	4.20	5.84	27.06	3
FZ-1	291.5	61	20.13	11.66	4.14	17.07	12.2	38.8	1	5	16.04	5.74	6.36	53.30	2

Conclusion

A wide range of variation was found among the six qualitative characters such as stem color, leaf color, petiole color, leaf shape etc. Significant variations were also found among fifteen quantitative characters such as plant technical height, plant base diameter, dry fibre weight, dry stick weight etc. The maximum co-efficient of variation was in dry fibre weight (75.58%) and minimum in top diameter (14.86%) of plant. Three germplasm (acc. 742, RS-4 & RS-8) were identified as promising and can be used for varietal development program.

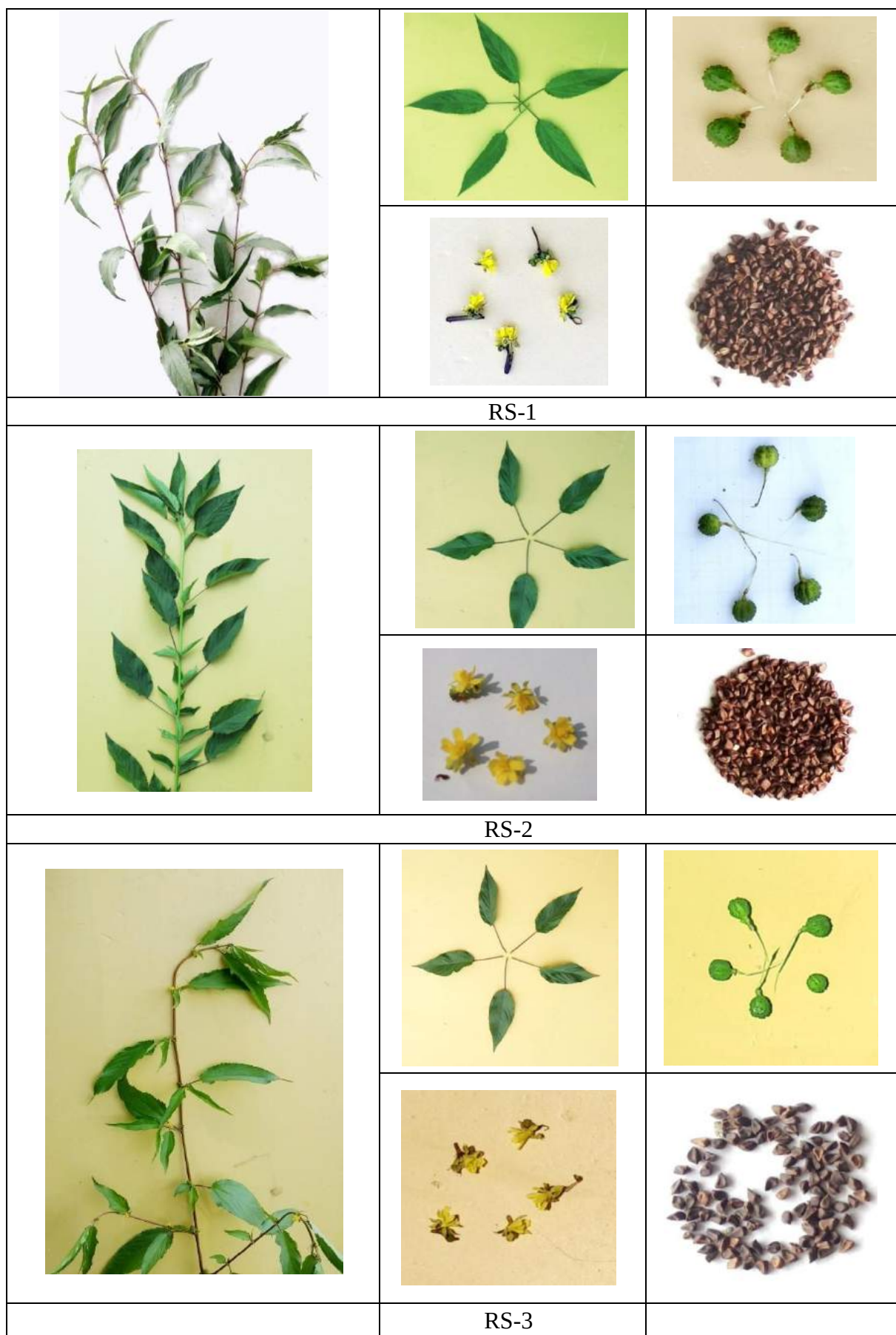
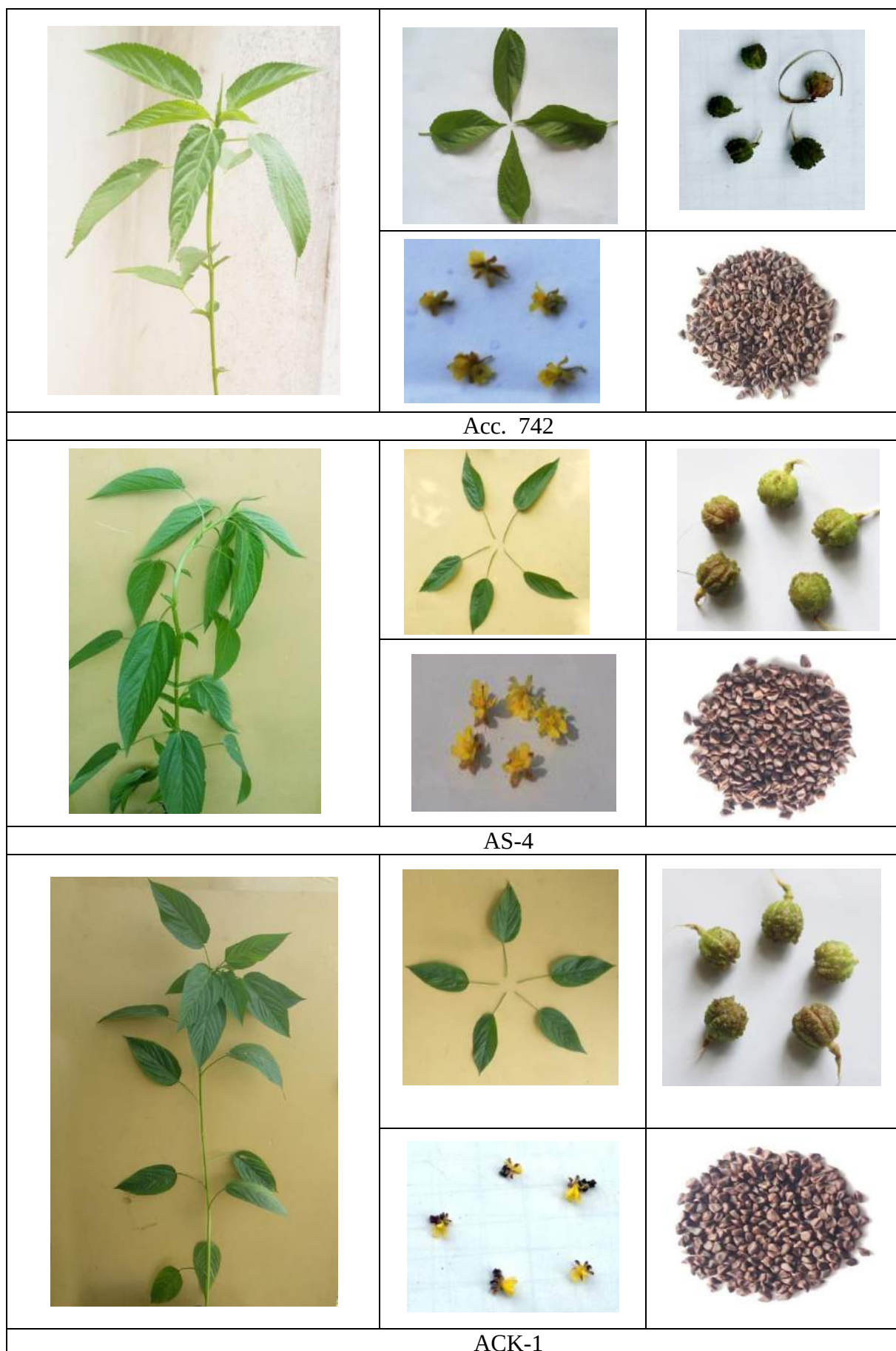


Fig. 68. Different plant parts of deshi jute, 2018



Cont'd. Fig. 68. Different plant parts of deshi jute, 2018



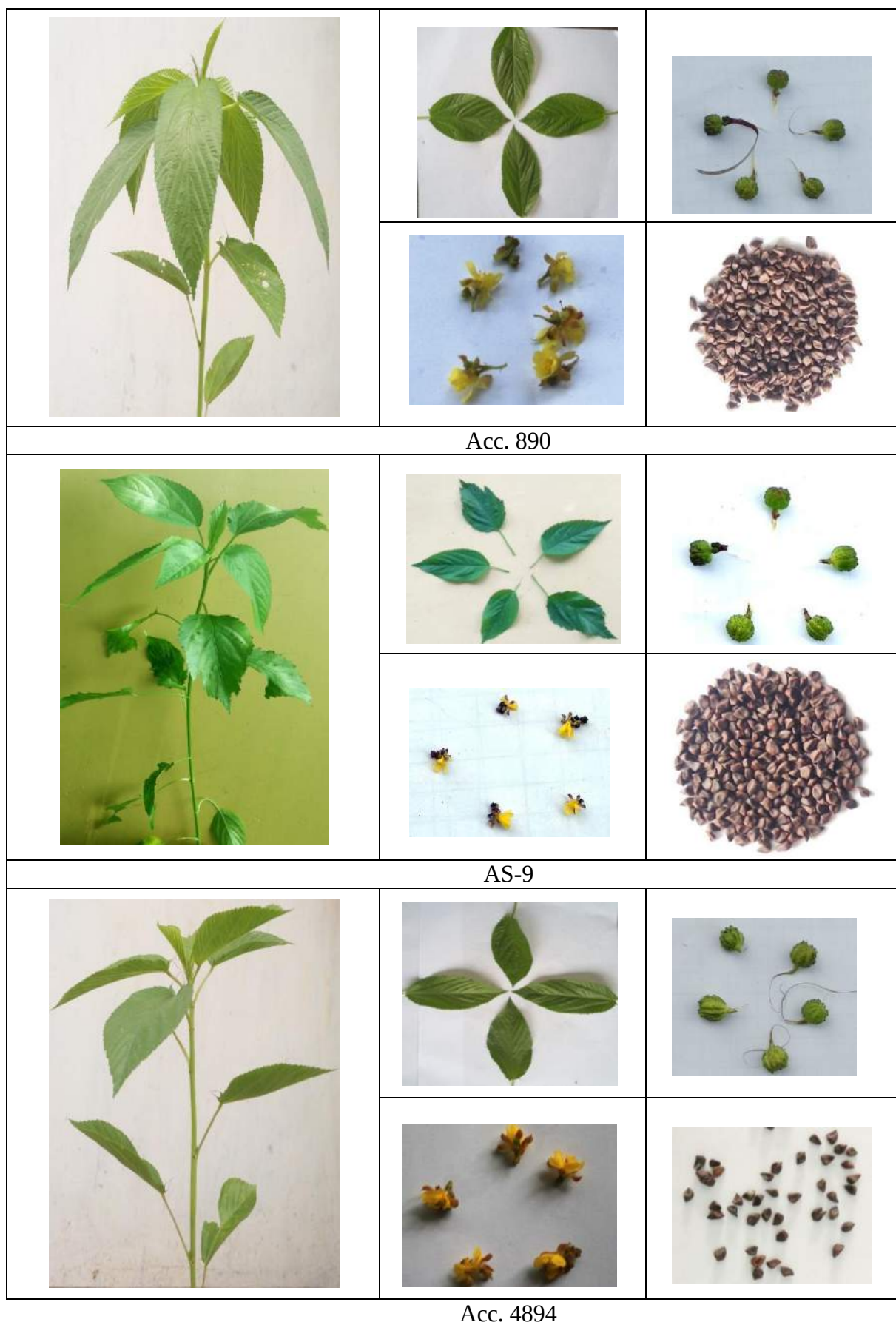
Cont'd. Fig. 68. Different plant parts of deshi jute, 2018

		
		
ACK-2		
		
		
ACK-3		
		
		
FM-1		

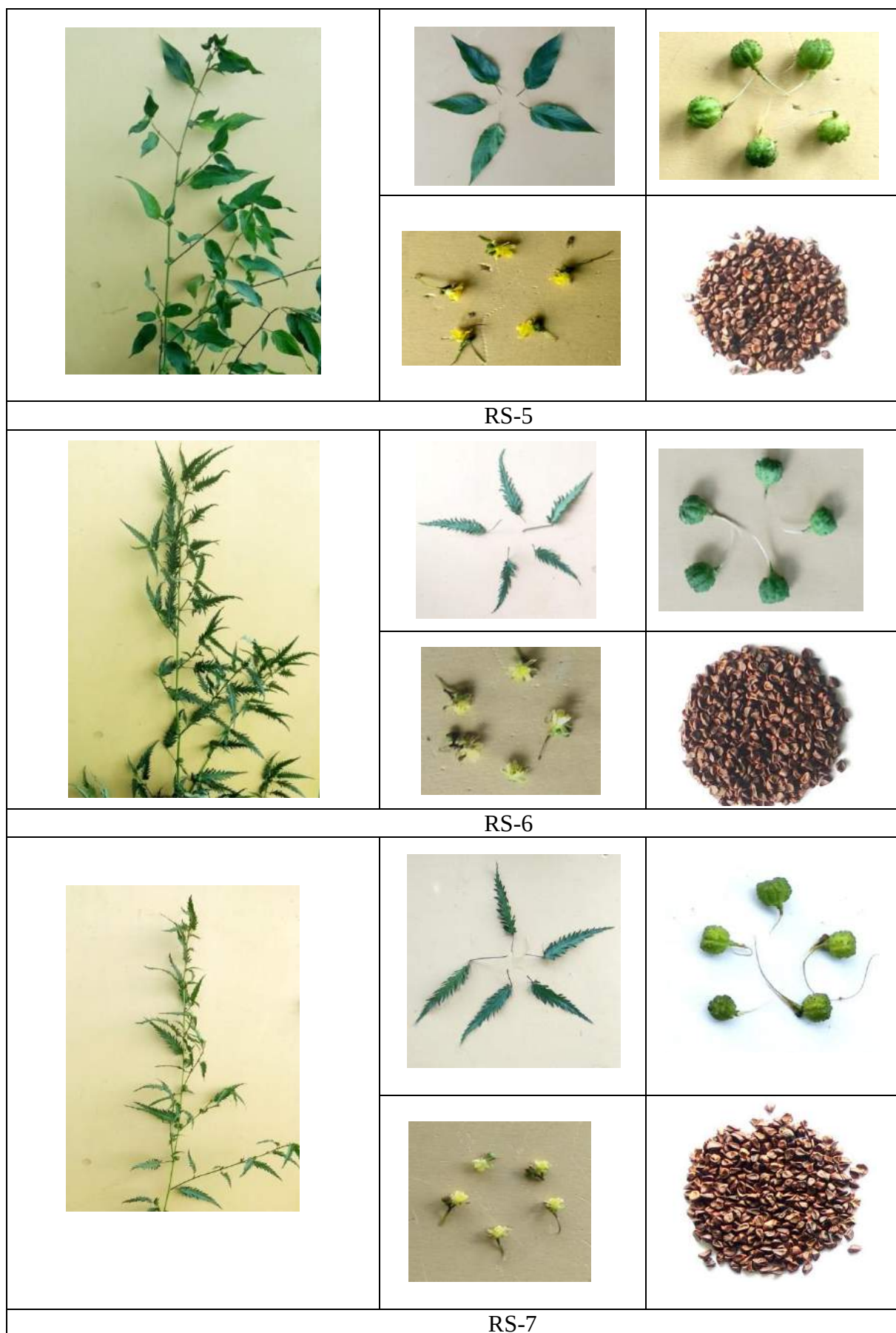
Cont'd. Fig. 68. Different plant parts of deshi jute, 2018



Cont'd. Fig. 68. Different plant parts of deshi jute, 2018



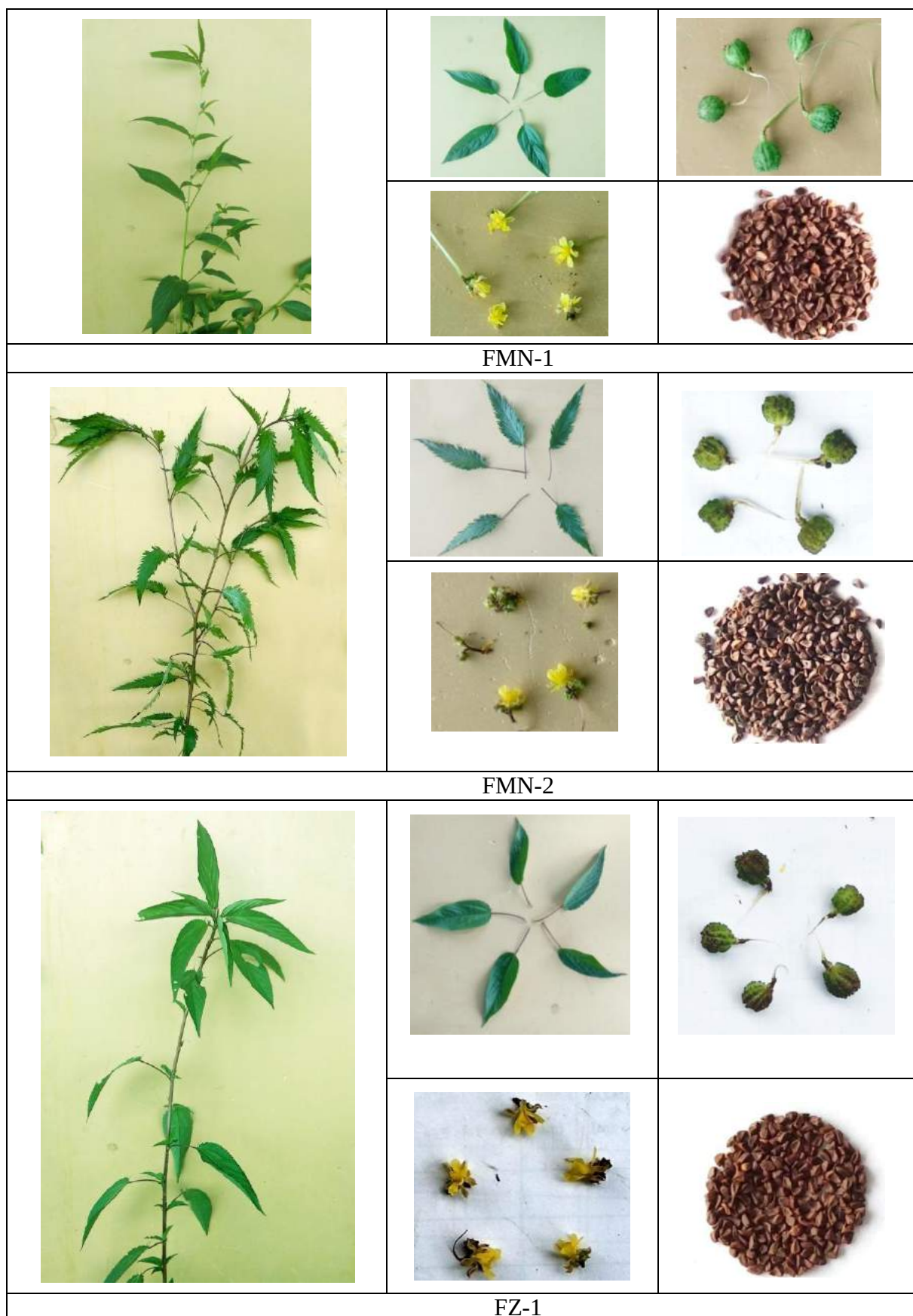
Cont'd. Fig. 68. Different plant parts of deshi jute, 2018



Cont'd. Fig. 68. Different plant parts of deshi jute, 2018

		
		
RS-8		
		
		
Acc. 3311		
		
		
Acc. 5134		

Cont'd. Fig. 68. Different plant parts of deshi jute, 2018



Cont'd. Fig. 68. Different plant parts of deshi jute, 2018

11.4.4. Characterization of Deshi Jute (*C. capsularis*) Germplasm, 2020

Qualitative variations of different characters in 35 germplasm are shown in table 72. Wide range of variation was found in plant stem color and stipule color. Green stem (71%), red (20%) and light red (9%) were found among the germplasm. Green leaf and leaf vein color was found in all the germplasm. Stipule was present in all germplasm with 66% green, 31% light red and 3% red color. Among them 83% germplasm were non-branched (Fig. 55 & 56).

Quantitative variations of 10 characters were shown in table 73 Range, mean, standard deviation and co-efficient of variations of quantitative characters were calculated. The maximum co-efficient of variation was in dry core weight (34.95%) followed by dry fibre weight (34.58%). The plant height was found highest in acc. no. 2023 (329 cm) followed by acc. no. 2122 (322 cm), acc. no. 2068 (318 cm), acc. no. 2020 (316 cm), acc. no. 2061 (315 cm) and acc. no. 2143 (312 cm) (Table. 75). Khatun and Sobhan (1992) studied the morphological characters of tossa jute germplasm and revealed that plant height and bark weight had great influence on fibre yield. The highest base diameter 24.58 mm was found in acc. no. 2023 followed by 23.40 mm in acc. no. 2061, 22.50 mm in acc. no. 2090, 21.94 mm in acc. no. 2096, 21.92 mm in acc. no. 2193, 21.72 mm in 2068 and 21.18 mm in acc. no. 2143. The highest leaf length was measured 18.60 cm in acc. no. 2167 followed by 17.54 cm in acc. no. 2143 and 17.42 cm in acc. no. 2106. In case of leaf width, the highest was 7.82 cm in acc. no. 2122 followed by 2.74 cm in acc. no. 2192 & 2193. Petiole length was highest 9.12 cm in acc. no. 2122 followed by 8.62 cm in acc. no. 2192 and 8.46 cm in acc. no. 2189 while the lowest was 170 cm in acc. no. 2085. Number of nodes per plant ranged from 38-72 with an average 56.88. Dry stick weight was highest (50.40 g) in acc. no. 2061 followed by 49 g in acc. no. 2122, 46 g in acc. no. 2067 & 2090, 45.8 g in acc. no. 2193, 44.8 g in acc. no. 2106 and 44.6 g in acc. no. 2143 & 2083. Dry fibre weight was highest 20 g in acc. no. 2143 followed by 19.8 g in acc. no. 2061, 19.20 g in acc. no. 2122, 19 g in acc. no. 2090 and 18.2 g in acc. no. 2193. Significant differences for the all the characters with wide range of variability were found. Islam and Ahmed (2003) suggested that jute genotype variability is considered for crop improvement program. Based on the yield contributing characters acc. no. 2143, 2061, 2122, 2090 and 2193 can be used in this regard.

Table 72. Qualitative variation in different characters of deshi jute (*C. capsularis*) germplasm, 2020

Characters	Descriptor state	No. of germplasm	Frequency (%)
Stem color	Green	25	71
	Red	7	20
	Light Red	3	9
Late stem color	Green	26	74
	Red	7	20
	Light red	2	6
Leaf lamina color	Green	35	100
Vein color	Green	35	100
Stipule color	Green	23	66
	Red	1	3
	Light red	11	31

Table 73. Quantitative variation in different descriptors of deshi jute (*C. capsularis*) germplasm, 2020

Name of descriptor	Range	Mean	SD	CV (%)
Plant height (cm)	170-329	283.31	36.52	12.89
Nodes per plant (no.)	38.40-71.40	56.88	9.31	16.37
Stem diameter (mm)	10.22-24.58	18.57	3.35	18.02
Leaf length (cm)	12.84-81.60	15.37	1.40	9.12
Leaf width (cm)	4.84-7.82	6.24	0.83	13.31
Petiole length (cm)	4-9.12	6.89	1.21	17.50
Dry fibre weight (g)/plant	2.8-20	13.31	4.60	34.58
Dry core weight (g)/plant	7.4-50.4	33.33	11.65	34.95

Table 74. Qualitative characters of deshi jute (*C. capsularis*) germplasm, 2020

Acc. No.	Stem Color (1)(g/lr/r)	Stem Color (2)(g/lr/r)	Leaf lemina Color (g/lr/r)	Leaf vein Color (g/lr/r)	Leaf shape	Stipule 0/1	Stipule color
2020	1	1	1	1	2	1	1
2023	99	1	1	1	3	1	99
2033	1	1	1	1	2	1	1
2339	1	1	1	1	2	1	1
2061	2	2	1	1	1	1	2
2063	2	2	1	1	2	1	99
2067	1	1	1	1	2	1	99
2068	1	1	1	1	2	1	1
2082	1	1	1	1	2	1	1
2083	1	1	1	1	2	1	1
2085	1	1	1	1	2	1	1
2090	2	2	1	1	2	1	99
2096	1	1	1	1	2	1	1
2106	1	1	1	1	2	1	1
2122	1	1	1	1	2	1	1
2123	1	1	1	1	2	1	1
2124	1	1	1	1	2	1	1
2141	2	2	1	1	2	1	99
2142	2	2	1	1	2	1	99
2143	1	1	1	1	2	1	1
2145	1	1	1	1	2	1	1
2146	2	2	1	1	2	1	99
2166	2	2	1	1	2	1	99
2167	99	99	1	1	2	1	99
2169	1	1	1	1	2	1	1
2170	1	1	1	1	2	1	1
2183	1	1	1	1	2	1	1
2186	1	1	1	1	2	1	1
2187	1	1	1	1	2	1	1
2188	1	1	1	1	2	1	1
2189	1	1	1	1	2	1	1
2192	99	99	1	1	2	1	99
2193	1	1	1	1	2	1	1
2200	1	1	1	1	2	1	1
7370	1	1	1	1	2	1	99

Table 75. Quantitative characters of deshi jute (*C. capsularis*) germplasm, 2020

Acc. No.	Plant height (cm)	Nodes per plant (no.)	Stem diameter (mm)	Leaf length (cm)	Leaf Width (cm)	Leaf angle	Petiole length (cm)	Branching habit	Dry fibre weight (g)/plant	Dry core (stick) wt. /plant (g)
2020	316	61.40	20.90	14.02	5.30	3.00	5.96	0	15.20	35.60
2023	329	63.40	24.58	13.22	4.96	3.00	5.22	0	15.80	42.80
2033	287	47.60	20.70	13.56	5.08	3.00	4.76	0	11.00	29.80
2339	233	48.80	14.62	14.74	5.58	3.00	6.50	0	9.00	28.00
2061	315	61.20	23.40	16.48	6.50	3.00	8.18	0	19.80	50.40
2063	232	50.80	18.26	13.36	5.50	3.00	6.30	0	14.20	38.00
2067	299	53.60	19.88	16.10	5.94	3.00	7.64	0	16.80	46.00
2068	318	71.40	21.72	15.26	5.80	3.00	6.46	0	17.20	38.80
2082	308	67.40	20.26	14.44	7.20	3.00	6.28	0	16.80	35.20
2083	289	49.60	20.60	14.86	6.54	3.00	5.76	0	15.20	44.60
2085	170	38.40	10.22	12.84	5.24	3.00	5.74	0	2.80	7.40
2090	304	61.60	22.50	16.20	6.18	4.00	5.94	0	19.00	46.00
2096	295	51.60	21.94	16.40	7.02	3.00	6.98	0	16.60	41.20
2106	291	49.40	19.92	17.42	6.34	4.00	7.26	0	16.80	44.80
2122	322	68.00	20.76	15.36	7.82	4.00	9.12	0	19.20	49.00
2123	202	40.40	11.08	13.38	5.30	3.00	6.48	0	4.00	9.40
2124	280	45.60	16.76	12.92	5.64	3.00	5.16	0	11.60	29.40
2141	290	53.60	16.84	16.11	5.62	3.00	7.16	0	12.20	30.80
2142	288	49.60	18.56	15.18	5.40	3.00	5.58	0	15.00	41.00
2143	312	62.80	21.18	17.54	4.84	4.00	7.96	0	20.00	44.60
2145	298	61.00	18.50	16.58	6.76	3.00	7.78	5	13.60	33.60
2146	307	66.40	18.82	16.34	6.16	4.00	7.82	0	13.80	33.60
2166	288	56.00	16.62	15.72	6.06	4.00	6.96	0	9.60	26.00
2167	305	69.80	19.50	18.60	6.74	4.00	8.08	0	16.20	40.60
2169	301	68.40	18.02	15.86	6.00	3.00	4.00	5	12.00	28.60
2170	219	41.80	12.82	13.70	6.08	3.00	6.62	0	4.00	9.40
2183	309	55.00	19.36	16.02	6.82	4.00	6.00	3	15.20	39.20
2186	290	68.20	19.70	15.10	7.20	4.00	7.78	3	14.20	32.60
2187	256	56.20	15.20	15.80	7.08	3.00	8.08	0	7.80	15.80
2188	250	58.80	15.48	15.28	6.98	4.00	8.18	0	7.40	14.60
2189	276	53.80	17.28	16.98	6.62	3.00	8.46	0	10.20	22.40
2192	300	70.00	19.56	16.98	7.74	3.00	8.62	5	14.80	33.00
2193	301	59.40	21.92	15.46	7.74	3.00	7.60	3	18.20	45.80
2200	236	43.60	13.16	14.90	7.08	3.00	6.70	0	6.60	22.60
7370	300	66.20	19.36	15.18	5.64	3.00	7.90	0	14.20	35.80

Conclusion

A wide range of variation was found among the qualitative characters such as stem color, stipule color, leaf shape etc. Significant variations were also found among ten quantitative characters such as plant height, stem diameter, dry fibre weight, dry stick weight etc. The maximum co-efficient of variation was in dry core weight (34.95%) and minimum in leaf length (9.12%). Some promising germplasm acc. no. 2143, 2061, 2122, 2090 and 2193 were selected.

		
Acc. no. 2020	Acc. no. 2023	Acc. no. 2033
		
Acc. no. 2039	Acc. no. 2061	Acc. no. 2063
		
Acc. no. 2067	Acc. no. 2068	Acc. no. 2082
		
Acc. no. 2083	Acc. no. 2085	Acc. no. 2090

Fig. 69. Different plant parts of deshi jute (*C. capsularis*) germplasm, 2020

		
Acc. no. 2096	Acc. no. 2106	Acc. no. 2122
		
Acc. no. 2123	Acc. no. 2124	Acc. no. 2141
		
Acc. no. 2142	Acc. no. 2143	Acc. no. 2145
		
Acc. no. 2146	Acc. no. 2166	Acc. no. 2167

Cont'd. Fig. 69 Different plant parts of deshi jute (*C. capsularis*) germplasm, 2020

		
Acc. no. 2169	Acc. no. 2170	Acc. no. 2183
		
Acc. no. 2186	Acc. no. 2187	Acc. no. 2188
		
Acc. no. 2189	Acc. no. 2192	Acc. no. 2193
		
Acc. no. 2200	Acc. no. 7370	

Cont'd. Fig. 69. Different plant parts of deshi jute (*C. capsularis*) germplasm, 2020

11.4.5. Characterization of tossa jute (*Corchorus olitorius*) germplasm, 2020

Qualitative variations of different characters in 35 germplasm were shown in table 76 & 77. Wide range of variation was found in plant stem color. Green stem (74%) and red (26%) stem color were found among the germplasm. Green leaf and leaf vein color was found in all the germplasm. Stipule was present in all germplasm with 23% green, 5% light red and 7% red color. Among them 63% germplasm were non-branched (Fig. 70).

Quantitative variations of 10 characters were shown in table 78. Range, mean, standard deviation and co-efficient of variations of quantitative characters were calculated (Table 79). The maximum co-efficient of variation was in dry core weight (27.54%). The plant height was found highest in Robi 1 (350 cm) followed by acc. no. 5141 (308 cm), acc. no. 5144 (307 cm), acc. no. 4142 (301 cm), acc. no. 5163 (300 cm), acc. no. 5038 (299 cm), acc. no. 5145 (298 cm), acc. no. 4792 (292 cm) while the lowest was 206 cm in acc. no. 5122. Number of nodes per plant ranged from 36-76 with an average 56.44. Khatun and Sobhan (1992) studied the morphological characters of tossa jute germplasm and revealed that plant height and bark weight had great influence on fibre yield. The highest base diameter was 22 mm found in Robi-1 variety followed by 21.66 mm in acc.s no. 5163, 19.05 mm in acc. no. 5145, 18.86 mm in acc. no. 4794, 18.72 mm in acc. no. 4792, 18.55 mm in 5103 and 18.04 mm in acc. no. 5149. The highest leaf length was measured in acc. no. 5145 (16.85 cm) followed by acc no. 5141 (16.70 cm) and BJRI variety Robi-1 (16.68 cm). In case of leaf width, the highest was 7.34 cm in acc. no. 5141. The highest petiole length was calculated in acc. no.5141 (7.1 cm) followed by acc. no. 5142 (7.06 cm). Dry fibre weight was highest in Robi-1 (24.5 g) followed by 23.8 g in acc. no. 5123, 22 g in acc. no. 5121, 21.6 g in acc. no. 5038 & 5142, 20.8 g in acc. no. 4792 and 20.5 g in acc. no. 5163, 3854 & 5103. Dry stick weight was highest in acc. no. 5103 (60.75 g) which was even higher than check variety Robi-1 (Table 79). Considering yield contributing parameters, the acc. nos. 5038, 4792, 5163, 4851, 5145, 4794 and 5121 can be selected for crop improvement program.

Table 76. Qualitative variation in different characters of tossa jute germplasm, 2020

Character	Descriptor state	No. of germplasm	% of variation
Stem color	Green	26	74
	Red	9	26
Late stem color	Green	26	74
	Red	6	17
	Light red	3	9
Leaf color	Green	35	100
Vein color	Green	35	100
Stipule color	Green	23	66
	Red	7	20
	Light red	5	14

Table 77. Qualitative characters of tossa jute germplasm

Acc. No.	StemColor (1) (g/lr/r)	StemColor (2) (g/lr/r)	Leaf lemina Color (g/lr/r)	Leaf vein Color (g/lr/r)	Leaf shape	Stipule 0/1	Stipule color
3854	1	1	1	1	2	1	1
3855	1	1	1	1	2	1	1
3862	2	99	1	1	2	1	99
3875	1	1	1	1	1	1	1
3887	1	1	1	1	2	1	1
3888	1	1	1	1	2	1	1
4674	1	1	1	1	2	1	1
4742	1	1	1	1	2	1	1
4792	1	1	1	1	3	1	1
4794	2	2	1	1	2	1	2
4851	1	1	1	1	2	1	1
4870	1	1	1	1	3	1	1
5008	1	1	1	1	2	1	1
5041	1	1	1	1	2	1	2
5103	1	1	1	1	3	1	1
5108	2	2	1	1	2	1	99
5118	2	99	1	1	2	1	2
5120	2	2	1	1	2	1	2
5121	2	2	1	1	2	1	99
5122	1	1	1	1	2	1	1
5123	1	1	1	1	2	1	1
5038	1	1	1	1	2	1	1
5141	1	1	1	1	3	1	1
5142	1	1	1	1	2	1	1
Robi-1	2	2	1	1	2	1	2
5145	1	1	1	1	3	1	2
5146	1	1	1	1	2	1	1
5148	1	1	1	1	2	1	1
5149	1	1	1	1	2	1	1
5150	1	1	1	1	1	1	1
5160	2	99	1	1	2	1	99
5162	1	1	1	1	2	1	99
5163	1	1	1	1	2	1	1
5166	1	1	1	1	2	1	1
5144	2	2	1	1	2	1	2

Table 78. Quantitative characters of tossa jute germplasm

Acc. No.	Plant height (cm)	Nodes per plant (no.)	Stem dia. (mm)	Leaf length (cm)	Leaf Width (cm)	Leaf angle	Petiole length (cm)	Branching habit	Dry fibrewt (g)/plant	Dry core (stick) wt (g) /plant
3854	256	52.60	16.96	14.52	5.58	4	6.14	5	20.50	56.60
3855	269	57.80	14.96	15.00	6.66	4	6.74	1	13.60	30.80
3862	224	47.40	15.36	13.00	6.26	4	5.60	3	14.20	41.20
3875	220	38.80	17.00	12.86	6.16	4	5.12	0	12.80	47.00
3887	217	40.80	14.78	13.16	5.76	4	4.56	0	13.00	38.40
3888	213	41.60	15.50	12.60	5.66	3	5.46	0	12.20	39.80
4674	230	43.60	15.80	13.18	5.74	3	5.86	0	12.40	38.40
4742	244	58.80	15.68	12.98	6.90	4	6.18	0	14.40	25.00

Table 78. Cont'd.

Acc. No.	Plant height (cm)	Nodes per plant (no.)	Stem dia. (mm)	Leaf length (cm)	Leaf Width (cm)	Leaf angle	Petiole length (cm)	Branching habit	Dry fibrewt (g)/plant	Dry core (stick) wt (g) /plant
4792	292	64.40	18.72	14.68	5.82	4	6.90	3	20.80	48.60
4794	274	59.60	18.86	15.16	6.34	4	6.04	0	19.60	41.20
4851	290	55.60	17.02	15.42	6.32	4	6.58	0	20.00	45.00
4870	260	58.40	14.68	16.48	6.50	3	6.48	5	15.40	33.40
5008	212	36.20	14.44	15.60	6.30	3	5.70	0	9.60	26.40
5041	241	47.40	14.06	15.78	6.42	4	6.58	-	17.80	31.00
5103	248	41.50	18.55	15.30	6.30	4	60	0	20.50	60.75
5108	289	65.40	17.94	14.50	6.25	4	6.08	0	18.00	38.60
5118	258	64.00	15.50	14.94	6.10	4	60	0	14.60	29.00
5120	253	47.80	14.86	15.18	5.94	4	6.04	0	16.20	51.60
5121	280	6.40	15.94	15.82	6.46	4	6.80	0	22.00	56.50
5122	206	51.40	12.06	13.90	5.58	3	6.16	0	9.00	14.60
5123	255	58.00	14.98	15.74	6.34	4	6.24	1	23.80	46.00
5038	299	65.00	16.54	16.54	6.86	4	6.56	3	21.60	43.20
5141	308	76.00	15.62	16.70	7.34	4	7.10	5	20.00	49.40
5142	301	68.20	14.74	16.32	6.12	4	7.06	0	21.60	38.20
Robi-1	350	60.00	22.00	16.68	6.18	4	7.00	0	24.50	60.50
5145	298	68.00	19.05	16.85	6.70	4	6.75	0	20.00	57.50
5146	238	53.80	13.70	15.18	6.20	4	6.00	0	16.20	32.40
5148	255	53.00	10.95	14.50	6.65	4	5.65	5	11.50	29.15
5149	277	66.40	18.04	15.64	6.84	4	6.42	5	15.20	31.80
5150	252	59.60	16.96	12.50	5.96	3	5.66	0	17.80	34.80
5160	261	63.20	16.52	15.76	6.50	4	6.08	5	18.60	55.40
5162	259	59.30	17.80	15.92	6.54	4	6.22	3	20.30	50.00
5163	300	64.80	21.66	16.64	7.18	4	6.20	0	20.50	55.00
5166	291	58.00	13.70	16.26	6.34	4	5.78	0	14.60	29.20
5144	307	68.60	16.38	16.28	6.72	4	6.00	3	19.50	48.40

Table 79. Quantitative variation of tossa jute germplasm

Name of descriptor	Range	Mean	SD	CV(%)
Plant height (cm)	206-350	263.63	33.25	12.61
Nodes per plant (no.)	36.2-76	56.44	9.75	17.28
Stem diameter (mm)	10.95-22	16.21	2.31	14.23
Leaf length (cm)	12.5-16.85	15.07	1.32	8.74
Leaf width 9 (cm)	5.58-7.34	6.33	0.43	6.75
Petiole length (cm)	4.56-7.1	6.16	0.55	8.92
Dry fibre weight (g/plant)	9-24.5	17.21	4.01	23.30
Dry core weight	14.6-60.75	41.57	11.45	27.54

Conclusion

A wide range of variation was found among the seven qualitative characters such as stem color, Stipule color, leaf shape etc. Significant variations were also observed among the fifteen quantitative characters such as plant height, stem diameter, dry fibre weight, dry stick weight etc. The maximum co-efficient of variation was in dry core weight (27.54%) and minimum in leaf width (6.75%). The acc. no. 5038, 4792 , 5163, 4851, 5145, 4794 and 5121 were identified as promising for varietal development program.

		
Acc. no. 3854	Acc. no. 3855	Acc. no. 3862
		
Acc. no. 3875	Acc. no. 3887	Acc. no. 3888
		
Acc. no. 4674	Acc. no. 4742	Acc. no. 4792
		
Acc. no. 4794	Acc. no. 4851	Acc. no. 4870

Fig. 70. Different plant parts of tossa jute germplasm, 2020

		
Acc. no. 5008	Acc. no. 5041	Acc. no. 5103
		
Acc. no. 5108	Acc. no. 5118	Acc. no. 5120
		
Acc. no. 5121	Acc. no. 5122	Acc. no. 5123
		
Acc. no. 5038	Acc. no. 5141	Acc. no. 5142

Cont'd. Fig. 70. Different plant parts of tossa jute germplasm, 2020

		
Acc. no. Robi-1	Acc. no. 5145	Acc. no. 5146
		
Acc. no. 5148	Acc. no. 5149	Acc. no. 5150
		
Acc. no. 5160	Acc. no. 5162	Acc. no. 5163
		
Acc. no. 5166	Acc. no. 5144	

Cont'd. Fig. 70. Different plant parts of tossa jute germplasm, 2020

11.4.6. Molecular characterization of jute germplasm through DNA fingerprinting

Closely related cultivars with low genetic variability can't readily be distinguished by morphological traits like pigmentation pattern, leaf shape, stipule shape, seed coat color and so on that are very difficult to identify in jute and allied fibregermplasm characterization. DNA fingerprinting for cultivar or varietal identification has become an important tool for genetic identification in germplasm management and plant breeding. When planning of DNA fingerprinting, one of the most important decision is the marker system and molecular technique to be used. Various systems and their related techniques are currently available, and those are based on polymerase chain reaction (PCR). PCR based techniques or molecular markers such as Randomly Amplified Polymorphic DNA (RAPDs), Simple Sequence Repeats (SSRs) or microsatellites and Amplified Fragment Length Polymorphisms (AFLPs), have an apparent advantage as cultivar descriptors. SSRs have become a powerful and popular tool for determining unique genetic identity or fingerprint, and establishing genetic relatedness as well as diversity among various crop cultivars. The present piece of work is undertaken to develop genetic fingerprints and to estimate genetic relatedness of 22 jute germplasm using some SSR markers.

The jute genotypes (Table 80) studied in this experiment was collected from the Gene Bank of Bangladesh Jute Research Institute (BJRI).

Table 80. List of jute germplasm with origin

Sl. no.	Acc. o./Variety	Species	Country of Origin
1	O-5	<i>Corchorusolitorius</i>	BJRI Variety
2	O-9897	<i>C. olitorius</i>	BJRI Variety
3	O-72	<i>C. olitorius</i>	BJRI Variety
4	OM-1	<i>C. olitorius</i>	BJRI Variety
5	O-795	<i>C. olitorius</i>	BJRI Variety
6	A.1039	<i>C. olitorius</i>	Bangladesh
7	A.1234	<i>C. olitorius</i>	Bangladesh
8	A.1245	<i>C. olitorius</i>	Bangladesh
9	A.1338	<i>C. olitorius</i>	Philippine
10	A.1347	<i>C. olitorius</i>	Uganda
11	A.1480	<i>C. olitorius</i>	Srilanka
12	A.1362	<i>C. olitorius</i>	Bangladesh
13	CVL-1	<i>C. capsularis</i>	BJRI Variety
14	BJC7370	<i>C. capsularis</i>	BJRI Variety
15	BJC2197	<i>C. capsularis</i>	BJRI Variety
16	BDPS1	<i>C. capsularis</i>	BJRI Variety
17	A.552	<i>C. capsularis</i>	Bangladesh
18	A.568	<i>C. capsularis</i>	Bangladesh
19	A.628	<i>C. capsularis</i>	Bangladesh
20	A.646	<i>C. capsularis</i>	Bangladesh
21	A.4484	<i>C. capsularis</i>	Thailand
22	A.4618	<i>C. capsularis</i>	Brazil

The seeds were placed on wet blotting paper in petri dishes and kept in a dark place. DNA was isolated from 4 days old seedlings using the mini preparation CTAB method (Doyle and Doyle, 1987) with some modifications. Approximately 1.5g tissue was grinded to fine powder with mortar and pestle in liquid nitrogen and was taken in 2ml centrifuge tube and 1ml extraction buffer (2% CTAB, 1.4M NaCl, 20mM EDTA, 100mM Trisbase, 100mM β -mercaptoethanol, 2% Polyvinylpolypyrrolidon) was added. The centrifuge tubes were kept in water bath with 65°C for 10 minutes and then centrifuged with 13000rpm for 10 minutes. The supernatants were collected and transferred to fresh 1.5ml centrifuge tubes.

DNA was purified by Phenol: Chloroform: Isoamyl alcohol(25:24:1) and was precipitated using ice cold isopropanol in presence of 0.3 M sodium acetate. Finally DNA was pelleted and washed with 70% and 100% ethanol. The pellets were dried with vacuum freeze dryer and dissolved in 100µl TE buffer (10 mMTris-HCl, 1mM EDTA pH-8.0) and stored at -20°C. For making working solutions extracted DNA solutions were diluted to 10 times in new centrifuge tubes. A total of 33 SSR primers (Table 81) were used in this experiment.

Table 81. SSR primers used for diversity analysis of jute germplasm

Sl. No.	Primer		Sequence	Repeat Motif	Status
1	JMBD 142	Forward Primer	ATGAAATGGAGGTGCTACGG	(CGC)6	Not amplified
		Reverse Primer	CACTTCCTTCGACTTCTCCG		
2	JMBD 148	Forward Primer	ACCCACCAAGTTCATGCTTC	(CAT)5	Polymorphic
		Reverse Primer	GAAGGAAGTGAGCAAGCCAG		
3	JMBD 154	Forward Primer	ATCCACGCCTCCAACATAAG	(TCA)5	Not amplified
		Reverse Primer	GAACAAACCCGCACTTGACT		
4	JMBD 166	Forward Primer	GCAGTTTGTGGTGATGGATG	(TTA)6	Polymorphic
		Reverse Primer	GCCTTAAAGTGCATACAGGAGG		
5	JMBD 238	Forward Primer	CACCGTGCAACTGCAAATAG	(GAA)6	Not amplified
		Reverse Primer	CTGTCTTCTCCTTCCGCTTG		
6	JMBD 423	Forward Primer	CACAGCCAAGCTGATGAGAA	(GAT)5	monomorphic
		Reverse Primer	CCTCACGCTCTGGAGACTTC		
7	JMBD 434	Forward Primer	TTGTGGGAGTAACAGGAGGG	(AAG)5	monomorphic
		Reverse Primer	GAGCTGATATTGGCGGTGTT		
8	JMBD 492	Forward Primer	AACCAAAGCACCACCCTTC	(ACC)5	monomorphic
		Reverse Primer	CGCTGACGACGATATCTTGA		
9	JMBD 563	Forward Primer	TGGGCTTGTAACCAAGGAAG	(GTA)5	Polymorphic
		Reverse Primer	CAAACAAATGTGCCATTCCA		
10	JMBD 598	Forward Primer	CCTAATTTCCACCACCAACG	(CTT)5	Polymorphic
		Reverse Primer	CGGGTTAAGGGTCTTGTTGA		
11	JMBD 616	Forward Primer	AGCATCCCATTTCTTCAGGTG	(CTT)5	monomorphic
		Reverse Primer	GTCATCTCGCTCTGCTCTCC		
12	JMBD 639	Forward Primer	TCATCCTCCACCTCCTCATC	(CAT)5	monomorphic
		Reverse Primer	CCTAACCTAATGCCACCCT		
13	JMBD 643	Forward Primer	TAATAACTGCGCCTTCGACC	(GCC)5	monomorphic
		Reverse Primer	GCTGTTGTGCTGCTGGTAA		
14	JMBD 709	Forward Primer	GTTGACCAGGCTTCTTCTGC	(ATC)5	Polymorphic
		Reverse Primer	CAAGCAGCAATCACAGCAAT		
15	JMBD 721	Forward Primer	CCCATCCAAATTAGCCACAC	(TGT)5	Polymorphic
		Reverse Primer	CTCTCTCCAAACTGCCCAAG		
16	JMBD 880	Forward Primer	GCTCCTACTTTCATTGAATGGC	(TCT)5	Polymorphic
		Reverse Primer	CCTGTTCTTGTTGCTGCTGA		
17	JMBD 929	Forward Primer	ACCCTTTCCTTGGATTACGC	(GAA)5	monomorphic
		Reverse Primer	GCTTCTTCAATTCGCGAGAG		
18	JMBD 969	Forward Primer	ATTCTTGCATGGAAACGGAG	(AAT)5	Polymorphic
		Reverse Primer	CCTTTGTTTCATCTGCTGCAA		
19	JMBD 989	Forward Primer	GGAAGAGATCAGGCTCAACG	(GGA)5	Polymorphic
		Reverse Primer	GATCTCATTCCTTGCCAAA		

Table 81. Cont'd.

Sl. No.	Primer		Sequence	Repeat Motif	Status
20	JMBD 1150	Forward Primer	CGCTATCTCCTCTGCTCCTG	(TTC)6	monomorphic
		Reverse Primer	CATTTTCGACGATCGGATTCT		
21	JMBD 1579	Forward Primer	TCAATCTTCACCAGCAGCAG	(ACA)5	monomorphic
		Reverse Primer	GCCGTCTCCTATTTCCATGA		
22	JMBD 1667	Forward Primer	AGTTCACCTTGGGATCGGTTG	(GTG)5	monomorphic
		Reverse Primer	GATAAAGCCACAGGAAGCCA		
23	JMBD 1774	Forward Primer	TCTTTCTGGTCCACCTTTGG	(GAG)5	monomorphic
		Reverse Primer	CTGGATTCTGCCACTCCCTA		
24	JMBD 1793	Forward Primer	TTCCGACTTCCGCAATAAAC	(TCT)5	monomorphic
		Reverse Primer	GTGTCGGACGAGGAAACACT		
25	JMBD 1806	Forward Primer	TGAGTCACCTTCTTGATGCCG	(GAT)5	Not amplified
		Reverse Primer	CTTGGCCTGGATAATAGGCA		
26	JMBD1824	Forward Primer	TTTACGAAACCTGCCACTCC	(GAA)5	Polymorphic
		Reverse Primer	CGCTCACAACTCCTTTCTCC		
27	JMBD 1912	Forward Primer	ACTACGTCCCGTCAGTCACC	(CTG)5	monomorphic
		Reverse Primer	GCACATTCTTCCGACCATCT		
28	JMBD 1950	Forward Primer	AGTGAACCTCCACAAATGCC	(AAC)6	Polymorphic
		Reverse Primer	GGCGAATTGCAAATGGTAGA		
29	JMBD 2032	Forward Primer	AAAGCATTGGATCTTCGTGG	(TGA)5	Polymorphic
		Reverse Primer	GTTGCATACTGGTGCATTGG		
30	JMBD 2045	Forward Primer	GGACAGAAGTTCGAGCCAAG	(CGG)5	Polymorphic
		Reverse Primer	GTTTCCCACCAGTAGTCCGA		
31	JMBD 2047	Forward Primer	CATACAAATGCAGACGGTGG	(AAG)5	Not amplified
		Reverse Primer	GCTCTCCTTCATTTGGCTCA		
32	JMBD 2054	Forward Primer	TTGGGAAGCAAGATGGAAAC	(GAA)5	Not amplified
		Reverse Primer	CGCACTTCCACCCATCTTAT		
33	JMBD 2064	Forward Primer	ACGAGATGGATTCTGATGCC	(GAC)5	Polymorphic
		Reverse Primer	CTCCAGCTTTGCTTGGAAAC		

PCR was performed in 10 µl reactions containing around 25 ng of DNA template (3 µl DNA with 10X dilution factor), 1 µl 10X TB buffer (containing 200 mM Tris-HCl pH 8.3, 500 mM KCl), 1.35 µl 25 mM MgCl₂, 0.2 µl of 10 mM dNTP, 0.5 µl each of 10 µM forward and reverse primers and 0.1 µl of Taq DNA polymerase (5 U/µl) using thermal cycler (Chen *et al.*, 1997; Neeraja *et al.*, 2007). After initial denaturation for 5 min at 94°C, each cycle comprises 45 sec denaturation at 94°C, 45 sec annealing at 55°C, and 2 min extension at 72°C with a final extension for 7 min at 72°C at the end of 35 cycles. 2.5 µl of 10x loading buffer (Bromophenol Blue 0.4%, Xylene cyanol 0.4%, Glycerol 50%) was added to each PCR product.

PCR products were run on 8 % polyacrylamide gel following standard lab protocols. Vertical gel electrophoresis system with 24 well was used. Electrophoresis was conducted at 130 volt for 90 minutes. DNA ladder (1 kb plus) were electrophoresed alongside the PCR products. After completion of the electrophoresis the gel was stained in ethidium bromide solution for 25 minutes. Then the gel was rinsed carefully with the tap water and placed on gel documentation system for visualization of DNA bands and the images were taken and saved in computer.

Molecular weight for each amplified allele was measured in base pair using AlphaEaseFC 4.0 software. The allele frequency data from Power Marker version 3.25 (Liu and Muse. 2005) was used to export the data in binary format (allele presence = 1 and allele absence = 0) for analysis with NTSYS-pc version 2.2 (Rohlf, 2002). The summary statistics including the number of alleles per locus, major allele frequency, genetic diversity, polymorphism information content (PIC) values were determined using Power Marker version 3.25 (Liu and Muse, 2005).

A similarity matrix was calculated with the Simqual subprogram using the DICE coefficient, followed by cluster analysis with the SAHN subprogram using the UPGMA clustering method and implemented in NTSYS-pc to construct a dendrogram showing relationship among the genotypes.

Thirty-three primers were used and a total number of 52 loci were amplified by these SSR primers. Out of 33 primers 14 primers were found polymorphic for the germplasm and they amplified 39 loci. Thirteen primers were monomorphic for the germplasm and 6 primers did not amplify properly. The SSR profiles of 22 Jute accessions using SSR primers JMBD148, JMBD563 and JMBD598 are shown in Fig. 71 (A, B & C).

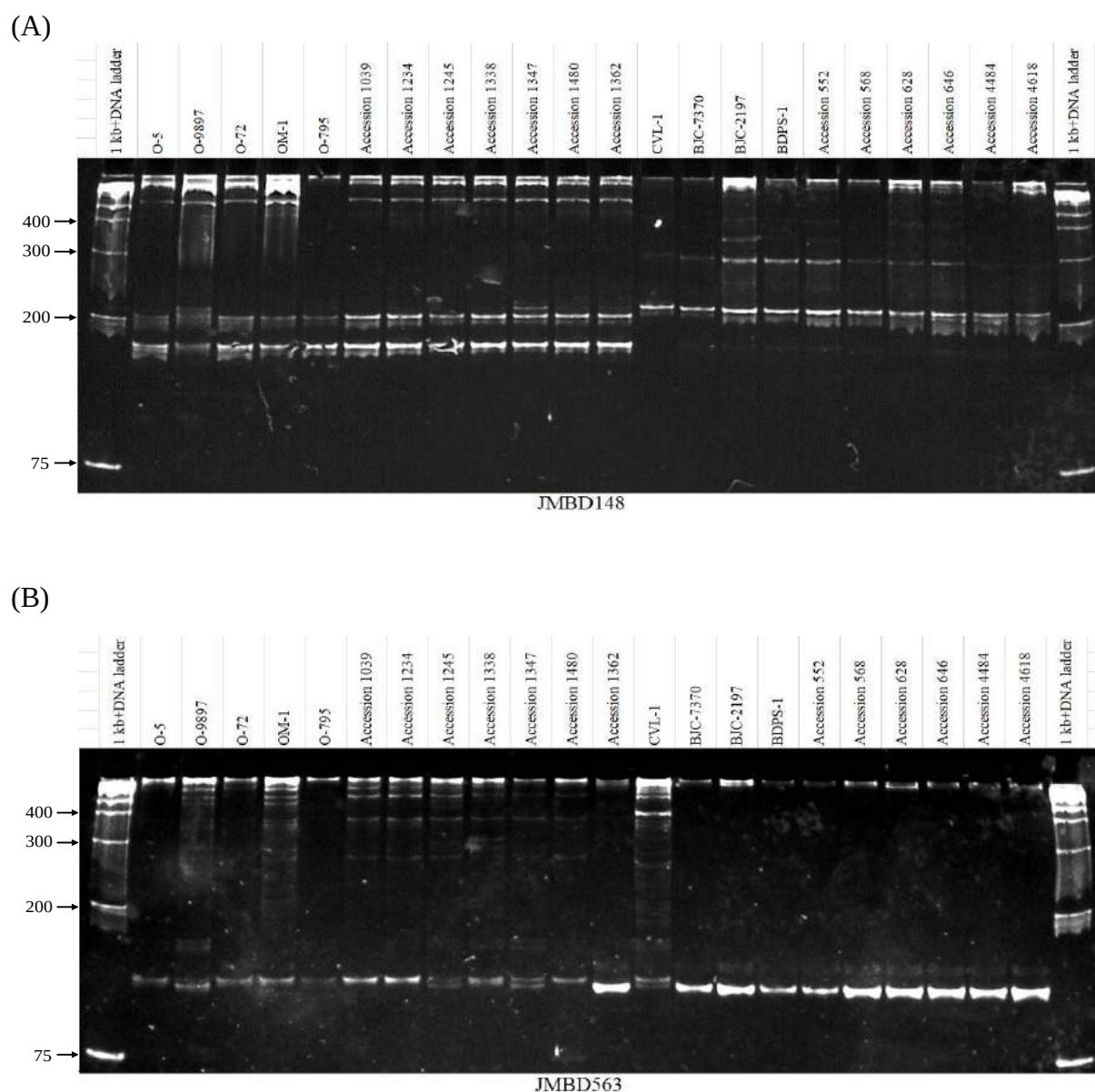
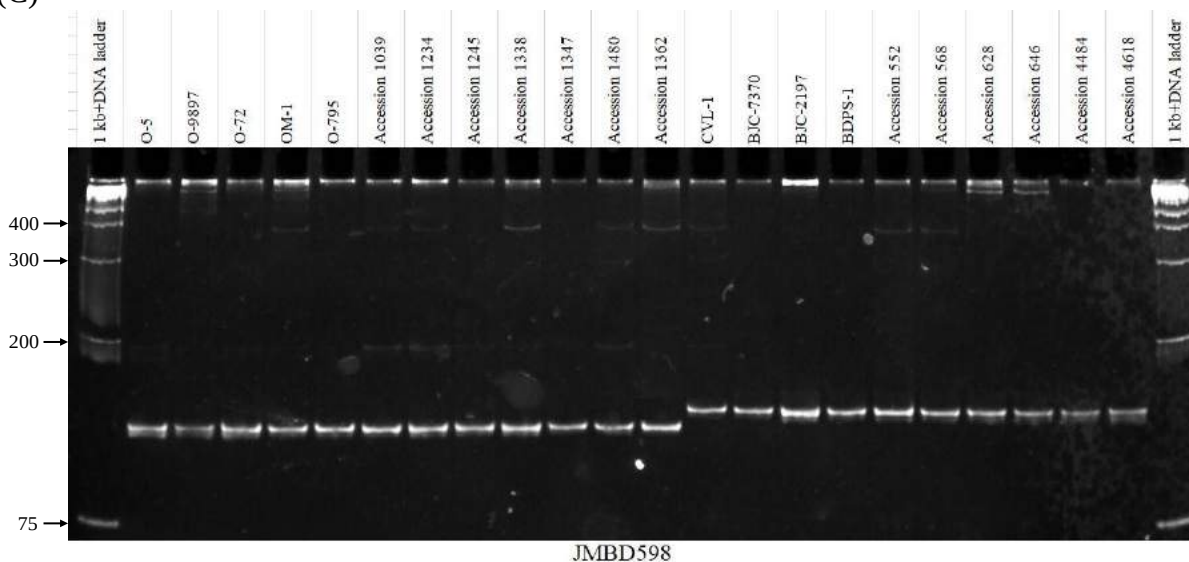


Fig. 71. DNA profile of jute germplasm with the SSR marker JMBD148 (A) and JMBD563 (B)

(C)



Cont'd. Fig. 71. DNA profile of jute germplasm with SSR marker, JMBD598(C)

Major allele frequency of 14 polymorphic primers and genetic diversity values are shown in table 82. The highest gene diversity value (0.685) and PIC (Polymorphism Information Content) value (0.635) were found for primer JMBD1824. The second highest gene diversity value (0.640) and PIC (Polymorphism Information Content) value (0.567) were found for primer JMBD563. The lowest gene diversity value (0.177) and Polymorphism Information Content (0.169) among the 14 primers were found for primer JMBD709. The result suggests that genetic variations exist among these jute germplasm. The overall gene diversity value and PIC value for all polymorphic primers were estimated as 0.507 and 0.413 respectively. The highest (0.90) major allele frequency was found for allele size 185bp for JMBD709 (Table 82 & 83).

Table 82. Summary of genetic variation for major alleles

Marker	SampleSize	No. of obs.	No. of Allele	Highest frequency allele		Gene Diversity	Polymorphism Information Content
				size (bp)	frequency		
JMBD148	22	22	3	168	0.50	0.541	0.436
JMBD 166	22	22	4	140	0.55	0.566	0.484
JMBD 563	22	22	3	111	0.45	0.640	0.567
JMBD 598	22	22	2	124	0.55	0.496	0.373
JMBD 709	22	21	3	185	0.90	0.177	0.169
JMBD 721	22	15	3	245	0.73	0.418	0.370
JMBD 880	22	20	3	195	0.50	0.545	0.441
JMBD 969	22	22	2	86	0.55	0.496	0.373
JMBD 989	22	16	2	185	0.56	0.492	0.371
JMBD 1824	22	20	5	305	0.45	0.685	0.635
JMBD 1950	22	18	3	293	0.50	0.549	0.448
JMBD 2032	22	22	2	170	0.55	0.496	0.373
JMBD 2045	22	22	2	220	0.55	0.496	0.373
JMBD 2064	22	21	2	225	0.52	0.499	0.374
Mean	22		3		0.56	0.507	0.413

The frequency and variance of all 39 allele from 14 polymorphic markers for twenty-two jute genotypes is presented in table 83. JMBD989₁₇₀ allele JMBD989₁₈₅ showed the highest variance for all 22 genotypes (Table 84).

Table 83. Allele frequency of 14 polymorphic markers for test jute germplasm

Sl no.	Marker	Allele Size (bp)	Frequency	Variance	SD
1	JMBD148	168	0.50	0.0114	0.107
2	JMBD148	172	0.05	0.0020	0.044
3	JMBD148	220	0.45	0.0113	0.106
4	JMBD166	135	0.36	0.0105	0.103
5	JMBD166	140	0.55	0.0113	0.106
6	JMBD166	145	0.05	0.0020	0.044
7	JMBD166	188	0.05	0.0020	0.044
8	JMBD563	111	0.45	0.0113	0.106
9	JMBD563	117	0.23	0.0080	0.089
10	JMBD563	124	0.32	0.0099	0.099
11	JMBD598	124	0.55	0.0113	0.106
12	JMBD598	137	0.45	0.0113	0.106
13	JMBD709	185	0.90	0.0041	0.064
14	JMBD709	190	0.05	0.0022	0.046
15	JMBD709	218	0.05	0.0022	0.046
16	JMBD721	236	0.07	0.0041	0.064
17	JMBD721	245	0.73	0.0130	0.114
18	JMBD721	253	0.20	0.0107	0.103
19	JMBD880	195	0.50	0.0125	0.112
20	JMBD880	205	0.05	0.0024	0.049
21	JMBD880	218	0.45	0.0124	0.111
22	JMBD969	86	0.55	0.0113	0.106
23	JMBD969	96	0.45	0.0113	0.106
24	JMBD989	170	0.44	0.0154	0.124
25	JMBD989	185	0.56	0.0154	0.124
26	JMBD1824	305	0.45	0.0124	0.111
27	JMBD1824	315	0.05	0.0024	0.049
28	JMBD1824	320	0.10	0.0045	0.067
29	JMBD1824	325	0.30	0.0105	0.102
30	JMBD1824	333	0.10	0.0045	0.067
31	JMBD1950	198	0.44	0.0137	0.117
32	JMBD1950	293	0.50	0.0139	0.118
33	JMBD1950	299	0.06	0.0029	0.054
34	JMBD2032	170	0.55	0.0113	0.106
35	JMBD2032	200	0.45	0.0113	0.106
36	JMBD2045	212	0.45	0.0113	0.106
37	JMBD2045	220	0.55	0.0113	0.106
38	JMBD2064	225	0.52	0.0119	0.109
39	JMBD2064	240	0.48	0.0119	0.109

Table 84. Allele size of monomorphic primers for test jute germplasm

Sl no.	Marker	Allele Size (bp)
1	JMBD423	203
2	JMBD434	205
3	JMBD492	270
4	JMBD616	380
5	JMBD639	210
6	JMBD643	250
7	JMBD929	315
8	JMBD1150	260
9	JMBD1579d	275
10	JMBD1667	295
11	JMBD1774	168
12	JMBD1793	180
13	JMBD1912	280

The values of pair wise Nei's genetic distance between accessions were computed from combined data for 14 SSR primers. The values were ranged from 0 to 1 (Table 85). BJRI tossa jute variety O-795 showed highest genetic distance value with accession no. 4484, 4618, 552, 568, 628, 646 and BJRI white jute varieties BJC-2197, BJC-7370, CVL-1 and BJRI Deshi Pat Sak-1. BJRI Deshi Pat Sak-1 showed highest genetic distance value with accession no. 1039, 1234, 1338, 1362, 1347 and BJRI tossa jute varieties O-72, O-5, O-9897 and O-795. Accession no. 1347 showed highest distance value with accession no. 552, 628 and BJRI white jute variety CVL-1, BJC-7370 and BJRI Deshi Pat Sak-1. As the primers used in this study were designed from tossa jute genome, 7 out of 10 germplasm viz. acc. nos. 4618, 552, 568, 628, 464 and varieties BJC-2197, BJC-7370 showed no genetic distance (genetic distance value 0) among them. Among the tossa jute germplasm, the highest genetic distance value (0.4) was found between accession no. 1039 and accession no. 1347. Among the *C. capsularis* germplasm, accession no. 4484 showed the highest genetic distance value (0.214) with varieties CVL-1 and BJRI Deshi Pat Shak-1

Table 85. Nei's (1983) genetic distance values among jute germplasm

	A1039	A1234	A1245	A1338	A1347	A1362	A1480	A4484	A4618	A552	A568	A628	A646	BDPS1	BJC2197	BJC7370	CVL-1	O-5	O-72	O-795	O-9897
A1234	0.083																				
A1245	0.300	0.167																			
A1338	0.167	0.071	0.250																		
A1347	0.400	0.250	0.182	0.167																	
A1362	0.333	0.214	0.167	0.214	0.167																
A1480	0.091	0.077	0.091	0.154	0.273	0.231															
A4484	0.917	0.857	0.750	0.857	0.917	0.857	0.769														
A4618	0.909	0.846	0.750	0.846	0.909	0.846	0.750	0.077													
A552	0.917	0.923	0.818	0.923	1	0.923	0.833	0.077	0												
A568	0.917	0.857	0.750	0.857	0.917	0.857	0.769	0.071	0	0											
A628	0.917	0.923	0.818	0.923	1	0.923	0.833	0.077	0	0	0										
A646	0.909	0.846	0.750	0.846	0.909	0.846	0.750	0.077	0	0	0	0									
BDPS1	1	1	0.917	1	1	1	0.923	0.214	0.154	0.077	0.143	0.077	0.154								
BJC2197	0.917	0.857	0.750	0.857	0.917	0.857	0.769	0.071	0	0	0	0	0	0.143							
BJC7370	0.909	0.923	0.833	0.923	1	0.923	0.833	0.154	0.077	0	0.077	0	0.077	0.077	0.077						
CVL-1	0.917	0.929	0.833	0.929	1	0.929	0.846	0.214	0.154	0.077	0.143	0.077	0.154	0.143	0.143	0.077					
O-5	0	0	0.222	0	0.222	0.182	0.091	0.909	0.900	0.909	0.909	0.909	0.900	1	0.909	0.900	0.909				
O-72	0.100	0	0.182	0.091	0.300	0.273	0.100	0.909	0.909	0.909	0.909	0.909	0.909	1	0.909	0.909	0.909	0			
O-795	0.333	0.200	0.200	0.200	0.111	0.200	0.333	1	1	1	1	1	1	1	1	1	1	0.222	0.200		
O-9897	0.250	0.214	0.250	0.286	0.333	0.286	0.308	0.929	0.923	0.923	0.929	0.923	0.923	1	0.929	0.923	0.929	0.182	0.182	0.200	
OM-1	0.167	0.154	0.364	0.154	0.364	0.231	0.250	0.846	0.833	0.846	0.846	0.846	0.833	0.923	0.846	0.833	0.846	0.091	0.182	0.300	0.308

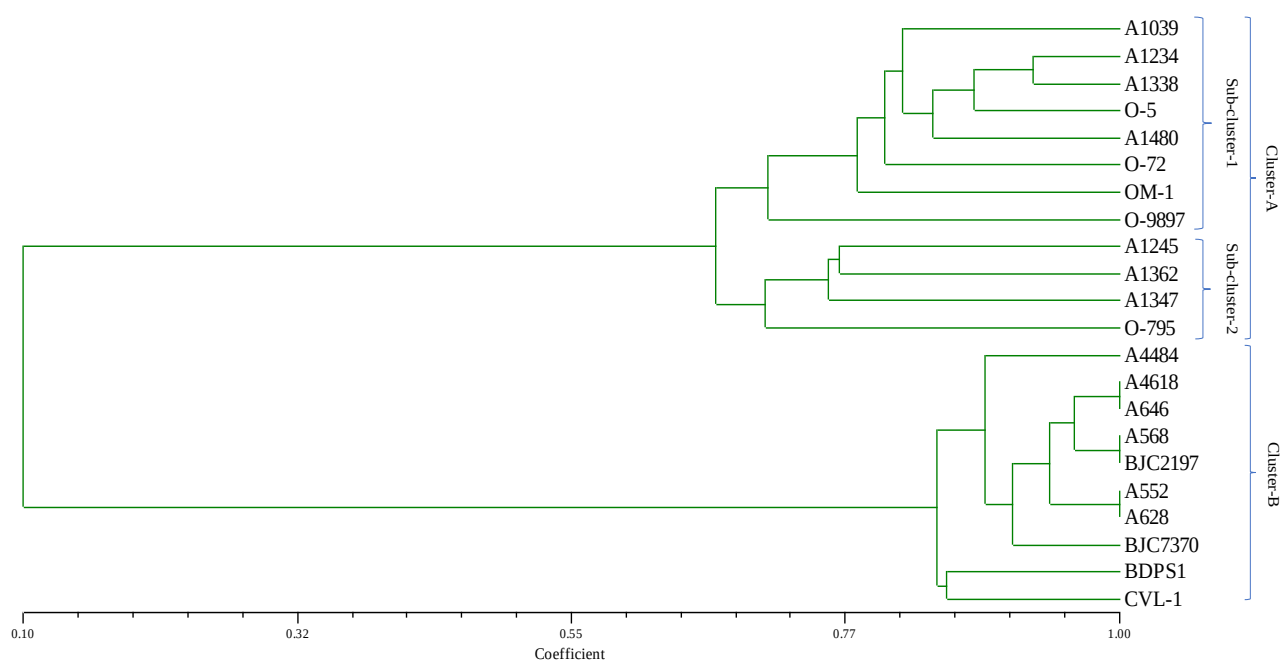


Fig. 72. UPGMA dendrogram showing Nei's genetic distance (Nei, 1983) among jute genotypes based alleles detected by microsatellite markers

Two species of jute, *Corchorus capsularis* and *C. olitorius* formed two main clusters in the dendrogram (Fig. 72). *C. olitorius* germplasm were divided in 2 sub-clusters. The dendrogram is based on Nei's (1983) genetic distance. Sub-Cluster 1 is comprised of accession no.1039, accession no.1234, accession no.1338, O-5, accession no.1480, O-72, OM-1 and O-9897. Sub-cluster 2 is comprised of accession no.1245, accession no.1362, accession no.1347 and O-795. Second main cluster cluster B is comprised of accession no. 4484, accession no. 4618, accession no. 646, accession no. 568, BJC-2197, accession no. 552, accession no. 628, BJC-7370 and BJRI deshi pat shak-1 and CVL-1.

Conclusion

The highest genetic distance value was found between germplasm from two different species of jute while no genetic distance was found among maximum white jute germplasm for the used primers. Among the tossa jute germplasm, highest genetic distance value was found between accession no. 1039 and accession no. 1347. In case of white jute, accession no. 4484 showed highest genetic distance with varieties CVL-1 and BJRI deshi pat shak-1. From the differences between the highest and the lowest value of genetic distance it was revealed that variability was existed among these 22 jute germplasm. It is hoped that, in future the present results will help breeders to make selection from the diverse accessions studied to use them as parents for crossing that are designed for breeding and for producing mapping populations, but more SSR primers should be used to find more genetic variation information among them.

11.7. Molecular characterization of jute germplasm through DNA fingerprinting

The jute genotypes (Table 86) studied in this experiment was collected from the Gene Bank of Bangladesh Jute Research Institute (BJRI). Among these germplasm, 12 are of deshi jute that are collected in the 2018-19 from Rangpur region of Bangladesh. There are 8 tossa jute accessions stored at the Gene Bank of BJRI. The rest 2 are deshi and tossa jute varieties of BJRI.

Table 86. List of jute germplasm with origin

Sl. no.	Accession Number/Collection no. (Collector's no.)/Variety	Species	Origin
1	Collection no. 1 (RS-1)	<i>C. capsularis</i>	Kurigram
2	Collection no. 9 (ACK-1)	<i>C. capsularis</i>	Panchegarh
3	Collection no. 11 (ACK-3)	<i>C. capsularis</i>	Panchegarh
4	Collection no. 12 (FM-1)	<i>C. capsularis</i>	Panchegarh
5	Collection no. 13 (AS-5)	<i>C. capsularis</i>	Dinajpur
6	Collection no. 19 (RS-5)	<i>C. capsularis</i>	Bogura
7	Collection no. 20 (RS-6)	<i>C. capsularis</i>	Bogura
8	Collection no. 21 (RS-7)	<i>C. capsularis</i>	Bogura
9	Collection no. 22 (RS-8)	<i>C. capsularis</i>	Bogura
10	Collection no. 25 (FMN-1)	<i>C. capsularis</i>	Rangpur
11	Collection no. 26 (FMN-2)	<i>C. capsularis</i>	Dinajpur
12	Collection no. 27 (FZ-1)	<i>C. capsularis</i>	Rangpur
13	BJRI deshi pat-6	<i>C. capsularis</i>	BJRI deshi jute variety
14	BJRI tossa pat-6	<i>C. olitorius</i>	BJRI tossa jute variety
15	Accession no. 1860	<i>C. olitorius</i>	BJRI Genebank
16	Accession no. 1402	<i>C. olitorius</i>	BJRI Genebank
17	Accession no. 1417	<i>C. olitorius</i>	BJRI Genebank
18	Accession no. 1460	<i>C. olitorius</i>	BJRI Genebank
19	Accession no. 2148	<i>C. olitorius</i>	BJRI Genebank
20	Accession no. 2345	<i>C. olitorius</i>	BJRI Genebank
21	Accession no. 2383	<i>C. olitorius</i>	BJRI Genebank
22	Accession no. 3227	<i>C. olitorius</i>	BJRI Genebank

The seeds were placed on wet blotting paper in petri dishes and kept in a dark place. DNA was isolated from 4 days old seedlings using the mini preparation CTAB method (Doyle and Doyle, 1987) with some modifications. Approximately 1.5g tissue was grinded to fine powder with mortar and pestle in liquid nitrogen and was taken in 2ml centrifuge tube and 1ml extraction buffer (2% CTAB, 1.4M NaCl, 20mM EDTA, 100mM Trisbase, 100mM β -mercaptoethanol, 2% Polyvinylpolypyrrolidone) was added. The centrifuge tubes were kept in water bath with 65°C for 10 minutes and then centrifuged with 13000rpm for 10 minutes. The supernatants were collected and transferred to fresh 1.5ml centrifuge tubes. DNA was purified by Phenol: Chloroform: Isoamyl alcohol (25:24:1) and was precipitated using ice cold isopropanol in presence of 0.3 M sodium acetate. Finally DNA was pelleted and washed with 70% and 100% ethanol. The pellets were dried with vacuum freeze dryer and dissolved in 100 μ l TE buffer (10 mM Tris-HCl, 1mM EDTA pH-8.0) and stored at -20°C. For making working solutions extracted DNA solutions were diluted to 10 times in new centrifuge tubes.

Table 87. SSR primers used for diversity analysis of jute germplasm

Sl #	Primer		Sequence	Repeat Motif	Status
1	JMBD115	Forward Primer	TCGGACAAGATCAAGTGCAG	(CAT)5	Monomorphic
		Reverse Primer	TGGCCCTTCTGGAATGTAAG		
2	JMBD148	Forward Primer	ACCCACCAAGTTCATGCTTC	(CAT)5	Polymorphic
		Reverse Primer	GAAGGAAGTGAGCAAGCCAG		
3	JMBD154	Forward Primer	ATCCACGCCTCCAACATAAG	(TCA)5	Not amplified
		Reverse Primer	GAACAAACCCGCACTTGACT		
4	JMBD1579	Forward Primer	TCAATCTTCACCAGCAGCAG	(ACA)5	Polymorphic
		Reverse Primer	GCCGTCTCCTATTTCCATGA		
5	JMBD 166	Forward Primer	GCAGTTTGTGGTGATGGATG	(TTA)6	Monomorphic
		Reverse Primer	GCCTTAAAGTGCATACAGGAGG		
6	JMBD 1667	Forward Primer	AGTTCACCTGGGATCGGTTG	(GTG)5	Not amplified
		Reverse Primer	GATAAAGCCACAGGAAGCCA		
7	JMBD 1774	Forward Primer	TCTTTCTGGTCCACCTTTGG	(GAG)5	Monomorphic
		Reverse Primer	CTGGATTTCGTCCACTCCCTA		
8	JMBD1824	Forward Primer	TTTACGAAACCTGCCACTCC	(GAA)5	Polymorphic
		Reverse Primer	CGCTCACAACCTCCTTTCTCC		
9	JMBD 1950	Forward Primer	AGTGAACCTCCACAAATGCC	(AAC)6	Monomorphic
		Reverse Primer	GGCGAATTCGAAATGGTAGA		
10	JMBD201	Forward Primer	GTTGTCCACATGAGAATGCG	(AAC)5	Monomorphic
		Reverse Primer	AAGGCAGCCATAAGAGCAAA		
11	JMBD 2032	Forward Primer	AAAGCATTGGATCTTCGTGG	(TGA)5	Polymorphic
		Reverse Primer	GTTGCATACTGGTGCATTGG		
12	JMBD 2045	Forward Primer	GGACAGAAGTTCGAGCCAAG	(CGG)5	Polymorphic
		Reverse Primer	GTTTCCCACCAGTAGTCCGA		
13	JMBD 2064	Forward Primer	ACGAGATGGATTCTGATGCC	(GAC)5	Polymorphic
		Reverse Primer	CTCCAGCTTTGCTTGGAAC		
14	JMBD 423	Forward Primer	CACAGCCAAGCTGATGAGAA	(GAT)5	Monomorphic
		Reverse Primer	CCTCACGCTCTGGAGACTTC		
15	JMBD 492	Forward Primer	AACCAAAGCACCACCACTTC	(ACC)5	Polymorphic
		Reverse Primer	CGCTGACGACGATATCTTGA		
16	JMBD563	Forward Primer	TGGGCTTGTAACCAAGGAAG	(GTA)5	Monomorphic
		Reverse Primer	CAAACAAATGTGCCATTCCA		
17	JMBD57	Forward Primer	CCTTCCAACCTCCTAATGCCA	(CTC)6	Monomorphic
		Reverse Primer	CCGAGGGATCAGGATAGTCA		
18	JMBD594	Forward Primer	CCAACAATTCGCCATCTCT	(CTG)5	Polymorphic
		Reverse Primer	GAGGTGGTTTCGTTTGAGAA		
19	JMBD 598	Forward Primer	CCTAATTTCCACCACCAACG	(CTT)5	Polymorphic
		Reverse Primer	CGGGTTAAGGGTCTTGTTGA		
20	JMBD613	Forward Primer	AACCCAACTGCAGGAACATC	(GAA)6	Polymorphic
		Reverse Primer	TGCAAGGACTTGAGCTTGTG		
21	JMBD635	Forward Primer	CCAAATGAAACACATGCCAG	(GAA)5	Polymorphic
		Reverse Primer	AAAGAAACAGCGAAGGCAAA		
22	JMBD709	Forward Primer	GTTGACCAGGCTTCTTCTGC	(ATC)5	Monomorphic
		Reverse Primer	CAAGCAGCAATCACAGCAAT		
23	JMBD721	Forward Primer	CCCATCCAAATTAGCCACAC	(TGT)5	Polymorphic
		Reverse Primer	CTCTCTCCAAACTGCCCAAG		
24	JMBD756	Forward Primer	TGTTGTTGTTCTGGGTTGAAA	(GCT)7	Polymorphic
		Reverse Primer	GCCCAGCAGTTCAAAAACAT		
25	JMBD880	Forward Primer	GCTCCTACTTTTCATTGAATGGC	(TCT)5	Polymorphic
		Reverse Primer	CCTGTTCTTGTTGCTGCTGA		
26	JMBD989	Forward Primer	GGAAGAGATCAGGCTCAACG	(GGA)5	Not amplified
		Reverse Primer	GATCTCATTCCCTTGCCAAA		

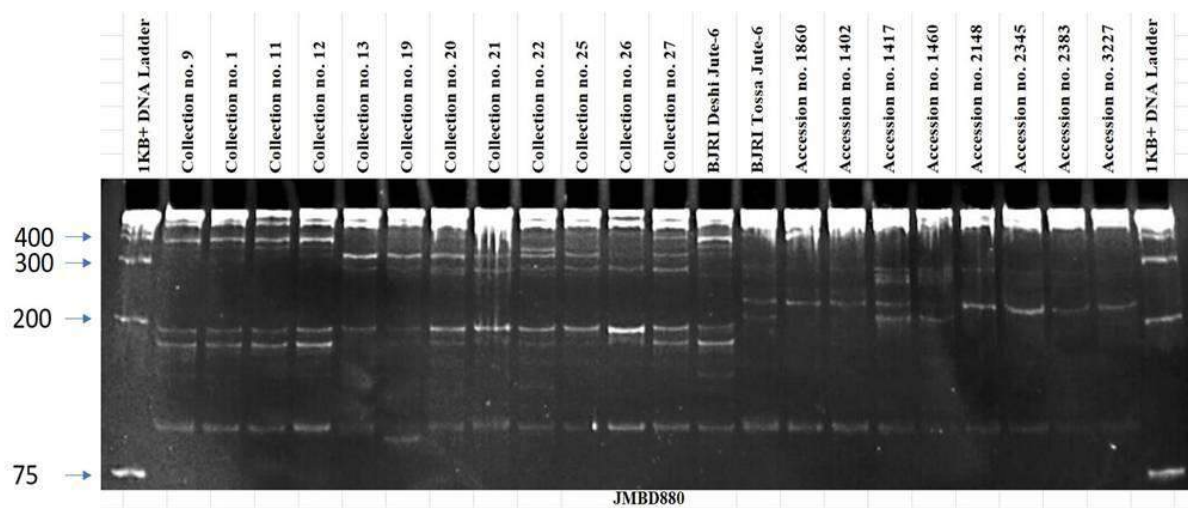
Cont'd. Table 87.

Sl #	Primer		Sequence	Repeat Motif	Status
27	TJMBD3	Forward Primer	TCGCGCTCCTTCGGTCTCCT		Monomorphic
		Reverse Primer	CGAACGGCCGGCGATTCTCA		
28	MJM1140	Forward Primer	GCTGTACCTGCCATCTTTT		Polymorphic
		Reverse Primer	TGCTTGCTGTTGCTGATAGG		
29	MJM1195	Forward Primer	GAGGCTGACAGCGAGTGTTA		Polymorphic
		Reverse Primer	CCTAAAACCCAGACGAACCA		
30	MJM1401	Forward Primer	CAG AAA CAA GTT CAA CAA CAT CA		Polymorphic
		Reverse Primer	GAC TCC TTG GTG GTG TCC TC		
31	MJM390	Forward Primer	AAA GCC GTG ACT GAG CTG TT		Monomorphic
		Reverse Primer	CTT TCT TCA CCG AGA GGT GC		
32	MJM562	Forward Primer	GAA GAA CAG GCG GTT GAC AT		Polymorphic
		Reverse Primer	CTT CCT TGG TTA CAA GCC CA		

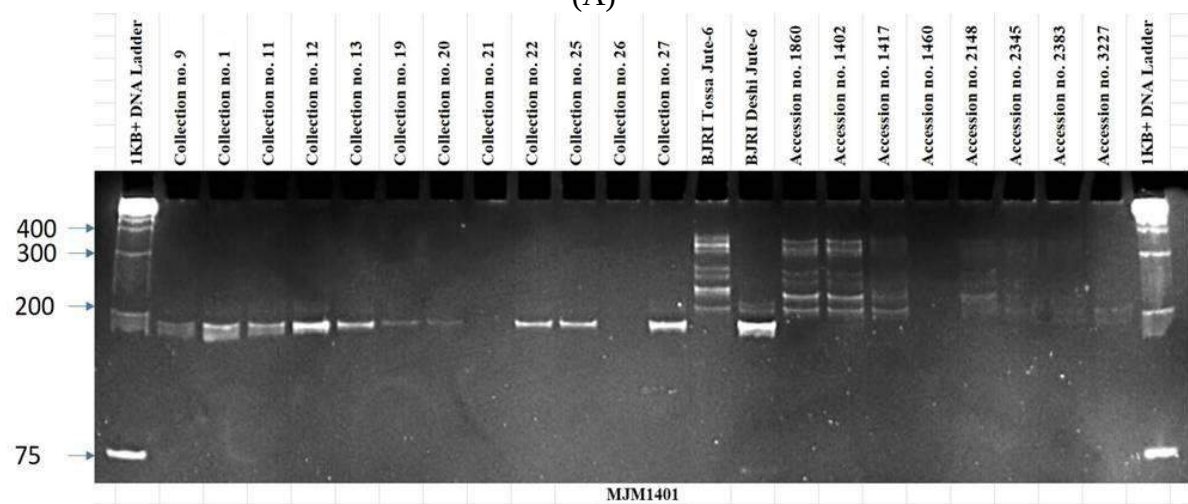
A total of 32 SSR primers (Table 87) were used in this experiment. PCR was performed in 10 µl reactions containing around 25 ng of DNA template (3 µl DNA with 10X dilution factor), 1 µl 10X TB buffer (containing 200 mM Tris-HCl pH 8.3, 500 mM KCl), 1.35 µl 25 mM MgCl₂, 0.2 µl of 10 mM dNTP, 0.5 µl each of 10 µM forward and reverse primers and 0.1 µl of Taq DNA polymerase (5 U/µl) using thermal cycler (Chen *et al.*, 1997; Neeraja *et al.*, 2007). After initial denaturation for 5 min at 94°C, each cycle comprises 45 sec denaturation at 94°C, 45 sec annealing at 55°C, and 2 min extension at 72°C with a final extension for 7 min at 72°C at the end of 35 cycles. 2.5 µl of 10x loading buffer (Bromophenol Blue 0.4%, Xylene cyanol 0.4%, Glycerol 50%) was added to each PCR product. PCR products were run on 8 % polyacrylamide gel following standard lab protocols. Vertical gel electrophoresis system with 24 wells was used. Electrophoresis was conducted at 130 volt for 90 minutes. DNA ladder (1 kb plus) were electrophoresed alongside the PCR products. After completion of the electrophoresis the gel was stained in ethidium bromide solution for 25 minutes. Then the gel was rinsed carefully with the tap water and placed on gel documentation system for visualization of DNA bands and the images were taken and saved in computer.

Molecular weight for each amplified allele was measured in base pair using Alpha Ease FC 4.0 software. The allele frequency data from Power Marker version 3.25 (Liu and Muse, 2005) was used to export the data in binary format (allele presence = 1 and allele absence = 0) for analysis with NTSYS-pc version 2.2 (Rohlf, 2002). The summary statistics including the number of alleles per locus, major allele frequency, genetic diversity, polymorphism information content (PIC) values were determined using Power Marker version 3.25 (Liu and Muse, 2005). A similarity matrix was calculated with the Simqual subprogram using the DICE coefficient, followed by cluster analysis with the SAHN subprogram using the UPGMA clustering method and implemented in NTSYS-pc to construct a dendrogram showing relationship among the genotypes.

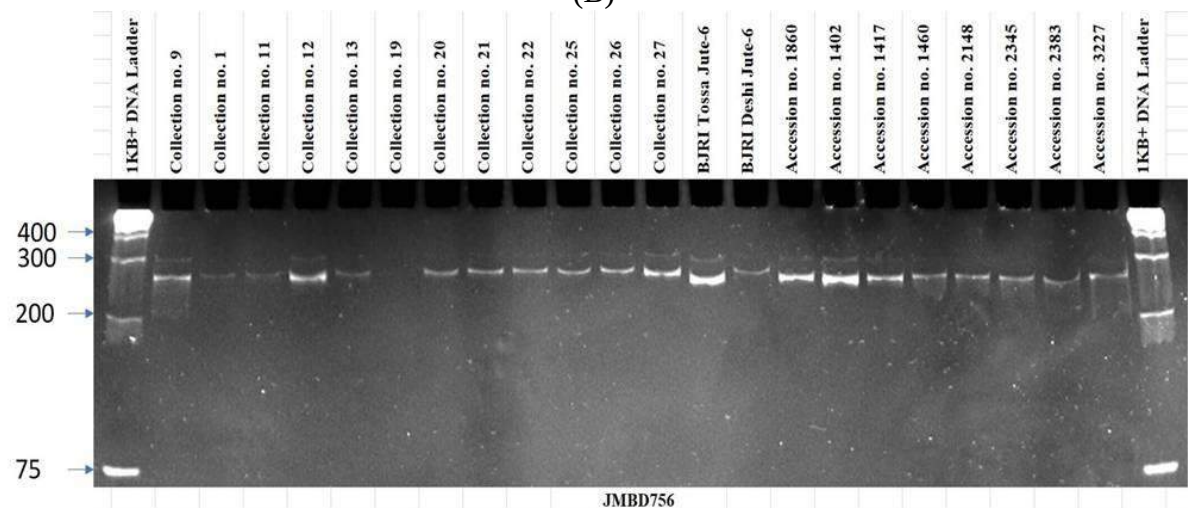
Thirty-two primers were used and a total number of 70 loci were amplified by these SSR primers. Out of 32 primers 18 primers were found polymorphic (Table 87) for the germplasm and they amplified 59 loci (Table 88). Eleven primers were monomorphic for the germplasm and 3 primers did not amplify properly. The SSR profiles of 22 jute accessions using SSR primers JMBD880, MJM1401, JMBD756 and JMBD721 are shown in Fig.73 (A, B, C & D). Major allele frequency of 18 polymorphic primers and genetic diversity values are shown in table 88.



(A)

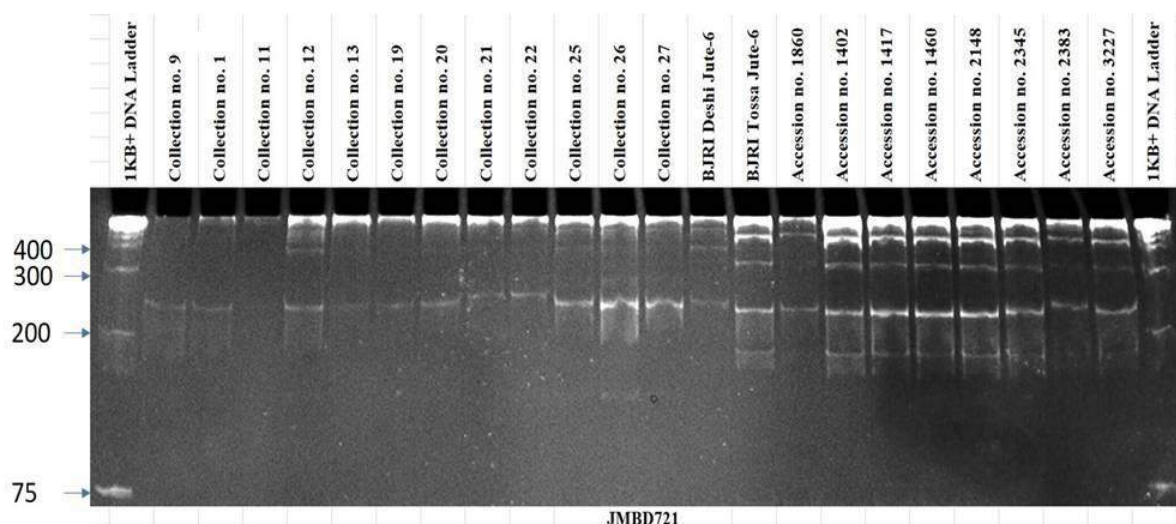


(B)



(C)

Fig. 73. DNA profile of jute germplasm with SSR marker, JMBD880 (A), MJM1401 (B) and JMBD756 (C)



Cont'd. Fig. 73. DNA profile of the jute germplasm with SSR marker JMBD721 (D)

Table 88. Summary of genetic variation for major alleles

Marker	Sample Size	No. of obs.	No. of Allele	Highest frequency allele		Gene Diversity	Polymorphism Information Content
				size (bp)	frequency		
JMBD148	22	22	2	220	0.591	0.483	0.367
JMBD1579	22	22	2	275	0.955	0.087	0.083
JMBD1824	22	21	5	335	0.381	0.726	0.679
JMBD2032	22	22	2	170	0.682	0.434	0.340
JMBD2045	22	22	2	220	0.955	0.087	0.083
JMBD2064	22	20	2	235	0.600	0.480	0.365
JMBD492	22	22	3	275	0.364	0.665	0.591
JMBD594	22	18	2	275	0.667	0.444	0.346
JMBD598	22	22	2	137	0.591	0.483	0.367
JMBD613	22	10	2	340	0.700	0.420	0.332
JMBD635	22	12	4	390	0.417	0.694	0.639
JMBD721	22	21	5	245	0.381	0.744	0.704
JMBD756	22	21	5	280	0.381	0.748	0.710
JMBD880	22	22	5	196	0.318	0.764	0.726
MJM1140	22	17	4	90	0.765	0.394	0.370
MJM1195	22	22	5	162	0.364	0.711	0.657
MJM1401	22	19	5	190	0.316	0.748	0.704
MJM562	22	22	2	252	0.591	0.483	0.367
Mean						0.519	0.452

The highest gene diversity value (0.764) and PIC (Polymorphism Information Content) value (0.726) were found for primer JMBD880. The second highest gene diversity value (0.748) was found for primer JMBD756 and MJM1401. The second highest PIC value (0.710) was found for primers JMBD756 and the third highest PIC value (0.704) was found for primers JMBD721 and MJM1401. The second highest gene diversity value (0.744) was found for primer JMBD721. The lowest gene diversity value (0.087) and PIC value (0.083) among the 18 polymorphic primers were found for primers JMBD1579 and JMBD2045.

The result suggests that genetic variations exist among these jute germplasm. The overall gene diversity value and PIC value for all polymorphic primers for major alleles were estimated as 0.519 and 0.452 respectively. The highest (0.955) Major Allele Frequency was found for allele size 275bp by JMBD1579 and allele size 220 by JMBD2045 (Table 89 & 90).

The frequency and variance of all 59 allele from 18 polymorphic markers for twenty-two jute genotypes is presented in table 89. JMBD613₃₄₀ allele JMBD613₃₄₅ showed the highest variance for all 22 genotypes (Table 89).

Table 89. Allele frequency of 18 polymorphic markers for jute germplasm

Sl. no	Marker	Allele Size (bp)	Frequency	Variance	SD
1	JMBD148	220	0.591	0.011	0.105
2	JMBD148	168	0.409	0.011	0.105
3	JMBD1579	275	0.955	0.002	0.044
4	JMBD1579	290	0.045	0.002	0.044
5	JMBD1824	335	0.381	0.011	0.106
6	JMBD1824	317	0.286	0.010	0.099
7	JMBD1824	308	0.190	0.007	0.086
8	JMBD1824	311	0.095	0.004	0.064
9	JMBD1824	330	0.048	0.002	0.046
10	JMBD2032	170	0.682	0.010	0.099
11	JMBD2032	200	0.318	0.010	0.099
12	JMBD2045	220	0.955	0.002	0.044
13	JMBD2045	225	0.045	0.002	0.044
14	JMBD2064	235	0.600	0.012	0.110
15	JMBD2064	240	0.400	0.012	0.110
16	JMBD492	275	0.364	0.011	0.103
17	JMBD492	280	0.318	0.010	0.099
18	JMBD492	300	0.318	0.010	0.099
19	JMBD594	275	0.667	0.012	0.111
20	JMBD594	280	0.333	0.012	0.111
21	JMBD598	137	0.591	0.011	0.105
22	JMBD598	124	0.409	0.011	0.105
23	JMBD613	340	0.700	0.021	0.145
24	JMBD613	345	0.300	0.021	0.145
25	JMBD635	390	0.417	0.020	0.142
26	JMBD635	370	0.250	0.016	0.125
27	JMBD635	400	0.250	0.016	0.125
28	JMBD635	380	0.083	0.006	0.080
29	JMBD721	245	0.381	0.011	0.106
30	JMBD721	253	0.238	0.009	0.093
31	JMBD721	235	0.190	0.007	0.086
32	JMBD721	168	0.095	0.004	0.064
33	JMBD721	240	0.095	0.004	0.064
34	JMBD756	280	0.381	0.011	0.106
35	JMBD756	290	0.238	0.009	0.093
36	JMBD756	275	0.143	0.006	0.076
37	JMBD756	285	0.143	0.006	0.076
38	JMBD756	270	0.095	0.004	0.064

Cont'd. Table 89.

Sl. no.	Marker	Allele Size (bp)	Frequency	Variance	SD
39	JMBD880	196	0.318	0.010	0.099
40	JMBD880	175	0.273	0.009	0.095
41	JMBD880	230	0.182	0.007	0.082
42	JMBD880	212	0.136	0.005	0.073
43	JMBD880	220	0.091	0.004	0.061
44	MJM1140	90	0.765	0.011	0.103
45	MJM1140	180	0.118	0.006	0.078
46	MJM1140	110	0.059	0.003	0.057
47	MJM1140	170	0.059	0.003	0.057
48	MJM1195	162	0.364	0.011	0.103
49	MJM1195	172	0.318	0.010	0.099
50	MJM1195	175	0.227	0.008	0.089
51	MJM1195	167	0.045	0.002	0.044
52	MJM1195	178	0.045	0.002	0.044
53	MJM1401	190	0.316	0.011	0.107
54	MJM1401	194	0.263	0.010	0.101
55	MJM1401	215	0.263	0.010	0.101
56	MJM1401	238	0.105	0.005	0.070
57	MJM1401	220	0.053	0.003	0.051
58	MJM562	252	0.591	0.011	0.105
59	MJM562	260	0.409	0.011	0.105

Table 90. Amplified allele size of monomorphic primers for jute germplasm

Sl no.	Marker	Allele Size (bp)
1	JMBD115	230
2	JMBD166	265
3	JMBD1774	165
4	JMBD1950	272
5	JMBD201	305
6	JMBD423	199
7	JMBD563	117
8	JMBD57	205
9	JMBD709	215
10	MJM390	70
11	TJMBD3	160

The values of pair wise Nei's genetic distance between accessions were computed from combined data for 29 SSR primers. The values were ranged from 0.04 to 0.609 (Table 91). BJRI tossa jute variety BJRI tossa jute-6 (O-3820) showed highest genetic distance value (0.609) with collection no. 20. The lowest genetic distance value (0.04) was found between collection numbers 21 and 22. Among the tossa jute germplasm, the highest genetic distance value (0.348) was found between BJRI tossa jute-6 (O-3820) and accession no. 3227. Tossa jute accessions 1417 and 2345 showed lowest genetic distance value (0.08) with tossa jute accessions 1402 and 2148 respectively. Among the deshi jute germplasm, collector's number 12 showed highest genetic distance (0.423) with collector's number 22.

Table 91. Nei's (1983) genetic distance among 22 jute germplasm

	Acc.1402	Acc.1417	Acc.1460	Acc.1860	Acc.2148	Acc.2345	Acc.2383	Acc.3227	BJC-83	Col.01	Col. 11	Col.12	Col.13	Col.19	Col.20	Col.21	Col.22	Col.25	Col.26	Col.27	Col.9
Acc.1417	0.080																				
Acc.1460	0.083	0.083																			
Acc.1860	0.125	0.174	0.136																		
Acc.2148	0.154	0.120	0.083	0.130																	
Acc.2345	0.240	0.167	0.130	0.174	0.080																
Acc.2383	0.125	0.167	0.130	0.130	0.208	0.167															
Acc.3227	0.167	0.167	0.174	0.130	0.125	0.125	0.208														
BJC-83	0.500	0.458	0.478	0.478	0.480	0.458	0.435	0.435													
Col.01	0.500	0.435	0.409	0.455	0.417	0.435	0.455	0.409	0.240												
Col.11	0.500	0.476	0.450	0.455	0.500	0.500	0.476	0.476	0.217	0.125											
Col.12	0.538	0.458	0.522	0.500	0.520	0.500	0.478	0.478	0.269	0.160	0.125										
Col.13	0.542	0.522	0.500	0.435	0.542	0.542	0.478	0.522	0.333	0.217	0.130	0.240									
Col.19	0.545	0.550	0.526	0.429	0.571	0.571	0.500	0.550	0.318	0.304	0.273	0.348	0.091								
Col.20	0.520	0.565	0.500	0.565	0.583	0.583	0.522	0.565	0.250	0.333	0.250	0.400	0.240	0.136							
Col.21	0.500	0.545	0.500	0.545	0.565	0.565	0.500	0.545	0.261	0.261	0.217	0.333	0.208	0.190	0.120						
Col.22	0.538	0.565	0.500	0.583	0.583	0.583	0.522	0.565	0.320	0.360	0.320	0.423	0.280	0.174	0.077	0.040					
Col.25	0.591	0.571	0.550	0.524	0.591	0.591	0.571	0.571	0.273	0.348	0.273	0.391	0.217	0.091	0.087	0.136	0.087				
Col.26	0.500	0.524	0.476	0.545	0.545	0.545	0.476	0.524	0.261	0.261	0.217	0.333	0.174	0.190	0.083	0.042	0.080	0.095			
Col.27	0.577	0.565	0.500	0.478	0.542	0.522	0.545	0.500	0.160	0.240	0.167	0.308	0.292	0.273	0.200	0.250	0.231	0.182	0.208		
Col.9	0.481	0.400	0.375	0.417	0.385	0.400	0.417	0.375	0.296	0.077	0.125	0.148	0.240	0.261	0.320	0.292	0.346	0.304	0.292	0.308	
O-3820	0.308	0.250	0.217	0.217	0.320	0.333	0.261	0.348	0.538	0.500	0.500	0.560	0.478	0.476	0.609	0.545	0.583	0.524	0.545	0.583	0.462

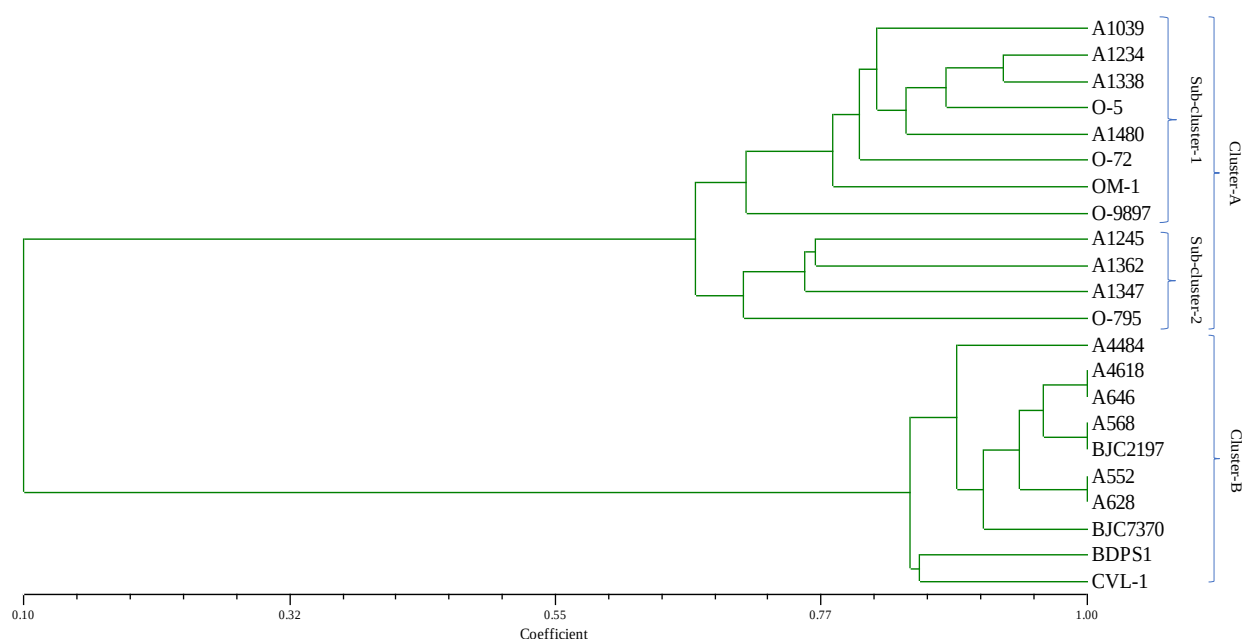


Fig. 74. UPGMA dendrogram showing Nei's genetic distance (Nei, 1983) among jute genotypes based on alleles detected by microsatellite markers

Two species of jute, *Corchorus capsularis* and *C. olitorius* formed two main clusters in the dendrogram (Fig. 74). Each germplasm Cluster was divided into 2 sub-clusters. The dendrogram is based on Nei's (1983) genetic distance. First sub-cluster of cluster 1 was comprised of tossa jute accessions that separated them from tossa jute variety BJRI tossa jute-6 (O-3820). First sub-cluster of cluster 2 was comprised of collector's numbers 27, 1, 9, 11, 12 and BJRI deshi jute-6 (BJC-83). Second sub-cluster of cluster 2 was comprised of collector's numbers 13, 19, 25, 20, 21, 22 and 26.

Conclusion

The highest genetic distance value was found between germplasm from two different species of jute for the used primers. BJRI tossa jute-6 variety showed highest genetic distance value with collection no 20, while collection numbers 21 and 22 showed the lowest genetic distance. From the differences between the highest and the lowest value of genetic distance it was revealed that high level of variability was existed among these 22 jute germplasm. It is hoped that, in future the present results will help breeders to make selection from the diverse accessions studied to use them as parents for crossing that are designed for breeding and for producing mapping populations, but more SSR primers should be used to find more genetic variation information among them.

11.8. Molecular characterization of jute germplasm through DNA fingerprinting

The jute genotypes (Table 92) studied in this experiment was collected from the Gene Bank of Bangladesh Jute Research Institute (BJRI). Among these germplasm, 7 are of deshi jute. There are 15 tossa jute germplasm including 2 new collections that were collected from southern region of Bangladesh. Four variety of BJRI were included in this study.

Table 92. List of jute germplasm with origin

Sl. no.	Acc./Collector's no./Variety	Species	Origin
1	Accession# 2025	<i>C. capsularis</i>	Brazil
2	Accession# 2022	<i>C. capsularis</i>	Brazil
3	Accession# 4616	<i>C. capsularis</i>	Brazil
4	Accession# 4617	<i>C. capsularis</i>	Brazil
5	Accession# 4374	<i>C. capsularis</i>	USA
6	BJRI Deshi Pat 9	<i>C. capsularis</i>	BJRI deshi jute variety
7	BJRI Deshi Pat 7	<i>C. capsularis</i>	BJRI deshi jute variety
8	BJRI Tossa Pat 7	<i>C. olitorius</i>	BJRI tossa jute variety
9	BJRI Tossa Pat 8	<i>C. olitorius</i>	BJRI tossa jute variety
10	Accession# 3809	<i>C. olitorius</i>	Kenya
11	Accession# 3815	<i>C. olitorius</i>	Kenya
12	Accession# 3726	<i>C. olitorius</i>	Kenya
13	Accession# 3755	<i>C. olitorius</i>	Kenya
14	Accession# 3782	<i>C. olitorius</i>	Kenya
15	Accession# 4254	<i>C. olitorius</i>	Tanzania
16	Accession# 4311	<i>C. olitorius</i>	Tanzania
17	Accession# 4323	<i>C. olitorius</i>	Tanzania
18	Accession# 4719	<i>C. olitorius</i>	USA
19	Collector's# TZ1	<i>C. olitorius</i>	BargunaSadar
20	Collector's# TP1	<i>C. olitorius</i>	Wazirpur, Barisal
21	Accession# 4158	<i>C. olitorius</i>	Kenya
22	Accession# 4575	<i>C. olitorius</i>	Nepal

The seeds were placed on wet blotting paper in petri dishes and kept in a dark place. DNA was isolated from 4 days old seedlings using the mini preparation CTAB method (Doyle and Doyle, 1987) with some modifications. Approximately 1.5 g tissue was grinded to fine powder with mortar and pestle in liquid nitrogen and was taken in 2 ml centrifuge tube and 1ml extraction buffer (2% CTAB, 1.4 M NaCl, 20 mM EDTA, 100mMTrisbase, 100 mM β -mercaptoethanol, 2% Polyvinylpyrrolidone) was added. The centrifuge tubes were centrifuged with 8500 $\times$ g for 10 minutes. The supernatants were collected and transferred to fresh 1.5ml centrifuge tubes. DNA was purified by Phenol: Chloroform: Isoamyl alcohol (25:24:1) and was precipitated using ice cold isopropanol in presence of 0.3 M sodium acetate. Finally DNA was pelleted and washed with 70% and 100% ethanol. The pellets were dried with vacuum freeze dryer and dissolved in 100 μ l TE buffer (10 mMTris-HCl, 1 mM EDTA pH-8.0) and stored at -20°C. For making working solutions extracted DNA solutions were diluted to 10 times in new centrifuge tubes. A total of 31 SSR primers (Table 93) were used in this experiment.

Table 93. SSR primers used for diversity analysis of jute germplasm

Sl. no.	Primer		Sequence	Status
1	JMBD880	Forward Primer	GCTCCTACTTTTCATTGAATGGC	Polymorphic
		Reverse Primer	CCTGTTCTTGTTGCTGCTGA	
2	JMBD1404	Forward Primer	ATGGCTTCACCATCTCCTTG	Polymorphic
		Reverse Primer	CGGCAATTAGACCTGGTTGT	
3	JMBD148	Forward Primer	ACCCACCAAGTTCATGCTTC	Polymorphic
		Reverse Primer	GAAGGAAGTGAGCAAGCCAG	
4	JMBD201	Forward Primer	GTTGTCCACATGAGAATGCG	Polymorphic
		Reverse Primer	AAGGCAGCCATAAGAGCAAA	
5	JMBD563	Forward Primer	TGGGCTTGTAACCAAGGAAG	Polymorphic
		Reverse Primer	CAAACAAATGTGCCATTCCA	
6	JMBD598	Forward Primer	CCTAATTTCCACCACCAACG	Polymorphic
		Reverse Primer	CGGGTTAAGGGTCTTGTTGA	
7	JMBD1061	Forward Primer	TGTAGCCTGCATAGTGCCTG	Polymorphic
		Reverse Primer	CCCAAAGCAGACAACCTCAT	
8	JMBD1824	Forward Primer	TTTACGAAACCTGCCACTCC	Polymorphic
		Reverse Primer	CGCTCACAACCTCTTCTCC	
9	JMBD2032	Forward Primer	AAAGCATTGGATCTTCGTGG	Polymorphic
		Reverse Primer	GTTGCATACTGGTGCATTGG	
10	JMBD2045	Forward Primer	GGACAGAAGTTCGAGCCAAG	Polymorphic
		Reverse Primer	GTTTCCCACCAGTAGTCCGA	
11	JMBD2047	Forward Primer	CATACAAATGCAGACGGTGG	Polymorphic
		Reverse Primer	GCTCTCCTTCATTTGGCTCA	
12	JMBD2064	Forward Primer	ACGAGATGGATTCTGATGCC	Polymorphic
		Reverse Primer	CTCCAGCTTTGCTTGAAAC	
13	MJM1401	Forward Primer	CAGAAACAAGTTCAACAACATCA	Polymorphic
		Reverse Primer	GAC TCC TTG GTG GTG TCC TC	
14	MJM467	Forward Primer	CATGAATTGAGTGAGCATCCA	Polymorphic
		Reverse Primer	ATCTTCAAGCCCAAATATGCC	
15	MJM1140	Forward Primer	GCTGTCACCTGCCATCTTTT	Polymorphic
		Reverse Primer	TGCTTGCTGTTGCTGATAGG	
16	MJM1195	Forward Primer	GAGGCTGACAGCGAGTGTTA	Polymorphic
		Reverse Primer	CCTAAAACCCAGACGAACCA	
17	JMBD492	Forward Primer	AACCAAAGCACCACCACTTC	Monomorphic
		Reverse Primer	CGCTGACGACGATATCTTGA	
18	JMBD635	Forward Primer	CCAAATGAAACACATGCCAG	Monomorphic
		Reverse Primer	AAAGAAACAGCGAAGGCAAA	
19	JMBD709	Forward Primer	GTTGACCAGGCTTCTTCTGC	Monomorphic
		Reverse Primer	CAAGCAGCAATCACAGCAAT	
20	MJM390	Forward Primer	AAA GCC GTG ACT GAG CTG TT	Monomorphic
		Reverse Primer	CTT TCT TCA CCG AGA GGT GC	
21	JMBD721	Forward Primer	CCCATCCAAATTAGCCACAC	Monomorphic
		Reverse Primer	CTCTCTCCAAACTGCCCAAG	
22	JMBD1017	Forward Primer	AAAGGGAAGAAGCAGAAGGC	Monomorphic
		Reverse Primer	CAAGACGCTCGAATTGTTGA	
23	TJMBD3	Forward Primer	TCGCGCTCCTTCGGTCTCCT	Monomorphic
		Reverse Primer	CGAACGGCCGGCGATTCTCA	

Table 93. Cont'd

Sl. no	Primer		Sequence	Status
24	JMBD1579	Forward Primer	TCAATCTTCACCAGCAGCAG	Monomorphic
		Reverse Primer	GCCGTCTCCTATTTCCATGA	
25	JMBD1604	Forward Primer	ATCGAGTGGCTTCAAAGGTG	Monomorphic
		Reverse Primer	CTCGAGTGGAGTGTTCTGCA	
26	MJM1305	Forward Primer	ACTACAAAAGACAGAGAAATAGGA AAA	Monomorphic
		Reverse Primer	ATGTGGGACCAAATTAATGC	
27	JMBD1496	Forward Primer	TACCTTTGGGCCAATCAGAG	Not amplified properly
		Reverse Primer	CGCCGTAGTATTGACTGGGT	
28	JMBD1497	Forward Primer	TGATCTGCTTGATGCTACCG	Not amplified properly
		Reverse Primer	GAATCCTCCATGCTTTCCAA	
29	JMBD1514	Forward Primer	TGAATCGGAGTAAGATCCCG	Not amplified properly
		Reverse Primer	CAAGAGAATGCGCCCTTTAG	
30	JMBD1343	Forward Primer	ACCAGTGAACCGCCAACTAC	Not amplified properly
		Reverse Primer	CTAGAACCGGATCGGTCAGA	
31	JMBD1403	Forward Primer	GGATGGTGCTCGTATGAAGG	Not amplified properly
		Reverse Primer	GATTCTTTCAGGGTGTCCGA	

PCR was performed in 10 µl reactions containing around 25 ng of DNA template (3 µl DNA with 10X dilution factor), 1 µl 10X TB buffer (containing 200 mM Tris-HCl pH 8.3, 500 mM KCl), 1.35 µl 25 mM MgCl₂, 0.2 µl of 10 mM dNTP, 0.5 µl each of 10 µM forward and reverse primers and 0.1 µl of Taq DNA polymerase (5 U/µl) using thermal cycler (Chen *et al.*, 1997; Neeraja *et al.*, 2007). After initial denaturation for 5 min at 94°C, each cycle comprises 45 sec denaturation at 94°C, 45 sec annealing at 55°C, and 2 min extension at 72°C with a final extension for 7 min at 72°C at the end of 35 cycles. 2.5 µl of 10x loading buffer (Bromophenol Blue 0.4%, Xylene cyanol 0.4%, Glycerol 50%) was added to each PCR product. PCR products were run on 8 % polyacrylamide gel following standard lab protocols. Vertical gel electrophoresis system with 24 wells was used. Electrophoresis was conducted at 100 volt for 90 minutes. DNA ladder (1 kb plus) were electrophoresed alongside the PCR products. After completion of the electrophoresis the gel was stained in ethidium bromide solution for 25 minutes. Then the gel was rinsed carefully with the tap water and placed on gel documentation system for visualization of DNA bands and the images were taken and saved in computer (Fig. 75).

Molecular weight for each amplified allele was measured in base pair using AlphaEaseFC 4.0 software. The allele frequency data from Power Marker version 3.25 (Liu and Muse, 2005) was used to export the data in binary format (allele presence = 1 and allele absence = 0) for analysis with NTSYS-pc version 2.2 (Rohlf, 2002). The summary statistics including the number of alleles per locus, major allele frequency, genetic diversity, polymorphism information content (PIC) values were determined using Power Marker version 3.25. A similarity matrix was calculated with the Simqual subprogram using the DICE coefficient, followed by cluster analysis with the SAHN subprogram using the UPGMA clustering method and implemented in NTSYS-pc to construct a dendrogram showing relationship among the genotypes.

Thirty one SSR primers were used and a total number of 59 (Table 95 & 97) loci were amplified by these SSR primers. Out of 31 primers 16 primers were found polymorphic for the germplasm and they amplified 49 loci (Table 94). Ten primers were monomorphic for the germplasm and 5 primers did not amplify properly. The SSR profile of 22 jute accessions using SSR primers MJM1401 is shown in Fig. 62. Major allele frequency of 16 polymorphic primers and genetic diversity values are shown in table 94.

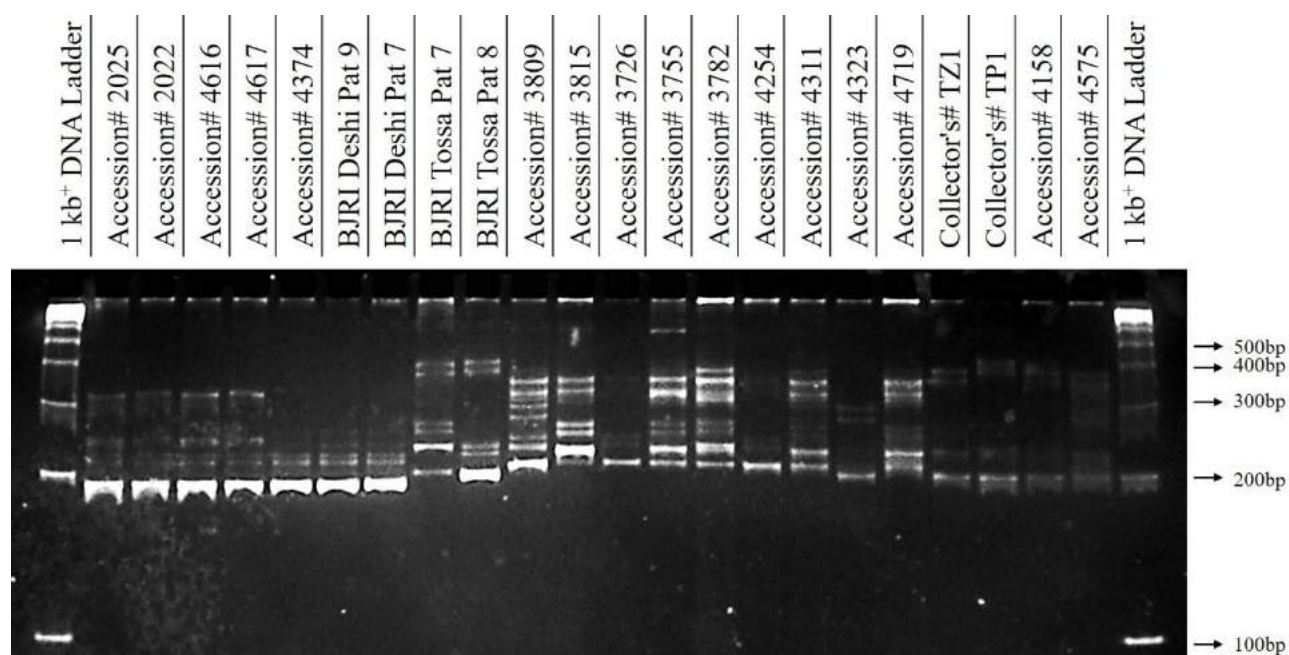


Fig. 75. DNA profile of jute germplasm with SSR marker, MJM1401

Table 94. Summary of genetic variation for major alleles

Marker	SampleSize	No. of obs.	No. of Allele	Highest frequency allele		Gene Diversity	Polymorphism Information Content
				size (bp)	frequency		
JMBD880	22	22	4	245	0.5	0.64	0.580
JMBD1404	22	21	3	310	0.467	0.608	0.527
JMBD148	22	21	2	185	0.667	0.444	0.346
JMBD201	22	22	3	300	0.727	0.417	0.360
JMBD563	22	22	3	150	0.5	0.574	0.484
JMBD598	22	22	2	150	0.682	0.434	0.340
JMBD1061	22	21	4	115	0.524	0.649	0.602
JMBD1824	22	22	3	340	0.682	0.483	0.434
JMBD2032	22	22	2	200	0.727	0.397	0.318
JMBD2045	22	22	4	170	0.409	0.69	0.633
JMBD2047	22	22	3	270	0.545	0.533	0.432
JMBD2064	22	20	3	250	0.5	0.58	0.492
MJM1401	22	22	5	235 & 210	0.318	0.719	0.666
MJM467	22	22	2	390	0.682	0.434	0.340
MJM1140	22	22	4	215	0.545	0.591	0.522
MJM1195	22	22	2	185	0.682	0.434	0.340

The highest number of allele (5) was found from primer MJM1401 for the studied germplasm. The highest gene diversity value (0.719) and PIC (Polymorphism Information Content) value (0.666) were also found from MJM1401. The second highest gene diversity value (0.69) and PIC value (0.633) was found for primer JMBD2045. Among the major alleles of the polymorphic primers the lowest gene diversity value (0.397) and PIC value (0.318) were found for JMBD2032. The result suggests that genetic variations exist among these jute germplasm. The highest (0.727) major allele frequency was found for allele size 300bp by JMBD201 and allele size 200 by JMBD2032 (Table-89 & 90). The frequency and variance of all 49 allele from 16 polymorphic markers for twenty-two jute genotypes is presented in Table 88. JMBD2064₂₅₀ allele showed the highest variance (0.013) for all 22 genotypes (Table 95). The size of amplified monomorphic allele primers for 22 jute germplasm is shown in table 96.

Table 95. Allele size and frequency of 16 polymorphic markers

Sl no.	Marker	Allele Size (bp)	Frequency	Variance	SD
1	JMBD880	210	0.273	0.009	0.095
2	JMBD880	215	0.045	0.002	0.044
3	JMBD880	235	0.182	0.007	0.082
4	JMBD880	245	0.500	0.011	0.107
5	JMBD1404	260	0.143	0.006	0.076
6	JMBD1404	290	0.381	0.011	0.106
7	JMBD1404	310	0.476	0.012	0.109
8	JMBD148	185	0.667	0.011	0.103
9	JMBD148	230	0.333	0.011	0.103
10	JMBD201	300	0.727	0.009	0.095
11	JMBD201	310	0.227	0.008	0.089
12	JMBD201	320	0.045	0.002	0.044
13	JMBD563	140	0.409	0.011	0.105
14	JMBD563	145	0.091	0.004	0.061
15	JMBD563	150	0.500	0.011	0.107
16	JMBD598	150	0.682	0.010	0.099
17	JMBD598	160	0.318	0.010	0.099
18	JMBD1061	115	0.524	0.012	0.109
19	JMBD1061	120	0.143	0.006	0.076
20	JMBD1061	140	0.143	0.006	0.076
21	JMBD1061	170	0.190	0.007	0.086
22	JMBD1824	315	0.182	0.007	0.082
23	JMBD1824	320	0.136	0.005	0.073
24	JMBD1824	340	0.682	0.010	0.099
25	JMBD2032	200	0.727	0.009	0.095
26	JMBD2032	225	0.273	0.009	0.095
27	JMBD2045	150	0.182	0.007	0.082
28	JMBD2045	160	0.091	0.004	0.061
29	JMBD2045	170	0.409	0.011	0.105
30	JMBD2045	240	0.318	0.010	0.099
31	JMBD2047	190	0.045	0.002	0.044
32	JMBD2047	210	0.409	0.011	0.105
33	JMBD2047	270	0.545	0.011	0.106
34	JMBD2064	230	0.100	0.005	0.067
35	JMBD2064	240	0.400	0.012	0.110
36	JMBD2064	250	0.500	0.013	0.112
37	MJM1401	210	0.318	0.010	0.099
38	MJM1401	220	0.273	0.009	0.095

Table 95. Cont'd

Sl no.	Marker	Allele Size (bp)	Frequency	Variance	SD
39	MJM1401	225	0.045	0.002	0.044
40	MJM1401	235	0.318	0.010	0.099
41	MJM1401	250	0.045	0.002	0.044
42	MJM467	360	0.318	0.010	0.099
43	MJM467	390	0.682	0.010	0.099
44	MJM1140	115	0.318	0.010	0.099
45	MJM1140	150	0.045	0.002	0.044
46	MJM1140	170	0.091	0.004	0.061
47	MJM1140	215	0.545	0.011	0.106
48	MJM1195	185	0.682	0.010	0.099
49	MJM1195	195	0.318	0.010	0.099

Table 96. Allele size of monomorphic primers for jute germplasm

Sl no.	Marker	Allele Size (bp)
1	JMBD492	290
2	JMBD635	260
3	JMBD709	240
4	MJM390	70
5	JMBD721	140
6	JMBD1017	195
7	TJMBD3	160
8	JMBD1579	285
9	JMBD1604	190
10	MJM1305	160

The values of pair wise Nei's genetic distance between accessions were computed from combined data for 16 polymorphic SSR primers. For the studied jute germplasm, the values were ranged from 0 to 1 (Table 97). Highest value (1) was found in between some deshi and tossa jute germplasm. It means that the genetic makeup of those germplasm from 2 different species have no or very negligible similarity. Deshi jute accession no. 2022 and 4616 showed no genetic difference for the used primers. May be the used primers were not polymorphic for them or they are genetically same or very much similar. Second lowest genetic distance (0.063) was also found among some deshi jute germplasm. Among deshi and tossa jute germplasm 2nd highest genetic distance was found 0.938. In case of tossa jute germplasm accession no. 3809 showed the highest genetic distance (0.533) with collector's no. TZ1. On the other hand tossa jute accessions 3782 and 3815 showed the lowest distance (0.063).

Table 97. Nei's (1983) genetic distance among jute germplasm

	Accession# 2022	Accession# 2025	Accession# 3726	Accession# 3755	Accession# 3782	Accession# 3809	Accession# 3815	Accession# 4158	Accession# 4254	Accession# 4311	Accession# 4323	Accession# 4374	Accession# 4575	Accession# 4616	Accession# 4617	Accession# 4719	BJRI Deshi Pat 7	BJRI Deshi Pat 9	BJRI Tossa Pat 7	BJRI Tossa Pat 8	Collector's# TP1
Accession# 2025	0.063																				
Accession# 3726	1.000	0.933																			
Accession# 3755	0.750	0.688	0.400																		
Accession# 3782	0.875	0.813	0.267	0.125																	
Accession# 3809	0.867	0.800	0.267	0.267	0.267																
Accession# 3815	0.875	0.813	0.333	0.188	0.063	0.333															
Accession# 4158	0.875	0.813	0.400	0.500	0.375	0.400	0.375														
Accession# 4254	0.875	0.813	0.267	0.188	0.125	0.333	0.188	0.438													
Accession# 4311	0.875	0.813	0.400	0.125	0.125	0.333	0.188	0.500	0.125												
Accession# 4323	1.000	0.938	0.200	0.375	0.250	0.400	0.250	0.250	0.313	0.375											
Accession# 4374	0.313	0.375	0.867	0.875	1.000	0.867	1.000	0.813	1.000	1.000	0.813										
Accession# 4575	0.933	0.867	0.357	0.467	0.400	0.286	0.400	0.200	0.467	0.467	0.267	0.867									
Accession# 4616	0.000	0.063	1.000	0.750	0.875	0.867	0.875	0.875	0.875	0.875	1.000	0.313	0.933								
Accession# 4617	0.063	0.125	1.000	0.750	0.875	0.867	0.875	0.875	0.875	0.875	1.000	0.375	0.933	0.063							
Accession# 4719	0.933	0.867	0.214	0.200	0.067	0.214	0.133	0.333	0.200	0.200	0.200	0.933	0.357	0.933	0.933						
BJRI Deshi Pat 7	0.313	0.375	0.933	0.813	0.938	0.867	0.938	0.938	1.000	0.938	0.938	0.125	1.000	0.313	0.375	0.933					
BJRI Deshi Pat 9	0.250	0.313	0.933	0.750	0.875	0.733	0.875	0.813	0.938	0.875	0.938	0.125	0.867	0.250	0.313	0.800	0.125				
BJRI Tossa Pat 7	1.000	0.938	0.333	0.375	0.313	0.467	0.313	0.375	0.375	0.313	0.188	0.875	0.333	1.000	1.000	0.267	1.000	0.938			
BJRI Tossa Pat 8	0.938	0.875	0.333	0.313	0.188	0.333	0.188	0.188	0.313	0.313	0.188	0.938	0.200	0.938	0.938	0.133	0.938	0.813	0.313		
Collector's# TP1	0.933	0.867	0.214	0.400	0.267	0.286	0.267	0.200	0.333	0.400	0.133	0.867	0.214	0.933	0.933	0.214	1.000	0.867	0.267	0.200	
Collector's# TZ1	1.000	0.938	0.333	0.500	0.438	0.533	0.438	0.250	0.500	0.438	0.188	0.813	0.267	1.000	1.000	0.400	0.938	0.938	0.250	0.250	0.200

Deshi jute

Tossa jute

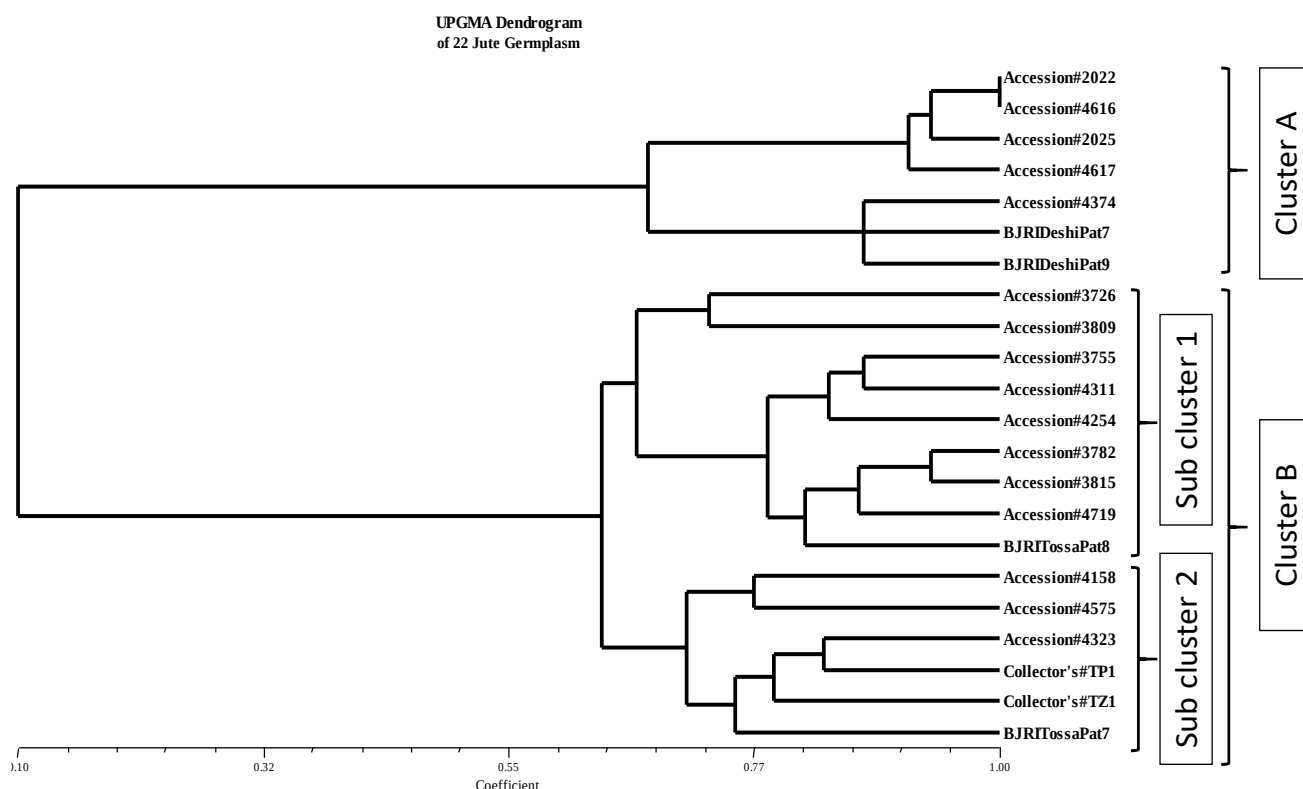


Fig. 76. UPGMA dendrogram showing Nei's genetic distance (Nei, 1983) among test jute germplasm based on alleles detected by microsatellite markers

Two species of jute, *Corchorus capsularis* and *C. olitorius* formed two clusters in the dendrogram (Fig. 76). Cluster of tossa jute were divided into 2 sub-clusters. The dendrogram is based on Nei's (1983) genetic distance. First sub-cluster of cluster B was comprised of tossa jute accession nos. 3726, 3809, 3755, 4311, 4254, 3782, 3815, 4719 and tossa jute variety BJRI Tossa Pat-8. Sub-cluster 2 of cluster B was comprised of accessions no. 4158, 4575, 4323; collector's no. TP1, TZ1 and variety BJRI Tossa Pat-7. BJRI Deshi Pat-7, BJRI Deshi Pat-9 and accession nos. 2022, 4616, 2025, 4617 and 4374 formed cluster A.

Conclusion

It is hoped that, in future the present results will help breeders to make selection from the diverse accessions studied to use them as parents for breeding and for producing mapping populations, but more SSR primers should be used to find more genetic variation information among them. For the used primers very little genetic distance was found for the deshi jute germplasm. So, more primer survey is needed for them. Tossa jute accessions showed decent genetic distance for the used primers which will be helpful for breeders to develop new high yielding variety.



Fig. 77. Lab activities for molecular characterization

11.5. Bangladesh Sugarcrop Research Institute

11.5.1. Germplasm collection

Three collecting missions were performed in south eastern hill districts of Bangladesh. In total 68 local sugarcane germplasm were collected from 31 upazilas of 20 districts of Bangladesh (Table 98, Fig. 78 & 79). In 2018, eleven germplasm were collected from Bandarban, Khagrachari and Rangamati districts by planned exploration and seven germplasm were collected from five districts through personal contact. In 2019, twenty three germplasm were collected from Bagerhat, Khulna, Patuakhali, Barishal, Borguna, and Rajbari districts. In 2020, twenty seven local germplasm were collected through an exploration trip in Sylhet, Sunamganj, Habiganj and Moulavibazar districts. The collected germplasm were maintained and conserved at BSRI germplasm bank with proper labelling. Passport information of the collected germplasm is shown in table 99.

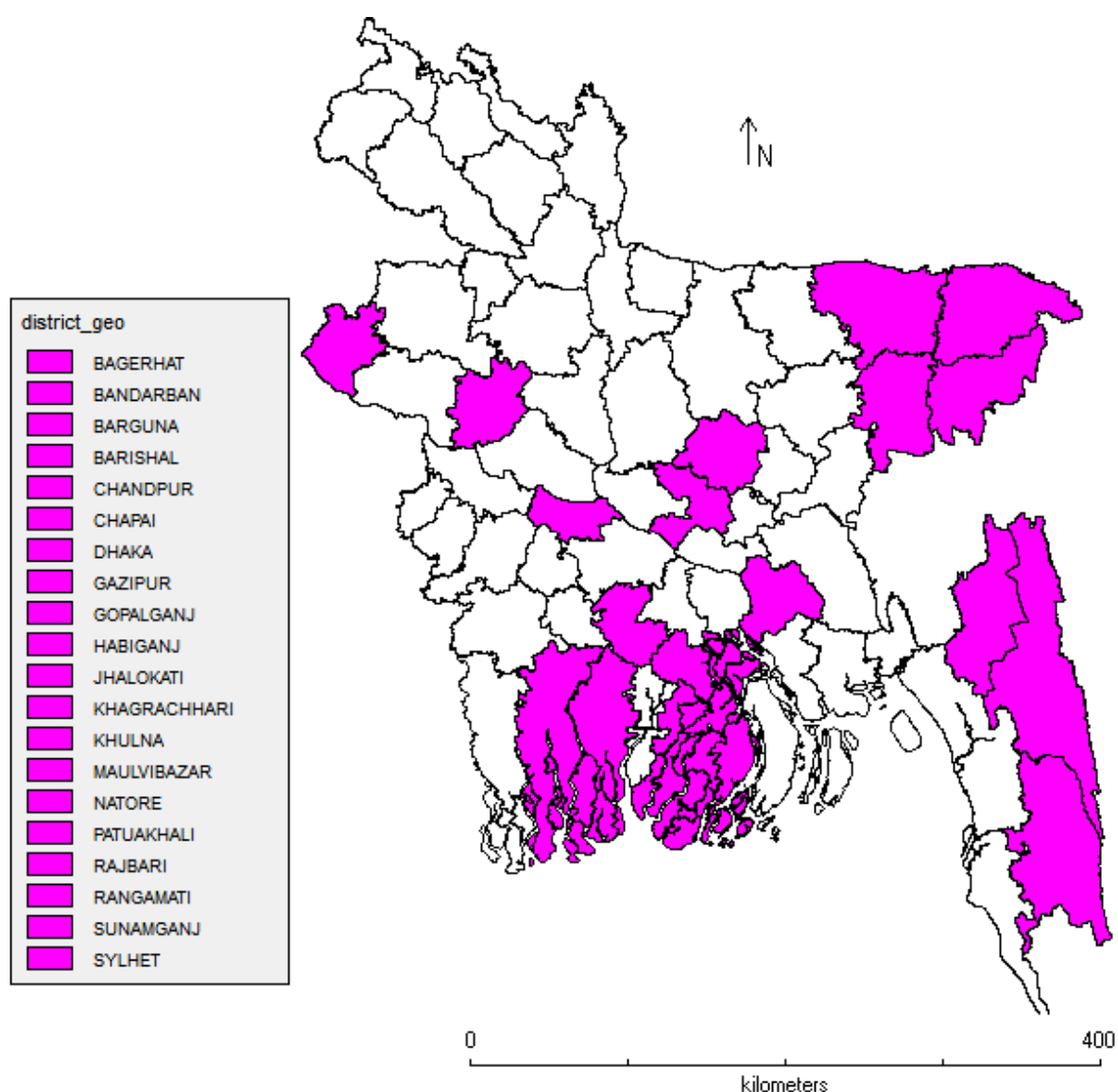


Fig. 78. Bangladesh map showing explored districts (20)

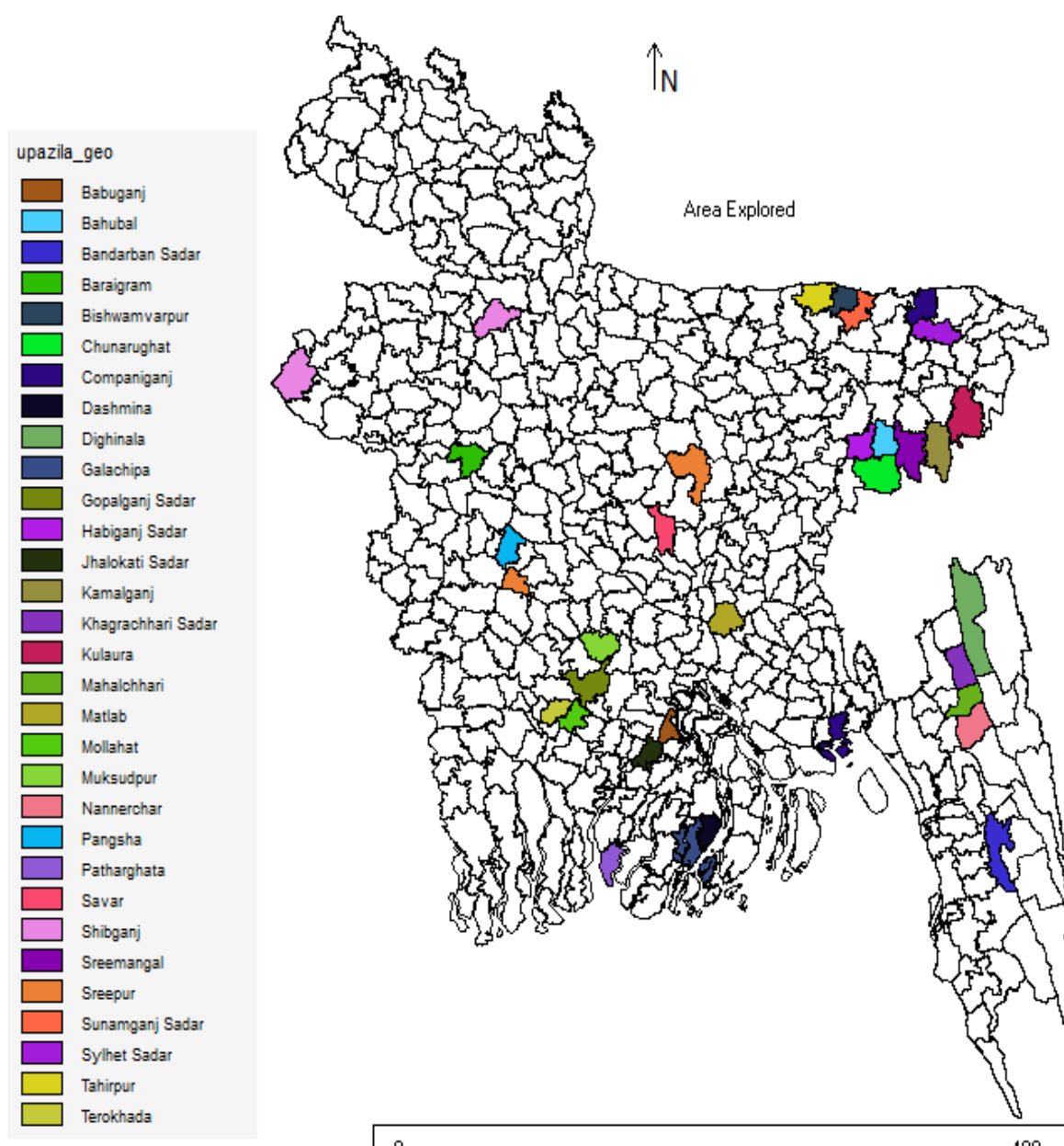


Fig. 79. Bangladesh map showing explored 31 upazilas

Out of 68 sugarcane germplasm under this sub-project 49 were chewing type, 17 were gur/sugar type and 2 were wild relatives. Maximum number of germplasm (9) were collected from Maulvibazar followed by Habiganj (8), Sunamganj (6), Borguna (5), Khagrachari (5) and Rajbari (5). Among the two wild relatives, one was collected from Sunamganj and another one from Sylhet. The districts from where maximum local cultivar/landraces were collected are mainly less accessible (situated in hilly, swamp and/or coastal regions). The results indicated that invaluable landraces and wild relatives of sugarcane are still available only in less accessible areas. Extensive collection explorations need to be made to these areas to rescue the endangered landraces from extinction and to minimize genetic erosion.

Table 98. List of sugarcane germplasm collected from different districts in Bangladesh, 2018-2020

District	No. of upazilas explored	No. of sugarcane germplasm collected			
		Chewing	Gur/Sugar	Wild	Total
1. Bagerhat	01	01	02	-	03
2. Bandarban	01	03	-	-	03
3. Barguna	01	04	01	-	05
4. Barishal	01	02	-	-	02
5. Chandpur	01	02	-	-	02
6. Chapainawabganj	01	01	-	-	01
7. Dhaka	01	01	-	-	01
8. Gazipur	01	01	-	-	01
9. Gopalganj	02	03	-	-	03
10. Habiganj	03	03	05	-	08
11. Jhalokati	01	01	-	-	01
12. Khagrachari	02	05	-	-	05
13. Khulna	01	-	02	-	02
14. Maulvibazar	03	07	02	-	09
15. Natore	01	01	-	-	01
16. Patuakhali	02	03	01	-	04
17. Rajbari	01	03	02	-	05
18. Rangamati	02	03	-	-	03
19. Sunamganj	03	03	02	01	06
20. Sylhet	02	02	-	01	03
Total	31	49	17	02	68

Table 99. Passport information of sugarcane germplasm collected under PBRG-PGR sub-project

SI No	Collector's No.	Cultivar/local name/cultural practice	Donor's name & Address	Geographical location and date	Photographs
1	T-01	Modhumala (Chewing)	Md. Shahazaman Majhy Village: Baher char Upazila: Babugonj Dist.: Barishal	01.12.2018 90.633330°E 23.400000°N	
2	T-02	Misrimala (Chewing)	Md. Shahazaman Majhy Village: Baher char Upazila: Babugonj Dist.: Barishal	01.12.2018 90.633330°E 23.400000°N	
3	R-01	Babulal (Chewing)	Md. Kabirul Village: Mobarakpur Upazila: Shibgonj Dist.: Chapainobabgonj	17.08.2018 88.597868°E 24.365876°N	

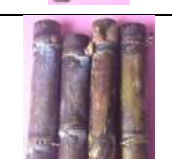
Sl No	Collector's No.	Cultivar/local name/cultural practice	Donor's name & Address	Geographical location and date	Photographs
4	M-01	Chandpur Gandari-2 (Chewing)	Md. Tofazzal Hossain Village: Dubgi Upazila: Matlab Uttar Dist.: Chandpur	08.09.2018 90.706997°E 23.348592°N	
5	M-02	Tangail Gandari (Chewing)	Mozil Dhali Village: Dubgi Upazila: Matlab Uttar Dist.: Chandpur	08.09.2018 91.893042°E 21.480697°N	
6	T-03	Bonpara Gandari (Chewing)	Golam Rasul Village: Mohis Vanga Upazila: Boraigram Dist.: Natore	21.09.2018 88.95449°E 25.50309°N	
7	AK-01	Kalikushail-2 (Chewing)	Mukul Chakma Ward no. 7, Khagrachari town, Upazila: Khagrachari Sadar Dist.: Khagrachari	04.01.2018 92.38407°E 22.66881°N	
8	AK-02	Bulong Kushail (Chewing)	Jatin Bikash Chakma Vil: Baraitala Paikujchari, Upazila: Khagrachari Sadar Dist.: Khagrachari	04.01.2018 90.12402°E 22.14554°N	
9	AK-03	Juamati (Chewing)	Chaifou Marma Village: Gesimonipara, Upazila: Bandarban Sadar Dist.: Bandarban	05.01.2018 92.19167°E 22.23333°N	
10	AK-04	Churick (Chewing)	Daieu Murang Village: Emupara Upazila: Bandarban Sadar Dist.: Bandarban	05.01.2018 92.191673°E 22.23333°N	
11	AK-05	Khagra (Chewing)	Hafez Ahmod Modhyapara Bandarban town Upazila: Bandarban Sadar Dist.: Bandarban	06.01.2018 92.19167°E 22.23333°N	
12	AK-06	Black Rubi (Chewing)	Md. Anwarul Islam Raju Hero Nursery, Asulia, Upazila: Savar Dist.: Dhaka	30.07.2018 90.247872°E 23.838665°N	

Sl No	Collector's No.	Cultivar/local name/cultural practice	Donor's name & Address	Geographical location and date	Photographs
13	AR-01	Dhanopudi (Chewing)	Sohel Chakma Village: Pollin Headman Para Upazila: Dighinala Dist.: Khagrachari	28.01.2019 91.993922°E 23.116819°N	
14	AR-02	208 (Chewing)	Nirmol Chakma Village: Babu Chara Upazila: Dighinala Dist.: Khagrachari	28.01.2019 91.993922°E 23.116819°N	
15	AR-03	Domba Kusail (Chewing)	Ganolal Chakma Village: Beltoli Babu Chara Upazila: Dighinala Dist.: Khagrachari	28.01.2019 91.993922°E 23.116819°N	
16	AR-04	Ranga (Chewing)	Burigoda Village: Gatghor Para Upazila: Mohal Chari Dist.: Rangamati	29.01.2019 88.11521°E 25.00984°N	
17	AR-05	Rangakushail (Chewing)	Koltamoni Chakma Village: Toi Chakma Dosor Para Upazila: Naniachar Dist.: Rangamati	29.01.2019 88.95449°E 25.50309°N	
18	AR-06	Dhubo Kusail (Chewing)	Koltamoni Chakma Village: Toi Chakma Dosor Para Upazila: Naniachar Dist.: Rangamati	29.01.2019 88.95449°E 25.50309°N	
19	AMS-01	Chini Joba (Chewing)	Basudev Sarker Village: Astail Upazila: Mollarhat Dist.: Bagerhat	25.09.2019 89.80701°E 22.65906°N	
20	AMS-02	Nata Khail (Gur)	Badol Sarker Village: Astail Upazila: Mollarhat Dist.: Bagerhat	25.09.2019 89.80701°E 22.65906°N	

Sl No	Collector's No.	Cultivar/local name/cultural practice	Donor's name & Address	Geographical location and date	Photographs
21	AMS-03	Dabir Khail (Gur)	Basudev Sarker Village: Astail Upazila: Mollarhat Dist.: Bagerhat	25.09.2019 89.80701°E 22.65906°N	
22	AMS-04	Huley Khail (Gur)	Md. Osman Village: Dhankhali Upazila: Terokhada Dist.: Khulna	25.09.2019 89.55806°E 22.84193°N	
23	AMS-05	Humber Khail (Gur)	Md. Osman Village: Dhankhali Upazila: Terokhada Dist.: Khulna	25.09.2019 89.55806°E 22.84193°N	
24	AMS-06	Khagri-1 (Chewing)	Md. Selim Hawlader Village: Bodorpur Upazila: Golachipa Dist.: Patuakhali	27.09.2019 89.801933°E 23.583550°N	
25	AMS-07	Bash Ganderi (Gur)	Md. Selim Hawlader Village: Bodorpur Upazila: Golachipa Dist.: Patuakhali	27.09.2019 89.801933°E 23.583550°N	
26	AMS-08	Bareng/Bombay (Chewing)	Md. Masud Village: Kamarhaola Upazila: Golachipa Dist.: Patuakhali	27.09.2019 89.801933°E 23.583550°N	
27	AMS-09	Bash Fuli (Chewing)	Md. Oliul Hawlader Village: Dokkhin Rongopaldi Upazila: Dashmina Dist.: Patuakhali	27.09.2019 90.562203°E 22.283246°N	
28	AMS-10	Kazli (Chewing)	Md. Eusuf Village: Hoglapasa Munsirhat Upazila: Patharghata Dist.: Borguna	28.09.2019 90.365223°E 23.719198°N	
29	AMS-11	Turpin-Yellow (Chewing)	Md. Abdul Hakim Village: Gohorpur Upazila: Patharghata Dist.: Borguna	28.09.2019 90.365223°E 23.719198°N	

Sl No	Collector's No.	Cultivar/local name/cultural practice	Donor's name & Address	Geographical location and date	Photographs
30	AMS-12	Kalo Ganderi (Chewing)	Md. Habibor Rahman Village: Pouro ward-3 Upazila: Patharghata Dist.: Borguna	28.09.2019 90.365223°E 23.719198°N	
31	AMS-13	Ganderi (Chewing)	Md. Mojnu Sarif Village: Amratoli Kalmegha Upazila: Patharghata Dist.: Borguna	28.09.2019 90.365223°E 23.719198°N	
32	AMS-14	Jhati Kusail (Gur)	M. Abdur Rahman Munsu Village: Jaliaghata Kakchira Upazila: Patharghata Dist.: Borguna	28.09.2019 90.365223°E 23.719198°N	
33	AMS-15	Turpin- Green (Chewing)	Gopal Mistri Village: Simulesor Dogolchira Upazila: Jhalokathi Sadar Dist.: Jhalokathi	29.09.2019 90.191105°E 22.684365°N	
34	AMS-16	Huley Khail-2 (Chewing)	Milon Poddar Village: Ulpur Upazila: Gopalganj Sadar Dist.: Gopalganj	29.09.2019 78.75629°E 23.83797°N	
35	AMS-17	Lal Bareng (Chewing)	Md. Miraj Munsu Village: Tengrakhola Pour Upazila: Muksudpur Dist.: Gopalganj	30.09.2019 89.869677°E 23.314691°N	
36	AMS-18	Chini Chompa (Chewing)	Md. Firoj Molla Village: Komlapur Upazila: Muksudpur Dist.: Gopalganj	30.09.2019 89.869677°E 23.314691°N	
37	AMS-19	Hazarpeyara Lal-1 (Gur)	Md. Barek Pk. Village: Charafra Habaspur Upazila: Pangsha Dist.: Rajbari	01.10.2019 89.429207°E 23.788879°N	
38	AMS-20	Hazarpeyara Sada (Chewing)	Md. Barek Pk. Village: Charafra Habaspur Upazila: Pangsha Dist.: Rajbari	01.10.2019 89.429207°E 23.788879°N	

SI No	Collector's No.	Cultivar/local name/cultural practice	Donor's name & Address	Geographical location and date	Photographs
39	AMs-21	Huley Joba-3 (Chewing)	Md. Barek Pk. Village: Charafra Habaspur Upazila: Pangsha Dist.: Rajbari	01.10.2019 89.429207°E 23.788879°N	
40	AMS-22	Sondesh Goja/ Sundori Joba (Chewing)	Md. Moizuddin Khan Village: Charpara Habaspur Upazila: Pangsha Dist.: Rajbari	01.10.2019 89.429207°E 23.788879°N	
41	AMS-23	Hazarpeyara Lal-2 (Gur)	Md. Moizuddin Khan Village: Charpara Habaspur Upazila: Pangsha Dist.: Rajbari	01.10.2019 89.429207°E 23.788879°N	
42	AMS-24	Dholbazari (Chewing)	Sri Anil Chandra Village: Bodnivanga Post: Maona Upazila: Sreepur Dist.: Gazipur	25.12.2019 90.365958°E 24.2127157°N	
43	AMS-25	Unknown (Chewing)	Md. Khosru Mian Village: West Pakuria Upazila: Chunarughat Dist.: Habiganj	26.10.2020 91.4126358°E 24.385837°N	
44	AMS-26	Unknown (Gur)	Md. KhosruMian Village: West Pakuria, Upazila: Chunarughat Dist.: Habiganj	26.10.2020 91.4126358°E 24.385837°N	
45	AMS-27	Unknown (Gur)	Md. Khosru Mian Village: West Pakuria, Upazila: Chunarughat Dist.: Habiganj	26.10.2020 91.4126358°E 24.385837°N	
46	AMS-28	Unknown (Gur)	Md. Abdun Noor Village: Kathuamara Union: Gazipur Upazila: Chunarughat Dist.: Habiganj	26.10.2020 91.4126358°E 24.385837°N	
47	AMS-29	Unknown (Gur)	Md. Abdun Noor Village: Kathuamara Union: Gazipur Upazila: Chunarughat Dist.: Habiganj	26.10.2020 91.4126358°E 24.385837°N	

Sl No	Collector's No.	Cultivar/local name/cultural practice	Donor's name & Address	Geographical location and date	Photographs
48	AMS-30	Unknown (Gur)	Md. Abdun Noor Village: Kathuamara Union: Gazipur Upazila: Chunarughat Dist.: Habiganj	26.10.2020 91.4126358°E 24.385837°N	
49	AMS-31	Manik Kushal (Chewing)	Abdus Salam Village: West Borochar Upazila: Sayestaganj Dist.: Habiganj	26.10.2020 91.4126358°E 24.385837°N	
50	AMS-32	Songso Kushal (Chewing)	Sri Dilip Chandra Paul Village: Mirpur Upazila: Bahubal Dist.: Habiganj	27.10.2020 91.4126358°E 24.385837°N	
51	AMS-33	Unknown (Chewing)	Md. Jahid Mian Village: Vunobir Upazila: Sreemangal Dist.: Moulvibazar	27.10.2020 91.725133°E 24.3105781°N	
52	AMS-34	Unknown (Chewing)	Md. Jahid Mian Village: Vunobir Upazila: Sreemangal Dist.: Moulvibazar	27.10.2020 91.725133°E 24.3105781°N	
53	AMS-35	Kalamanik (Chewing)	Md. Anowar Mian Village: Boilashir Union: Mirzapur Upazila: Sreemangal Dist.: Moulvibazar	27.10.2020 91.725133°E 24.3105781°N	
54	AMS-36	Unknown (Chewing)	Md. Anowar Mian Village: Boilashir Union: Mirzapur Upazila: Sreemangal Dist.: Moulvibazar	27.10.2020 91.725133°E 24.3105781°N	
55	AMS-37	Asami-1 (Chewing)	Md. Jamal Uddin Village: Boilashir Union: Mirzapur Upazila: Sreemangal Dist.: Moulavibazar	27.10.2020 91.725133°E 24.3105781°N	
56	AMS-38	Asami-2 (Gur)	Md. Harun Mian Village: West Bilerpar Kotarkona Union: Hazipur Upazila: Kulaura Dist.: Moulvibazar	27.10.2020 92.0340732°E 24.5226336°N	
57	AMS-39	Khagri-2 (Gur)	Md. Nazrul Islam Village: Shamsernagar Upazila: Komolganj Dist.: Moulvibazar	27.10.2020 92.0340732°E 24.5226336°N	
58	AMS-40	Unknown (Chewing)	Md. Sanowar Ali Village: Kotarkona Union: Hazipur Upazila: Kulaura Dist.: Moulvibazar	27.10.2020 92.0340732°E 24.5226336°N	

Sl No	Collector's No.	Cultivar/local name/cultural practice	Donor's name & Address	Geographical location and date	Photographs
59	AMS-41	Unknown (Chewing)	Md. Ismat Ali Village: Kotarkona Union: Hazipur Upazila: Kulaura Dist.: Moulvibazar	27.10.2020 92.0340732°E 24.5226336°N	
60	AMS-42	Kuair (Chewing)	Md. Sajib Ahmed Village: Borodeo Upazila: Companiganj Dist.: Sylhet	28.10.2020 91.81343079°E 25.08062377°N	
61	AMS-43	Wild-1 (Wild)	Md. Sajib Ahmed Village: Borodeo Upazila: Companiganj Dist.: Sylhet	28.10.2020 91.81343079°E 25.08062377°N	
62	AMS-44	Wild-2 (Wild)	Village: Lokhir par Union: Donpur Upazila: Biswamvorpur Dist.: Sunamganj	29.10.2020 91.81343079°E 25.08062377°N	
63	AMS-45	Kutting (Gur)	Md. Abdus Sattar Mian Village: Lokhir par Union: Donpur Upazila: Biswamvorpur Dist.: Sunamganj	29.10.2020 91.30943298°E 25.10052306°N	
64	AMS-46	Misridana (Chewing)	Md. Abdus Sattar Mian Village: Lokhir par Union: Donpur Upazila: Biswamvorpur Dist.: Sunamganj	29.10.2020 91.30943298°E 25.10052306°N	
65	AMS-47	Tenai (Chewing)	Md. Abdus Sattar Mian Village: Lokhir par Union: Donpur Upazila: Biswamvorpur Dist.: Sunamganj	29.10.2020 91.30943298°E 25.10052306°N	
66	AMS-48	Bata fuli (Chewing)	Md. Aminur Hossain Village: Laura gor Union: Bathaghat Upazila: Tahirpur Dist.: Sunamganj	29.10.2020 91.17622375°E 25.09430488°N	
67	AMS-49	Unknown (Chewing)	Md. Hanif Mian Village: Kanda para Union: Narayan tola Upazila: Sunamganj Sadar Dist.: Sunamganj	29.10.2020 91.43165588°E 25.09430488°N	
68	AMS-50	Unknown (Chewing)	Md. Sahjahan Village: Chalk gram Khadimnagar Upazila: Sylhet Sadar Dist.: Sylhet	30.10.2020 91.89376831°E 24.89141948°N	



Fig. 80. Sugarcane germplasm collection from Chittagong Hill Tracts



Fig. 81. Sugarcane germplasm collection from southern part of Bangladesh



Fig. 82. Sugarcane germplasm collection from Sylhet region

11.5.2. Germplasm conservation

The collected germplasm were evaluated at BSRI germplasm bank. Germplasm collected upto 2019 were evaluated and characterized using DUS descriptor of BSRI. Then these were conserved at field genebank of BSRI after putting an accession number (Table 100). Last year (2020) collections were planted upon treated with carbendazim fungicide @1g/L for evaluation. After evaluation and characterization the selected materials will be conserved at field genebank of BSRI.

Table 100. Conservation status of collected sugarcane germplasm, 2018-2020

Sl.	Collector's No.	Type of planting material	Planting site	Date of planting	Acc. No.
1.	T-01	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1520
2.	T-02	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1528
3.	R-01	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1521
4.	M-01	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1522
5.	M-02	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1524
6.	T-03	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1523
7.	AK-01	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1532
8.	AK-02	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1527
9.	AK-03	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1525
10.	AK-04	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1526
11.	AK-05	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1577
12.	AK-06	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1531
13.	AR-01	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1529
14.	AR-02	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1569
15.	AR-03	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1530
16.	AR-04	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1579
17.	AR-05	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1568
18.	AR-06	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1570
19.	AMS-01	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1533
20.	AMS-02	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1534
21.	AMS-03	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1535
22.	AMS-04	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1503
23.	AMS-05	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1536
24.	AMS-06	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1537
25.	AMS-07	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1538
26.	AMS-08	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1539
27.	AMS-09	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1540
28.	AMS-10	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1541
29.	AMS-11	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1542
30.	AMS-12	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1543
31.	AMS-13	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1544
32.	AMS-14	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1545
33.	AMS-15	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1546
34.	AMS-16	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1510
35.	AMS-17	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1547
36.	AMS-18	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1548
37.	AMS-19	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1549
38.	AMS-20	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1550
39.	AMS-21	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1551
40.	AMS-22	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1552
41.	AMS-23	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1553
42.	AMS-24	Two eyed sett	Block# D, Plot # 5	19.11.2020	BSRI-1554
43.	AMS-25	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
44.	AMS-26	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
45.	AMS-27	Two eyed sett	Block# D, Plot # 6	20.11.2020	-

Cont'd Table 100.

Sl.	Collector's No.	Type of planting material	Planting site	Date of planting	Acc. No.
46.	AMS-28	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
47.	AMS-29	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
48.	AMS-30	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
49.	AMS-31	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
50.	AMS-32	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
51.	AMS-33	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
52.	AMS-34	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
53.	AMS-35	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
54.	AMS-36	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
55.	AMS-37	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
56.	AMS-38	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
57.	AMS-39	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
58.	AMS-40	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
59.	AMS-41	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
60.	AMS-42	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
61.	AMS-43	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
62.	AMS-44	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
63.	AMS-45	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
64.	AMS-46	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
65.	AMS-47	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
66.	AMS-48	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
67.	AMS-49	Two eyed sett	Block# D, Plot # 6	20.11.2020	-
68.	AMS-50	Two eyed sett	Block# D, Plot # 6	20.11.2020	-

11.5.3. Morphological Characterization

A total of 51 sugarcane germplasm were characterized morphologically during 2nd and 3rd year of the sub-project period (Table 101). Thirty five germplasm were from new collection and rest sixteen from previous collection. In 2019, twenty eight sugarcane germplasm were characterized morphologically. In 2020, twenty three sugarcane germplasm were characterized morphologically and analyzed their diversity parameters together.

Table 101. List of germplasm characterized morphologically, 2018-20

Sl. No.	Cultivar /Local name	Acc. No.	Upazila	District
1	Kali kushal-1	BSRI-1504	Khagracharisadar	Khagrachari
2	Misridana	BSRI-1505	Babugonj	Barisal
3	Senegal	BSRI-1506	QS, Gazipur Sadar	Gazipur
4	Kaptai-3	BSRI-1507	Kaptai	Rangamati
5	Baskusal Kaptai	BSRI-1508	Kaptai	Rangamati
6	Turag	BSRI-1509	Shibgonj	Chapainobabgonj
7	Huleykhali-2	BSRI-1510	Terokhada	Khulna
8	CO 527	BSRI-1511	Kaliganj	Satkhira
9	Shung	BSRI-1512	Kalapara	Patuakhali
10	Q 69	BSRI-1513	Mohasthan	Bogura
11	Atkushail	BSRI-1514	Sadar	Rangamati
12	Raujan	BSRI-1515	Dighinala	Khagrachari

Cont'd Table 101.

Sl. No.	Cultivar /Local name	Acc. No.	Upazila	District
13	Chitra	BSRI-1516	QS, Gazipur Sadar	Gazipur
14	Kharki	BSRI-1517	Khagrachari sadar	Khagrachari
15	Malaysia	BSRI-1518	Kustia sadar	Kustia
16	Chorua	BSRI-1519	Sadar	Kurigram
17	Modhumala	BSRI-1520	Babugonj	Barishal
18	Babulal	BSRI-1521	Shibgonj	Chapainobabgonj
19	Chandpuri Gandary	BSRI-1522	Matlab Uttor	Chandpur
20	Bonpara Gandary	BSRI-1523	Boraigram	Natore
21	Tangail Gandary	BSRI-1524	Matlab Uttor	Chandpur
22	Juamoti	BSRI-1525	Bandarban Sadar	Bandarban
23	Cheuric	BSRI-1526	Bandarban Sadar	Bandarban
24	Bhulong	BSRI-1527	Khagrachari sadar	Khagrachari
25	Misrimala	BSRI-1528	Babugonj	Barisal
26	Dhonupodi	BSRI-1529	Dighinala	Khagrachari
27	Domba Kusail	BSRI-1530	Dighinala	Khagrachari
28	Black Ruby	BSRI-1531	Savar	Dhaka
29	Kali kushal-2	BSRI-1532	Khagrachari Sadar	Khagrachari
30	Chini Joba	BSRI-1533	Mollarhat	Bagerhat
31	Nata Khail	BSRI-1534	Mollarhat	Bagerhat
32	Dabir Khail	BSRI-1535	Mollarhat	Bagerhat
33	Humber Khail	BSRI-1536	Terokhada	Khulna
34	Khagri-1	BSRI-1537	Golachipa	Patuakhali
35	Bash Ganderi	BSRI-1538	Golachipa	Patuakhali
36	Bareng/Bombay	BSRI-1539	Golachipa	Patuakhali
37	Bash Fuli	BSRI-1540	Dashmina	Patuakhali
38	Kazli	BSRI-1541	Patharghata	Borguna
39	Turpin-Yellow	BSRI-1542	Patharghata	Borguna
40	Kalo Ganderi	BSRI-1543	Patharghata	Borguna
41	Ganderi	BSRI-1544	Patharghata	Borguna
42	Jhati Kusail	BSRI-1545	Patharghata	Borguna
43	Turpin- Green	BSRI-1546	Sadar	Jhalokathi
44	Lal Bareng	BSRI-1547	Muksudpur	Gopalganj
45	Chini Chompa	BSRI-1548	Muksudpur	Gopalganj
46	Hazarpeyara Lal-1	BSRI-1549	Pangsha	Rajbari
47	Hazarpeyara Sada	BSRI-1550	Pangsha	Rajbari
48	Huley Joba-3	BSRI-1551	Pangsha	Rajbari
49	Sondesh Goja	BSRI-1552	Pangsha	Rajbari
50	Hazarpeyara Lal-2	BSRI-1553	Pangsha	Rajbari
51	Dholbazari	BSRI-1554	Sreepur	Gazipur

Table 102. Morphological traits of sugarcane germplasm as per DUS descriptor

Sl. No.	Characteristic	Descriptor State	No of Germplasm	Frequency (%)
01	Plant: Growth habit	Erect	28	54.90
		Semi-erect	23	45.10
02	Plant: Adherence of leaf sheath	Weak (self de-trashing)	13	25.49
		Medium (semi clasping)	38	74.51
03	Plant: Number of millable canes (NMC) per stool	Low (<3.0)	4	7.84
		Medium (3.0 – 5.0)	19	37.25
		High (5.1 – 7.0)	28	54.90
04	Plant: Leaf carriage	Open	31	60.78
		Compact	20	39.22
05	Plant: Intensity of green color of leaf canopy	Light	14	27.45
		Medium	25	49.02
		Dark	12	23.53
06	Plant: Cane height	Medium (1.75-3.0 m)	22	15.69
		Tall (>3.0 m)	29	43.14
07	Internode: Diameter	Thin (<2.2 cm)	2	56.86
		Medium (2.2 – 3.0 cm)	37	3.92
		Thick (>3.0 cm)	12	72.55
08	Internode: Shape	Cylindrical	40	78.43
		Tumescant	6	11.76
		Bobbin shaped	2	3.92
		Conoidal	3	5.88
09	Internode: Cross- section	Round	51	100.00
10	Internode: Colour (Exposed to sun)	Green yellow group (RHS 1)	30	58.82
		Yellow green group (RHS 144-154)	8	15.69
		Yellow group (RHS 3-13, 22)	2	3.92
		Purple group (RHS 59-65, 77)	11	21.57
11	Internode: Colour (Not exposed to sun)	Green (RHS 138-143)	0	0.00
		Green yellow (RHS 1)	6	11.76
		Yellow (RHS 2-11)	28	54.90
		Yellow green (RHS 145 - 154)	2	3.92
		Yellow white (RHS 158)	3	5.88
		Greyed green (RHS 193)	2	3.92
		Greyed yellow (RHS 160)	10	19.61
12	Internode: Split/growth crack	Absent	39	76.47
		Present	12	23.53
13	Internode: Alignment	Straight	47	92.16
		Zigzag	4	7.84
14	Internode: Appearance (rind surface)	Smooth	22	43.14
		Corky patches only	12	23.53
	Internode: Appearance (rind surface)	Ivory marks only	3	5.88
		Corky patches and ivory marks	14	27.45
15	Internode: Pithiness	Absent	26	50.98
		Present	25	49.02
16	Internode: Waxiness	Absent	3	5.88
		Light	17	33.33
		Medium	27	52.94
		Heavy	4	7.84

Cont'd Table 102.

Sl. No.	Characteristic	Descriptor State	No of Germplasm	Frequency (%)
17	Node: Width of root band	Narrow (< 6mm)	6	3.6
		Medium (6-8mm)	23	11.76
		Broad (> 8mm)	22	45.10
18	Node: Bud shape	Round	18	43.14
		Ovate	33	35.29
19	Node: Bud prominence	Flat	7	64.71
		Bulging	44	13.73
20	Node: Depth of bud groove	Absent	27	78.43
		Shallow	7	52.94
		Medium	14	13.73
		Deep	3	27.45
21	Node: Size of bud	Medium (6-9 mm),	11	86.27
		Large (9 mm or more)	40	21.57
22	Node: Bud tip position in relation to growth ring	Clearly below growth ring	5	25.49
		Touching the ring	22	9.80
		Clearly above growth ring	24	43.14
23	Node: Pubescence on the bud	Absent	38	5.88
		Present	13	74.51
24	Node: Bud cushion (Space between bud base and leaf scar)	Absent	43	47.06
		Present	8	84.31
25	Node: Growth ring appearance	Weak (Not swollen)	39	76.47
		Strong (Swollen)	12	23.53
26	Node: Root primordial arrangement	One row	3	5.88
		Two rows	38	74.51
		Three rows	2	3.92
		Four rows	2	3.92
		Irregular	6	11.76
27	Leaf sheath: Number of hairs (groups 57)	Absent	5	9.80
		Few	16	31.37
		Many	30	58.82
28	Leaf sheath: Distribution of hairs	Absent	5	9.80
		Only dorsal	46	91.20
		Lateral and dorsal	0	0.00
29	Leaf sheath: Shape of ligule	Crescent-shaped	31	60.78
		Bow-shaped	20	39.22
30	Leaf sheath: Shape of inner auricle	Sloping transitional	9	17.65
		Straight transitional	12	23.53
		Ascending transitional	5	9.80
		Deltoid	7	13.73
		Unciform	3	5.88
		Lanceolate	15	29.41
31	Leaf sheath: Shape of outer auricle	Sloping transitional	8	15.69
		Straight transitional	14	27.45
		Ascending transitional	15	29.41
		Deltoid	6	11.76
		Dentoid	2	3.92
		Lanceolate	6	11.76

Cont'd Table 102.

Sl. No.	Characteristic	Descriptor State	No of Germplasm	Frequency (%)
32	Leaf sheath: Colour of dewlap	Greenish-yellow	15	29.41
		Yellowish-green	7	13.73
		Brown	10	19.61
		Purple	19	37.25
33	Leaf blade: Curvature	Erect to tip	19	37.25
		Curved near tip	4	7.84
		Bent near tip	7	13.73
		Curved near middle	21	41.18
34	Leaf blade: Width at the longitudinal mid point	Medium (3.0-5.0 cm)	23	45.10
		Broad (>5.0 cm)	28	54.90
35	Leaf blade: Serration of margin	Absent	4	7.84
		Present	47	92.16
36	Cane top: Waxiness	Weak	29	56.86
		Medium	22	43.14
37	Special Character (If any): Brix %	>20	18	35.29
		16-20	23	45.10
		<16	10	19.61

Table 103. Analysis of variance for 12 characters of sugarcane germplasm

SV	df	NMC	LLB	WLB	LB	WB	PH
Replication	2	0.05	2.3	0.005	0.055	0.008	136.0
Genotype	50	3.79***	1578.7***	4.78**	10.35**	4.28***	9472.0***
Residuals / Error	100	0.256	2.4	0.005	0.108	0.127	47
CV (%)		9.41	1.1	1.21	3.37	4.43	1.49

Table 103. Analysis of variance for 12 characters of sugarcane germplasm (Cont'd)

SV	df	SL	NI	IL	ID	SCW	BR
Replication	2	31.0	2.02	3.63***	0.0001	1.62***	0.251*
Genotype	50	8455.0***	40.84***	8.58***	0.62***	0.965***	23.21***
Residuals / Error	100	57	1.71	0.183	0.0079	0.0033	0.055
CV (%)		2.61	4.66	4.1	3.29	3.22	1.43

Note: SV = Source of variation, df = Degrees of freedom, NMC = Number of millable cane, LLB = Length of leaf blade (cm), WLB = Width of leaf blade (cm), LB = Length of bud (mm), WB = Width of bud (mm), PH = Plant height (cm), SL = Stalk length (cm), NI = Number of internode, IL = Internode length (cm), ID = Internode diameter (cm), SCW = Single cane weight (kg), BR = Brix percentage.

Cluster analysis

Cluster analysis for phenotypic traits showed a clear demarcation between sugarcane accessions. Cluster differences were observed by summarizing cluster means for the 12 quantitative traits. All the genotypes were clustered on the basis of agglomerative cluster analysis, where specifications were made based on Euclidean distance and grouping was made on average clustering method. Based on these traits, the accessions were grouped into four different clusters (Tables 104 & 105). The dendrogram divided the accessions into four different clusters consisting 11, 16, 18 and 6 genotypes respectively. Cluster analyses grouped genotypes with greater similarity for agronomic trait (Fig. 83), they did not necessarily include the genotypes from the same source of origin as well as collection site. In most of the germplasm resources lack of accessions between agronomic traits and origin has been reported (Ghafoor *et al.*, 2005 and Perera *et al.*, 2012). This information will be helpful to use in crop breeding through identification of parents. Crosses involving parents from these genetically divergent clusters are expected to manifest maximum heterosis and generate wide variability in genetic architecture. These are also likely to produce potential recombinants with desired traits (Singh and Singh, 1989).

Table 104. Clustering of sugarcane germplasm using mean of 12 quantitative characters

Cluster	No. of genotypes	Genotype
C ₁	11	4, 5, 7, 8, 9, 12, 13, 15, 19, 40 and 42
C ₂	16	2, 10, 14, 22, 24, 28, 29, 30, 31, 33, 34, 36, 38, 46, 49 and 50
C ₃	18	1, 3, 6, 11, 16, 17, 18, 20, 21, 23, 37, 39, 41, 43, 44, 47, 48 and 51
C ₄	6	25, 26, 27, 32, 35 and 45

Note: Number refers to number of genotypes

Table 105. Differences among four clusters of sugarcane germplasm for mean performance of 12 quantitative characters

Character	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Grand mean
Number of millable cane	6.37	5.03	5.25	4.86	5.38
Length of leaf blade (cm)	148.68	142.48	139.59	148.46	144.80
Width of leaf blade (cm)	6.16	5.86	5.41	5.52	5.74
Length of bud (mm)	9.11	10.07	9.47	10.75	9.85
Width of bud (mm)	7.53	8.87	7.66	7.87	7.98
Plant height (cm)	535.54	430.95	479.00	357.68	450.79
Stalk length (cm)	352.55	261.28	310.47	186.90	277.80
Number of Internode	29.95	28.87	27.87	22.85	27.39
Internode length (cm)	11.68	9.47	11.25	8.57	10.24
Internode dia (cm)	2.83	2.68	2.57	2.91	2.75
Single cane weight (kg)	2.19	1.63	1.71	1.66	1.80
Brix %	15.92	16.77	16.74	14.40	15.95

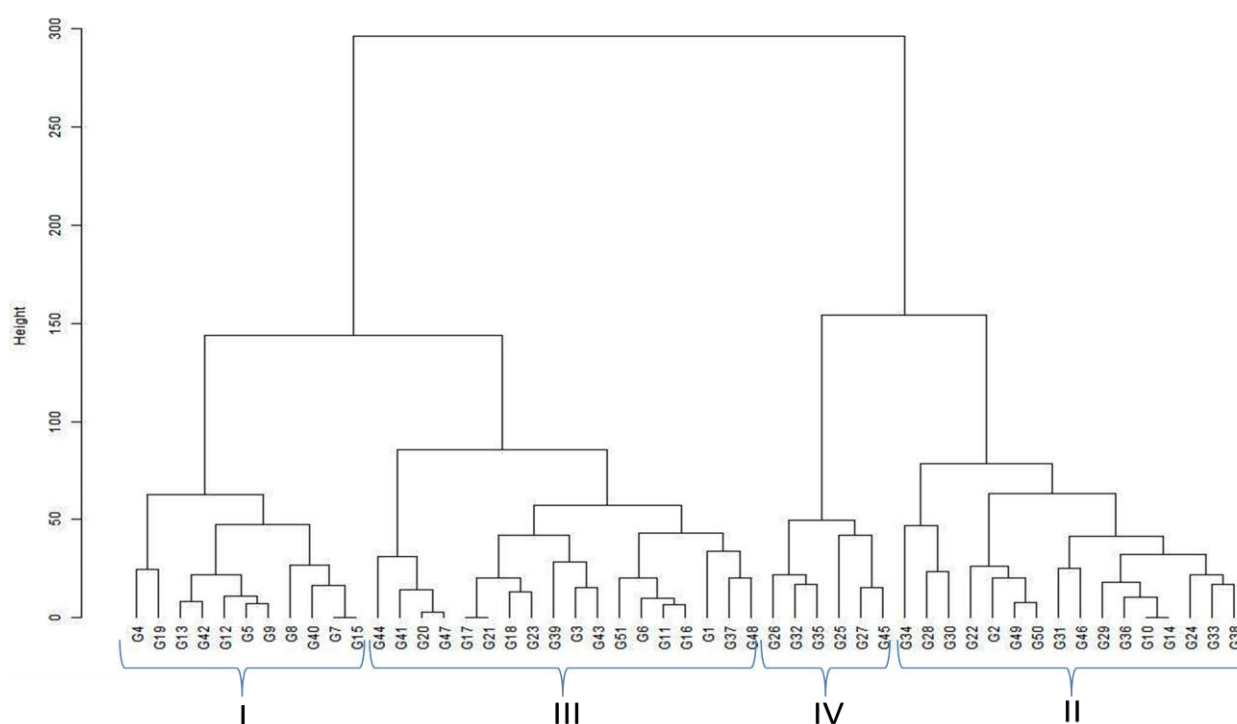


Fig. 83. Dendrogram based on mean performance of variables in test sugarcane germplasm

Principal component analysis

In the present study the PCA grouped the 12 phenotypic characters into 12 components, which accounted for the entire (100%) variability among the studied accessions (Table 106). As Chatfield *et al.* (1980) stated, components with an eigen value of less than one should be eliminated so that fewer components are dealt with. Furthermore, Hair *et al.* (1998) suggested that eigen values greater than one are considered significant and component loadings greater than ± 0.3 were considered to be meaningful. Hence, from this study, only the first four components which had eigen values greater than one and cumulatively explained about 76.5% of the total variation among the accessions were discussed. The first principal component (PC 1) alone explained 32.28% of the total variation. Characters which contributed more to the second PC accounted for 24.62% of the total variation. The third and fourth PC expressed 11.43% and 8.2% of the variation.

The first component of variation is mainly due to length of leaf blade (cm), width of leaf blade (cm), length of bud (mm), width of bud (mm), number of internode, internode dia (cm) and single cane weight (kg). Characters which contributed more to the second component are plant height (cm), stalk length (cm), number of internode and single cane weight (kg). The variation of third PC composed of length of bud (mm), width of bud (mm) and brix %. Number of millable cane, length of leaf blade (cm) and length of bud (mm) contribute to the variation in fourth PC.

The PCA biplots provide an overview of the similarities and differences between the quantitative traits of different accessions and of the interrelationships between the measured variables. The biplot demarcated the accessions with characteristics most explained by the first two dimensions. The first and second PCs explained the most variation among the accessions, revealing a high degree of association among the characters studied (Fig. 84).

Table 106. Principal component analysis of 12 quantitative characters in sugarcane germplasm

Character	Eigen vector			
	PC1	PC2	PC3	PC4
Number of millable cane	-0.252	0.147	0.160	0.692
Length of leaf blade (cm)	0.036	0.059	-0.580	0.118
Width of leaf blade (cm)	0.359	0.268	0.033	0.037
Length of bud (mm)	0.284	-0.104	0.349	0.312
Width of bud (mm)	0.234	-0.112	0.512	0.030
Plant height (cm)	-0.245	0.482	0.027	0.005
Stalk length (cm)	-0.225	0.489	0.152	-0.108
Number of internode	0.115	0.378	0.263	-0.522
Internode length (cm)	-0.417	0.182	-0.058	0.104
Internode dia (cm)	0.418	0.239	-0.109	0.210
Single cane weight (kg)	0.294	0.404	-0.035	0.255
Brix percentage	-0.336	-0.108	0.378	0.063
Proportion of variance	0.3228	0.2462	0.1143	0.082
Cumulative proportion	0.3228	0.569	0.6833	0.765

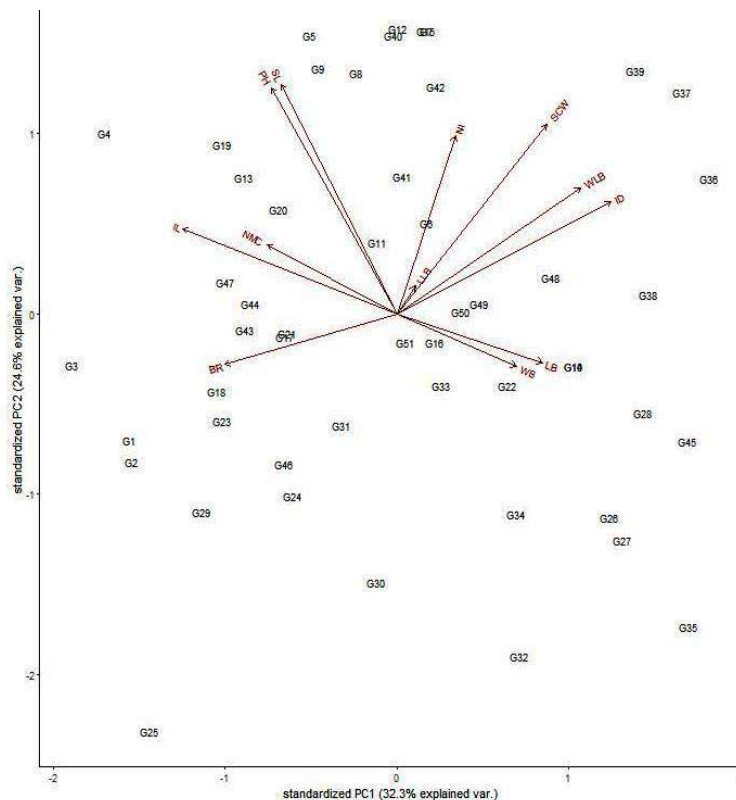


Fig. 84. Genotype by trait (GT) biplot of sugarcane germplasm

11.6. Bangladesh Institute of Nuclear Agriculture

11.6.1. Germplasm Collection

One hundred and ninety nine local germplasm of different crops were collected from February, 2018 to December, 2020 (Figs. 85 & 86). During germplasm collection, passport data form was used for record preliminary data of the collected germplasm. Twenty eight expeditions were made for collection of rice, oilseeds, pulses, spices and vegetables germplasm from Mymensingh (including Tangail) and Sylhet regions of Bangladesh. The team members visited 38 upazilas of 10 districts viz. Mymensingh, Tangail, Sherpur, Jamalpur, Netrakona, Kishoreganj, Tangail, Sylhet, Habiganj and Sunamganj. Number of upazilas explored and number of germplasm collected from each district is shown in table 107. Passport information of collected germplasm of assigned crops is shown in tables 108-112.

Table 107. District wise germplasm collection status of target crops

Name of District	No. of Upazilas explored	Number of germplasm collected																
		Rice	Chilli	Bitter gourd	Egg-plant	Groundnut	Mustard	Sesame	Black gram	French bean	Hyacinth bean	White gourd	Sweet gourd	Bottle gourd	Sponge gourd	Turneric	Ginger	Okra
Mymensingh	6	17	3	1	2	1		2									1	2
Netrokona	2	9	2															
Kishoreganj	2	8				3			1							1		
Jamalpur	4	5		2	2													
Sherpur	2	32			2													
Tangail	5	9			1							2	3	1	1	1	1	
Sylhet	5	7																
Sunamganj	8	64			2		1			1	7	1						1
Moulvibazar	1	2																
Habiganj	3	3																
Total	38	151	5	3	9	4	1	2	1	1	7	3	3	1	1	2	2	3



Fig. 85. Collecting seeds from farmers and seed agency and recording passport data



Fig. 86. Collecting seeds from farmer's seed store and house

Table 108. Passport information of collected rice (*Oryza sativa*) germplasm

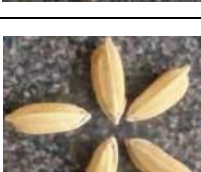
Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
1.	MM-01	Purabinni T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19°	
2.	MM-04	Goati binni T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
3.	MM-05	Markabinni T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19°	
4.	MM-06	Bishali binni-1 T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19°	
5.	FS-02	Bishalibinni-2 T. Aman	Md. Wasim Village : Shimultoli Upazila : Durgapur District : Netrokona	9 January 2019 N-25.12° E-90.68°	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
6.	MM-18	Shongbinni T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19°	
7.	MM-19	Ledabinni T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19°	
8.	MM-27	Dudhbinni T. Aman	Sentu hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19°	
9.	M-02	Kashiabinni T. Aman	Md. Wasim Village : Shimultoli Upazila : Durgapur District : Netrokona	9 May 2018 25.12°N 90.68°E	
10.	MM-02	Malonchi Aman T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	01 June 2018 N- 25.14° E-90.19°	
11.	MM-03	Dhepa T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19°	
12.	MM-07	Lal chinishail T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19°	
13.	MM-11	Ranishail T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19°	
14.	MM-13	Sentushail T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
15.	MM-23	Rupashail T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19°	
16.	FS-11	Chinisail T. Aman	Mohammad Ali Village : Nethpara Union : Kullagora Upazila : Durgapur District : Netrokona	09 May 2019 N-25.13° E-90.68°	
17.	FS-18	Chinisail-3 T. Aman	Rasel Mia Village: Dharmapasha Union: Dharmapasha Sadar Upazila : Dharmapasha District : Sunamganj	25 May 2019 24.900°N 91.016°E	
18.	FS-40	Moinashail T. Aman	Md. ALi Village : Dhapkai Union : Rajanogor Upazila : Dirai District : Sunamganj	25 May 2019 24.783°N 91.350°E	
19.	FM-35	Birushail T. Aman	Chan Mia Village : Muslimpur Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	27 November 2019 25.06°N 91.44°E	
20.	FM-36	Laittashail T. Aman	Almas Ali Village:Kandigaon Union : Rongar chor Upazila: Sunamganj Sadar District : Sunamganj	27 November 2019 25.75°N 91.26°E	
21.	FM-37	Atonishail T. Aman	Chan Mia Village : Muslimpur Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	27 November 2019 25.06°N 91.44°E	
22.	FM-38	Gandhishail T. Aman	Md. Shahjahan Village : Kandigaon Union : Dokkhipara Upazila : Rongar chor District : Sunamganj	27 November 2019 25.75°N 91.26°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
23.	FM-39	Moinashail-2 T. Aman	Md. Abul Kashem Village : Buristhol Union : Mollapara Upazila: Sunamganj Sadar District : Sunamganj	27 November 2019 25.11°N 91.26°E	
24.	MM-08	Motamarang T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
25.	FI-01	Poshu shail/ Sylhetshail T. Aman	Ali Ahammad Village: Bristol Union: Mollapara Upazila: Shunamganj District: Shunamganj	20 July 2020 25.11°N 91.26°E	
26.	MSF-12	Dudhshail T. Aman	Abul Hoshen Village: Mushulli Union: Mushulli Upazila: Nandail District: Mymensingh	23 June 2020 25.08°N 90.538°E	
27.	MM-09	Sentu-16 T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
28.	MM-10	Mery gold T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
29.	MM-12	Pairjaat T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
30.	MM-14	Chapal-2 T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
31.	MM-16	Chapal-1 T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
32.	MM-15	Sentu gold-12 T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 25.14°N E- 90.19 °N	
33.	MM-17	Biroi-1 T. Aman	Sentu hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
34.	FS-06	Biroi-2 T. Aman	Ali Hossain Village : Ghosgao Union : Ghosgao Upazila : Dhobaura District : Mymensingh	23 June 2019 25.09°N 90.533°E	
35.	FS-27	Biroi dhan-1 T. Aman	Mokhlesh Village : Goatola Union : Goatola Upazila : Dhobaura District : Mymensingh	23 June 2019 25.091°N 90.533°E	
36.	FM-6	Biroi-3 T. Aman/ B. Aman	Md.Abul Kashem Village : Buristhol Union : Mollapara Upazila: Sunamganj Sadar District : Sunamganj	25November 2019 24.9000°N 91.0167°E	
37.	MM-20	Ful lota T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
38.	MM-21	Sentu-18 T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
39.	MM-22	Sentu-19 T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
40.	MM-24	Champamasuri T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
41.	MM-25	Sentu-17 T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
42.	MM-26	Ful kainja T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
43.	MM-28	Soto shornolota T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
44.	MM-29	Sentu-15 T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
45.	MM-30	Gaindha T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 N-25.14° E-90.19 °	
46.	MM-31	Madhobilota T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 25.14°N E 90.19 °N	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
47.	MM-32	Lalmatia T. Aman	Sentu Hajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 25.14°N E 90.19 °N	
48.	H-01	Kalahapa Aus	Md. Abdul Gani Village: Kalitoli Union : Bhairab Upazila: Bhairab District: Kishoreganj	1 June 2018 25.14°N E- 90.19 °N	
49.	FA-01	Binnatoa Boro	Baten Mia Village: Kathgola Union : Khagdoho Upazila: Mymensingh Sadar District : Mymensingh	16 May 2019 24.43°N 90.79 °E	
50.	FA-02	Gourohati Boro	Baten Mia Village: Kathgola Union : Khagdoho Upazila: Mymensingh Sadar District : Mymensingh	16 May 2019 24.43°N 90.79 °E	
51.	FA-03	Begunbichi Aman	Baten Mia Village: Kathgola Union : Khagdoho Upazila: Mymensingh Sadar District : Mymensingh	16 May 2019 24.43°N 90.79 °E	
52.	FHS-01	Rati Boro (local Aromatic rice) Boro	Md. Abdul Latif Village : Chander chor Union : Gojaria Upazila : Bhairab District : Kishorganj	20 May 2019 25.09°N 90.53°E	
53.	FHS-02	Lafaya Boro	Md. Liton Village : Duo Union : Duo Upazila : Atpara District : Netrokona	16 May 2019 24.52°N 90.44 °E	
54.	FM-01	Chengri T. Aman	Md. Golam Azam Village: Saitola Union : Sreemangal Upazila: Sreemangal District: Moulvibazar	16 May 2019 24.31°N 91.73 °E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
55.	FM-02	Arai T. Aman	Md. Golam Azam Village: Saitola Union : Sreemangal Upazila: Sreemangal District: Moulvibazar	16 May 2019 24.31°N 91.73 °E	
56.	FMM-01	Laldinga Boro	Siddik Mia Village : Babigao Union : Surma Upazila : Sunamganj Sadar District : Sunamganj	16 May 2019 25.07°N 91.40 °E	
57.	FMM-02	Local (Boro)	Siddik Mia Village : Saidpur Union : Surma Upazila : Sunamganj District : Sunamganj	23 May 2019 24.90°N 91.02°E	
58.	FS-01	Lalkumri T. Aman	Md. Wasim Village : Shimultoli Union : Bakaljora Upazila : Durgapur District : Netrokona	9 January 2019 25.12°N 90.68°E	
59.	FS-03	Paijam T. Aman	Siddik mia Village : Terapur Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	23 May 2019 25.07°N 91.40 °E	
60.	FS-09	Lal paijam T. Aman	Baset Ali Village :Uttor Gamaritola Union : Gamaritola Upazila : Dhobaura District :Mymensingh	23 June 2019 25.0917°N 90.5333°E	
61.	FS-36	Paijam T. Aman	Taimur Ali Village : Dolua Union: Rajanogor Upazila : Dirai District : Sunamganj	25 May 2019 24.783°N 91.350°E	
62.	FS-41	Faijam T. Aman	Md. Ali Village: Dhapkai Union : Rajanogor Upazila : Dirai District : Sunamganj	25 May 2019 24.783°N 91.350°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
63.	FM-22	Desi paijam T. Aman	Jainal Abedin Village : Laalpur Union : Mollapara Upazila: Sunamganj Sadar District : Sunamganj	24November 2019 25.11°N 91.26°E	
64.	FM-25	Sada paijam T. Aman	Chan Mia Village : Muslimpur Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	24November 2019 25.06°N 91.44°E	
65.	FM-26	Painjab T. Aman	Abul Kalam Village : Konagaon Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	24November 2019 25.06°N 91.44°E	
66.	FS-04	Gobinda T. Aman	Abul Kalam Village : Bottola Union : Goatola Upazila : Dhobaura District : Mymensingh	23 June 2019 25.097°N 90.533°E	
67.	FS-05	Tulsimala T. Aman	Ali Hossain Village : Ghosgao Union : Ghosgao Upazila : Dhobaura District : Mymensingh	23 June 2019 25.091°N 90.533°E	
68.	FS-07	Chanmoni T. Aman	Baten Mia Village : Shimultoli Union : Bakaljora Upazila : Durgapur District : Netrokona	9 May 2019 25.12°N 90.68°E	
69.	FS-08	Hashemirri T. Aman	Hanif Mia Village : Arapara Union : Kullagora Upazila : Durgapur District : Netrokona	9 May 2019 25.120°N 90.687°E	
70.	FS-10	Boroabji T. Aman	Mohammad Ali Village : Arapara Union : Kullagora Upazila : Durgapur District : Netrokona	09 January 2019 25.1250°N 90.6875°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
71.	FS-12	Kalojira T. Aman	Mokhlesh Village : Goatola Union : Goatola Upazila : Dhobaura District : Mymensingh	23 June 2019 25.0917°N 90.5333°E	
72.	FM-19	Deshi kalojira T. Aman	Chan Mia Village : Muslimpur Union : Surma Upazila : Sunamganj Sadar District : Sunamganj	24November 2019 24.90°N 91.01°E	
73.	MSF-01	Kalijira T. Aman	Md. Ajim Uddin Village : Kushtia Union : Kushtia Upazila: Mymensingh Sadar District: Mymensingh	12 May 2020 25.0917°N 90.5333°E	
74.	FS-13	Bashiraj T. Aman	Motaleb Rahman Village : Chandigar Union : Chandigar Upazila : Durgapur District : Netrokona	9 May 2019 25.1250°N 90.6875°E	
75.	FS-14	Lombaail T. Aman	Motaleb Rahman Village : Chandigar Union : Chandigar Upazila : Durgapur District : Netrokona	9 May 2019 25.1250°N 90.6875°E	
76.	FS-15	Nagra T. Aman	Rasel Mia Village : Dharmapasha Union: Dharmapasha Sadar Upazila: Dharmapasha District : Sunamganj	25 May 2019 24.900°N 91.017°E	
77.	FS-16	Maloti T. Aman	Hashem Ali Village : Monjurabad Union : Golapganj Sadar Upazila : Golapganj District : Sylhet	25 May 2019 24°54'N 91°52'E	
78.	FS-17	Guamouri T. Aman	Rasel Mia Village : Dharmapasha Union: Dharmapasha Sadar Upazila : Dharmapasha District : Sunamganj	25 May 2019 24.900°N 91.016°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
79.	FS-19	Molairiti T. Aman	Rasel Mia Village : Dharmapasha Union: Dharmapasha Sadar Upazila : Dharmapasha District : Sunamganj	25 May 2019 24.900°N 91.016°E	
80.	FS-20	Putibirun T. Aman	Rasel Mia Village : Dharmapasha Union: Dharmapasha Sadar Upazila : Dharmapasha District : Sunamganj	25 May 2019 24.900°N 91.016°E	
81.	FM-13	Birun-1 T. Aman	Hafijul Islam Village : Puraton Gudigaon Union : Zahangirnogor Upazila: Sunamganj Sadar District : Sunamganj	24November 2019 25°66'N 91°44'E.	
82.	FM-14	Birun-2 T. Aman	Abul Kashem Village : Kandigaon Union : Rongarchor Upazila: Sunamganj Sadar District: Sunamganj	24November 2019 25°75'N 91°26'E.	
83.	FS-21	Kutimurar Birun T. Aman	Rasel Mia Village : Dharmapasha Union: Dharmapasha Sadar Upazila : Dharmapasha District : Sunamganj	25 May 2019 24.9000°N 91.0167°E	
84.	FS-24	Soragotobirun T. Aman	Wali ullah Village : Habibpur Union : Habibpur Upazila : Shalla District : Sunamganj	24 May 2019 24.900°N 91.016°E	
85.	FS-26	Ojana birun T. Aman	Aziz Rahman Village : Sukhaipur Union: Sukhair Rajpur Uttor Upazila : Dharmapasha District : Sunamganj	24 May 2019 24.90°N 91.016°E	
86.	FS-39	Kalobirun T. Aman	Md. ALi Village : Dhapkai Union : Rajanogor Upazila : Dirai District : Sunamganj	25 May 2019 24.7833°N 91.3500°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
87.	FS-42	Bedabirun T. Aman	Latifa Banu Village : Noagaon Union: Dharmapasha Sadar Upazila : Dharmapasha District : Sunamganj	24 May 2019 24.54°N 91.10°E	
88.	FM-08	Asamyo birun T. Aman	Chan Mia Village : Muslimpur Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	25November 2019 24.9000°N 91.0167°E	
89.	FM-10	Laal birun T. Aman	Motiur Rahman Village : Rampur Union : Mannargaon Upazla : Sunamganj Sadar District : Sunamganj	25November 2019 25°04'N 91°24'E	
90.	FS-22	Guarchara-1 T. Aman	Rasel Mia Village : Dharmapasha Union : Dharmapasha Sadar Upazla : Dharmapasha District : Sunamganj	25 May 2019 24.9000°N 91.0167°E	
91.	FS-23	Chinigura-1 T. Aman	Rasel Mia Village : Mainpur Union : Surma Upazla: Sunamganj Sadar District : Sunamganj	23 May 2019 24.90°N 91.016°E	
92.	FM-18	Chinigura-2 T. Aman	Abul Kashem Village : Kandigaon Union : Rongarchor Upazila : Sunamganj Sadar District : Sunamganj	24 November 2019 25.75°N 91.26°E	
93.	MFS-21	Chiniguri T. Aman	Md. Jamir Uddin Village : Kumargata Union : Kumargata Upazila : Muktagacha District : Mymensingh	20 May 2020 25.091°N 90.533°E	
94.	M-23	Guabari T. Aman	Md. Jamir Uddin Village: Kumargata Union: Kumargata Upazila: Muktagacha District: Mymensingh	20 May 2020 25.091°N 90.533°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
95.	FS-25	Chakloshi T. Aman	Wali ullah Village : Habibpur Union : Habibpur Upazila : Shalla District : Sunamganj	24 May 2019 24.9000°N 91.0167°E	
96.	FM-15	Chaplash T. Aman	Abul Kashem Village : Kandigaon Union : Rongarchor Upazila: Sunamganj Sadar District: Sunamganj	24November 2019 25°75'N 91°26'E	
97.	FS-28	Mukta T. Aman	Wali Ullah Village : Habibpur Union : Habibpur Upazila : Shalla District : Sunamganj	24 May 2019 24.900°N 91.016°E	
98.	FS-29	Deshi-32 T. Aman	Wali Ullah Village : Habibpur Union : Habibpur Upazila : Shalla District : Sunamganj	24 May 2018 24.900°N 91.016°E	
99.	FS-30	Hashakalo T. Aman	Wali Ullah Village : Habibpur Union : Habibpur Upazila : Shalla District : Sunamganj	24 May 2019 24.900°N 91.016°E	
100.	FS-31	Shonajuri T. Aman	Keramot Ali Village : Bolorampur Union : Shalla Sadar Upazla : Shalla District : Sunamganj	24 May 2019 24.900°N 91.016°E	
101.	FS-32	Hasa sada T. Aman	Azmat Ali Village : Badaghat Union : Badaghat Upazila : Tahirpur District : Sunamganj	24 May 2019 24.900°N 91.016°E	
102.	FM-16	Chengermuri-1 T. Aman	Motiur Rahman Village : Rampur Union : Mannargaon Upazila : Doarbazar District : Sunamganj	24November 2019 25°65'N 91°26'E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
103.	FM-17	Chengermuri-2 T. Aman	Abul Kashem Village : Kandigaon Union : Rongarcho Upazila : Sunamganj Sadar District : Sunamganj	24November 2019 25.75°N 91.26°E	
104.	FS-34	Parbotjira T. Aman	Keramot Ali Village : Bolorampur Union : Shalla Sadar Upazila : Shalla District : Sunamganj	24 May 2019 24.900°N 91.016°E	
105.	FS-35	Noliguarchara T. Aman	Keramot Ali Village : Bolorampur Union : Shalla Sadar Upazila : Shalla District : Sunamganj	24 May 2019 24.9000°N 91.0167°E	
106.	FS-37	Laal cheng T. Aman	Taimur Ali Village : Dolua Union : Rajanogor Upazila : Dirai District : Sunamganj	25 May 2019 24.783°N 91.350°E	
107.	FS-38	Ailaguta T. Aman	Md. Akkas Village : Modhupur Union : Rajanogor Upazila : Dirai District : Sunamganj	25 May 2019 24.783°N 91.350°E	
108.	FM-3	Chollish (40) T. Aman	Md. Shahjahan Village : Kandigaon Union : Dokkhinpara Upazla : Rongarchor District : Sunamganj	27 November 2019 25.75°N 91.26°E	
109.	FM-4	Chechollish (46) T. Aman/ B. Aman	Chan Mia Village : Muslimpur Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	25 Novemer 2019 24.9000°N 91.0167°E	
110.	FM-5	Bolok T. Aman/ B. Aman	Md.Abul Kashem Village : Buristhol Union : Mollapara Upazila : Sunamganj Sadar District : Sunamganj	25November 2019 24.9000°N 91.0167°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
111.	FM-07	Abdul Halim dhan T. Aman/ B. Aman	Chan Mia Village : Muslimpur Union : Surma Upazila : Sunamganj Sadar District : Sunamganj	25November 2019 24.9000°N 91.0167°E	
112.	FM-20	Deshi-32 T. Aman	Motiur Rahman Village : Rampur Union : Mannargaon Upazila: Sunamganj Sadar District : Sunamganj	24 November 2019 25.36°N 91.30°E	
113.	FM-22	Desi paijam T. Aman	Jainal Abedin Village : Laalpur Union: Mollapara Upazila: Sunamganj Sadar District : Sunamganj	24November 2019 25.11°N 91.26°E	
114.	FM-23	Laal paijam T. Aman	Chan Mia Village : Muslimpur Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	24November 2019 25.06°N 91.44°E	
115.	FM-24	Dshi paijam-2 T. Aman	Montaj Ali Village : Muslimpur Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	25November 2019 25.06°N 91.44°E	
116.	FFH-03	Sada paijam-2 T. Aman	Montaj ali Village : Muslimpur Union : Surma Upazila : Sunamganj Sadar District : Sunamganj	25November 2019 25.06°N 91.44°E	
117.	FFH-04	Painjab T. Aman	Abul Kalam Village : Konagaon Union : Surma Upazila : Sunamganj Sadar District : Sunamganj	24November 2019 25.06°N 91.44°E	
118.	FM-27	Goarchara T. Aman	Abul Kashem Village : Kandigaon Union : Dokkhipara Upazila : Rongar chor District : Sunamganj	24November 2019 25.75°N 91.26°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
119.	FM-28	Goarchara-2 T. Aman	Motiur Rahman Village : Rampur Union : Mannargaon Upazila: Sunamganj Sadar District : Sunamganj	24November 2019 25.06°N 91.44°E	
120.	FM-29	Khudbadal/ Chinigura T. Aman	Abul Kalam Village : Konagaon Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	24November 2019 25.06°N 91.44°E	
121.	FM-30	Kotkoti T. Aman	Abul Kashem Village : Kandigaon Union : Dokkhinpara Upazila : Rongar chor District : Sunamganj	24 November 2019 25.75°N 91.26°E	
122.	FM-31	Maloti T. Aman	Abul Kashem Village : Kandigaon Union : Dokkhinpara Upazila : Rongar chor District : Sunamganj	24 November 2019 25.75°N 91.26°E	
123.	FM-32	Maloti T. Aman	Chan Mia Village : Muslimpur Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	25 November 2019 25.06°N 91.44°E	
124.	FM-34	Murabadam T. Aman	Abul Kalam Village : Konagaon Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	27 November 2019 25.06°N 91.44°E	
125.	MSF-02	Jiradhan T. Aman	Abdul Motaleb Village : Charpakerdoho Union : Charpakerdoho Upazila : Madarganj District : Jamalpur	25 May 2020 24.88°N 89.76°E	
126.	MSF-03	Jirabuti T. Aman	Abdul Baset Village : Sidhuli Union : Sidhuli Upazila : Madarganj District : Jamalpur	25 May 2020 24.88°N 89.76°E	
127.	MSF-04	Rajbuti T. Aman	Zohurul Islam Village : Ganggail Union : Ganggail Upazila : Nandail District : Mymensingh	25 May 2020 24.56°N 90.69°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
128.	MSF-05	Chiniatob T. Aman	Shamser Ali Village : Borogram Union : Borogram Upazila : Muktagacha District : Mymensingh	22 June 2020 24.76°N 90.25°E	
129.	MSF-06	Chini sakthor T. Aman	Abdul Momen Village : Salla Union : Salla Upazila : Kalihati District : Tangail	20 May 2020 24.33°N 89.92°E	
130.	MSF-07	Shakthor khora T. Aman	Main Uddin Village : Anaitara Union : Anaitara Upazila : Mirzapur District : Tangail	20 May 2020 25.13°N 82.56°E	
131.	MSF-08	Kaonkhir T. Aman	Md. Rubel Village : Bajgati Union : Bajgati Upazila : Nandail District : Mymensingh	26 May 2020 24.56°N 90.69°E	
132.	MSF-09	Khirshabuti T. Aman	Md. Chan Mian Village : Mogra Union : Mogra Upazila: TangailSadar District : Tangail	20 May 2020 24.26°N 89.86°E	
133.	MKF-01	Khirsapat T. Aman	Abdul Barek Village : Digpaith Union : Digpaith Upazila : Jamalpu Sadar District : Jamalpur	26 May 2020 24.92°N 89.94°E	
134.	MSF-10	Sadagura T. Aman	Zahir Uddin Village : Hadira Union : Hadira Upazila : Gopalpur District : Tangail	20 May 2020 24.56°N 89.92°E	
135.	MSF-11	Doiorgura T. Aman	Md. Rubel Village : Solimabad Union : Solimabad Upazila : Nagorpur District : Tangail	20 May 2020 24.05°N 89.87°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
136.	MSF-13	Chanmoni T. Aman	Abdul Latif Village : Mogra Union : Tangail Sadar Upazila : Mogra District : Tangail	20 May 2020 24.26°N 89.86°E	
137.	MSF-14	Ranjit T. Aman	Abdur Rashid Village : Latibabad Union : Latibabad Upazila : Kishoreganj Sadar District : Kishoreganj	22 June 2020 24.43°N 90.78°E	
138.	MSF-15	Sylhet balam T. Aman	Nabin Chandra Paul Village : Kandigaon Union : Kandigaon Upazila : Sylhet Sadar District : Sylhet	10 June 2020 24.96°N 91.81°E	
139.	MSF-16	Lalbalam T. Aman	Nabin Chandra Paul Village : Kandigaon Union : Kandigaon Upazila : Sadar, Sylhet District : Sylhet	10 June 2020 24.96°N 91.81°E	
140.	MSF-18	Shatta T. Aman	Abdul Baten Village : Goulabazar Union : Goulabazar Upazila : Balaganj District : Sylhet	10 June 2020 24.56°N 91.82°E	
141.	MSF-19	Hutra T. Aman	Mejbah Uddin Village : Bajitkhila Union : Bajitkhila Upazila: Sherpur Sadar District : Sherpur	25 May 2020 24.96°N 91.81°E	
142.	MSF-20	Ajanta T. Aman	Mobarak Hossen Village : Sadipur Union : Sadipur Upazila : Balaganj District : Sylhet	10 June 2020 24.65°N 91.82°E	
143.	MSF-17	Kasalath Boro	Md. Hashim Uddin Village : Karab Union : Karab Upazila : Lakhai District : Habiganj	12 June 2020 24.38°N 91.41°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Ggeographical location and date	Photograph
144.	MKF-02	Halui T. Aman	Md. Rabin Village : Titpalla Union : Titpalla Upazila : Jamalpur Sadar District : Jamalpur	26 May 2020 24.90°N 89.95°E	
145.	FFH-07	Jagli Boro Boro	Mohammad Ali Village : Mokambari Union : Jointapur Upazila : Jointapur District : Sylhet	8November 2020 24°53 N 91°52 E	
146.	FFH-06	Baiyakauchi Boro	Kutub Mian Village : Satghori Union : Satbakh Upazila : Kanaighat District : Sylhet	8November 2020 24°53 N 91°52 E	
147.	FFH-09	Rata Boro Boro	Hanif Mian Village : Ranigaon Union : Ranigaon Upazila : Chunarughat District : Habiganj	7November 2020 24° 22 N 91° 24 E	
148.	FFH-08	Muraikka Boro	Hanif Mian Village : Noagaon Union : Mirpur Upazila : Bahubal District : Habiganj	7November 2020 24° 22 N 91° 24 E	
149.	FFH-05	Bayful Boro	Md.Abul Kashem Village : Buristhol Union : Mollapara Upazila: Sunamganj Sadar District : Sunamganj	25 November 2019 24.9000°N 91.0167°E	
150.	FFH-01	Ponkhiraj Aman	Ali Hossain Village : Ghosgao Union : Ghosgao Upazila : Dhobaura District : Mymensingh	23 June 2019 25.09°N 90.533°E	
151.	FFH-02	Thoa Aman	Ali Hossain Village : Ghosgao Union : Ghosgao Upazila : Dhobaura District : Mymensingh	23 June 2019 25.09°N 90.533°E	

Table 109. Passport information of collected spices, chilli (*Capsicum frutescens* L.), ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) germplasm

Sl. no.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Geographical location and date	Photograph
152.	S-01	Superhot master Rabi	Abdur Rahman Village: Sutiakhali Union: Boiara Upazila: Mymensingh Sadar District: Mymensingh	3 June 2018 25.14°N 90.19 °E	
153.	S-02	Balijhuri morich (Shyampur) Rabi	Md. Atab Uddin Village: Shyampur Union: Shyampur Upazila: Melandoho District: Jamalpur	18 October 2018 24.92° N 89.95 °E	
154.	S-03	Balijhuri (Kagmari) Rabi	Alom Mia Village: Jhaugora Union: Goalpara Upazila: Melandoho District: Jamalpur	2 March 2018 25.14°N 90.19 °E	
155.	S-04	Chata morich Rabi	Shah Alom Village: Sutiakhali Union: Boiara Upazila: Sadar District: Mymensingh	2 October 2018 25.45° N 90.24 °E	
156.	S-05	Ulto morich Rabi	Shah Alom Village: Sutiakhali Union: Boiara Upazila: Sadar District: Mymensingh	2 March 2018 25.45°N 90.24 °E	
157.	H-06	Turmeric (Local)	Abdul Gani Village : Bhairab Union : Bhairab Upazila : Bhairab District : Kishoreganj	19 October 2018 25.14°N 90.19 °E	
158.	FM-11	Ginger Haluaghat local Kharif	Abed Ali Village : Dhara Union : Dhara Upazila : Haluaghat District : Mymensingh	23 February 2019 25.0917°N 90.5333°E	

Sl. no.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Geographical location and date	Photograph
159.	FM-12	Ginger Modhupur local Kharif	Taimur Ali Village : Oronkhola Union : Oronkhola Upazila : Madhupur District : Tangail	23 February 2019 24.900 0°N 91.0167°E	
160.	FM-13	Turmeric Modhupur local Kharif	Md. Abdul Latif Village : Golabari Union : Golabari Upazila : Madhupur District : Tangail	20 January 2019 24.9000°N 91.0167°E.	

Table 110. Passport information of collected bittergourd (*Momordica charantia*), eggplant (*Solanum melongena*), white gourd (*Benincasa hispida*), sweetgourd (*Cucurbita moschata*), bottle gourd (*Lagenaria siceraria*) and sponge gourd (*Luffa aegyptiaca*) germplasm

Sl. No.	Collector's No.	Cultivar/local name/cultural practice	Donor's name and address	Geographical location and date	Photograph
161.	M-01	Matikorla Rabi	Rasel mia Village: Komorchor Union: Komorchor Upazila: Melandoho District: Jamalpur	19 October 2018 25.14°N 90.19 °E	
162.	M-02	Bolderusta	Rasel mia Village: Komorchor Union: Komorchor Upazila: Melandoho District: Jamalpur	19 October 2018 24.92° N -89.95 °E	
163.	F-1	Goj corolla	Ashrab Ali Village: Sitra Union: Sitra Upazila: Sadar District: Mymensingh	10 February 2020 24.78° N 90.3 5 °E	
164.	M-03	Taal Begun Rabi	Habibur Rahman Village: Belgacha Union : Belgacha Upazila : Islampur Dist. Jamalpur	28 October 2018 24.92° N 89.95 °E	

Sl. No.	Collector's No.	Cultivar/local name/cultural practice	Donor's name and address	Geographical location and date	Photograph
165.	M-4	Local Begun (Norshingdi) Rabi	Habibur Rahman Village: Belgacha Union : Belgacha Upazila : Islampur Dist. Jamalpur	28 October 2018 25.14°N 90.19 E	
166.	M-5	Local Begun Rabi	Sentuhajang Village: Chatkeya Union: Noyabil Upazila: Nalitabari District: Sherpur	1 June 2018 25.14°N 90.19 E	
167.	FMI-01	Islampuri begun Rabi	Shajahan Village: Balijuri Union : Madarganj Upazila: Madarganj District: Jamalpur	1 July 2020 24.90° N 89.71° E	
168.	FMI-02	Gaforgaon Begun Rabi	Belal uddin Village : Datter bazar Union : Datter Bazar Upazila : Gaforgaon District : Mymensingh	15 July 2020 24.45° N 90.54° E	
169.	FMI-03	Jhumki begun Rabi	Al Amin Village: Madhupur Union: Madhupur Upazila: Madhupur District: Tangail	10 July 2020 24.26° N 86.64° E	
170.	FMI-04	Golbegun Rabi	Belal uddin Village: Datter bazar Union: Datter Bazar Upazila: Gaforgaon District: Mymensingh	15 July 2020 24.45° N 90.54° E	
171.	FMM-11	Singnath Rabi	Mobarak Village : Fenibil Union : Jahangirnagar Upazila: Sunamganj Sadar District : Sunamganj	23 May 2019 24.9000°N 91.0167°E	
172.	FMM-12	Mohisasing Rabi	Chanmia Village : Fenibil Union : Jahangirnagar Upazila: Sunamganj Sadar District: Sunamganj	23 May 2019 24.9000°N 91.0167°E	

Sl. No.	Collector's No.	Cultivar/local name/cultural practice	Donor's name and address	Geographical location and date	Photograph
173.	FMM-14	White gourd local (Sunamganj) Rabi	Ayesha Khatun Village : Muslimpur Union : Surma Upazila : Surma District : Sunamganj	23 February 2019 24.9000°N 91.0167°E	
174.	FM-03	White gourd Local (Vabokhali) Rabi	Shafikul Islam Village : Oronkhola Union : Oronkhola Upazila : Madhupur District : Tangail	23 February 2019 24.9000°N 91.0167°E	
175.	FM-04	White gourd Local (Sinha) (Modhupur) Summer	Amzad Ali Village : Oronkhola Union : Oronkhola Upazila : Madhupur District : Tangail	23 February 2019 24.6167°N 90.0250°E	
176.	FM-06	Sweet gourd / matilau Kharif	Amzad Ali Village : Oronkhola Union : Oronkhola Upazila : Madhupur District : Tangail	23 February 2019 24.6167°N 90.0250°E	
177.	FM-07	Sweet gourd Local Modhupur Oron khola Kharif	Amzad Ali Village : Oronkhola Union : Oronkhola Upazila : Madhupur District : Tangail	23 February 2019 24.6167°N 90.0250°E	
178.	FM-09	Sweet gourd Zolchotro lau/khet lau Kharif	Milton Kumar Village : Alokdia Union : Alokdia Upazila : Madhupur District : Tangail	23 February 2019 24.6167°N 90.0250°E	
179.	FM-08	Bottle gourd Modhupur lau Kharif	Md. Helal Village : Oronkhola Union : Oronkhola Upazila : Madhupur District : Tangail	23 February 2019 24.6167°N 90.0250°E	

Sl. No.	Collector's No.	Cultivar/local name/cultural practice	Donor's name and address	Geographical location and date	Photograph
180.	FM-10	Spongegourd Sogorika Kharif	Mamun Sarkar Village : Oronkhola Union : Oronkhola Upazila : Madhupur District : Tangail	23 February 2019 24.6167°N 90.0250°E	
181.	FM-35	Okra Baromasi	Naeb Ali Village : Kustia Union : Kustia Upazila: Kustia Sadar District : ymensingh	23 February 2020 23.90°N 89.12°E	
182.	FM-36	Okra Local Sunamganj	Md. Rubel Village : Dhalagao Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	10 February 2020 24.45°N 90.54°E	
183.	FM-37	Okra Local Modhupur	Aiman Village : Tarati Union :Tarati Upazila: Muktagacha District: Mymnsingh	12 February 2020 24.42°N 90.51°E	

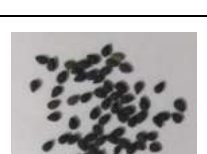
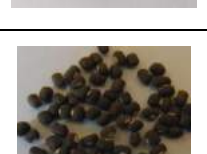
Table 111. Passport information of collected french bean (*Phaseolus vulgaris*) and hyacinth bean (*Lablab purpureus*) germplasm

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Geographical location and date	Photograph
184.	FMM-03	Forasi sim Rabi	Siddik Mia Village : Dhalagao Union : Surma Upazila: Sunamganj Sadar District: Sunamganj	23 May 2019 24.9000°N 91.0167°E	
185.	FMM-04	Khoilla sim Rabi	Abul Kalam Village : Haluargaon Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	23 May 2019 24.9000°N 91.0167°E	
186.	FMM-05	Sada nag Rabi	Asmani Village : Shologhor Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	23 May 2019 24.9000°N 91.0167°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Geographical location and date	Photograph
187.	FMM-06	Ankhi sim Rabi	Abul Kalam Village : Haluargaon Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	23 May 2019 24.9000°N 91.0167°E	
188.	FMM-07	Hatir kani/ Goal gadda Rabi	Raghunath Village : Kalengarpar Union : Hatkhola Upazila: SylhetSadar District : Sylhet	23 May 2019 24.9000°N 91.0167°E	
189.	FMM-08	Kaikka sim Rabi	Asma Khatun Village : Shologhor Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	23 May 2019 24.9000°N 91.0167°E	
190.	FMM-09	Chitagaia sim Rabi	Abdul Momen Village : Bagmara Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	23 May 2019 24.9000°N 91.0167°E	
191.	FMM-10	Bampata sim Rabi	Asma Khatun Village : Shologhor Union : Surma Upazila: Sunamganj Sadar District : Sunamganj	23 May 2019 24.9000°N 91.0167°E	

Table 112. Passport information of collected groundnut (*Arachis hypogaea*), mustard (*Brassica sp.*) and blackgram (*Vigna mungo*) germplasm

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Geographical location and date	Photograph
192.	H-02	Soto Elachibadam (Kharif)	Abdul Gani Village: Bhairab Union : Bhairab Upazila : Bhairab Dist. Kishoreganj	19 October 2018 25.14°N 90.19°E	
193.	H-03	Boro Elachibadam (Kharif)	Abdul Gani Village: Bhairab Union : Bhairab Upazila : Bhairab Dist. Kishoreganj	19 October 2018 25.14°N 90.19°E	
194.	H-04	Tridanabadam (Kharif)	Abdul Gani Village: Bhairab Union : Bhairab Upazila : Bhairab Dist. Kishoreganj	19 October 2018 25.14°N 90.19°E	

Sl. No.	Collector's No.	Cultivar /local name/cultural practice	Donor's name and address	Geographical location and date	Photograph
195.	F-02	Khenkhen Kharif	Abdul Mazid Village: Ashtadhar Union : Ashtadhar Upazila : Sadar Dist. Mymensingh	10 February 2020 25.74°N 90.42 °E	
196.	FMM-13	Deshi sorisha Rabi	Shafikul Islam Village : Vati tahirpur Union: Tahirpur Sadar Upazila : Tahirpur District : Sunamganj	23 May 2019 24.9000°N 91.0167°E	
197.	F-03	Sadatil	Anwar Hossen Village : Rasulpur Union : Rasulpur Upazila : Gaforgaon District : Mymensingh	11 February 2020 25.64°N 90.40 °E	
198.	F-04	Kalotil	Abdul Muhit Village : Daogao Union : Daogao Upazila : Muktagacha District : Mymensingh	13 February 2020 24.76°N 90.25 °E	
199.	H-05	Mashkalai (Local) Rabi	Abdul Gani Village : Bhairab Union : Bhairab Upazila : Bhairab District : Kishoreganj	19 October 2018 25.14°N 90.19 °E	

MM = Mirza Mofazzal Islam, DG, BINA, SB = Shamsun Nahar Begum, PSO. PBD; F = Fahmina Yasmine, SSO, PBD; ST = Sadia Tasmin, SSO, HRD; M = Mehedi Hasan, SO, HRD; MI = Majharul Islam, SO, SSD; FH = Forhad Hossain, SO, Sunamganj, SA = Md.Shahjahan Ahmed, ASO, PBD; H = Md. Habibur Rahman Mridha SA-1, PBD and Md. Aktar Hossain, SA-2, PBD.

11.6.2. Morphological Characterization Local Landraces of Aman Rice Collected from Mymensingh Region during 2018

The experiment was carried out during the period from July to December 2018. In this study, 31 rice germplasm were used as plant materials. The list of the experimental materials along with their sources of collection is shown in Table 113.

Table 113. List of test rice germplasm

SL No.	Local name	Collector's number	SL No.	Local name	Collector's number
1	Gaindha	MM-30	17	Markabinni	MM-05
2	Purabinni	MM-01	18	Bishalibinni	MM-06
3	Fulkainja	MM-26	19	Goatibinni	MM-04
4	Rupashail	MM-23	20	Shongbinni	MM-18
5	Leda binni	MM-19	21	Sentu-18	MM-21
6	Biroi	MM-17	22	Fullota	MM-20
7	Chapal	MM-16	23	Mery gold	MM-10

SL No.	Local name	Collector's number	SL No.	Local name	Collector's number
8	Sentu-15	MM-29	24	Lalmatia	MM-32
9	Sentu-19	MM-22	25	Chapal-2	MM-14
10	Lalchinishail	MM-07	26	Sentu-6/ Madhobilota	MM-30
11	Dudhbinni	MM-27	27	Sentushail	MM-13
12	Champamashuri	MM-24	28	Sentu-17	MM-25
13	Chotosornolota	MM-28	29	Sentu-16	MM-09
14	Motamorang	MM-08	30	Ranishail	MM-11
15	Pairjaat	MM-12	31	Sentu-5/Malonchi	MM-02
16	Sentu gold	MM-15			

Characterization based on qualitative characters by DUS test

Thirty one rice germplasm were evaluated considering 31 qualitative and morphological traits to characterize the germplasm as per BRRI descriptor (2018). All the germplasm scored exactly same for the traits such as blade pubescence, basal leaf sheath color, ligule shape, auricle color and decorticated grain and aroma (Table 114). Such result indicated that there was no variation for these traits among the studied germplasm. Differences were found in the germplasm studied for rest of the qualitative characteristics. A wide range of variation was found in all the germplasm for blade color, leaf angle, flag leaf angle, culm angle, internode color, culm strength, panicle exertion, shattering, thresh ability, apiculus color, stigma color, lemma and palea color, lemma and palea pubescence, sterile lemma color, seed coat color and leaf senescence.

Low to moderate variability was observed for leaf sheath, anthocyanin color, ligule color, collar color, culm anthocyanin color, panicle type, secondary branching, axis, and awn distribution, awn color and endosperm type.

Table 114. Characterization of rice germplasm based on qualitative characters, T. Aman, 2019

Sl. No.	Character	State of characters	No. of germplasm	Germplasm (serial no. in Table 113)	Frequency (%)
1	Blade Pubescence	Glabrous	31	All	100
2	Blade color	Pale green	1	3	9.68
		Green	21	1,2,4,6,7,10,11,12,15,16,17,20,21,22,24,25,26,27,29,30,31	67.74
		Dark green	8	5,8,9,13,14,18,19,23	25.81
3	Leaf sheath: Anthocyanin color	Absent	30	1,2,3,4,5,6,7,8,9,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31	96.77
		Present	1	11	3.23
4	Basal leaf sheath color	Green	31	All	100
5	Leaf angle	Erect	12	11,13,14,15,24,25,26,27,28,29, 30,31	38.71
		Horizontal	19	1,2,3,4,5,6,7,8,9,10,12,16,17,18,19,20,21,22,23	61.29
6	Flag leaf angle	Erect	16	3,4,8,9,13,14,18,19,24,25,26,27,28,29,30,31	51.61
		Semi-erect	15	1,2,5,6,7,10,11,12,15,16,17,20,21,22,23	48.39
7	Ligule color	White	25	1,3,5,6,7,8,10,12,13,15,16,17,18,19,21,22,23,24,25,26,27,28,29,30,31	80.65
		Purple lines	5	2,4,9,14,20	16.13
		Purple	1	11	3.23

Sl. No.	Character	State of characters	No. of germplasm	Germplasm (serial no. in Table 113)	Frequency (%)
8	Ligule shape	2-cleft	31	All	100
9	Collar color	Pale green	29	1,2,3,4,5,6,7,9,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31	93.55
		Green	1	8	3.23
		Purple	1	11	3.23
10	Auricle color	Pale green	31	All	100
11	Culm anthocyanin color	Absent	30	1,2,3,4,5,6,7,8,9,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31	96.77
		Present	1	11	3.23
12	Culm angle	Erect	17	4,5,8,9,12,13,16,19,22,24,25,26,27,28,29,30,31	54.84
		Intermediate	9	1,3,6,7,10,11,14,17,18,23	29.03
		Open	3	2,20,21	9.68
		Spreading	1	15,	3.23
13	Internode color	Green	19	2,3,4,5,8,9,11,12,14,15,16,18,20,22,23,24,27,29,30	61.29
		Light gold	12	1,6,7,10,13,17,19,21,31 25,26,28	38.71
14	Culm strength (lodging resistance)	Strong	1	18	3.23
		Moderately strong	10	5,6,8,9,16,20,25,26,29,30	32.26
		Intermediate	8	3,4,14,22,23,24,27,28	25.81
		Weak	11	1,2,7,10,11,12,13,15,17,21,31	35.48
		Very weak	1	19	3.23
15	Panicle type	Intermediate	27	1,3,4,5,7,8,9,10,11,12,13,14,15,16,17,18,20,21,22,23,24,25,26,28,29,30,31	87.10
		Open	4	2,6,19,27	12.90
16	Secondary branching	Absent	7	2,5,6,7,8,11,20	22.58
		Light	24	1,3,4,9,10,12,13,14,15,16,17,18,19,21,22,23,24,25,26,27,28,29,30,31	77.42
17	Panicle exertion	Partly exerted	8	5,12,13,16,22,25,26,28	25.81
		Just exerted	10	8,9,10,11,14,17,18,20,21,31	32.26
		Moderately well exerted	11	1,2,3,4,6,7,15,23,24,29,30	35.48
		Well exerted	2	19,27	
18	Axis	Straight	10	4,5,8,16,17,18,19,20,29,30	32.26
		Droopy	21	1,2,3,6,7,9,10,11,12,13,14,15,21,22,23,24,25,26,27,28,31	67.74
19	Shattering	Very low	20	2,4,5,14,15,16,17,18,19,21,22,23,24,25,26,27,28,29,30,31	64.52
		Low	8	1,3,6,9,11,12,13,20	25.81
		Moderate	3	7,8,10	9.68
20	Threshability	Difficult	1	19	3.23
		Moderately difficult	4	5,16,17,31	12.90
		Intermediate	18	1,2,3,4,6,9,11,12,13,14,15,21,22,23,26,28,29,30	58.07
		Loose	4	7,8,10,26	12.90
		Easy	4	18,20,24,27	12.90
21	Awn: distribution	None	25	1,2,4,6,7,8,9,10,11,12,13,14,15,16,17,21,22,23,24,25,26,27,28,29,31	80.65
		Tip only	4	3,5,20,30	12.90
		Upper quarter only	1	18	3.23
		Upper three-quarters only	1	19	3.23
		Whole length			0

Sl. No.	Character	State of characters	No. of germplasm	Germplasm (serial no. in Table 113)	Frequency (%)
22	Awn color	Straw	4	3,5,18,30	12.90
		Gold			0
		Brown (tawny)	2	19,20	6.45
23	Apiculus color	Straw	11	6,8,14,15,16,20,24,25,26,27,28	35.48
		Brown	14	1,3,4,7,9,10,12,13,21,22,23,29,30,31	45.16
		Red apex	2	18,19	6.45
		Purple	1	5	3.23
		Black	3	2,11,17	9.68
24	Stigma color	White	2	6,11	6.45
		Light green	2	2,7	6.45
		Yellow	22	1,3,4,8,9,12,13,14,16,17,19,21,22,23,24,25,26,27,28,29,30,31	70.97
		Light purple	2	5,10	6.45
		Purple	3	15,18,20	9.68
25	Lemma and palea color	Straw	6	12,25,26,27,28,30	19.36
		Gold & gold furrows on straw background	5	15,16,20,23,24	16.13
		Brown spots on straw	2	1,14,	6.45
		Brown furrows on straw	7	3,4,7,17,19,22,29	22.58
		Brown	4	6,8,13,21	12.90
		Reddish to light purple	2	9,31	6.45
		Purple	3	5,10,18	9.68
		Black	2	2,11	6.45
		White			
26	Lemma and palea pubescence	Glabrous	22	1,2,3,4,6,7,8,10,12,15,16,20,22,23,24,25,26,27,28,29,30,31	70.97
		Hairs on upper portion	3	17,19,21	9.68
		Short hairs	6	5,9,11,13,14,18	19.36
27	Sterile lemma color	Straw	14	1,2,3,4,6,13,16,22,23,24, 25,26,29, 30	45.16
		Gold	10	8,10,12,14,15,18,20,27,28,31	32.26
		Red	6	7,9,11,17,19,21,	19.35
		Purple	1	5	3.23
28	Seed coat (bran) color	White	20	2,3,4,5,7,8,9,12,13,14,15,16,17,18,21,22,23,29,30,31	64.52
		Light brown	5	11,19,26,27,28	16.13
		Speckled brown	1	25	3.23
		Brown	1	24	3.23
		Red			0
		Variable purple	3	6,10,20	9.68
29	Endosperm type	Non-glutinous (no waxy)	2	10,19	6.45
		Glutinous (waxy)	23	2,3,4,5,6,8,9,12,13,14,15,16,17,18,21,22,23,25,26,27,29,30,31	74.19
		Intermediate	6	1,7,11,20,24,28	19.36
30	Decorticated grain: Scent (aroma)	Non-scented	31		100
31	Leaf senescence	Very early	11	4,6,10,13,14,17,19,21, 25,26,31	35.48
		Early	2	7,12	6.45
		Intermediate	5	1,11,15,16,31	16.13
		Late and slow	8	3,8,9,18,20,22,24,30	25.81
		Very late	5	2,5,23,27,29	16.13

Characterization based on quantitative characters by DUS test

Range, mean, standard deviation (SD) and coefficient of variation (CV) of different quantitative characters of 31 T. Aman (2018) rice germplasm have been shown in Table 115. The range of plant height was found 71.33 cm to 134.67 cm. The tallest plant height was found in Ranishail (134.67 cm) whereas the shortest plant was recorded in Lalmatia germplasm (71.33 cm) and average plant height was 105.26 cm. The average days to 50% flowering were 109 and range was found as 97.67 to 118. Among the studied germplasm, the highest data for days to 50% flowering was recorded for Shongbinni (118 days) followed by Ledabinni and Ranishail (117.67 days) which exhibited late flowering whereas days 50% flowering was the lowest in Sentu-5 (97.67 days).

Days to maturity ranged from 135.33 to 151.33 days with the average of 145.62 days. Gaindha (151.33 days), Mery gold (151.33 days) and Ranishail (151.33 days) showed the maximum days to maturity whereas Sentu-17 showed the minimum days to maturity (135.33 days). Sentu-16 had the maximum number of total tillers hill⁻¹ (18.00) whereas Pairjaat had minimum number of total tillers hill⁻¹ (8.67) with the average of 14.25. The CV% for number of effective tillers hill⁻¹ was 15.78%. Sentu-16 had the highest number of effective tillers hill⁻¹ (16.50) followed by Ranishail (16.33) whereas Fullota (5.33) had the lowest number of effective tillers hill⁻¹. Gaindha had the longest panicle (28.83 cm) whereas Rupashail (22.33 cm) had the shortest panicle (Fig.87).

The highest number of filled grains panicle⁻¹ was recorded for Ranishail (250.11) whereas, in Gaindha, the lowest number of filled grains panicle⁻¹ was recorded (70.03). Sentu-5 had the maximum number of unfilled grains panicle⁻¹ (66.67) and Purabinni had the minimum number of unfilled grains panicle⁻¹ (9.11). 1000-grain weight was marked the highest in Bishalibinni (31.42 g) followed by Fulkainja (28.13 g) whereas the lowest in Gaindha (9.38g). Among the studied rice germplasm, the highest grain yield was recorded in Sentu-16 (10.33 g) followed by Ranishail (10.17 g plant⁻¹) and lowest in Gaindha (4.91 g).

Table 115. Variability in test rice germplasm considering 10 quantitative characters, Boro, 2018-19

Character	Range	Mean	SD	CV (%)
Plant height (cm)	71.33- 134.67	105.26	18.44	17.52
Days to 50% flowering	97.67- 118	109.3	4.78	4.37
Days to 80% maturity	135.33-151.33	145.62	5.61	3.85
Number of total tillers hill ⁻¹	8.67- 18	14.25	2.25	15.78
Number of effective tillers hill ⁻¹	5.33 - 16.5	11.88	2.67	22.47
Panicle length (cm)	22.33 - 28.83	24.69	1.50	6.08
Number of filled grains panicle ⁻¹	70.03 - 250.11	173.01	40.93	23.66
Number of unfilled grains panicle ⁻¹	9.11-66.67	28.26	15.00	53.07
1000-grain weight (g)	9.38 - 31.42	19.33	5.02	25.99
Grain yield plant ⁻¹ (g)	4.91-10.33	8.42	1.15	13.64

Conclusion: The traits blade color, leaf angle, flag leaf angle, culm angle, internode color, culm strength, panicle exertion, shattering, thresh ability, apiculus color, stigma color, lemma and palea color, lemma and palea pubescence, sterile lemma color, seed coat color and leaf senescence were found as desired traits which could be used for further development of rice. Sentu-16 and Ranishail was the promising germplasm for higher yield and Sentu-17 was for short duration.

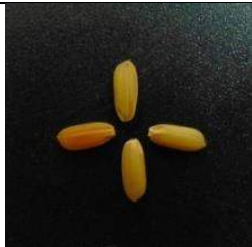
				
Green	Purple lines	Light purple	Uniform purple	
Basal leaf sheath color				
				
Variation in ligule colour and shape				
				
Absent	Present	Awn less	Short awn	Long awn
Lemma: anthocyanin colouration of apex		Variation in awn		
				
White	Light brown	Light red	Red	
Decorticated grain: color				
				
Short	Medium	Long		
Decorticated grain: length				

Fig. 87. Leaf sheath color, ligule color and shape, lemma color, awn variation, grain color and lenth of rice germplasm

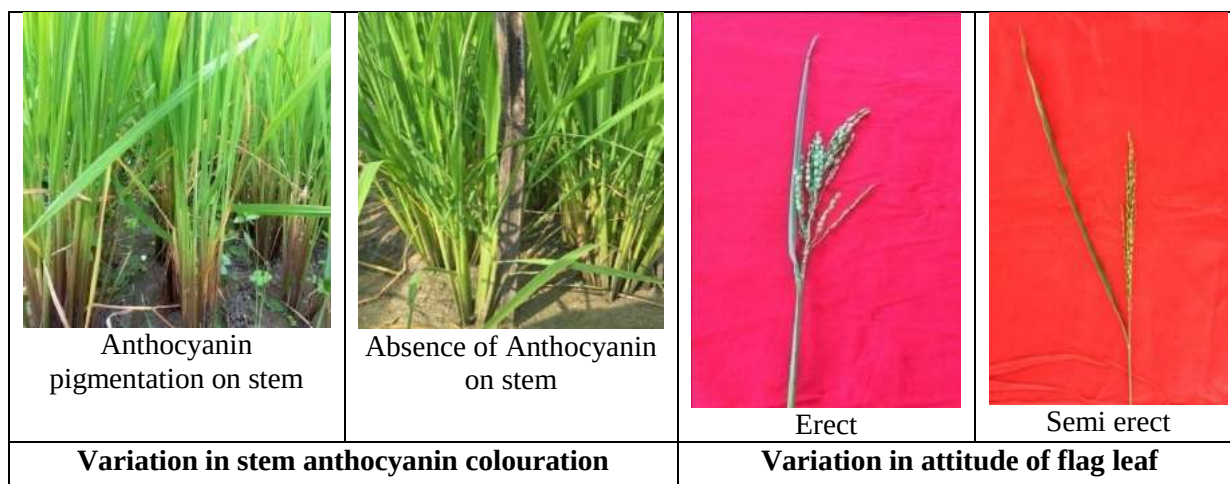


Fig. 87. Leaf sheath color, legule color and shape of rice germplasm (cont'd)

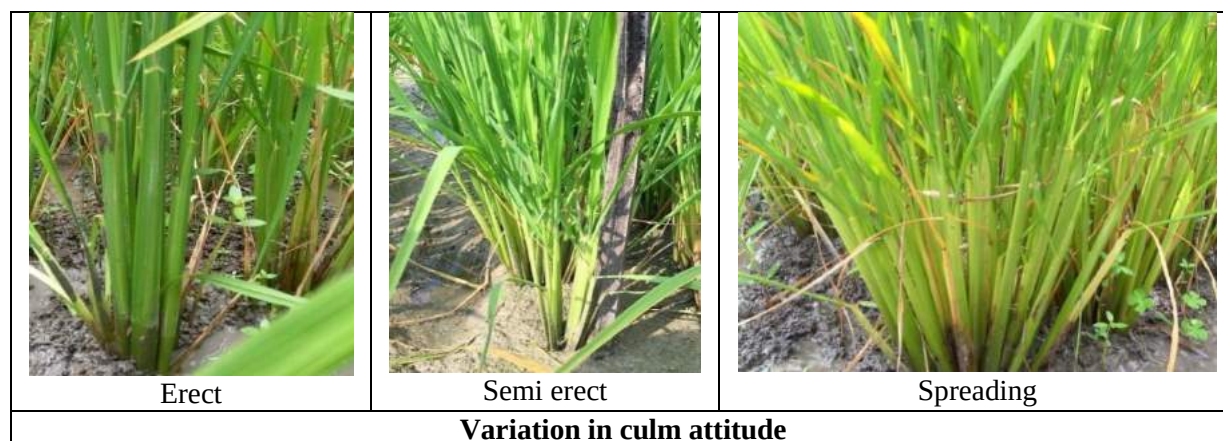


Fig. 88. Stem anthocyanin color, attitude of flag leaf and culm of rice germplasm

11.6.3. Morphological Characterization of Rice Landraces during Aman, 2019 Season

Continuous effort is needed to develop high yielding rice varieties to feed the ever increasing population. Therefore, study of morphological characterization of the germplasm is very much essential to find the desirable traits to use as potential breeding tool. In this regard, forty two rice germplasm were evaluated to assess the variation considering 10 quantitative and 31 qualitative traits under field condition during the period from July to December 2019 at the BINA Head Quarters Farm, Mymensingh following Randomized Complete Block Design (RCBD) with three replications. Qualitative characterization by DUS test revealed that a wide range of variation was observed among the studied germplasm for blade color, leaf angle, flag leaf angle, culm angle, internode color, culm strength, panicle exertion, axis, shattering, threshability, apiculus color, stigma color, lemma and palea color, lemma and palea pubescence, sterile lemma color, seed coat color and leaf senescence. Therefore, this study would be helpful for breeders and researchers to choose and identify the restoration and conservation of beneficial genes for crop improvement. The experiment was carried out during the period from July to December 2019. In this study, 42 rice germplasm were used as plant materials. The list of the experimental materials along with their sources of collection is shown in table 116.

Table 116. List of test rice germplasm

SL No.	Rice germplasm	Collector's number	SL No.	Rice germplasm	Collector's number
1	Ailagota	FS-38	22	Guar chara	FS-22
2	Kaijam	FS -36	23	Putibirun	FS-20
3	Kalobirun	FS-39	24	Guabari	M-23
4	Mukta	FS-28	25	Molairati	FS-19
5	Moinashail	FS-40	26	Guamouri	FS-17
6	Deshi-32	FS-29	27	Maloti	FS-16
7	Paijam	FS-03	28	Nagra	FS-15
8	Bedhabirun	FS-42	29	Lomba ail	FS-14
9	Chengermuri	FS-33	30	Bashiraj	FS-13
10	Parbotjira	FS-38	31	Kalojira	FS-12
11	Lalcheng	FS-37	32	Boroabji	FS-10
12	Hasakalo	FS-30	33	Lalpaijam	FS-09
13	Shonajuri	FS-31	34	Chinishail	FS-11
14	Noliguar chara	FS-35	35	Chinishail-3	FS-3
15	Hasa sada	FS-32	36	Hashemirri	FS-08
16	Birui dhan	FS-06	37	Chanmoni	FS-07
17	Ojanabirun	FS-26	38	Birui	FS-06
18	Soragotobirun	FS-24	39	Gobinda	FS-04
19	Chaklosh	FS-25	40	Sadapaijam	FS-03
20	Kutimurarbirun	FS-21	41	Kashiabinni	M-02
21	Chinigura-1	FS-23	42	Lalkumri	FS-01

Characterization based on qualitative characters by DUS test

A total of 42 rice land races were taken for DUS characterization using 37 characters which include 18 qualitative and seven quantitative characters as per BRRI descriptor (2018). The rice landraces undertaken for this study showed wide range of distinctiveness characters for all most all the morphological traits studied. Frequency distribution for all the characters under study was computed and qualitative and quantitative characters of different agronomic and morphological parameters are given in Table 117. Out of 42 germplasm studied, 90.48% germplasm didn't show anthocyanin coloration of apex while only 9.52% exhibited the anthocyanin colouration on leaf sheath. In case of blade pubescence 69.05% germplasm exhibited glabrous, 28.57% exhibited intermediate and only one germplasm had shown pubescent.

All most all the landraces were of green coloured basal leaf sheath, among the germplasm only one germplasm (Maloti) had purple green and 3 had light green basal leaf sheath color. With respect to leaf characters, among 42 germplasm, 36 had shown erect leaf angle, 5 had horizontal and one germplasm Lombaail had drooping type of leaf angle of main axis. In case of legule shape, most of the germplasm (95.25%) had 2-cleft legule shape. For collar color and auricle color most of the germplasm were pale green. Anthocyanin color in culm was absent in 37 germplasm and present in 6 germplasm. Most of the germplasm (64.29%) had erect culm angle, 9 had intermediate, 4 had open and 2 germplasm (Kalabirun and Chengermuri) had spreading culm angle.

Among 42 germplasm, 23 germplasm had strong lodging resistance while 6 had shown very weak performance to lodging resistance. But at dough stage, 100% plants of 10 germplasm had lodged and the plants of 22 germplasm had not lodged. Compact and enclosed panicle was

found in 8 germplasm (Kaijam, Kalobirun, Ojanabirun, Kalojira, Boroabji, Hashemiri, Gobinda and sadapaijam). With respect to panicle characters, 23.81% germplasm were straight and 76.19% germplasm were of drooping type of panicle curvature of main axis.

In case of awn distribution, 71.43% germplasm recorded the absence of awns and 12 germplasm (i.e. Chengermuri, Molaireti, Chanmoni, Kashiabinni, Kalobirun, Chaklosh, Kutimurarbirun, Lombaail, Sonajuri, putibirun, Chinigura-1, and Lalpaijam) recorded the presence of awns. Out of which, six germplasm found straw, four germplasm were brown and two germplasm had purple coloured awns. In stigma colour, 73.80% cultivars exhibited white stigma, 23.81% landraces were of light green stigma and 2.38% were of purple stigma.

With regard to colour of the lemma and palea, 47.48% of germplasm were straw colour, 33.33% germplasm recorded gold and gold furrows on straw background, 2.38% germplasm were of brown spots on straw, 2.38% germplasm were of brown furrows on straw, 4.76% germplasm were of brown, 4.76% germplasm were reddish to light purple, 2.38% germplasm were of brown (tawny), 4.76% germplasm were purple and 4.76% germplasm were of black. In case of density of pubescence of lemma, 32 germplasm exhibited short hairs, 2 germplasm with long hairs, 6 germplasm with hairs on lemma keel and 22 germplasm had no pubescence. All most all the landraces were of straw coloured sterile lemma, except for 7 germplasm, which have gold and purple colour sterile lemma. For the character seed coat (bran) colour of 11 germplasm were of white in colour, 13 germplasm were of light brown, 14 germplasm were of Speckled brown, 3 germplasm were of brown and 14 germplasm exhibited Variable purple type seed coat color. Non-glutinous (no waxy) endosperm was found in 11 germplasm, 22 germplasm had shown glutinous endosperm and 9 germplasm had shown Intermediate type endosperm. Aroma of decorticated grain was recorded in six germplasm, among them Parbotjira was lightly scented and 5 germplasm (Hasakalo, Chinigura-1, Kalojira, Chinishail and Chinishail-3) were of highly scented.

Table 117. Characterization of rice germplasm based on qualitative characters, T. Aman, 2019

Sl. no.	Character	State of characters	No. of germplasm	Germplasm (Table 116)	Frequency (%)
1	Blade Pubescence	Glabrous	29	1,2,3,4,5,6,7,8,9,10,11,12,14,22,23,24,26, 27, 28,30,31,32,33,34,35,37,38,39,42	69.05
		Intermediate	12	15,16,17,18,19,20,21,25,29,36, 40,41	28.57
		Pubiscent	1	13	2.38
2	Blade color	Pale green (1)	9	4,7,8,15,24,26,34,39,42	21.43
		Green (2)	25	3,5,6, 10,14,16,17,18,19,20,21,22,23, 25, 27,28,29,30,32,33,35,36,38,40,41	59.53
		Dark green (3)	6	1,9,11,13,31, 37	14.29
		Purple tips (4)	1	2	2.38
		Purple (7)	1	12	2.38
3	Leaf sheath: Anthocyanin color	Absent (1)	38	1,2,3,4,5,6,7,8,9,10,11,12,14,15,16,17,18,19,20,22,24,25, 26,27,28,29,30,31,32,33,34,35,36, 37,38,40, 41, 42	90.48
		Present (9)	4	13, 21, 23, 39	9.52
4	Basal leaf sheath color	Green (1)	38	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,22,23, 24,25,26, 28,29, 30,31,32,33,34,35,36, 38,39,40, 42	90.48
		Purple green (2)	1	27	2.38
		Light green(3)	3	21, 37, 41	7.14
5	Leaf angle	Erect (1)	36	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,18,19,20,21, 22,23, 24,25,26,27, 28, 30,32,34,36, 37,38,39, 40, 41, 42	85.72

Sl. no.	Character	State of characters	No. of germplasm	Germplasm (Table 116)	Frequency (%)
6	Flag leaf angle	Horizontal (5)	5	15,17,31,33, 35	11.91
		Drooping (9)	1	29	2.38
		Erect (1)	38	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20, 21, 22,23,24,25,26, 28, 30,32,33,34,36, 37, 38,39,40, 41, 42	90.48
		Semi-erect (3)	1	29	2.38
7	Ligule color Stem elongation to booting	Horizontal (5)	3	15,31, 35,	7.14
		White (1)	27	1,2,3,4,5,6,8,10,11,12,13,14,19,20,21,22,23,24,25,28,33,35,37,39,40,41,42	64.29
		Purple lines (2)	13	7,9,15,16,17,18,27, 30,31,32, 34,36,38	30.95
		Purple (3)	2	26,29	4.76
8	Ligule shape	Acute to acuminate (1)	2	7,16,	4.76
		2-cleft (2)	40	1,2,3,4,5,6,8,9,10,11,12,13,14,15,17,18,19,20,21,22,23,24, 25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42	95.24
9	Collar color	Pale green (1)	39	2,3,4,5,6,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,24,25, 26,27,28,29,30,31,32, 33,34,35,36,37,38,39,40,41,42	92.86
		Purple (3)	3	1,7,23,	7.14
10	Auricle color	Pale green (1)	37	1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,18,19,20,21,24,25,26, 27,28,29,30,31,32,33,34,35,36,37, 38,39,40,41,42	88.10
		Purple (2)	5	4, 14,18,22,23	11.91
11	Culm anthocyanin color	Absent (1)	36	1,2,4,5,7,9,10,11,13,14,15,16,17,18,19,21,22,23,24,25,26, 27,28,29,30,31,32,33,34,35, 37, 38,39,40,41,42	85.72
		Present (9)	6	3,6,8,12,20, 36	14.29
12	Culm angle	Erect (1)	27	2,4,7,10,12,13,14,15,17,18,19,20,21,22,23,24,25,26,28,29, 34,35, 37, 38,39,40,41,42	64.29
		Intermediate ((3)	9	5,6,8,11,27, 30,32, 33,36	21.43
		Open (5)	4	1,16, 20,31	9.52
		Spreading (7)	2	3,9,	4.76
13	Inter node color	Green (1)	32	4,5,7,9,10,11,13,14,15,16,17,18,19,21,22,23,24,25,26,27, 28,29,31,32,34,35, 37, 38,39,40,41,42	76.19
		Light gold (2)	4	1,2,30,33	9.52
		Purple lines (3)	4	3,6,8,20,	9.52
		Purple (4)	2	36,12	4.76
14	Culm strength (lodging resistance)	Strong (1)	23	4,7,13,14,17,18,22,23,24,25,28,29, 31,32,34,35, 37, 38,39,40,41,42	54.76
		Moderately strong (3)	4	2,5,10,26	9.52
		Intermediate (5)	4	1,12,30, 33	9.52
		Weak (7)	5	6,11,15,19,27	11.91
		Very weak (9)	6	3,8, 9,16,20,21,	14.29
15	Lodging incidence (%) (% of plants that lodged)	Lodging (0%)	22	2,4,7,13,14,17,18,22,23,24,25,28,29,31,32,34,35,36,37,38, 39,40	52.38
		Lodging $\geq$ (30-50%)	6	6,10,26,33, 41,42	14.29
		Lodging $\geq$ (60-90%)	4	5,12,15,21,	9.52
		Lodging (100%)	10	1,3,8,9,11,16,19,20,27,30,	23.81
16	Panicle type	Compact (1)	23	1,2,4,5,6,7,8, 9,10,11,13,14, 15,16,17, 28,31,32,36, 38,39,40	54.76
		Intermediate (5)	14	3,18,19,20,21,22,23,24,25,26,27,29,30,41	33.33
		Open (9)	5	28,34,35,37,42	11.91
17	Panicle exertion	Enclosed (1)	11	2,4,17,24,25,31,32,33,36,39,40	26.19
		Partly exerted (3)	18	1,3,5,6,7,8,10,11,12,13,14,15,27,29,30,34,35,37	42.86
		Just exerted (5)	1	9	2.38
		Moderately well exerted (7)	4	21,22,28,41	9.52
		Well exerted (9)	8	16,18,19,20,23,26,38,42	19.05

Sl. no.	Character	State of characters	No. of germplasm	Germplasm (Table 116)	Frequency (%)
18	Axis	Straight (1)	10	1,7,9,11,13,14,15,17,18,24,	23.81
		Droopy (2)	32	2,3,4,5,6,8,10,12,16,19,20,21,22,23,25,26,27,28,29,30,31,32,33,34,35,36,37, 38,39,40,41,42	76.19
19	Shattering	Very low (1)	9	3,5,6,11,13,17,18,22,25	21.43
		Low (3)	29	1,2,4,7,12,14,15,16,19,20,21,23,24,26,28,32,34,35,36,39,41,42	69.05
		Moderate (5)	3	8,9,10	7.14
		High (7)	1	31	2.38
20	Threshability	Moderately Difficult (3)	3	6,11,15	7.14
		Intermediate (5)	14	3,8,13,16,17,18,19,20,,22,23,25,27, 29,30	33.33
		Loose (7)	12	5,14,21,26,28,32,34,35,36,37,39,42	28.57
		Easy(9)	13	1,2,4,7,9,10,12,24,31,33,38,40,41	30.95
21	Awn: distribution	None (0)	30	1,2,4,5,6,7,8,10,11,12,13,14,15,16,17,18,21,24,26,27,28,30,31,32,34,35, 36,38,39,40,42	71.43
		Tip only (1)	4	9,25,41,37,	9.52
		Upper quarter only (2)	4	3,19,20,29,	9.52
		Upper half only (3)	2	13,23,	4.76
		Upper three-quarters only (5)	2	33,21	4.76
22	Awn color at maturity	Straw (1)	6	9,19,20,25,29,37	14.29
		Brown (tawny) (3)	4	3, 23,33,41,	9.52
		Purple (5)	2	13,22,	4.76
23	Length of the longest awn	Very short (1)	3	3,20, 37	
		Short (3)	6	9,23, 25,29,33, 41	
		Intermediate (5)	3	13, 19,22,	
24	Apiculus color	White (1)	13	1,3,6,7,10,18,24,26,27,30,33,36,40	30.95
		Straw (2)	4	2,4,9,41	9.52
		Brown (3)	21	5,11,14,15,16,17,19,20,21,22,23,25,28,29,32,34,35,37,39,42	50.00
		Red apex (6)	1	8	2.38
		Purple (7)	3	13,31,38	7.14
		Black(9)	1	12	2.38
25	Stigma color	White(1)	31	1,3,6,7,8,12,13,14,17,18,42,19,20,22,23,24,28,29,30,31,32,33,34,35,36,37,38,39, ,41	73.80
		Light green (2)	10	2,4,5,10,11,15,17,22,25,26,27	23.81
		Yellow (3)	1	40	2.38
26	Lemma and palea color	Straw (0)	17	1,6,9,10,11, 14,15,17, 19,21,26,29,30, 34,35,36,40	40.48
		Gold & gold furrows on straw background (1)	14	2, 7,13, 20, 25,27,28,32,33,37,38,39,41,42	33.33
		Brown spots on straw (2)	1	24,	2.38
		Brown furrows on straw (3)	1	12,	2.38
		Brown (4)	2	4,18,	4.76
		Reddish to light purple (5)	2	5, 8,	4.76
		6	1	23	2.38
		Purple (8)	2	3,8,16	4.76
		Black (9)	2	22, 31	4.76
27	Lemma and palea pubescence	Glabrous (1)	2	38,24	4.76
		Hairs on lemma keel (2)	6	16,21, 25,33,34,40	14.29

Sl. no.	Character	State of characters	No. of germplasm	Germplasm (Table 116)	Frequency (%)
		Short hairs (4)	32	1,2,3,4,5,6,7,9,10,11,12,14,15,17,18,19,20,22,23,24,26,27,28,29,30,31,32,35,36,37,38,39, 41,42	76.19
		Long hairs (5)	2	8,13	4.76
28	Sterile lemma color	Straw (1)	35	1,4,6,8,9,10,11,12,14,15,17,18,19,20,21,22,23,24,25,26,27,28,29,30,32,33,34,35,36,37,39,40,41	83.34
		Gold (2)	4	2, 7,38,42	9.52
		Purple (4)	3	3,5,31,	7.14
29	Seed coat (bran) color	White (1)	11	1,4,6,15,24, 26, 27, 28,32,36, 40	26.19
		Light brown (2)	13	7,9,10,11,14,19,21,29, 30,33,34,35,38	30.95
		Speckled brown (3)	14	3,8,12,13,16,18,20,22,23, 25,31,37, 41, 42,	33.33
		Brown (4)	3	2,17,39	7.14
		Variable purple (6)	1	5	2.38
30	Endosperm type	Non-glutinous (no waxy) (1)	11	3,8,14, 21, 23, 27, 30,32, 33, 39, 42	26.19
		Glutinous (waxy) (2)	22	1,2,4,5, 6,7,9,10, 11,13,17,19,24,25,26,28, 35,36,37,38	52.38
		Intermediate (3)	9	12,15, 16, 18,20, 22, 26, 29,41	21.43
31	Decorticated grain: Scent (aroma)	Non-scented (0)	36	1,2,3,4,5,6,7,8,9,11,13,14,15,16,17,18,19,20,22,23,24,25, 26, 27, 28, 29,30,32, 33,34,36,37,,38,39,40,41,42	85.71
		Lightly scented (1)	1	10	2.38
		Scented (2)	5	21, 34, 12,31,35	11.90

Characterization based on quantitative characters by DUS test

Observed variables of quantitative characters of included seven traits and five plants from each replication of each germplasm were randomly selected for recording data on plant height (cm), Days to 50% flowering, Days to 80% of maturity, Number of effective tillers, Panicle length (cm), 100 seed weight (g), Grain yield m^{-2} .

Range, mean, standard deviation (SD) and coefficient of variation (CV) of different quantitative characters of rice germplasm have been given in Table 118. The range of plant height 82cm -130.67cm, tallest plant was recorded in Hasakalo (130.67 cm) whereas the shortest plant was recorded in Mukta (82.00cm). Sumanth *et al.* (2017) and Sarkar (2014) also observed significant variation in rice for plant height.

Sumanth *et al.* (2017) reported that the significant variation was observed among the genotypes for plant height. Haque and Biswas (2014) found significant variation for plant height in their experiment.

Days to fifty % flowering ranged from 87.67 to 113.67 days with an average 104 days. Among the studied germplasm, Nagra took longest time (113 days) while Bashiraj (87.67 days) took the shortest time. Saha (2018) reported in her MS thesis Days to 50% flowering ranged from 80.67 to 120.33. The maturity (80%) of the studied germplasm ranged 120.33-146.33 days with an average of 137.31 days and CV% was lowest (3.47%) among the characters. Shonajuri and Hashemiri took the maximum time (146.33 days) to mature, while Bashiraj took only 120.33 days to mature. Number of effective tillers per hill ranged 4.33 to 14.33 with an average 9.6, CV% was 21.84 and SD was 2.10. Sadapaijam had produced maximum number of effective tillars (14.33), Maloti had lowest number of effective tillers. Parbotjira had the longest panicle length (29.67 cm) and Kashiabinni (15.33cm) had the shortest panicle. Average panicle length was 23.24 with 12.10 % CV and SD was found 2.81.

The highest grain yield m^{-2} found 640.00 g in Ojanabirun and lowest was 200.00 g in Birui and average yield was 370.76 g. The highest CV% (28.48%) was found in grain yield among the studied quantitative characters and SD was 105.59. In this study, 100-grain weight ranged from 0.84 g to 3.03g with an average value of 1.83 g. The variation observed for this trait was highly significant. Hundred grain weights have been used for characterizing rice varieties which was reported by several workers (Bose and Pradhan, 2005 and Joshi *et al.*, 2007). Hundred-grain weight was marked the highest in Lalpaijam (3.03 g) whereas 100-grain weight was marked the lowest in Kalojira (0.84g).

Table 118. Variability in test rice germplasm in quantitative characters, T. Aman, 2019

Characters	Range	Mean	SD	CV (%)
Plant height (cm)	82.00-130.67	109.86	9.20	8.37
Days to 50% flowering	87.67-113.67	104.89	5.69	5.42
Days to 80% maturity	120.33- 146.33	137.31	4.76	3.47
Number of effective tillers hill ⁻¹	4.33-14.33	9.6	2.10	21.84
Panicle length (cm)	15.33-29.67	23.24	2.81	12.10
Grain yield plant ⁻¹ (g)	200.00 – 640.00	370.76	105.59	28.48
1000-grain weight (g)	0.84-3.03	1.83	0.50	27.31

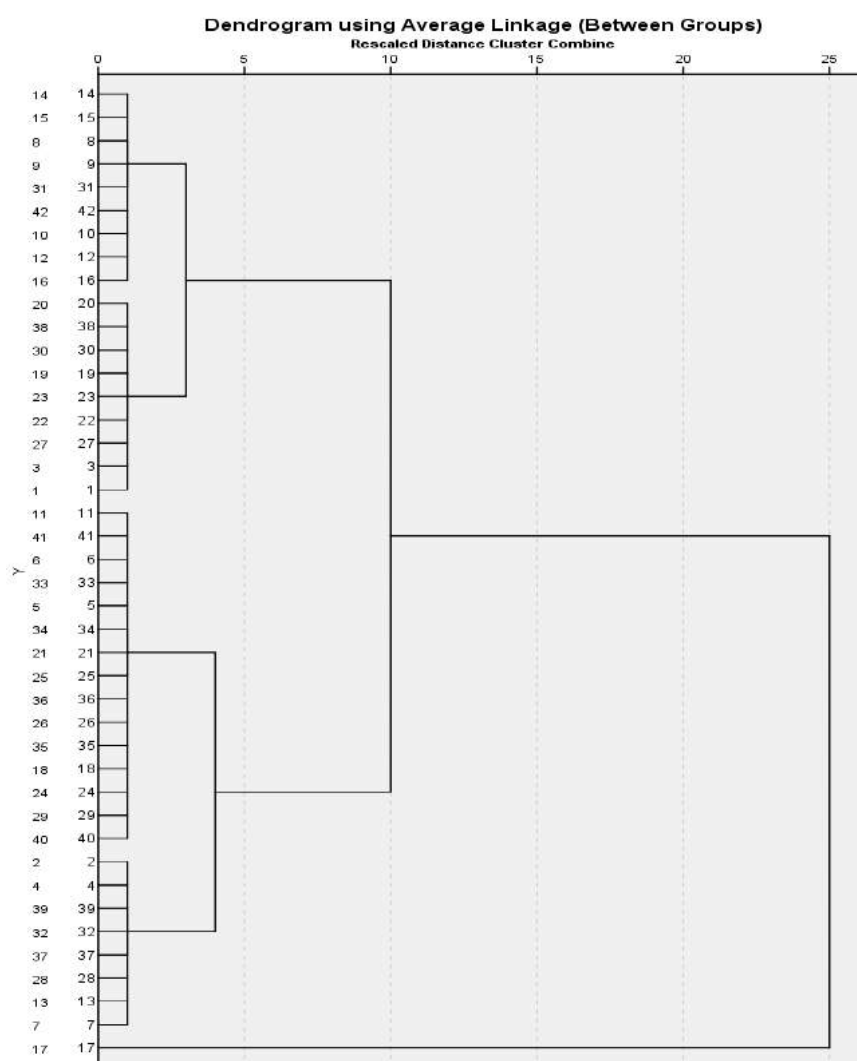


Fig. 89. Hierarchical cluster analysis using UPGMA among test rice germplasm

Table 119. Distribution of germplasm in different non-hierarchical clusters of rice germplasm

Name of cluster	No. of germplasm	Name of germplasm
Cluster-I	9	Bedhabirum, Chengermuri, Parbotjira, Hasakalo, Noliguarchara, Hasasada, Biruidhan, Kalojira, Lalkumri
Cluster-II	9	Ailagota, Kalobirun, Chaklosh, Kutimurabirun, Guar chara, Putibirun, Maloti, Bashiraj, Birui
Cluster-III	15	Moinashail, Deshi-32, Lalcheng, Soragotobirun, Chinigura-1, Guabari, Molaireti, Guamouri, Lomba ail, Lalpaijam, Chinishail, Chinishail-3, Hashemirri, Sadapaijam, Kashiabinni
Cluster-IV	8	Kaijam, Mukta, Paijam, Shonajuri, Nagra, Boroabji, Chanmoni, Gobinda
Cluster-V	1	Ojanabirun
Total	42	

Hierarchical cluster analysis using UPGMA among 42 germplasm of rice are shown in figure 63. The 42 germplasm were grouped into five non-hierarchical clusters (Table 119). Number of germplasm in each cluster ranged from 1 (cluster-V) to 15 (cluster III). Ojanabirun classified into Cluster-V (Fig. 90).

On the basis of cluster analysis, different qualitative and quantitative characters Ojanabirun, Paijam, Boroabji, Birui, Nagra, Bashiraj, Deshi-32, Kalojira, Hasa sada, Hasakalo, Parbotjira would be selected for breeder for further varietal development. For short duration Bashiraj and Deshi-32, based on higher yield Ojanabirun, Paijam, Boroabji, Birui and Nagra, based on fine and scented grain Kalojira, Parbotjira, Hasasada, Hasakalo, chinisail would be selected. In this study, among the germplasm, Ojanabirun and Paijam had performed best. Ojanabirun and Paijam produced higher yield with shorter plant height, 0% lodging tendency, flag leaf and leaf angle erect, compact and enclosed panicle. Among five scented rice germplasm, Chinishail performed best. These identified germplasm will be used for developing improved varieties through breeding program that would be high yield potential with superior quality.

Conclusion

Wide variations were found among the 31 qualitative characters like blade color, legule color, culm angle, Internode color, Culmstrength, Lodging incidence, panicle type, panicle exertion, lemma palea color, seed coat color etc. Significant variations were found among the seven quantitative characters such as plant height, days to 50 % flowering, days to 80 % maturity, panicle length. 100 Seed weight, grain yield per m² had shown significant difference among the germplasm. The maximum coefficient of variations was in grain yield per m². The 42 germplasm were classified into five clusters. Some promising germplasm (Ojanabirun, Paijam, and Chinishail) were identified and these germplasm would be used for varietal development.

11.6.4. Morphological characterization of chilli germplasm

A total of 5 local chilli germplasm have been characterized at morphological level during winter 2018-19 season. Five local chilli germplasm exhibited a wide variation for several morphological characters studied. The frequency percentage of each parameter is presented in Table 120.

Table 120. Qualitative descriptors of chilli germplasm

Sl. No.	Character	Character state	No. of germplasm	Name of germplasm	% of germplasm
1	Hypocotyl colour	Purple	4	Balijhuri (Kagmari), Chata morich, Balijhuri (shayampur) , Super hot master	80
		White	1	Ultra morich	20
2	Hypocotyl pubescence	Intermediate	5	-	100
3	Cotyledonous leaf color	light green	3	Ultra morich, Balijhuri (shayampur), Balijhuri (Kagmari),	60
		Green	2	Super hot master, Chata morich	40
4	Cotyledonous leaf shape	Ovate-2	2	Super hot master, Ultra morich	40
		Lanceolate-3	3	Balijhuri (Kagmari), Chata morich, Balijhuri (shayampur)	60
5	Life cycle	Annual	4	Balijhuri (Kagmari), Chata morich, Balijhuri (shayampur)	80
		Biennial	1	Ultra morich	20
6	Stem colour	Green	5		100
7	Nodal anthocyanin	Green	5		100
8	Stem shape	Angular	5		100
9	Stem pubescence	Intermediate	2	Super hot master, Ultra morich	20
		Dense	2	Balijhuri (Kagmari), Balijhuri (shayampur)	20
10	Plant growth habit	Erect	2	Super hot master, Ultra morich	40
		Intermediate	3	Chata morich, Balijhuri (Kagmari), Balijhuri (shayampur)	60
11	Branching habit	Intermediate	4	Balijhuri (Kagmari), Balijhuri (shayampur) ,Super hot master, Ultra morich	80
		Sparse	1	Chata morich,	20
12	Tillering	Intermediate	3	Balijhuri (Kagmari), Balijhuri (shayampur) ,Super hot master,	60
		Sparse	1	Chata morich,	20
		Dense	1	Ultra morich	20
13.	Leaf density	Dense	3	Super hot master, Ultra morich, Chata morich	60
		Intermediate	2	Balijhuri (Kagmari), Balijhuri (shayampur)	40
14	Leaf colour	Green	4	Super hot master , Chata morich, Balijhuri (shayampur), Balijhuri(Kagmari)	80
		Light green	1	Ultamorich	20
15	Leaf shape	Deltoid	2	Super hot master, Ultra morich	40
		Lanceolate	2	Balijhuri (shayampur), Balijhuri(Kagmari)	40
		Ovate	1	Chata morich	20
16	Leaf margin	Entire	3	Super hot master, Ultra morich, Chata morich	60
		Undulate	2	Balijhuri (shayampur), Balijhuri(Kagmari)	40
17	Leaf pubescence	Sparse	5		100
18	Number of flowers per axil	2	1	Super hot master	20
		3 or more	4	Balijhuri (shayampur), Balijhuri(Kagmari), Chata morich, Ultamorich	80

Cont'd. Table 120.

Sl. No.	Character	Characters	No. of germplasm	Name of germplasm	% of germplasm
19	Flower position	Pendant	4	Super hot master , Balijhuri (shayampur), Balijhuri (Kagmari), Chata morich	80
		Erect	1	Ultamorich	20
20	Corolla color	Yellow-	1	Super hot master	20
		Light yellow	3	Balijhuri (shayampur), Balijhuri (Kagmari), Chata morich	60
		White	1	Ultamorich	20
21	Corolla spot color	Purple	1	Super hot master	20
		Green	2	Balijhuri (shayampur), Balijhuri (Kagmari)	40
		White	2	Ultamorich, Chata morich	40
22	Corolla shape	Rotate	5		100
23	Anther colour	Blue	1	Super hot master	20
		Pale blue	4	Balijhuri (shayampur), Balijhuri (Kagmari), Ultamorich, Chata morich	80
24	Filament colour	Purple	1	Super hot master	20
		Light purple	4	Balijhuri (shayampur), Balijhuri (Kagmari), Ultamorich, Chata morich	80
25	Stigma exertion	Same level	2	Super hot master , Chata morich	40
		Exerted	3	Balijhuri (shayampur), Balijhuri (Kagmari), Ultamorich	60
26	Male sterility	Absent	4	Super hot master , Chata morich, Balijhuri (shayampur), Balijhuri (Kagmari),	80
		Present	1	Ultra morich	20
27	Calyx pigmentation	Absent	5		100
28	Calyx margin	Intermediate	3	Super hot master , Chata morich, Ultra morich	60
		Entire	2	Balijhuri (shayampur), Balijhuri (Kagmari),	40
29	Calyx annular constriction	Absent	3	Super hot master , Chata morich, Ultra morich	60
		Present	2	Balijhuri (shayampur), Balijhuri(Kagmari),	40
30	Anthocyanin spots or stripes	Absent	5		100
31	Fruit color at intermediate stage	Green	3	Super hot master , Chata morich, Balijhuri (shayampur)	60
			2	Balijhuri (Kagmari), Ultra morich	40
32	Fruit set	Intermediate	5		100
33	Fruit color at mature stage	Red	5		100
34	Fruit shape	Elongate	5		100
35	Fruit shape at pedicel attachment	Obtuse	5		100
36	Neck at base of fruit	Absent	2	Chata morich, Ultra morich	40
		Present	3	Super hot master , Balijhuri (Shayampur), Balijhuri (Kagmari),	60

Cont'd. Table 120.

Sl. No.	Character	Characters	No. of germplasm	Name of germplasm	% of germplasm
37	Fruit shape at blossom end	Pointed	4	Super hot master , Chata morich, Balijhuri (shayampur), Balijhuri (Kagmari)	80
		Blunt	1	Uta morich	20
38	Fruit blossom end appendage	Absent	5		100
39	Fruit cross-sectional corrugation	Intermediate	4	Super hot master , Chata morich, Balijhuri (Shayampur), Balijhuri (Kagmari)	80
		Slightly corrugated	1	Uta morich	20
40	Fruit surface	Semi wrinkle	5		100
41	Seed colour	Brown	1	Super hot master	20
		Deep yellow	4	Chata morich, Balijhuri (shayampur), Balijhuri (Kagmari), Uta morich	80
42	Seed surface	Wrinkle	3	Super hot master, Balijhuri (shayampur), Balijhuri (Kagmari)	60
		Smooth	2	Chata morich, Uta morich	40
43	Seed size	Intermediate	5		100

All germplasm performed same for the characters of hypocotyl pubescence, stem colour, nodal anthocyanin, stem shape, leaf pubescence, corolla shape, calyx pigmentation, anthocyanin spots or stripes, fruit set, fruit color at mature stage, fruit shape, fruit shape at pedical attachment, fruit blossom end appendage, fruit surface and seed size. Hypocotyl colour observed purple and white. Cotyledon leaf colour ranged from light green to green with ovate to lanceolate shape. Stem pubescence had shown dense and intermediate with sparse character. Two modes of plant growth were observed. Leaf shape varied between deltoid, ovate and lanceolate. Yellow-green corolla was common among the germplasm with filament colour mostly white. Anther colour varied from pale blue to blue. Fruit colour at intermediate stage ranged from green to pale green.

Table 121 shows the mean performance for all the quantitative traits measured. Cotyledon leaf length ranged from 11mm in Balijhuri (Shayampur) to 20 mm in Super hot master with an average of 15.4 mm. Cotyledon leaf widths is ranging from 5-10 mm. The heights of the chilli germplasm ranged from 45.00-108 cm with the average of 66.2 cm. Days to flowering ranged from 89-150 after sowing was done. Fruit length and width ranged from 3.5-9 cm and 0.75-1.4 cm, respectively. The mean fruit length was 6.26 cm with Uta morich and Super hot master having the shortest and longest fruit lengths. Fruit weight which is the most economic trait ranged from 0.86 -1.75g with Uta morich and Super hot master. Seed diameter ranged from 3mm -5mm in Super hot master to Uta morich with an average of 3.8 mm.

Table 121. Quantitative descriptors of chilli germplasm

SL. No.	Character	Measurable indicator					Mean
		Super hot master	Balijhuri (shayampur)	Chata morich	Balijhuri (Kagmari)	Uta morich	
1	Cotyledonous leaf length (mm)	20	11	17	10	19	15.4
2	Cotyledonous leaf width (mm)	10	5	7	6	9	7.4
3	Plant height(cm)	72	49	57	45	108	66.2
4	Plant canopy width (cm)	50	57	70	36	57	54
5	Stem length(cm)	20	17	18	18	29	20.4
6	Stem diameter (cm)	2.0	1.5	1.75	1.25	2.5	1.8
7	Mature leaf length (cm)	6.0	4.0	5.2	5.0	12.0	6.44
8	Mature leaf width	2.2	1.4	1.8	1.8	5.4	2.52
9	Days to flowering	101	85	83	79	150	99.6
10	Corolla length (cm)	1.5	0.75	1.2	0.80	1.1	1.07
11	Anther length (mm)	0.75	0.5	0.65	0.6	0.45	0.59
12	Filament length (mm)	5	5	4	6	6	5.2
13	Days to fruiting	105	99	87	86	110	97.4
14	Fruit bearing period (d)	150	160	150	140	322	-
15	Fruit length (cm)	9	7	5	6.8	3.5	6.26
16	Fruit width (cm)	1.4	0.95	1.5	0.90	0.75	1.1
17	Fruit weight (g)	1.75	1.0	1.6	1.2	0.86	1.28
18	Seed diameter(mm)	3	3.5	4	3.5	5	3.8
19	1000 seed weight (g)	4.8	4.0	4.8	4.5	4.8	4.58
20	Number of seeds per fruit	70	59	93	77	12	62.2

Conclusion: Superhot master and Chata morich was the promising germplasm for higher yield, fruit shape and color. The germplasm ultra morich was good for getting year round chilli yield.

11.6.5. Characterization of sesame germplasm

The aim of the present study is to characterize 30 germplasm of sesame (*Sesamum indicum* L.) based on the DUS descriptors. The list of the experimental materials along with their collector's number is shown in Table 122. The experiment was conducted at the Experimental field of Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh during kharif 2020. On the basis of DUS descriptors, sesame varieties were characterized for 18 morphological traits. A significant amount of variation was observed for most of the traits studied. The results revealed that maximum variation was recorded in seed coat colour, capsule shape, leaf lobe, leaf size, leaf serration, capsule hairiness, capsule arrangement, stem hairiness, petal colour, seed size, days to 50% flowering, branching pattern and petal hairiness. On the basis of frequency distribution, a majority of sesame germplasm were found to possess early duration of 50% flowering with light purple petal colour, sparse petal hairiness, basal branching pattern, medium plant height, medium plant branching, sparse stem hairiness, medium leaf size, slightly lobed leaf, strong leaf serration, sparse capsule hairiness, broad oblong capsule shape, alternate capsule arrangement, medium capsule length, early maturity and white seed coat colour.

Above study revealed the distinct characteristics of sesame germplasm and indicated that morphological variations exist in these germplasm due to variation in genetic makeup and could be better utilized by breeders in the selection based on their specific requirement for breeding program. This is highly useful study for varietal identification and conservation.

Table 122. List of sesame germplasm used in this study

Sl. No.	Name	Collectors No.	Sl. No.	Name	Collectors No.
1	BD-6987	FI-01	16	BD-6979	FI-15
2	BD-6988	FI-02	17	BD-6972	FI-16
3	BD-6989	FI-03	18	BD-6978	FI-17
4	BD-6995	FI-04	19	Binatil-3	FI-18
5	BD-6983	FI-05	20	BD-6993	FI-19
6	BD-6986	FI-06	21	BD-6994	FI-20
7	Kalotil *	F-03	22	BD-6991	FI-21
8	BD-6984	FI-07	23	BD-6992	FI-22
9	BD-6971	FI-08	24	BD-6990	FI-23
10	BD-6970	FI-09	25	BD-6980	FI-24
11	BD-6968	FI-10	26	BD-6966	FI-25
12	BD-6962	FI-11	27	BD-6964	FI-26
13	BD-6982	FI-12	28	BD-6985	FI-27
14	Binatil-2	FI-13	29	Binatil-4	FI-28
15	BD-6981	FI-14	30	Sadatil *	F-04

*Indicate collected germplasm

The qualitative characters for germplasm are presented in table 123. Range, mean, standard deviation and coefficient of variation of quantitative characters were calculated (Table 126). The collected data on 16 quantitative characters were analyzed for ANOVA. Hierarchical and non-hierarchical cluster analysis was done using SPSS 16 software (Fig. 82 and Table 127).

Qualitative descriptor

Results revealed that a significant amount of variation was recorded on almost all the characters recorded. Qualitative variations of different characters in sesame are shown in Table 123. Most of germplasm were indeterminate type (93.33 %) and only two germplasm were determinate (6.67%) Erect (53.33%), semi-erect (26.67%) and prostrate (6.67%) were found on plant growth habit. Among the 30 germplasm, only one germplasm showed glabrous (3.33%) stem hairiness, 15 germplasm had weak (50%), 11 had medium (36.67%) and 3 germplasm had strong (10%) stem hairiness. In this study, basal (50%) and top (50%) patterns were observed.

Leaf characters varied significantly among the germplasm. In case of leaf color, 70% germplasm were found green, 23.33 % were green with yellowish cast and 6.67 % germplasm were green with purple cast. Among the 30 germplasm, 2 germplasm had no hairiness in leaf and one had strong hairiness. 63.33 % germplasm were weak and 26.67% germplasm were medium hairiness in leaf. Most of the germplasm (90%) had shown lanceolate leaf shape. There were no leaf lobes in all germplasm except one. In case of leaf angle, 17 had acute, 10 had horizontal and 3 had drooping. All the germplasm were exhibited entire basal leaf margin. Among 30 germplasm, 14 had green, 13 had greenish purple and 3 had purple petiole color. Most of the germplasm (66.67%) had produced one flower per axil and 33.33 % had produced more. Sixteen germplasm had small, 5 had rudimentary, 5 had medium and 4 had large extra floral development in inflorescence.

On the basis of capsule number per leaf axil, 21 had four locules, 5 had eight locules and 4 had five locules per capsule. Among the 30 genotypes, 23 had narrow oblong and 7 had broad oblong shaped capsules. On the basis of capsule arrangement, 26 germplasm had monocapsular and only 4 germplasm had monocapsular type in capsule arrangement. Among the 30 germplasm, 19 were short capsule, 8 were medium and 3 were long and bent in shape of capsule hairiness. 50% germplasm had shown straw color, 46.67% had brown or tan color in dry capsule. Six distinct seed coat colours such as cream (3.33 %), medium brown (6.67%), tan (13.33%), grey (26.67%), dull black (36.67%) and bright black, (13.33) were observed among the germplasm at maturity stage after sun drying.

Table 123. Qualitative descriptors for individual sesame germplasm

Sl. no.	Character	State of characters	No. of germplasm	Germplasm (List in Table 124)	Frequency (%)
1	Plant growth type	Indeterminate (1)	28	1,2,3,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,23,24,25,26,27,28,29,30	93.33
		Determinate (2)	2	4,16	6.67
2	Plant growth habit	Prostrate (1)	6	15,16,17,27,28,30	20.00
		Semi-erect (2)	8	4,7,8,12,14,18,19,26	26.67
		Erect (3)	16	1,2,3,5,6,9,10,11,13,20,21,22,23,24,25,29	53.33
3	Stem hairiness	Glabrous (0)	1	10	3.33
		Weak or sparse (3)	15	2,3,4,6,11,12,13,16,17,18,19,23,25,27, 29,	50.00
		Medium (5)	11	1,5,7,8,9,15,21,22,24,28,30	36.67
		Strong (7)	3	14,20,26	10.00
4	Branching pattern	Basal branching (1)	15	7,8,9,10, 11,15,16,18,20,21, 22,23,24,28,30	50.00
		Top branching (2)	15	1,2,3,4,5,6, 12,13,14,17,19,25,26,27,29	50.00
5	Leaf color	Green (1)	21	1,6,7,8,9,10,11,12,15,16,19,21,22,23,24,25,26,27,28,29,30	70.00
		Green with yellowish cast (2)	7	2,3,4,5,13,14,17	23.33
		Green with purple cast (4)	2	18,20	6.67
6	Leaf hairiness	Glabrous (0)	2	4,23	6.67
		Weak or sparse (3)	19	1,3,5,6,8,9,12,13,15,16,17,18,19,20,22,25,27, 29,30,	63.33
		Medium (5)	8	2,7,10,14,21,24,26,28	26.67
		Strong (7)	1	11,	3.33
7	Leaf shape	Linear (1)	2	20,23	6.67
		Lanceolate (2)	27	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,19,21,22,24,25,26,27,28,29,30	90.00
		Elliptic (3)	1	5,	3.33
8	Basal leaf margin	Entire (1)	30	All	100
		Serrate (2)			0.00
9	Lobe incision of basal leaf	Absent (0)	29	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17,19,20, 21,22,23,24,25,26,27,28,29,30	96.67
		Weak (3)	1	18	3.33
10	Leaf angle to main stem	Acute (1)	17	1,2,3,4, 6, 7,8,9,10,11,12,17, 23,24,25,30	56.67
		Horizontal (2)	10	5,13,14, 16,18, 20, 21,22,28,30	33.33
		Drooping (3)	3	15,19,29	10.00
11	Petiole Color	Green (1)	14	1,2,3,4, 5,6,7,8,9,18,27,28,29,30	46.67
		Greenish purple (2)	13	13,14,15,16,17,19,,20,21,22,23,24,25,26	43.33
		Purple (3)	3	10,11,12,	10.00
12	Petiole hairiness	Weak or sparse (3)	17	2,3,6,8,9,10,12,13,14,15,17,18, 19,20,21,28, 29 30	56.67
		Medium (5)	12	1,4,5,7,11,16,22,23,24,25,26,27,	40.00
		Strong or profuse (7)	1	19,	3.33

Cont'd. Table 123.

Sl. no.	Character	State of characters	No. of germplasm	Germplasm (List in Table 124)	Frequency (%)
13	No. of flowers/ axil	One (1)	20	1,2,3,6,7,8,9,10,12,13,14,15,17,18,19,20,21,28, 29, 30,	66.67
		More than one (2)	10	4,5,11,16,22,23,24,25,26,27,	33.33
14	Extra floral nectar development	Rudimentary (1)	5	2,9,11,16,17,	16.67
		Small (2)	16	3,5,12,18, 19,21,22,23,24,25,26,27,28,29,30	53.33
		Medium (3)	5	1,4,10,13,14, 20,	16.67
		Large (4)	4	6,7,8,15,	13.33
15	Number of locules per capsule	Four (1)	21	1,2,4,6,7,8,10,11,14,15,16,17,18,20,21,22,27,28,29,30	70.00
		Eight (3)	5	5,9,23,24,25,	16.67
		Mix (4)	4	3,12,19,26,	13.33
16	Bicarpellate capsule shape	Narrow oblong (2)	23	1,2,3,4,5,6,7,8,10,11,12,13,14,15,16,18,19,20,22,23,24,28,30	76.67
		Broad oblong (3)	7	9,17,21,25,26,27,29	23.33
17	Capsule arrangement	Monocapsular (1)	26	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,16,18,20,21, 22,23,24,28,29,30	86.67
		Multi capsular (2)	4	19,25,26,27	13.33
18	Capsule hairiness	Weak or sparse (3)	21	1,4,5,6,7,8,9,10,13,14,15,16,17,19,21,22,23,27,28,29	70.00
		Medium (5)	6	2,3,11,12, 20,25,30	20.00
		Strong (7)	3	18, 24,26	10.00
19	Shape of capsule hair	Short and strait (1)	19	1,2,4,5,6,7,8,9,10,13,14,16,21,22,23,24,26,28,30	63.33
		Medium & strait (2)	8	3,11,12,15,17,20,25,27	26.67
		Long and bent (3)	3	18,19,20, 29	10.00
20	Color of dry capsule	Green (1)	1	7	3.33
		Straw or Yellow (2)	15	2,5,6,8,9,10,11,16,17,16,17,20,21,22,23,24,25,	50.00
		Brown /tan (3)	14	1,3,4,12,13,14,15,18,19,26,27,28,29,30	46.67
21	Type of capsule beak	Short (1)	1	1,2,5,6,7,10,22,23,24,28	3.33
		Long (2)	4	8,11,21,28	13.33
		Curved (3)	16	3,4,9,12,13,14,15,16,17,18,19,20,25,26,27,29,30	53.33
22	Seed coat color	Cream (2)	1	30	3.33
		Medium brown (5)	2	5,12	6.67
		Tan (8)	4	2,16,17,28	13.33
		Grey (10)	8	1,4,6,8,19,24,26,29	26.67
		Dull black (11)	11	7,10,13,14,15,18,20,21,23,25,27,	36.67
		Bright black (12)	4	3,9,11,22	13.33

Quantitative descriptor

Quantitative variations of 16 descriptors in sesame are shown in table 124. The highest plant height was exhibited in BD-6990 (153.33 cm) while the lowest 108.00 cm was observed in BD-6995. Internodes length ranges 8.33 cm (BD-6971) to 18 cm (BD-6987) with an average of 13.50 cm. Number of primary branches ranges from 2 (BD-6995) to 7 (Kalotil). Length of basal leaf and width of basal leaf ranged from 4.50 to 15.33cm and 1.17 to 7.50 cm, respectively. Length of top leaf and width of top leaf ranged from 3.33 to 7.67 cm and 0.23 to 1.00 cm, respectively. The highest petiole length of basal leaf (7.67 cm) was found in BD-6968 while BD-6988 had produced the shortest petiole length (3.17cm) with an average of 4.30 cm. The germplasm produced fifty% flower on 40.33 days (BD-6964) to 49.33 days (Sadatil). Maximum number of capsule (137) per plant was found in the landrace Kalotil while minimum number of capsule (19) was found in BD-6962.

The variation in capsule per plant might be due to differences in number of inflorescence per plant and shattering tendency of plant. The mean capsule length ranged from 20.67 to 29.33 mm in BD-6966 and BD-6979, respectively. On the contrary, mean capsule width ranged from 5.33 to 11.33 mm in BD-6995 and BD-6983, respectively. The germplasm produced 23 to 85.67 seeds per capsule from Binatil-2 and Kalotil, respectively. An average of 46 seeds per capsule was found. The germplasm exhibited 0.13 to 0.90 g 100 seed weight from BD-6978 and BD-6970, respectively with an average of 0.14 g.

Finally the yield per plant ranged from 2.97 to 57.71 g. The germplasm BD-6979 produced highest yield per plant while BD-6995 yielded lowest. Such the lowest yield might be inherent characteristics of the germplasm and also due to the inherent potential of germplasm. The maximum co-efficient of variation was found in petiole length of top leaf (19.15%) followed by width of top leaf (18.76%), seeds per capsule (16.72%), number of primary branch and length of basal leaf (14.63%), mean capsule width (13.93%), petiole length of basal leaf (13.58%), width of basal leaf (13.11%), length of top leaf (7.34%), number of capsule per plant (7.15%), 100-seed weight (6.82%), mean capsule length (6.59%), internode length (6.34%), plant height (3.80%) and seed yield per plant (1.44%). The quantitative descriptors for individual characters are presented in table 126.

Table 124. Quantitative variation in different descriptors of sesame germplasm

Sl.#	Name of descriptor	Range	Mean	SD	CV (%)
1	Plant height (cm)	108.00-153.33	126.83	12.14	3.80
2	Internodes length (cm)	8.33-18.00	13.50	2.12	6.40
3	No. of primary branch	2.00-7.00	4.00	1.35	14.63
4	Length of basal leaf (cm)	4.50-15.33	8.25	2.14	14.63
5	Width of basal leaf (cm)	1.17-7.50	1.88	1.38	13.11
6	Length of top leaf (cm)	3.33-7.67	4.30	1.01	7.34
7	Width of top leaf (cm)	0.23-1.00	0.48	0.20	18.76
8	Petiole length of basal leaf (cm)	3.17-7.67	4.30	0.99	13.58
9	Petiole length of top leaf (cm)	0.13-1.13	0.37	0.24	19.15
10	Days to fifty % flowering	40.33-49.33	45.67	1.86	1.96
11	Number of capsules per plant	19-137	48.83	28.06	7.15
12	Mean capsule length (mm)	20.67-29.33	25.67	2.39	6.59
13	Mean capsule width (mm)	5.33-11.33	6.67	1.46	13.93
14	Seeds per capsule	23.00-85.67	46.00	17.31	16.72
15	100 seed weight (g)	0.13-0.90	0.20	0.138325	6.82
16	Seed yield per plant (g)	2.97-57.71	13.09	12.38027	1.44

Table 125. Distribution of germplasm in different non-hierarchical clusters of sesame

Name of cluster	No. of germplasm	Germplasm with their code number
Cluster-I	08	BD-6962, BD-6982, BD-6983, BD-6992, BD-6984, BD-6980, Binatil-2, BD-6995
Cluster-II	08	Binatil-3, Binatil-4, Sadatil, BD-6978, BD-6966, BD-6964, BD-6989, BD-6972
Cluster-III	09	BD-6986, BD-6994, BD-6991, BD-6988, BD-6985, BD-6993, BD-6970, BD-6990, BD-6971
Cluster-IV	02	BD-6987, BD-6968
Cluster-V	03	BD-6981, BD-6979, Kalotil
Total	30	

Hierarchical cluster analysis using UPGMA among 30 germplasm of sesame are shown in Fig. 90. The 30 germplasm were grouped into 5 non-hierarchical clusters (Table 125). Number of germplasm in each cluster ranged from 2 (cluster-IV) to 9 (cluster-III). Kalotil classified into Cluster-V.

Breeding objectives in sesame have focused many characters such as seed size, shape, coat color and oil content. Especially for physiological needs, color is an important argument because color production is an integral part of the development of various plant parts; type of color may adapt the plant part for a specific function (Padi, 2003). Therefore, these characters are most important attributes of foods, being considered as a quality indicator and determining frequently their acceptance (Azerado, 2009).

On the basis of cluster analysis, different qualitative and quantitative characters Kalotil, BD-6979, BD-6981, BD-6987, BD-6972, BD-6978, BD-6970, BD-6985, BD-6988, BD-6984 may be selected. Based on elongated capsule, BD-6987, BD-6988, Kalotil and BD-6984 would be selected. Based on maximum number of seeds per plant Kalotil, BD-6979, BD-6981, BD-6987 would be selected. BD-6970, BD-6972, BD-6979, BD-6981, BD-6985 as bold seed; for higher yield Kalotil, BD-6979, BD-6981, BD-6972 and BD-6978 would be selected. Considering all characters Kalotil, BD-6979, BD-6981 selected for varietal development and seeking further research to sesame breeder.

Conclusion

Wide variations were found among the 22 qualitative characters like plant growth habit, stem hairiness, leaf color, leaf hairiness, capsule shape, capsule color, seed size, seed color etc. Significant variations were found among the 16 quantitative characters such as days to 50 % flowering, length, width of basal leaf, top leaf and petiole length. 100 Seed weight, seed yield capsule per plant, seeds per capsule had shown significant difference among the germplasm. The maximum coefficient of variations was found in petiole length of top leaf and minimum in seed yield per plant. The 30 germplasm were classified into four clusters. Some promising germplasm (Kalotil, BD-6979 and BD-6981) were identified and these germplasm can be used for varietal development of sesame.

**Dendrogram using Average Linkage (Beween Groups)
Rescaled Distance Cluster Combine**

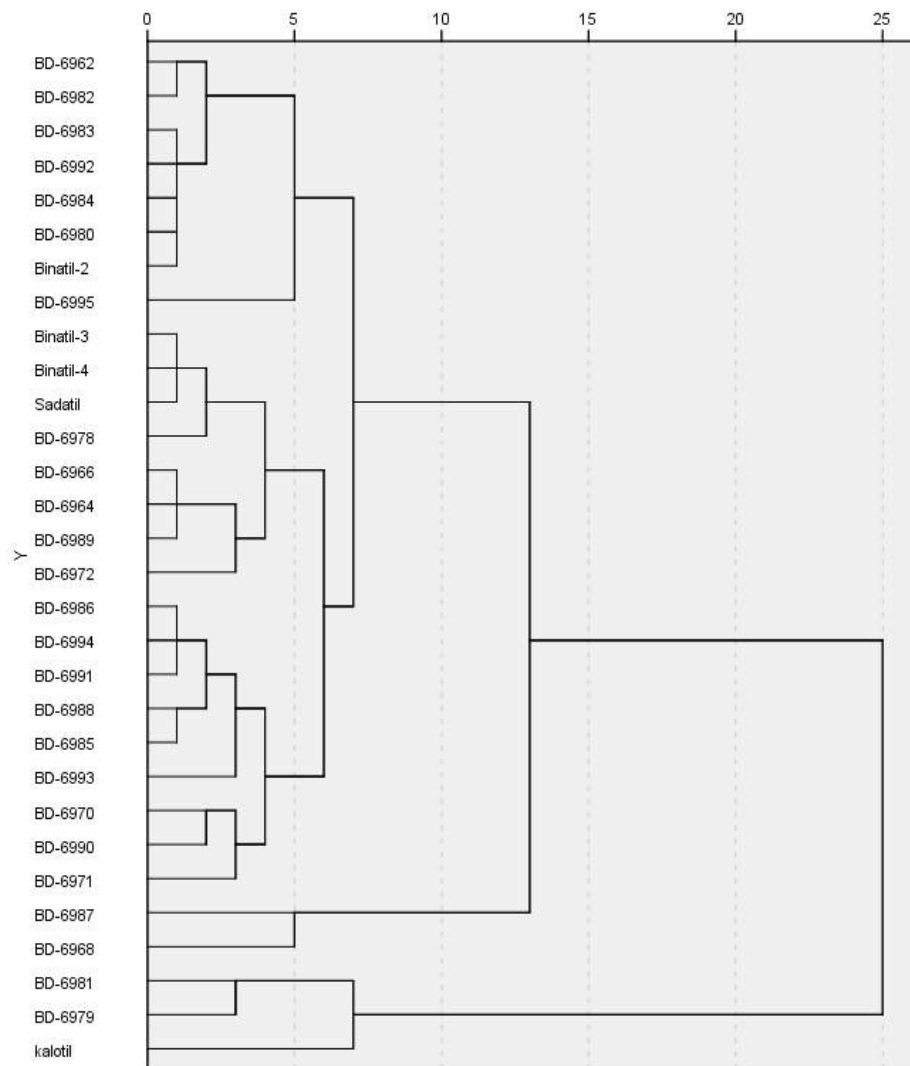


Fig. 90. Hierarchical cluster analysis using UPGMA among test sesame germplasm

Table 126. Quantitative characters of sesame germplasm

Genotype	Plant height (cm)	Internode length (cm)	Number of primary branch	Length of basal leaf (cm)	Width of basal leaf (cm)	Length of top leaf (cm)	Width of top leaf (cm)	Petiole length of basal leaf (mm)	Petiole length of top leaf (mm)	Number of capsules per plant
1	2	3	4	5	6	7	8	9	10	11
BD-6987	124.67	18.00	3.33	4.50	1.17	3.83	0.47	3.83	0.43	103.33
BD-6988	137.67	13.67	5.00	7.73	1.77	3.33	0.50	3.17	0.13	54.67
BD-6989	133.00	13.67	3.00	7.00	1.40	3.77	0.23	3.77	0.13	35.33
BD-6995	108.00	11.67	2.00	6.83	1.47	3.67	0.43	3.67	0.13	20.00
BD-6983	125.67	13.67	3.67	6.17	1.83	4.33	0.67	4.00	0.67	38.00
BD-6986	142.00	16.67	5.67	6.00	1.60	4.07	0.43	4.07	0.33	66.33
Kalotil	119.67	10.33	7.00	11.27	4.47	6.00	0.80	5.20	0.67	137.00
BD-6984	112.33	11.33	4.67	7.10	1.33	4.67	0.53	4.63	0.33	41.33
BD-6971	134.67	8.33	6.00	7.33	1.33	5.00	0.50	4.87	0.47	76.00
BD-6970	133.67	16.67	4.00	8.67	1.67	6.57	0.70	6.67	0.80	51.33
BD-6968	152.00	17.33	6.67	10.33	3.57	7.67	1.00	7.67	0.90	87.33
BD-6962	118.00	11.00	4.00	7.67	1.30	4.57	0.30	4.73	0.33	19.00
BD-6982	116.67	14.00	4.00	8.07	1.43	3.67	0.33	3.67	0.23	20.00
Binatil-2	114.00	14.33	3.00	7.83	1.57	3.80	0.33	3.80	0.50	36.00
BD-6981	134.00	12.33	7.00	12.33	2.23	6.73	0.83	6.73	1.13	110.33
BD-6979	126.00	12.33	5.00	15.33	5.67	4.83	0.50	4.93	0.33	97.67
BD-6972	133.33	12.00	3.67	10.17	2.40	5.03	0.67	5.03	0.37	36.67
BD-6978	124.67	14.67	3.67	9.83	2.90	5.20	0.67	5.20	0.73	46.33
Binatil-3	122.33	14.67	3.33	7.67	2.40	3.80	0.70	5.03	0.73	43.33
BD-6993	143.00	14.00	4.33	7.50	7.50	3.83	1.00	3.80	0.60	72.00
BD-6994	136.00	12.67	6.33	7.50	1.50	4.07	0.37	4.07	0.33	68.33
BD-6991	140.00	12.67	6.33	11.00	2.83	4.83	0.33	4.83	0.27	75.33
BD-6992	125.33	12.33	4.67	11.00	2.83	3.87	0.33	4.07	0.27	39.33
BD-6990	153.33	11.67	6.00	8.97	1.87	4.63	0.43	4.63	0.33	53.67
BD-6980	110.67	11.33	3.00	10.07	2.90	4.87	0.47	4.87	0.40	43.33
BD-6966	134.67	11.33	4.00	8.33	2.43	4.27	0.43	4.27	0.50	44.33
BD-6964	142.00	14.33	4.00	8.27	2.33	4.17	0.60	4.17	0.33	39.00
BD-6985	127.67	14.00	3.33	8.23	1.90	4.00	0.47	4.00	0.37	55.67
Binatil-4	110.33	13.33	3.00	8.50	1.77	3.80	0.67	4.33	0.30	40.33
Sadatil	117.67	14.33	4.00	9.50	1.93	4.47	0.47	4.17	0.37	55.67
Max	153.33	18.00	7.00	15.33	7.50	7.67	1.00	7.67	1.13	137.00
Min	108.00	8.33	2.00	4.50	1.17	3.33	0.23	3.17	0.13	19.00
Mean	126.83	13.50	4.00	8.25	1.88	4.30	0.48	4.30	0.37	48.83
SD	12.1353	2.123998	1.3547	2.141	1.384	1.01	0.1965	0.985	0.237	28.06

Table 126. Quantitative characters of sesame germplasm (Cont'd)

Genotype	Yield/ m ² (g)	100 Seed weight (g)	Mean capsule length (mm)	Mean capsule width (mm)	Seeds/ capsule	Days to flowering (50 %)
1	12	13	14	15	16	17
BD-6987	12.92	0.16	29.33	9.00	38.33	46
BD-6988	15.77	0.14	29.33	9.67	46.00	48
BD-6989	15.65	0.15	23.33	6.00	50.33	46
BD-6995	2.97	0.16	26.33	5.33	57.67	45
BD-6983	8.83	0.23	24.33	11.33	33.33	43
BD-6986	15.75	0.24	27.00	6.00	46.00	48
Kalotil	32.95	0.16	29.00	6.33	85.67	45.67
BD-6984	9.52	0.16	29.00	6.00	30.67	47
BD-6971	8.24	0.18	26.00	6.67	25.00	45
BD-6970	7.76	0.9	28.67	7.67	23.00	47
BD-6968	24.84	0.16	26.67	5.67	24.33	47
BD-6962	10.01	0.24	24.67	5.67	26.67	44
BD-6982	12.73	0.22	26.00	5.67	28.33	44
Binatil-2	8.25	0.23	24.67	7.33	23.33	43
BD-6981	45.19	0.3	25.67	7.67	74.00	47
BD-6979	57.71	0.28	29.33	6.00	58.67	45
BD-6972	38.24	0.25	26.67	6.33	52.33	46
BD-6978	30.98	0.13	25.00	7.00	67.00	43
Binatil-3	17.17	0.16	25.67	7.67	67.67	45
BD-6993	16.01	0.24	22.00	7.67	66.67	43
BD-6994	14.26	0.2	22.00	6.67	48.33	45
BD-6991	16.60	0.21	24.67	8.33	47.67	46
BD-6992	6.20	0.17	26.33	7.67	29.33	45.67
BD-6990	10.11	0.14	22.00	10.00	31.00	47
BD-6980	10.82	0.17	25.00	5.33	31.00	44
BD-6966	13.25	0.19	20.67	7.00	46.67	44
BD-6964	9.02	0.23	22.33	6.00	46.00	40.33
BD-6985	8.78	0.31	24.33	7.00	42.00	45.67
Binatil-4	11.91	0.35	24.67	6.67	69.33	45.67
Sadatil	15.77	0.18	25.67	5.67	61.67	49.33
Max	57.71	0.90	29.33	11.33	85.67	49.33
Min	2.97	0.13	20.67	5.33	23.00	40.33
Mean	13.09	0.20	25.67	6.67	46.00	45.67
SD	12.38	0.138	2.3949	1.46	17.31	1.864

11.6.6. Characterization of Peanut Germplasm

Exploring the genetic variation is the base of peanut (*Arachis hypogaea* L.) breeding program since peanut is an important food legumes and oilseed crop of the world. The aim of the present study is to characterize 33 germplasm of peanut based on the DUS descriptors. The experiment was conducted at the experimental field of Department of Agronomy, Bangladesh Agricultural University, Mymensingh during kharif 2020. On the basis of DUS descriptors, peanut varieties were characterized for twenty five morphological traits. A significant amount of variation was observed for most of the traits studied. The results revealed that maximum variation was recorded in growth habit, branching pattern, leaflet shape, leaflet surface, pod beak, pod constriction, pod reticulation, pod width, leaflet length and pod yield per plant. On the basis of frequency distribution, a majority of peanut germplasm was found in erect type, with alternate branching pattern; moderately stem surface, light green leaf color, oblong leaflet shape, hairy leaflet margin, acute leaflet tip, moderate pod beak and rose color seed. There were no variation in peg pigmentation and seed color.

Above study revealed the distinct characteristics of peanut germplasm and indicated that morphological variations exist in these germplasm due to variation in genetic makeup and could be better utilized by breeders in the selection based on their specific requirement for breeding programme. The list of the experimental materials along with their collector's number is shown in table 127.

Table 127. List of test peanut germplasm

Sl. No.	Name	Collector's Number	Sl. No.	Name	Collector's Number
1	7112-4-4-1	FI-29	18	ICGV-1901	FI-45
2	7112-2-1-2	FI-30	19	ICGV-5261	FI-46
3	ICGV-94322	FI-31	20	PK-1	FI-47
4	9112-2-1-1	FI-32	21	Beijing-2	FI-48
5	ICGV-1352	FI-33	22	ISD-4414	FI-49
6	Khenkhon	F-02	23	Vietnam	FI-50
7	ICGV-93389	FI-34	24	Mahosha	FI-51
8	7112-4-3-1	FI-35	25	ICGV-347	FI-52
9	9112-2-1-2	FI-36	26	ICGV-87055	FI-53
10	ICGV-94062	FI-37	27	ICGV-5268	FI-54
11	Binachinabadam-4	FI-38	28	ICGV-93199	FI-55
12	SM-6	FI-39	29	BARIBadam-9	FI-56
13	7112-4-1-2	FI-40	30	ISD-1314	FI-57
14	ICGV-4514	FI-41	31	ICGV-94366	FI-58
15	ICGV-211	FI-42	32	ICGV-88388	FI-59
16	9112-5-2-2	FI-43	33	Boro Elachibadam	H-03
17	China-1	FI-44			

The qualitative characters for germplasm are presented in table 128. Range, mean, standard deviation and coefficient of variation of quantitative characters were calculated (Table 129).

Qualitative descriptor

Qualitative variations of different characters in peanut are shown in Table 128. Most of germplasm were erect type (57.58 %), 30.30% germplasm were Decumbent-3 type, two germplasm were found in Procumbent-2, one in Decumbent-1 and one in Decumbent-2 type plant growth habit. only two germplasm were determinate (6.67%), erect (53.33%), semi-erect (26.67%) and prostrate (6.67%) were found on plant growth habit. Among the 33 germplasm, only two germplasm showed irregular with flower on main stem, five germplasm showed irregular without flower on main stem and most of the germplasm (26) had alternate branching pattern. Stem pigmentation was absent in all germplasm except two germplasm (7112-4-4-1 and ICGV-94322). But peg pigmentation was absent in all germplasm.

Leaf characters varied significantly among the germplasm. In case of leaf color, 39.39% germplasm were found light green, 24.24 % were yellow and 36.36 % germplasm were orange yellow. Among the 33 germplasm, 3 germplasm had elliptic type in leaflet shape, 15 had oblong- elliptic, one had narrow-elliptic and 11 had wide elliptic, one had narrow- elliptic and only two had ovate leaflet shape. In case of leaflet margin, 63.64% germplasm had hairy leaflet margin and 15.15% germplasm had entire. There were three types leaflet tip, among the germplasm 18 germplasm were acute, 8 were mucronate and 5 were entire. All the germplasm were 2-1 seeded pod. On the basis of pod beak, 22 had moderate, 8 had slight, one prominent and 3 had not pod beak. Among the 33 germplasm, 12 had not any pod constriction, 10 had moderate, 7 had slight and one had deep pod constriction. All germplasm are in one color. In case of primary seed color, most of the germplasm were rose in color.

Table 128. Qualitative descriptors for test peanut germplasm

Sl. no.	Character	State of characters	No. of germplasm	Germplasm's serial No. (List in Table 129)	Frequency (%)
1	Growth habit	Procumbent-2	2	28, 31	6.06
		Decumbent-1	1	32	3.03
		Decumbent-2	1	3	3.03
		Decumbent-3	10	1,2, 4, 7, 8, 20, 22, 23, 27, 30	30.30
		Erect	19	5,6,9,10,11,12,13,14,15,16,17,18,19,21,24,25,26,29, 33	57.58
2	Branching Pattern	Alternate	26	1, 2, 4, 5, 6, 7, 8, 9, 11, 14, 16, 17, 18, 19, 20, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33	78.79
		Irregular with flower on main stem	2	3, 10	6.06
		Irregular without flower on main stem	5	12, 13, 15, 22, 21	15.15
3	Stem pigmentation	0 Absent	20	2,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22	60.61
		+ Present	2	1, 3	6.06
4	Stem surface	Sub glabrous	1	2	3.03
		Moderately hairy	26	1, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32	78.79
		Very hairy	5	6, 7, 20, 21, 33	15.15
		Woolly	1	15	3.03
5	Peg pigmentation	Absent (0)	33	All the germplasm	100
		Present(+)	0	-	0
6	Leaf color	Light green	13	1, 3, 11, 12, 14, 15, 17, 20, 28, 29, 30, 31, 33	39.39
		Yellow	8	2, 6, 7, 10, 13, 18, 21, 24	24.24
		Orange yellow	12	4, 5, 8, 9, 16, 19, 22, 23, 25, 26, 27, 32	36.36
7	Leaflet shape	Elliptic	3	20, 29, 31	9.09
		Oblong- elliptic	15	2, 3, 4, 5, 6, 9, 13, 14, 16, 18, 21, 24, 26, 28, 30, 32	45.45
		Narrow-elliptic	1	25	3.03
		Wide- elliptic	11	7, 10, 11, 12, 15, 17, 19, 22, 23, 27, 33	33.33
		Ovate	2	1, 8	6.06
8	Leaflet surface	Almost glabrous on both surface	1	24	3.03
		Almost glabrous bellow, hair above	4	1, 4, 29, 33	12.12
		Hairs on both surface, without bristol	21	2, 3, 5, 6, 7, 9, 12, 14, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 30, 31, 32	63.64
		Hairs on both surface, with bristol	3	11, 15, 17	9.09
		Woolly without bristol	3	8, 10, 13	9.09
		Woolly with bristol	1	16	3.03
9	Leaflet margin	Entire	5	1, 2, 3, 4, 12	15.15
		Hairy	21	5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26	63.64
10	Leaflet tip	Obtuse	4	1, 2, 21, 28	12.12
		Acute	18	3, 8, 11, 13, 14, 15, 16, 18, 19, 20, 22, 23, 24, 25, 27, 30, 31, 33	54.55
		Mucronate	8	4, 9, 10, 12, 17, 26, 29, 32	24.24
11	No. of seeds/pod	2-1 seed	33	All the germplasm	100
12	Pod beak	Absent	3	7, 11, 28	9.09
		Slight	8	1, 4, 5, 6, 9, 22, 25, 27	24.24
		Moderate	22	2, 3, 8, 10, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 26, 29, 30, 31, 32, 33	66.67
		Prominent	1	16	3.03

Cont'd. Table 128.

Sl.#	Character	State of characters	No. of germplasm	Germplasm's serial No. (List in Table 129)	Frequency (%)
13	Pod constriction	None	12	3, 7, 11, 12, 15, 18, 19, 22, 23, 24, 25, 29	36.36
		Slight	7	8, 9, 10, 13, 16, 17, 28	21.21
		Moderate	10	1, 2, 4, 5, 6, 9, 14, 20, 21, 27	30.30
		Deep	1	26	3.03
14	Pod reticulation	None	2	31, 32	6.06
		Slight	11	7, 10, 11, 12, 18, 23, 24, 25, 26, 27, 29	33.33
		Moderate	12	1, 2, 3, 5, 6, 8, 9, 15, 20, 28, 30, 33	36.36
		Prominent	6	4, 13, 14, 16, 19, 21	18.18
		Very prominent	2	17, 22	6.06
15	Seed color	One color	33	All the germplasm	100
16	Primary seed color	White	1	22	3.03
		Off-white	2	2, 12	6.06
		Rose	28	4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33	84.85
		Light red	2	1, 2	6.06

B. Quantitative descriptor

Quantitative variations of 9 descriptors in peanut are shown in Table 129. The height of main stem ranged 7.33 to 35 cm. The highest plant was found in 9112-2-1-1 (35.00 cm) while the lowest 7.33 cm was observed in 7112-2-1-2 with a mean of 24.63 cm. The CV% and SD was found in plant height were 25.78% and 6.35, respectively. Plant width ranged from 3.67 cm to 19.33cm with a mean of 7.02. The highest plant width was found in 7112-4-4-1 while the lowest was observed in ICGV-4514. The highest CV (49.97%) was found in plant width. Leaflet length and width ranged from 10.67 to 28.33 mm and 1.47 to 5.40 cm with average of 4.65 and 1.12 respectively. Longest leaflet was found in ICGV-93389 while ICGV-5261 had produced the shortest (10.67) with an average of 19.90mm. Longest leaflet width was found in ISD-1314 while PK-1 had produced the shortest with an average of 3.63. Pod length and width of ranged from 10.67 (ICGV-1901) to 20.67 (ICGV-211) with the mean of 14.25mm and 4.00 (ICGV-1901) to 8.67 (Vietnam) with the mean of 5.71 respectively. Seed length ranged from 6.33 to 14.33 mm and seed width ranged from 1.90 to 3.13 mm. Long seed was found in ISD-4414 while ICGV-1901 had produced the shortest (6.33) with an average of 10.79 mm. Maximum seed width was found in ICGV-87055 while Mahosha had produced the shortest with an average of 2.52. The germplasm produced 3.19 g to 16.29 g yield per plant from ISD-4414 and 7112-4-3-1, respectively with an average of 10.44 g yield per plant was found.

Table 129. Quantitative variation in different descriptors of peanut germplasm

Sl. no.	Name of descriptor	Range	Mean	SD	CV (%)
1	Height of main stem (cm)	7.33-35.00	24.63	6.35	25.78
2	Plant width or spread (cm)	3.67-19.33	7.02	3.51	49.97
3	Leaflet length (mm)	10.67-28.33	19.90	4.65	23.35
4	Leaflet width (mm)	1.47-5.40	3.63	1.12	30.96
5	Pod length (mm)	10.67-20.67	14.25	2.49	17.47
6	Pod width (mm)	4.00-8.67	5.71	1.55	27.19
7	Seed length (mm)	6.33-14.33	10.79	2.33	21.59
8	Seed width (mm)	1.90-3.13	2.52	0.35	13.70
9	Yield/plant (g)	3.19-16.29	10.44	3.42	32.76

Conclusion

Wide variations were found among the 13 qualitative characters like plant growth habit, branching pattern, stem surface, leaflet shape, leaflet surface, pod beak, pod constriction, pod reticulation. Significant variations were found among the 9 quantitative characters such as plant width, leaflet length, yield per plant had shown significant difference among the germplasm. The maximum coefficient of variations was in plant width and minimum in pod length. Some promising germplasm (7112-4-4-1, 9112-2-1-1, 7112-4-3-1 and ICGV-347) were identified and these germplasm can be used for varietal development of peanut.

11.6.7. Genetic Diversity Analysis in Rice Landraces using SSR Markers

Plant materials

This study was conducted at pot yard and Molecular Laboratory of Plant Breeding Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh. Eighty-three rice landraces of different location of Bangladesh were studied (Table 130) using SSR marker. Each of the entry was sown in plastic pots for growth and subsequent DNA extraction.

Table 130. List of test rice germplasm used for molecular characterization

SL. No.	Local name	SL. No.	Local name
1.	Kuttimora Birun	43.	Kashia Binni
2.	Dudh Binni	44.	Chinishail-3
3.	Goa Mouri	45.	Goabari
4.	Chaklashi	46.	Marrygold
5.	Goar chara	47.	Lalkumri
6.	Hashem Iri	48.	Porbot Jira
7.	Lal Paijam	49.	Sentu-18
8.	Birui	50.	Sentu-19
9.	Shoragot Birun	51.	Lalmatia
10.	Aila gota	52.	Faijam
11.	Bedha Birun	53.	Leda Binni
12.	Ojana Birun	54.	Hasa Shada
13.	Lal goarchara	55.	Lal Chini shail
14.	Kaijam	56.	Peyarjat
15.	Kotkoti	57.	Shonajuri
16.	Lalcheng	58.	Mukta-10
17.	Puti birun	59.	Choto Sharnalota
18.	Noli Goarchara	60.	Motamorang
19.	Chanmoni	61.	Chapal
20.	Sentu-6	62.	Ful lota
21.	Chapal-2	63.	Sentu-5
22.	Lomba Ail	64.	Hashakalo
23.	Shada Paijam	65.	Champa Mushuri
24.	Birushail	66.	Madhobi lota
25.	Chini shail	67.	Sentu-16
26.	Chenger muri	68.	Nagra
27.	Sentushail	69.	Gobinda

SL. No.	Local name	SL. No.	Local name
28.	Chinigura	70.	Sentu-9
29.	Shong Binni	71.	Sentu-11
30.	Champa mushuri	72.	Tulshimala
31.	Bashiraj	73.	Sentu-17
32.	Gandhishail	74.	Hashashada
33.	Boro Abji	75.	Laldinga
34.	Malai reti	76.	Goatibinni
35.	Deshi-32	77.	Sentu-18
36.	Moynashail	78.	Porabinni
37.	Maloti	79.	Ranishail
38.	Chollish	80.	Shonajuri
39.	Paijam	81.	Bishali Binni
40.	Sentu gold	82.	Kalo Birun
41.	Markabinni	83.	Fulkainja
42.	Moyna shail		

Genotyping

Nine SSR markers (Table 131) were used for diversity analysis. Total genomic DNA was extracted from young leaves of three-week-old plants following CTAB method (Doyle and Doyle 1987). PCR analysis was performed in 10µl reaction sample containing 50 ng of DNA template of 2 µl, 5 µl of master mix, 2 µl nuclear free water, 1µl each of 10 µM forward and reverse primers using Biometra T₃ thermal cycler with single 96-well. After initial denaturation for five minutes at 94°C, each cycle comprised one min denaturation at 94°C, one min annealing at 55°C, and two min extension at 72°C with a final extension for 7 min at 72°C at the end of 35 cycles. The PCR products were analyzed by electrophoresis on 8% polyacrylamide gel using mini vertical polyacrylamide gels for high throughput manual genotyping (CBS Scientific Co. Inc., CA, and USA). 2µl of amplification products were resolved by running gel in 1x TBE buffer for 2-2.5 hrs depending upon the allele size at around 80 volts and 400 mA current. The gels were stained in 0.5 mg/ml ethidium bromide and were documented using Whatman Biometra gel Documentation System (prod nr: 1603209).

Table 131. List of simple sequence repeat (SSR markers)

Locus name	Amplicon size range(bp)	Repeat motif	Sequence	Annealing Temperature (°C)
RM493	211	(CTT) ⁹	Forward:TAGCTCCAACAGGATCGACC Reverse:GTACGTAAACGCGGAAGGTG	55
RM248	102	(CT) ²⁵	Forward :TCCTTGTGAAATCTGGTCCC Reverse: GTAGCCTAGCATGGTGCATG	55
RM262	154	(CT) ¹⁶	Forward :CATTCCGTCTCGGCTCAACT Reverse:CAGAGCAAGGTGGCTTGC	55
RM7075	155	(ACAT) ¹³	Forward:TATGGACTGGAGCAAACCTC Reverse:GGCACAGCACCAATGTCTC	50
RM224	157	(AAG) ⁸ (AG) ¹³	Forward:ATCGATCGATCTTCACGAGG Reverse:TGCTATAAAAGGCATTCCGGG	55
RM551	192	(AG) ¹⁸	Forward:AGCCCAGACTAGCATGATTG Reverse:GAAGGCGAGAAGGATCACAG	55

Locus name	Amplicon size range(bp)	Repeat motif	Sequence	Annealing Temperature (°C)
RM585	233	(TC) ⁴⁵	Forward: CAGTCTTGCTCCGTTTGTG	55
			Reverse: CTGTGACTGACTTGGTCATAGG	
RM3412b	211	(TA) ³⁴	Forward: TCATGATGGATCTCTGAGGTG	55
			Reverse: GGGAGGATGCACTAATCTTTC	
RM336	154	(CTT) ¹⁸	Forward: CTTACAGAGAAACGGCATCG	55
			Reverse: GCTGGTTTGTTCAGGTTTCG	

Data analysis

Molecular weight for each amplified allele was measured in base pair using Alpha-Ease 5.0 software. The summary statistics including the number of alleles per locus, major allele frequency, gene diversity, polymorphism information content (PIC) values were analysed using Power Marker - 3.25 (Liu and Muse, 2005). For the unrooted phylogenetic tree, genetic distance was calculated using the “C.S. Chord 1967” distance measure (Cavalli-Sforza and Edwards, 1967) followed by phylogeny reconstruction using neighbourjoining as implemented in Power Marker using Treeview (Page, 1996).

Ninety-six rice landraces were successfully amplified with the nine micro-satellite markers where primer pairs referred to as loci and DNA bands as alleles. A total of 262 alleles were detected using nine micro-satellite markers across 83 rice landraces. The highest average band size was found for RM585 (233) followed by RM493 (211), and RM3412b (205). Among the nine SSR markers, the highest number of alleles (34) was found for RM336 followed by RM248 (33) and RM585 (32). The polymorphism information content (PIC) values ranged from 0.951 (RM336) to 0.766 (RM262), with an average of 0.90. The PIC values for other markers were 0.910 (RM493), 0.844 (RM7075), 0.913 (RM224) and 0.926 (RM551), respectively (Table 132). PIC value revealed RM336 as the best marker. Figure 91 shows the polymorphism survey of some SSR marker of two landraces. The allele frequency ranged from 37.35% (RM262) to 10.84% (RM585, RM336) with an average of 18.47%. Gene diversity varied from 0.95 to 0.78 and their average value was 0.91, which also indicated the presence of adequate genetic diversity (Table 132). Figure 92 and 93 shows the DNA profiles of 83 landraces with SSR marker RM493 and RM262, respectively (Figs. 91-93).

Table 132. Allele number, frequency, genetic diversity and PIC of 83 rice landraces screened with nine micro-satellite markers

Locus name	No. of Allele	Allele Frequency (%)	Gene Diversity	PIC
RM493	27	0.2169	0.9154	0.9106
RM248	33	0.1084	0.9531	0.9512
RM262	13	0.3735	0.7891	0.7660
RM7075	16	0.2530	0.8585	0.8443
RM224	25	0.2048	0.9186	0.9139
RM551	26	0.1205	0.9310	0.9269
RM585	32	0.1084	0.9496	0.9474
RM3412b	28	0.1687	0.9369	0.9338
RM336	34	0.1084	0.9537	0.9518
Mean	26	0.1847	0.9118	0.9051

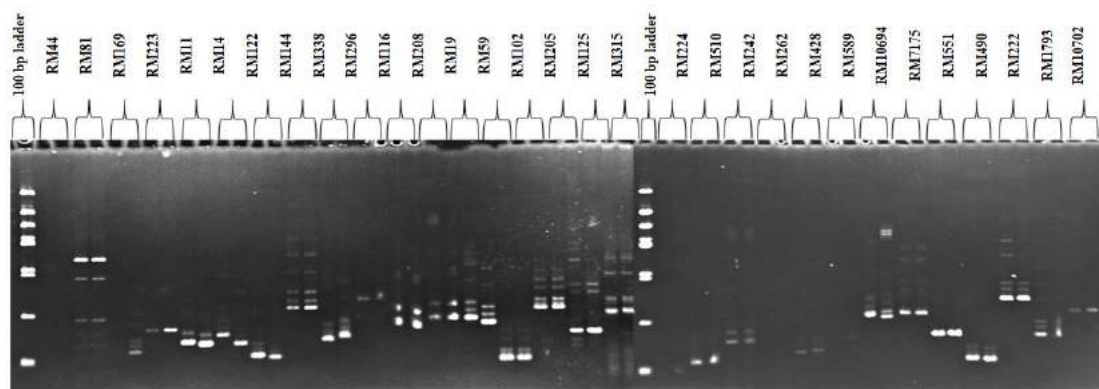


Fig. 91. Primer survey of two rice landraces

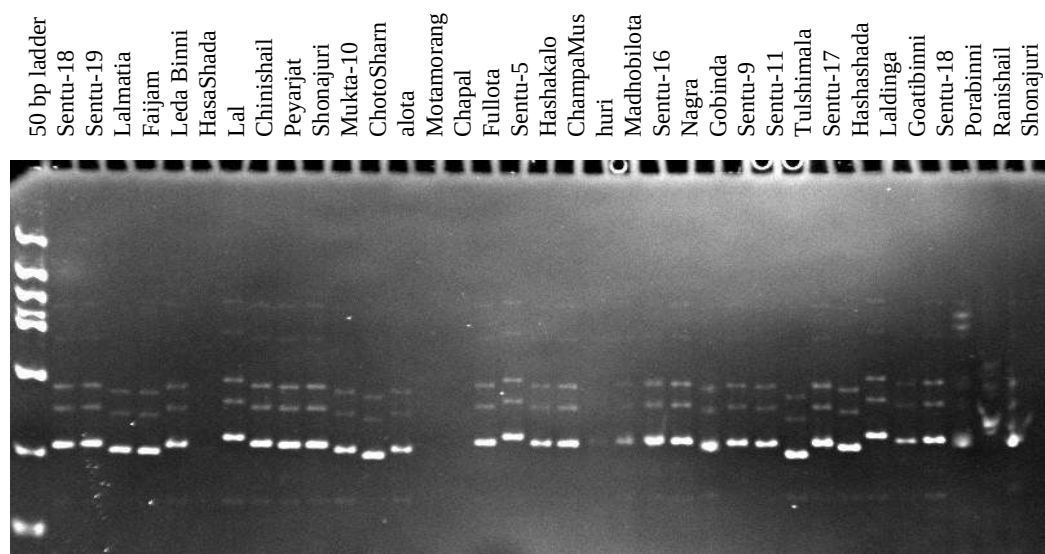
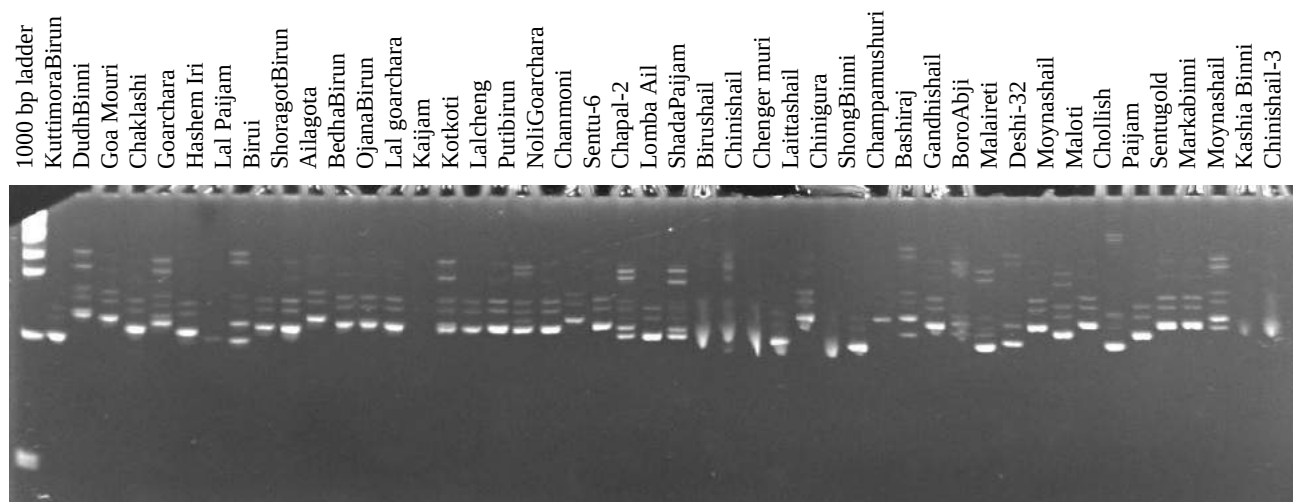


Fig. 92. DNA profile of 83 rice landraces with marker, RM493

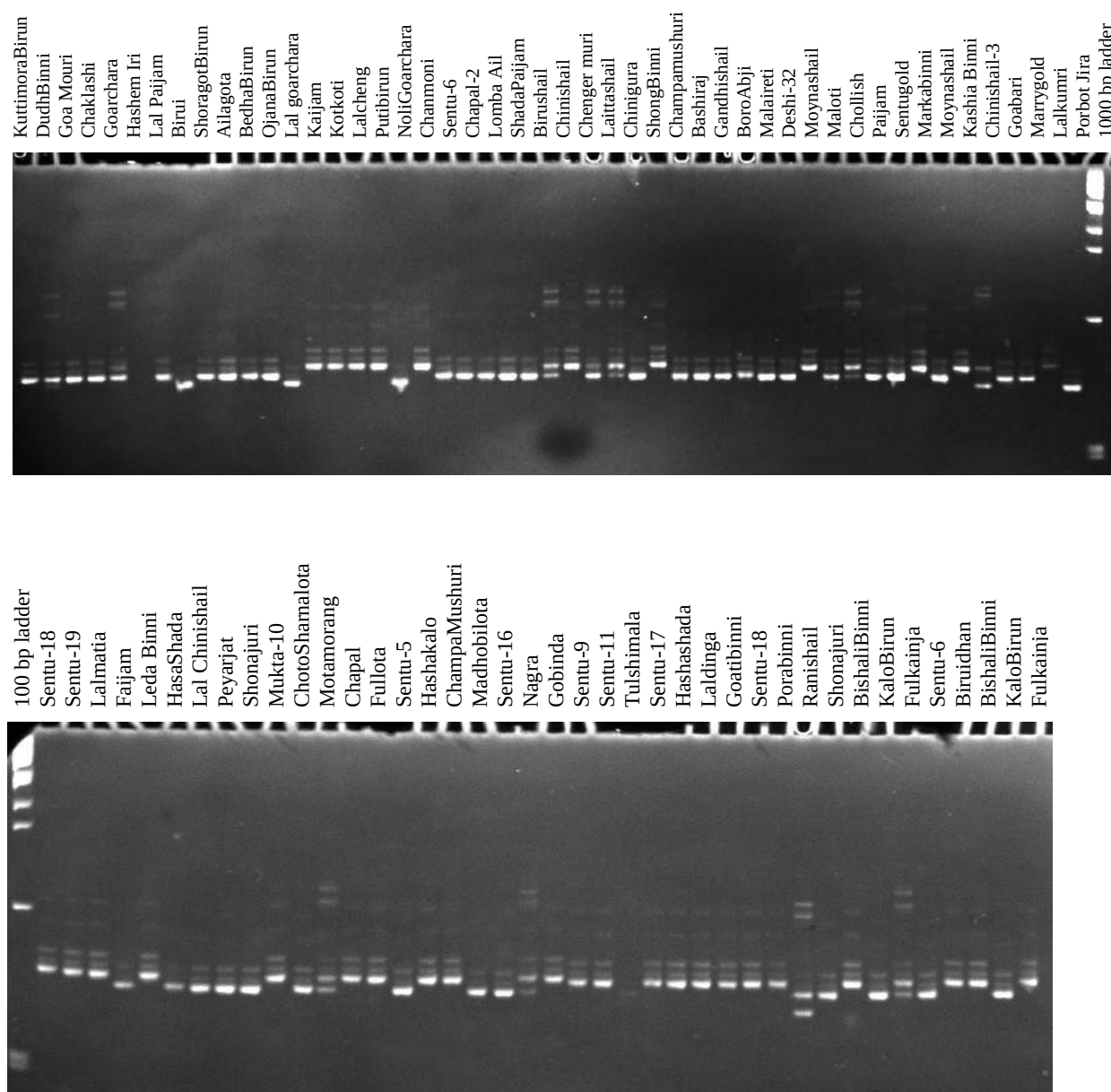


Fig. 93. DNA profile of 83 rice landraces with marker, RM262

Genetic distance-based analysis

Cluster analysis was done to group the genotypes into a dendrogram. From this dendrogram, the 83 rice landraces were grouped into five major clusters by 9 markers. All the 83 rice genotypes could be easily distinguished. The UPGMA cluster analysis led to the grouping of 83 rice genotypes in five major clusters at a coefficient of 0.6 and the similarity coefficient value ranged from 0.08 to 1.0. Cluster 2 consisted of 31 landraces and is the biggest group among five clusters, followed by cluster 4, which contained 30 landraces; cluster 3 comprised 11 landraces; cluster 1 comprised 6 landraces; cluster 5 was composed of 5 landraces (Fig. 94).

Conclusion

The traditional rice landraces can propose a valuable gene pool. There was a high level of genetic diversity among landraces of rice. In this study, it is suggested that SSR markers were effective in the detection of polymorphism in this ecosystem. To broaden the genetic base and for the improvement of rice, landraces having the lowest genetic similarities could be selected as parents. Therefore, hybridization may be made between two distant populations. Considering all these criteria and results from genetic diversity analysis, landraces that are far apart based on their genetic distance (like Kuttimura Biruin and Puti Biruin; Bedha Birun and Lalgoarchara; Ranishail and Gandhishail; Ojana Birun and Laldinga; Dudh Binni and Lalcheng; Chinigura and Noli Goarchara etc.) could be selected as parents for further breeding programs.

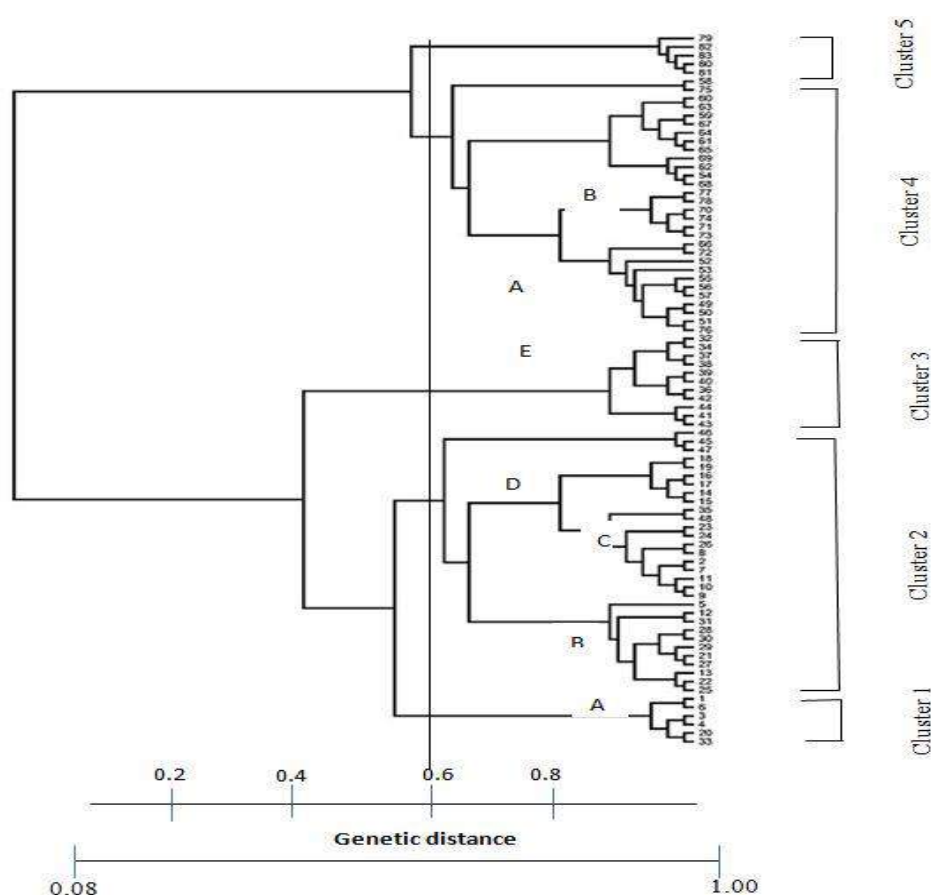


Fig. 94. An UPGMA dendrogram showing genetic relationships among 83 rice landraces based on alleles detected by nine micro-satellite markers

Legend: 1-Kuttimora Birun, 2-Dudh Binni, 3-Goa Mouri, 4-Chaklashi, 5-Goar chara, 6-Hashem Iri, 7-Lal Paijam, 8-Birui, 9-Shoragot Birun, 10-Aila gota, 11-Bedha Birun, 12-Ojana Birun, 13-Lal goarchara, 14-Kaijam, 15-Kotkoti, 16-Lalcheng, 17-Puti birun, 18-Noli Goarchara, 19-Chanmoni, 20-Sentu-6, 21-Chapal-2, 22-Lomba Ail, 23-Shada Paijam, 24-Birushail, 25-Chini shail, 26-Chenger muri, 27-Laittashail, 28-Chinigura, 29-Shong Binni, 30-Champa mushuri, 31-Bashiraj, 32-Gandhishail, 33-Boro Abji, 34-Malai reti, 35-Deshi-32, 36-Moynashail, 37-Maloti, 38-Chollish, 39-Paijam, 40-Sentu gold, 41-Markabinni, 42-Moyna shail, 43-Kashia Binni, 44-Chinishail-3, 45-Goabari, 46-Marry gold, 47-Lalkumri, 48-Porbot Jira, 49-Sentu-18, 50-Sentu-19, 51-Lalmatia, 52-Faijam, 53-Leda Binni, 54-Hasa Shada, 55-Lal Chinishail, 56-Peyarjat, 57-Shonajuri, 58-Mukta-10, 59-Choto Sharnalota, 60-Motamorang, 61-Chapal, 62-Ful lota, 63-Sentu-5, 64-Hashakalo, 65-Champa Mushuri, 66-Madhobi lota, 67-Sentu-16, 68-Nagra, 69-Gobinda, 70-Sentu-9, 71-Sentu-11, 72-Tulshimala, 73-Sentu-17, 74-Hashashada, 75-Laldinga, 76-Goatibinni, 77-Sentu-18, 78-Porabinni, 79-Ranishail, 80-Shonajuri, 81-Bishali Binni, 82-Kalo Birun, 83-Fulkainja

11.6.8. Conservation of Collected Germplasm

BINA collected 198 rice, oilseeds, pulses, spices and vegetables germplasm from Mymensingh, Tangail and Sylhet regions. Collected germplasm were multiplied in respective season and conserved in mid and short term storage room assigning accession number during March 2019 to September 2020. After confirmation 99-100% germination rate of multiplied or regenerated seeds were preserved with appropriate moisture % and quantity.

Table 133. Conservation status of germplasm collected under PBRG-PGR sub-project

Sl. No.	Cultivar name	Collector's No.	Quantity of seeds conserved (g)	Moisture content (%)	Germination rate (%)	Date of conservation	Acc. No.
Rice							
1.	Gaindha	MM-30	200g	12	100	March 2019	BINA-1780
2.	Purabinni	MM-1	200g	12	100	March 2019	BINA-1781
3.	Fulkainja	MM-26	200g	12	100	March 2019	BINA-1782
4.	Rupashail	MM-23	200g	12	100	March 2019	BINA-1783
5.	Leda binni	MM-19	200g	12	100	March 2019	BINA-1784
6.	Biroi-2	MM-17	200g	12	100	March 2019	BINA-1785
7.	Chapal-1	MM-16	200g	12	100	March 2019	BINA-1786
8.	Sentu-15	MM-29	200g	12	100	March 2019	BINA-1786
9.	Sentu-19	MM-22	200g	12	100	March 2019	BINA-1787
10.	Lalchinishail	MM-07	200g	12	100	March 2019	BINA-1788
11.	Dudhbinni	MM-27	200g	12	100	March 2019	BINA-1789
12.	Champamashuri	MM-24	200g	12	100	March 2019	BINA-1790
13.	Chotosornolota	MM-28	200g	12	100	March 2019	BINA-1791
14.	Motamorang	MM-08	200g	12	100	March 2019	BINA-1792
15.	Pairjaat	MM-12	200g	12	100	March 2019	BINA-1793
16.	Sentu gold	MM-15	200g	12	100	March 2019	BINA-1794
17.	Markabini	MM-05	200g	12	100	March 2019	BINA-1795
18.	Bishalibini	MM-06	200g	12	100	March 2019	BINA-1796
19.	Goatibinni-1	MM-04	200g	12	100	March 2019	BINA-1797
20.	Shongbini	MM-18	200g	12	100	March 2019	BINA-1798
21.	Sentu-18	MM-21	200g	12	100	March 2019	BINA-1799
22.	Fullota	MM-20	200g	12	100	March 2019	BINA-1800
23.	Mery gold	MM-10	200g	12	100	March 2019	BINA-1801
24.	Lalmatia	MM-32	200g	12	100	March 2019	BINA-1802
25.	Chapal-2	MM-14	200g	12	100	March 2019	BINA-1803
26.	Sentu-6	MM-31	200g	12	100	March 2019	BINA-1804
27.	Sentushail	MM-13	200g	12	100	March 2019	BINA-1779
28.	Sentu-17	MM-25	200g	12	100	March 2019	BINA-1778
29.	Sentu-16	MM-09	200g	12	100	March 2019	BINA-1777
30.	Ranishail	MM-11	200g	12	100	March 2019	BINA-1776
31.	Sentu-5/Malonchi	MM-02	200g	12	100	March 2019	BINA-1775
32.	Kalahapa	H-01	200g	12	100	January 2020	BINA-1772
33.	Binnatoa	FA-01	200g	12	100	January 2020	BINA-1770
34.	Gourohati	FA-02	200g	12	100	January 2020	BINA-1769
35.	Begunbichi	FA-03	200g	12	100	January 2020	BINA-1768
36.	Rati Boro (local Aromatic rice)	FHS-01	200g	12	100	January 2020	BINA-1767
37.	Lafaya	FHS-02	200g	12	100	January 2020	BINA-1766
38.	Chengri	FM-01	200g	12	100	January 2020	BINA-1765

Cont'd. Table 133.

Sl. No.	Cultivar name	Collector's No.	Quantity of seeds conserved (g)	Moisture content (%)	Germination rate (%)	Date of conservation	Acc. No.
39.	Arai	FM-02	200g	12	100	January 2020	BINA-1764
40.	Laldinga	FMM-01	200g	12	100	January 2020	BINA-1763
41.	Local (Boro)	FMM-02	200g	12	100	January 2020	BINA-1762
42.	Lalkumri	FS-01	200g	12	100	January 2020	BINA-1761
43.	Bishalibinni	FS-02	200g	12	100	January 2020	BINA-1760
44.	Paijam	FS-03	200g	12	100	January 2020	BINA-1759
45.	Gobinda	FS-04	200g	12	100	January 2020	BINA-1758
46.	Tulsimala	FS-05	200g	12	100	January 2020	BINA-1757
47.	Biroi	FS-06	200g	12	100	January 2020	BINA-1756
48.	Chanmoni	FS-07	200g	12	100	January 2020	BINA-1755
49.	Hashemirri	FS-08	200g	12	100	January 2020	BINA-1754
50.	Lal paijam	FS-09	200g	12	100	January 2020	BINA-1753
51.	Boroabji	FS-10	200g	12	100	January 2020	BINA-1752
52.	Chinisail	FS-11	200g	12	100	January 2020	BINA-1751
53.	Kalojira	FS-12	200g	12	100	January 2020	BINA-1750
54.	Bashiraj	FS-13	200g	12	100	January 2020	BINA-1749
55.	Lombaail	FS-14	200g	12	100	January 2020	BINA-1748
56.	Nagra	FS-15	200g	12	100	January 2020	BINA-1747
57.	Maloti	FS-16	200g	12	100	January 2020	BINA-1746
58.	Guamouri	FS-17	200g	12	100	January 2020	BINA-1745
59.	Chinisail-3	FS-18	200g	12	100	January 2020	BINA-1744
60.	Molairiti	FS-19	200g	12	100	January 2020	BINA-1743
61.	Putibirun	FS-20	200g	12	100	January 2020	BINA-1742
62.	Kutimurar birun	FS-21	200g	12	100	January 2020	BINA-1741
63.	Guarchara	FS-22	200g	12	100	January 2020	BINA- 1740
64.	Chinigura	FS-23	200g	12	100	January 2020	BINA-1739
65.	Soragotobirun	FS-24	200g	12	100	January 2020	BINA-1738
66.	Atonishail	FM-37	200g	12	100	February 2020	BINA-1781
67.	Gandhishail	FM-38	200g	12	100	February 2020	BINA-1782
68.	Chinishail-3	FS-18	200g	12	100	February 2020	BINA-1783
69.	Moinashail-1	FS-40	200g	12	100	February 2020	BINA-1784
70.	Birushail	FM-35	200g	12	100	February 2020	BINA-1785
71.	Laittashail	FM-36	200g	12	100	February 2020	BINA-1786
72.	Moinashail-2	FM-39	200g	12	100	February 2020	BINA-1787
73.	Biroi-1	MM-17	200g	12	100	February 2020	BINA-1788
74.	Biroi dhan-1	FS-27	200g	12	100	February 2020	BINA-1789
75.	Biroi-3	FM-06	200g	12	100	February 2020	BINA-1790
76.	Birun-1	FM-13	200g	12	100	February 2020	BINA-1791
77.	Birun-2	FM-14	200g	12	100	February 2020	BINA-1792
78.	Soragoto birun	FS-24	200g	12	100	February 2020	BINA-1793
79.	Ojana birun	FS-26	200g	12	100	February 2020	BINA-1794
80.	Kalobirun	FS-39	200g	12	100	February 2020	BINA-1795
81.	Bedabirun	FS-42	200g	12	100	February 2020	BINA-1796
82.	Asamyo birun	FM-08	200g	12	100	February 2020	BINA-1797
83.	Lal birun	FM-10	200g	12	100	February 2020	BINA-1798
84.	Paijam	FS-36	200g	12	100	February 2020	BINA-1799
85.	Faijam	FS-41	200g	12	100	February 2020	BINA-1800
86.	Desi paijam	FM-22	200g	12	100	February 2020	BINA-1801
87.	Sada paijam	FM-25	200g	12	100	February 2020	BINA-1802
88.	Painjab	FM-26	200g	12	100	February 2020	BINA-1803
89.	Biroi dhan-2	FS-27	200g	12	100	February 2020	BINA-1804
90.	Biroi-4	FM-	200g	12	100	February 2020	BINA-1632
91.	Kalijira	MSF-01	200g	12	100	February 2020	BINA--1633

Cont'd. Table 133.

Sl. No.	Cultivar name	Collector's No.	Quantity of seeds conserved (g)	Moisture content (%)	Germination rate (%)	Date of conservation	Acc. No.
92.	Desi kalojira	FM-19	200g	12	100	February 2020	BINA-1634
93.	Guarchara	FS-22	200g	12	100	February 2020	BINA-1635
94.	Chinigura-1	FS-23	200g	12	100	February 2020	BINA-1636
95.	Chinigura -2	FM-18	200g	12	100	February 2020	BINA-1637
96.	Chiniguri	MFS-21	200g	12	100	February 2020	BINA-1638
97.	Guabari	M-23	200g	12	100	February 2020	BINA-1639
98.	Chakloshi	FS-25	200g	12	100	February 2020	BINA-1640
99.	Cplash	FM-15	200g	12	100	February 2020	BINA-1641
100.	Mukta	FS-28	200g	12	100	February 2020	BINA-1642
101.	Deshi-32	FS-29	200g	12	100	February 2020	BINA-1643
102.	Hashakalo	FS-30	200g	12	100	February 2020	BINA-1644
103.	Shonajuri	FS-31	200g	12	100	February 2020	BINA-1645
104.	Hasa sada	FS-32	200g	12	100	February 2020	BINA-1646
105.	Chenger muri-2	FM-17	200g	12	100	February 2020	BINA-1647
106.	Parbotjira	FS-34	200g	12	100	February 2020	BINA-1648
107.	Noliguar Chara	FS-35	200g	12	100	February 2020	BINA-1649
108.	Laal cheng	FS-37	200g	12	100	February 2020	BINA-1650
109.	Ailaguta	FS-38	200g	12	100	February 2020	BINA-1651
110.	Chollish (40)	FM-3	200g	12	100	February 2020	BINA-1652
111.	Chechollish (46)	FM-4	200g	12	100	February 2020	BINA-1653
112.	Bolok	FM-5	200g	12	100	February 2020	BINA-1654
113.	Abdul Halim dhan	FM-07	200g	12	100	February 2020	BINA-1655
114.	Deshi-32	FM-20	200g	12	100	February 2020	BINA-1656
115.	Desi paijam	FM-22	200g	12	100	February 2020	BINA-1657
116.	Laal paijam	FM-23	200g	12	100	February 2020	BINA-1658
117.	Sada paijam	FM-25	200g	12	100	February 2020	BINA-1659
118.	Painjab	FM-26	200g	12	100	February 2020	BINA-1660
119.	Goarchara-3	FM-27	200g	12	100	February 2020	BINA-1661
120.	Goarchara-2	FM-28	200g	12	100	February 2020	BINA-1662
121.	Guarchara-1	FS-22	200g	12	100	February 2020	BINA-1663
122.	Khudbadal/ Chinigura	FM-29	200g	12	100	February 2020	BINA-1664
123.	Kotkoti	FM-30	200g	12	100	February 2020	BINA-1665
124.	Maloti	FM-31	200g	12	100	February 2020	BINA-1666
125.	Maloti-2	FM-32	200g	12	100	February 2020	BINA-1667
126.	Murabadam	FM-34	200g	12	100	February 2020	BINA-1668
127.	Jiradhan	MSF-02	200g	12	100	February 2020	BINA-1669
128.	Jirabuti	MSF-03	200g	12	100	February 2020	BINA-1670
129.	Rajbuti	MSF-04	200g	12	100	February 2020	BINA-1671
130.	Chiniatob	MSF-05	200g	12	100	February 2020	BINA-1672
131.	Chini sakchor	MSF-06	200g	12	100	February 2020	BINA-1673
132.	Shakchor khora	MSF-07	200g	12	100	February 2020	BINA-1674
133.	Kaonkhir	MSF-08	200g	12	100	February 2020	BINA-1675
134.	Khirshabuti	MSF-09	200g	12	100	February 2020	BINA-1676
135.	Khirsapat	MKF-01	200g	12	100	February 2020	BINA-1677
136.	Sadagura	MSF-10	200g	12	100	February 2020	BINA-1678
137.	Doiorgura	MSF-11	200g	12	100	February 2020	BINA-1679
138.	Chanmoni	MSF-13	200g	12	100	February 2020	BINA-1680
139.	Ranjit	MSF-14	200g	12	100	February 2020	BINA-1681
140.	Sylhet balam	MSF-15	200g	12	100	February 2020	BINA-1682
141.	Lalbalam	MSF-16	200g	12	100	February 2020	BINA-1683
142.	Shatta	MSF-18	200g	12	100	February 2020	BINA-1684

Cont'd. Table 133.

Sl. No.	Cultivar name	Collector's No.	Quantity of seeds conserved (g)	Moisture content (%)	Germination rate (%)	Date of conservation	Acc. No.
143.	Hutra	MSF-19	200g	12	100	February 2020	BINA-1685
144.	Ajanta	MSF-20	200g	12	100	February 2020	BINA-1686
145.	Kasalath	MSF-17	200g	12	100	February 2020	BINA-1687
146.	Halui	MKF-02	200g	12	100	February 2020	BINA-1688
147.	Ponkhiraj	FFH-01	200g	12	100	February 2020	BINA-1689
148.	Thoa	FFH-02	200g	12	100	February 2020	BINA-1690
149.	Bayful	FFH-05	200g	12	100	February 2020	BINA-1691
150.	Muraikka	FFH-08	200g	12	100	February 2020	BINA-1692
151.	Rataboro	FFH-09	200g	12	100	February 2020	BINA-1693
152.	Baiyakaichi	FFH-06	200g	12	100	February 2020	BINA-1694
Chilli							
153.	Superhot master	S-01	20g	10	100	Nov. 2019	BINA-2007
154.	Balijhuri morich (Shampur)	S-02	20g	10	100	Nov. 2019	BINA-2006
155.	Balijhuri (Kagmari)	S-03	20g	10	100	Nov. 2019	BINA-2005
156.	Chatamorich	S-04	20g	10	100	Nov. 2019	BINA-2004
157.	Ulto morich	S-05	20g	10	100	Nov. 2019	BINA-2003
Bitter gourd							
158.	Matikorla	M-01	75g	9	98	Nov. 2019	BINA-2023
159.	Bolder usta	M-02	75g	9	98	Nov. 2019	BINA-2022
160.	Goj korla	F-01	75g	9	98	July 2020	BINA-2021
161.	Soto elachibadam	H-02	300g	7.5	98	Sep. 2019	BINA-955
162.	Boro elachibadam	H-03	300g	7.5	98	Sep. 2019	BINA-954
163.	Tridanabadam	H-04	300g	7.5	98	Sep. 2019	BINA-953
164.	Khenkhen	F-02	300g	7.5	98	July 2020	BINA-956
165.	Deshi sorisha (Sunamganj)	FMM-13	200g	12	100	July 2020	BINA-351
166.	Sadatil	F-03	200g	12	100	July 2020	BINA-651
167.	Kalotil	F-04	200g	12	100	July 2020	BINA-652
Sweet gourd							
168.	Matilau	FM-06	300g	6-8	98	Jan. 2020	BINA-2058
169.	Oron khola Local Modhupur	FM-07	300g	6-8	98	Jan. 2020	BINA-2057
170.	Zolchotro lau/khet lau	FM-08	300g	6-8	98	Jan. 2020	BINA-2056
White gourd							
171.	Sunamganj local	FMM-14	300g	6-8	98	Jan. 2020	BINA-2068
172.	Vabokhali Local	FM-03	300g	6-8	98	Jan. 2020	BINA-2067
173.	Modhupur Local (Sinha)	FM-04	300g	6-8	98	Jan. 2020	BINA-2066
Sponge gourd							
174.	Sogorika	FM-10	250g	6-8	98	Jan. 2020	BINA-3004
Turmeric							
175.	Kishoreganj local	H-06	500g	65	98	Jan. 2020	BINA-1911
176.	Modhupur local	FM-13	500g	65	98	Jan. 2020	BINA-1910
Ginger							
177.	local Haluaghat	FM-11	500g	65	98	Jan. 2020	BINA-1981
178.	Modhupur local	FM-12	500g	65	98	Jan. 2020	BINA-1980

Cont'd. Table 133.

Sl. No.	Cultivar name	Collector's No.	Quantity of seeds conserved (g)	Moisture content (%)	Germination rate (%)	Date of conservation	Acc. No.
Brinjal							
179.	Taal Begun	M-03	100g	12	98	Jan. 2020	BINA-2068
180.	Mymensingh Local	M-4	100g	12	98	Jan. 2020	BINA-2067
181.	Local Begun	M-5	100g	12	98	Jan. 2020	BINA-2071
182.	Singnath	FMM-11	100g	12	98	Jan. 2020	BINA-2070
183.	Mohisasing	FMM-12	100g	12	98	Jan. 2020	BINA-2069
184.	Islampuri begun	FMI-01	100g	12	98	Jan. 2020	BINA-2072
185.	Gaforgaon Begun	FMI-02	100g	12	98	Jan. 2020	BINA-2073
186.	Jhumki begun	FMI-03	100g	12	98	Jan. 2020	BINA-2074
187.	Golbegun	FMI-04	100g	12	98	Jan. 2020	BINA-2075
188.	Blackgram (Maskalai local)	H-05	100g	12	98	Jan. 2020	BINA-2076
Okra							
189.	Baromasi	FM-35	100g	12	98	Sep. 2020	BINA-2035
190.	Sunamganj local	FM-36	100g	12	98	Sep. 2020	BINA-2036
191.	Modhupur local	FM-37	100g	12	98	Sep. 2020	BINA-2037
Bean							
192.	Khoilla sim	FMM-04	100g	12	98	February 2020	BINA-3004
193.	Sada nag	FMM-05	100g	12	98	February 2020	BINA-3005
194.	Ankhi sim	FMM-06	100g	12	98	February 2020	BINA-3006
195.	Hatir kani/ Goal gadda	FMM-07	100g	12	98	February 2020	BINA-3007
196.	Kaikka sim	FMM-08	100g	12	98	February 2020	BINA-3008
197.	Chitagaia sim	FMM-09	100g	12	98	February 2020	BINA-3009
198.	Bampata sim	FMM-10	100g	12	98	February 2020	BINA-3010

12. Research Highlights

12.3. Bangladesh Agricultural Research Institute

12.3.1. Title: Exploration and Collection of Plant Genetic Resources during January 2018- December 2020

Background: Plant genetic resources provide biological basis for world food security and support the livelihoods of mankind. Many plant species are in danger of extinction, threatened by habitat transformation, over-exploitation of natural resources, alien invasive species, pollution and climate change. It is essential to collect and conserve landraces, which possess some important characters regarding quality, tolerance to biotic and abiotic stresses etc. Future progress in crop improvement, food and nutrition security largely depends on conservation of vulnerable crop genetic resources and their sustainable use. The genetic resources are in danger not only in Bangladesh but all over the world and are being lost with the development of modern agriculture. Natural calamities occur almost every year, which is also one of the causes of genetic erosion. Systematic collection, conservation and utilization of genetic resources are very important for future generations to be able to breed crop varieties and face new challenges for food and nutritional security.

Objectives: i. to enrich genetic stock of PGRC, BARI genebank
ii. to rescue endangered PGR from erosion and
iii. to collect special genetic resources

Methodology: Fourteen (14) collecting missions were made for collection of different crops' germplasm from different regions of Bangladesh. Eleven teams such as NSR, SU, NRI, MRI, NSR, NQR, SN, SNQR, SAA, SSR and NQ were formed comprising 1-3 scientists in each team. Number of samples of a crop were depleted on the extent and availability of varieties observed during collection. The teams were equipped with plastic carton, GPS, compass, digital camera, hand lens, envelop, knife, scissors, drying sheet, pencil, stapler etc. Germplasm of target crops were collected from farmers' field/house/threshing floor and market especially from floating seed traders (Arora, 1991). Local extension services and scientists of BARI assisted the team in exploring the crops. Collector's number and date were recorded during collection. Name of crop species along with English, Bangla, local and cultivar name were recorded. Name of donor with ethnic group, village, union, upazila/thana, district, latitude and longitude were noted. Type of soil, topography, sample status, sample source, habitat, frequency, type of materials, cultural practices, season, sole or mixed with, sample type, sampling method, insect and disease, agronomic score and plant characteristics were documented. Passport Data Form was developed to record passport information. The samples were registered in Germplasm Collection Register after collection and conserved in medium term conservation unit (active collection) following appropriate procedure.

Key Findings: A total of 600 germplasm of 66 crops were collected from 69 upazilas of 30 districts. Among them, 14 germplasm from cereals (Barley, Foxtail millet and Wheat), 39 pulses (Black gram, Black pea, Cowpea, Field pea, Grass pea, Lentil, Mung bean, Pigeon pea and White pea), 26 oilseeds (Linseed, Mustard, Safflower and Sesame), 36 spices (Black cumin, Chilli, Coriander, Fennel, Fenugreek, Garlic, Onion and Turmeric), 455 vegetables (Amabashashak, Amaranth, Ash gourd, Babar shak, Bitter gourd, Bottle gourd, Brinjal, Chinese mellow, Country bean, Cucumber, French bean, Indian spinach etc.), 14 fruits (Banana, Custard apple, Musk melon and Papaya), 12 medicinal plants and 04 other germplasm (Indigo and Sesbania) have been collected and conserved.

Key Words: Exploration, Collection, Conservation, Germplasm

12.3.2. Title: Characterization of Pumpkin Germplasm

Background: Pumpkin (*Cucurbita moschata*) is a common and popular vegetable in Bangladesh. It is locally known as “Mistikumra”. The pumpkin is a diploid, self-compatible monoecious annual plant and cultivated all over the country. It belongs to the family Cucurbitaceae. There are three common types of pumpkin worldwide, namely *Curcubita pepo*, *Curcubita maxima* and *C. moschata* (Lee *et al.*, 2003). It grows extensively throughout the tropical and subtropical countries. The area of winter pumpkin is 177, 899 ha and production is 177, 899 metric tons and the area of summer pumpkin is 9,653 ha and production is 78,057 metric tons (BBS, 2017). Pumpkin is a good source of carotene, pectin, mineral salts, vitamins and other substances that are beneficial to health (Jun *et al.*, 2014). Pumpkin can be found in many shapes, sizes and colors. Pumpkin has a long storage capacity compared to other vegetables. Generally, the growers of Bangladesh store full ripe pumpkin fruits in house for 3 to 4 months under ordinary conditions. Four hundred and seventy-eight (478) accessions of pumpkin are conserved at PGRC genebank. Of them three hundred twenty-three germplasm have so far been characterized. Sixty-four germplasm of pumpkin were used in this study.

Objectives: i. to study the genetic variability and diversity in pumpkin germplasm,
ii. to identify salient features that distinguish germplasm from one another
iii. to identify germplasm having useful traits.

Methodology: The experiment was conducted at the Plant Genetic Resources Centre of BARI, Gazipur during winter 2017-18. Sixty-four (64) accessions of pumpkin were sown in the plastic pot on 16 November, 2017. Plant spacing was 2x2 m and unit plot size was 3 x 4 m. The seedlings were transplanted on 10 December 2017. The recommended doses of manure and fertilizers such as 5 ton/ha cow dung, 100 kg N, 48 kg P, 80 kg K, 28 kg S, 3 kg Zn and 2.1 kg/ha B in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc-sulphate and boric acid were applied in the experimental field (FRG, 2012). The full doses of cow dung, TSP, MP, gypsum, zinc-sulphate and boric acid were applied during pit preparation before one week of transplanting. The urea was applied in four installments as top dressing at 15, 35, 55 and 75 days after transplanting. Normal cultivation techniques and intercultural operations were followed to have a good crop. Pheromone trap was used for insect control. Thirty-three observations on qualitative (21) and quantitative (12) characters were recorded as per Minimal Descriptors of Agri-Horticultural Crops. Part II (Srivastava, 2001). Range, mean, standard deviation and coefficient of variation of quantitative characters were calculated

Key Findings: Wide variations were observed among the germplasm in respect of qualitative and quantitative characters studied. Based on sweetness of fruit on brix % like AHI-63 (10% TSS), RAI-87 (10% TSS), RAI-254 (10% TSS), RAI-279 (8% TSS) and AC-512(8% TSS) were selected.

Key Words: Characterization, Diversity, Germplasm, Pumpkin

12.3.3. Title: Characterization of Cucumber Germplasm

Background: Cucumber (*Cucumis sativus* L.) is one of the oldest vegetable crops grown widely throughout the country, tropical and sub-tropical parts of the world (Singh and Prasad, 1992). Cucumber, which is one of the monoecious annual crops of the cool climates, belongs to the Cucurbitaceae family. Cucumber is generally rich in nutritional composition such as, carbohydrate, protein, total fat, dietary fiber, vitamins, minerals, and a number of phyto-nutrients. The crop is grown worldwide and according to Tatlioglu (1993) it ranks fourth in the list of economic vegetables in Asia after tomato, cabbage and onion. The cucumber is grown in Bangladesh in the kitchen garden and in commercial farm for substantial economic return. The production of cucumber in the country was about 55000 m. tons in 2013- 2014 (BBS, 2014). Although the crop is widely cultivated all over the country, the most extensively cultivated areas seem to be Narsingdi, Rangpur, Dinajpur, Rajshahi, Pabna and Chattogram districts. The yield of cucumber is very low compared to that of other developing countries. The potential yield of cucumber in the country is 15t/ha (Rashid, 1999). Generally, cucumber produces male and female flowers separately on the same individual plant (monoecious), though some may produce bisexual flowers (Lower *et al.*, 1986). Very few research works relating to variability of cucumber have been conducted in Bangladesh. So, Intensive research efforts are needed in several areas, particularly, selection of superior genotypes. There are a lot of variabilities among the existing cucumber germplasm of Bangladesh. An understanding of the nature and magnitude of the variability among the genetic stocks of cucumber is of prime importance for the breeder.

Objectives: to assess the characteristics in cucumber accessions.

Methodology: The experiment was conducted at the Plant Genetic Resources Centre Farm, BARI, Gazipur during the period from March to June, 2019. Twenty-six accessions of cucumber were included in this study. Among them eighteen accessions seed were finally harvested. Some plants died due to excessive rain just after transplanting of seedling. The materials were collected from different parts of Bangladesh. The experiment was laid out in non-replicated design. One accession represented one treatment, with two plants. The unit plot size was 2 m x 2 m maintaining 0.5 m between the plots. Treatments were randomly assigned to different plots of each block separately. After final land preparation, the bed was raised about 30 cm from the ground level. The cucumber seeds of different accessions were dibbled in the pot on 12 March 2019. The seedlings were transferred to the field on 10 April, 2019. Necessary intercultural operations were done throughout the cropping season for proper growth and development of the plant. Trellis were made with bamboo and plastic wire for proper growth and development of the cucumber plants. Harvesting of mature fruits continued up to end of June, 2019. Data was collected on qualitative and quantitative characters following descriptor and data were analyzed to find out the variable characters among associations of cucumber.

Key Findings: Variability was observed in different fruit characters at edible stage and at mature stage. In quantitative characters, days to edible fruit stage ranged from 73 to 85 respectively. Average fruit length and fruit width was 20.33 and 6.47 cm, number of fruits per plant ranged from 3.5 to 7.5. Maximum number fruit per plant was obtained from RAI-209 and minimum number of fruits per plant was recorded from IAH- 331. The highest coefficient of variation was found in fruit length (19.85 %) followed by number of fruits per plant (18.71%) and lowest in hundred seed weight (4.71%)

Key Words: Germplasm, Plant growth, Diversity, Cucumber

12.3.4. Title: Characterization of Brinjal germplasm

Background: Brinjal (*Solanum melongena* L.) is a member of large species-rich genus *Solanum* L. in the nightshade family Solanaceae. Approximately 1300 species comprise in the genus *Solanum* L. Not only because of its large size, *Solanum* L. is also important for containing species of great economic important crops, such as potato, tomato and eggplant, plus a host of minor fruit and leaf crops cultivated locally worldwide (Särkinen *et al.*, 2018). The combination of high species richness, considerable phenotypic plasticity of the species and their presence in a wide range of climatic and ecological conditions (Aubriot and Daunay, 2019).

Brinjal is the third most important vegetable in terms of production in Bangladesh. It was grown on 50,956 hectares during both rabi and kharif seasons 2018–2019 (BBS, 2019). Brinjal is grown all over the country but the yield is comparatively low due to the lack of improved variety and infestation of insect pests. To develop a variety through a hybridization program, characterization is definitely significant for finding out genetic information. Characterization is a fundamental work to provide necessary information for plant breeding programs (Lin, 1991).

Characterization is necessary to recognize the variability and to improve the local germplasm. It is also equally important for easy and rapid evaluation of collected germplasm. Different genotypes of brinjal are available in Bangladesh. Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI) collected and conserved different types of brinjal germplasm from different areas of Bangladesh. In crop breeding programs, investigations to identify the available level of diversity is an essential step in crop improvement, and this can be achieved by collection and classification of germplasm. Therefore, the present investigation was carried out to characterize indigenous brinjal germplasm through qualitative and quantitative characters to identify the promising germplasm and provide genetic diversity for crop improvement program.

Objectives: i. to characterize indigenous brinjal germplasm through qualitative and quantitative characters,
ii. to identify the promising germplasm and
iii. to provide genetic diversity for crop improvement program

Methodology: The experiment was conducted in the experimental field of Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur during winter 2018-19. A total of 240 accession and four check varieties were used in this experiment. Direct seeding was done in the well-prepared seed beds on 14th November, 2018. Thirty-eight days aged seedlings were transplanted in the prepared pits of main experimental field on 28th December 2018. The plot size was 3x2.1 m². Each germplasm was planted in a plot of three rows. Row to row and plant to plant distance was 70×60 cm. The experimental design used in the study was Augmented Randomized Complete Block Design (Augmented RCBD) with four check varieties and 12 blocks. All check varieties received 12 replications, giving a total of 284 experimental plots.

Fertilizer doses were 10 ton/ha Cowdung, 210 kg/ha Urea, 33 kg/ha TSP, 200 kg/ha MP and 5 kg/ha Borax (Mondal *et al.*, 2011). The full doses of Cow-dung, TSP and Borax were applied during land preparation before one week of transplanting. Urea and MP were applied in the three equal splits at 15, 35 and 50 days after transplanting. Weeding and mulching were done four times at 25 days' interval starting from mid-December. Individual net was used per

plot to avoid the cross pollination. Sevin 75 WP @ 0.1 g/pit, Sumithion 60 EC @ 2.5 ml/L and Vertimac 18 EC @ 1.2 ml/L were sprayed for controlling insect and mite, respectively. The data was recorded as per the descriptor developed by IBPGR, 1990.

Key Findings: A wide variation was observed in the collected brinjal germplasm. Most of the qualitative characters showed distinct variation among the germplasm. Qualitatively the maximum variation was observed in leaf prickles, fruit calyx prickles, fruit color at ripening and fruit flesh density. Quantitatively highest variation was observed in fruit length which was followed by 100 seed weight and yield per plant. The overall performance of the genotypes indicated that the genotypes AC-285, K-12, K-19, K-28, K-20, K-47 and NSR-26 had higher yield potentiality. Therefore, selection of these genotypes might play a significant role for future breeding program.

Key Words: Characterization, Variability, Germplasm, Brinjal (set I)

12.3.5. Characterization of Landraces of Bitter gourd germplasm

Background: Bitter gourd (*Momordica charantia* L.), is one of the most important and a popular cucurbit vegetable grown in Bangladesh. The area of bitter gourd is 26,250 acres and production is 57,386 metric tons (BBS, 2017). Among the cucurbits, it is considered a prized vegetable because of its high nutritive values especially ascorbic acid and iron (Behera, 2004). It is rich in vitamin C (88 mg/100g) (Akter *et al.*, 2009). A compound known as charatin present in the bitter gourd is used in the treatment of diabetes to lower blood sugar levels (Shetty *et al.*, 2005). Bitter gourd is widely cultivated in this country during kharif season. Forty-six (46) germplasm along with two (02) check varieties of bitter gourd was collected in 2017-18. Hence, characterization of the collected germplasm is essential. The objectives of this study were to study the genetic diversity in bitter gourd germplasm, to identify the salient features that distinguish germplasm from one another and to identify germplasm having useful traits.

Objectives: i. to study the genetic diversity in bitter gourd germplasm
ii. to identify the salient features that distinguish germplasm from one another
iii. to identify germplasm having useful traits.

Methodology: The experiment was conducted at the Plant Genetic Resources Centre of BARI, Gazipur during summer 2019. Forty-six germplasm along with two check varieties of bitter gourd were used in this study. Passport data of germplasm used in this experiment. Two seeds were sown in each plastic pot (6 cm in diameter approximately) on 14 March 2019. Pits of 40x 40 x40 cm were prepared 10 days before transplanting the seedlings in the main field. Plant spacing was 2x2 m and unit plot size was 3 x 4 m with two replications. The seedlings were transplanted on 31 March 2019. The plants were given support of 4 m height bamboo stick. Two plants were used for each germplasm. The recommended doses of manure and fertilizers such as 5 ton/ha decomposed cow dung, 100 kg N, 40 kg P, 60 kg K, 20 kg S and 1.5 kg/ha B in the form of urea, triple super phosphate, murate of potash, gypsum and boric acid were applied in the experimental field (FRG, 2012). The full doses of cow dung, TSP, MP, gypsum and boric acid were applied during pit preparation before one week of transplanting. Normal cultivation techniques and intercultural operations were followed to have a good crop. Pheromone traps were used for controlling insects. Data were recorded as per NBPGR (2001) descriptors for bitter gourd. Nevertheless, selection was done based on total fruiting period and yield for future use.

Key Findings: Among forty-six newly collected germplasm all were identified as landraces. However, fruit of forty-six bitter melon germplasm showed variation in shape, skin color, skin luster, surface texture, nature of tubercles, blossom-end shape, bitterness and also in seediness. Likewise, distinction was observed in early plant vigor, plant growth habit, twining tendency, tendril branching, leaf size, leaf pubescence, and in flower color. Similarly, notable variation was observed among 16 quantitative characters of forty-six germplasm. The maximum coefficient of variations was fruit weight and minimum in days to last fruit harvest. Also, among all few germplasms were selected based on total fruiting period and yield, where AHI-85 was certainly a good one.

Key Words: Characterization, Variability, Germplasm, Bitter melon.

12.3.6. Title: Characterization of Brinjal germplasm (Set-II)

Background: Brinjal (*Solanum melongena* L.) is the second most important vegetable in Bangladesh. It is grown on approximate 52,227 hectares of land across the country both in winter and summer season, yielding an average of 10.13 ton per hectare for a total yield of about 528,923 ton (BBS, 2020). BARI released 14 varieties including 4 transgenic varieties of brinjal. The crop is extremely diverse in Bangladesh. PGRC of BARI conserved 282 accessions in the gene bank. About 175 accessions have already been characterized and 40 accessions have not characterized. Before these resources can be exploited, they should be systematically evaluated to assess genetic diversity, until a collection has been properly evaluated and its attributes become known to breeders, it has little practical use (Thomas and Mathur, 1991). Such a situation is just like a library where none of the books are catalogued. The experiment was undertaken to study the genetic diversity, identify salient features that distinguish accessions from one another, and identify the accessions having useful traits. The present investigation was conducted with the specific objective of identifying from suitable local brinjal accessions.

Objectives: i. to study the genetic diversity,
ii. to identify salient features that distinguishes accessions from one another and
iii. to identify the accessions having useful traits

Methodology: The experiment was conducted at Regional Plant Genetic Resources Center, RARS, Ishwardi, Pabna during 2019-2020. The experiment involved thirty-six brinjal accessions. Main field was prepared 10 days before transplanting the seedlings. The recommended doses of manure and fertilizers such as 5-ton ha⁻¹ cow dung, 120 kg N, 36 kg P, 90 Kg K, 15 kg S and 2.0. kgha⁻¹ Zn in the form of urea, triple super phosphate, murate of potash, gypsum and zinc sulphate (monohydrate), respectively were applied in the experimental field (FRG, 2018). The full doses of cowdung, TSP, gypsum and zincsulphate were applied during land preparation before one week of transplanting. Urea and MP were applied in the three equal splits at 21,35 and 50 days after transplanting as ring method around the plant followed by irrigation (105) days interval during dry season. The experiment was conducted in a non-replicated design. The unit plot size was 3 m X 2 m and 9 plants were accommodated in a plot with a plant spacing of 75 cm apart and row to row distance of 100 cm (excluding 50 cm drain). The seedlings were transplanted on 19 October, 2019. The plants were given support of 1 m height bamboo sticks. Admire (0.5 ml per liter) was applied for controlling aphids. Twenty-five observations on qualitative (12) and quantitative (13) characteristics were classified into descriptor state as per Descriptors for Eggplant (IBPGR, 1990). Range, mean, standard deviation and coefficient of variation of quantitative characters were calculated.

Key Findings: Variations among 36 brinjal accessions were observed in different qualitative characteristics. Upright, intermediate to prostrate plant growth were observed. Leaf blade lobing was found weak, intermediate to strong and very acute, acute to intermediate in leaf blade tip angle were observed. Variations were found in number of prickles and leaf hair. Among the accessions, different corolla color was observed like pale violet, light violet and bluish violet. The accessions SM Ish-010 (4.98), SM Ish-015 (5.38) and SM Ish-025 (5.05) germplasm gave high edible fruit weight per fruit and per plant (4.77 to 5.38 kg/plant) and it may be considered as better accessions. These accessions may be used in brinjal improvement program.

Key Words: Brinjal, Qualitative character, Quantitative character, Characterization

12.3.7. Title: Characterization of Mung bean germplasm

Background: Mung bean (*Vigna radiata* (L.) also known as green gram or mung is one of the most important edible food legumes in Asia, particularly in the Indian subcontinent. It is one of the important pulse crops of Bangladesh, since it is a short duration legume, it fits well into many cropping systems, on an average in Bangladesh diet only 8 to 10% of the protein intake originates from animal sources, the rest can be met from plant sources by increasing the consumption of pulses. Hence from the point of nutritional value, mung bean is perhaps the best of all other pulses. However, the average yield of mung bean in the country is about 663 kg/ha, which is much lower than that of India and some other countries of the world. This poor yield may be attributed due to climatic condition, adaptation of varieties, disease and insect problems, poor crop management practices and judicious application of fertilizer especially nitrogenous fertilizers/biofertilizers as nitrogen is the most important element for crop. In the present investigation, the mung bean germplasm was collected from different districts in Bangladesh. A set of mung bean germplasm studied for genetic variability, varietal identification and genetic diversity based on qualitative and quantitative traits.

Objectives: i. to study genetic variability among collected mung bean germplasm,
ii. to confirm varietal identification and
iii. to verify genetic diversity based on qualitative and quantitative traits

Methodology: The experiment was carried out with 91 germplasm of mung bean with 6 check varieties at Plant Genetic Resources Centre, BARI, Gazipur during kharif 2020. The seeds were directly sown in prepared land dated on 08 March, 2020. The distance between line to line and accessions to accession was 30 cm and 50 cm in augmented design with 6 check varieties. Measurement was performed on five individual plants of each accession. Optimum cultural practices were followed mung bean production system. Data was recorded in qualitative and quantitative traits as per pulse descriptor on International Board for Plant Genetic Resources (IBPGR).

Key Findings: Wide variation was found among the accessions in both qualitative and quantitative characters. The frequency distribution observed higher on number of seed per pod and medium on days to 1st flowering and yield per plant. Unique selection and trait information is available within the population studied which may offer crop improvement opportunity. In addition of the evaluation for agronomic traits, DNA markers will be used to study the genetic diversity of present collection of mung bean germplasm.

Key Words: Mung bean, Germplasm, Characterization, Variation.

12.3.8. Title: Characterization of Bottle gourd germplasm

Background: Bottle gourd (*Lagenaria siceraria*) is a popular cucurbitaceous vegetable in Bangladesh. The climatic condition of winter in Bangladesh favors better growth and yield of bottle gourd. Bottle gourd is widely cultivated throughout the country. Its cultivation and uses are wide in winter season. It is found to cultivate in commercial way in the field as well as homestead in rural Bangladesh. The national average yield of bottle gourd is only 9.38 tons/hectare (Islam *et. al.*, 2015). Presence of variability in a base population is very important for any improvement program. Collection, conservation and maintenance of germplasm are important to develop new varieties. A large number of germplasm were collected from different district. Two hundred eighteen (218) germplasm were collected from different districts of Bangladesh. The present work has been undertaken to study characterization and genetic variability in bottle gourd for desirable yield contributing characters.

Objectives: to study characterization and genetic variability in bottle gourd for desirable yield contributing characters.

Methodology: The experiment was conducted at the Plant Genetic Resources Center, BARI, Joydebpur, Gazipur during 2019-2020. Two hundred eighteen (218) accessions of bottle gourd collected from different districts and five (5) check varieties were taken in this study. The seeds were sown in poly bags on 13 November, 2019. After 15 days, the seedlings were transplanted in prepared pits in the field. Lay out: Pit to pit and line to line distance was 4m X 4m. The experiment was conducted in augmented design with 5 check varieties. Fertilizer: When land was prepared the following fertilizers and manure were mixed in each pit, Cow dung-10kg, Urea- 50g, TSP-200g and MP-150g, Gypsum-75g. In vegetative stage, 20g Urea with water was sprayed per pit. Normal cultivation techniques, intercultural operations and irrigations were followed to grow the crop. Observations were recorded on eighteen (18) qualitative and fifteen (15) quantitative traits as per IBPGR descriptor.

Key Findings: All germplasm showed variation in qualitative and quantitative traits. Significant differences were observed among the quantitative traits. In qualitative traits, variability was found in fruit shape, matured fruit skin color, early plant vigor, leaf margin. The seeds are preserved as active and base collections for future utilization.

Key Words: Bottle gourd, Germplasm, Variability, Characterization

12.3.9. Title: Characterization of Amaranth germplasm

Background: Germplasm collection, conservation and evaluation are being regularly practiced in this crop for identification of new potential genotypes. So far, Plant Genetic Resources Centre (PGRC) is maintaining 773 accessions of amaranth. Knowledge of genetic diversity and trait variations in populations is useful in plant breeding and for developing ex-situ conservation strategies of plant genetic resources (Engles *et al.*, 2002). The availability of genetic variation among and within the different accessions for agronomic traits provides great scope for crop improvement through selection and other breeding methods to develop desired genotypes. Thus, insight into the genetic variation within and among the available amaranth genotypes in relation to the morphological traits is necessary. Such empirical knowledge will enhance effective genetic resources exploration, conservation, management, and utilization of amaranths species in future breeding programs.

Objectives: i. to study the genetic variation in 80 amaranths accessions and
ii. to identify salient features that distinguish germplasm from one another

Methodology: The experiment was conducted in augmented block design at the Plant Genetic Resources Centre of BARI, Gazipur during winter 2019-20. Eighty accessions of amaranth were considered in this study. Line sowing was done on 2 rows in 3m long plot maintaining 15 cm plant spacing. Row to row distance was 50 cm and plot to plot distance was 100 cm. Chemical fertilizers were applied (FRG, 2018). Sevin 20 was applied periodically in early stage to control ants. Normal cultivation techniques and intercultural operations were followed to have a good crop. Data were recorded as per NBPGR (2001) descriptors for Amaranth. However, under the epidemic status quo of the world due to COVID-19 some of the parameters stated in the descriptor were not possible to execute.

Key Findings: All the accessions of amaranth studied in this experiment showed color dissimilarity in leaf, stem, inflorescence and seed. However, based on the phenotypic appearance and performance in the field condition few accessions can be recommended as top-notch genotypes for future study. For instance, leaf amaranth: BD-2961, BD-9790, BD-9795 and BD-9825; stem amaranth: BD-9822, BD-9941 and BD-9942

Key Words: Amaranth, Accessions, Variability, Characterization

12.3.10. Title: Characterization of Guava germplasm

Background: There are probably more than 400 guava cultivars around the world, but only a few are under common cultivation (Pommer and Murakami, 2009). The cultivated cultivars are widely diverse regarding tree size, bearing habit, and yield, as well as fruit size, shape, ripening season and quality in terms of nutrient composition (Pommer and Murakami, 2009; Sharma *et al.*, 2010). Irrespective of the morphological and chemical diversities observed in these cultivars, several reports indicate that selection of the accessions was based on a few traits considered important (Mehmood *et al.*, 2013; Galli *et al.*, 2015; Mehmood *et al.*, 2015; Valera-Montero *et al.*, 2016), and, therefore, much of the variation is left untapped. This is likely to lead to genetic vulnerability of the crop (Nogueira *et al.*, 2014), especially with respect to climate change.

Objectives: i. to assess the morphological variations through phenotypic study,
ii. to investigate the genetic variability and
iii. to select parents for better and more production

Methodology: The study was conducted in the fruit orchard of Agricultural Research Station (ARS), Pahartali, Chattogram and Regional Agricultural Research Station (RARS), Hathazari, Chattogram during 2019-20. About 22 diversified guava germplasm were included in the experiment. The data was recorded as per the descriptor.

Key Findings: A wide variation was observed in the guava germplasm in this study. The maximum variation was observed in pulp color and seediness in guava fruits. The morphological dendrogram generated from agglomeration hierarchical clustering grouped the 22 genotypes into 5 major clusters. The biplot explaining the overall performance of the genotypes indicated that the genotypes PG Hat 017, PG Hat 012, PG Pah 07, BARI Peyara 2 and BARI Peyara 4 had higher yield potentiality. Therefore, selection of these genotypes might play a significant role for future guava improvement program.

Key Words: Guava, Production, Variety

12.3.11. Title: Molecular Characterization of Rapeseed-Mustard Germplasm using SSR Marker

Background: Among the different marker microsatellite or simple sequence repeat (SSR) is another PCR-based marker which is preferred by many geneticists and plant breeders because of higher repeatability, co-dominant nature, specificity and having multiple alleles (Plieske and Struss, 2001; Halton *et al.*, 2002). SSR markers have been developed and characterized for the efficient use of genetic studies of *Brassica* species (Sadia *et al.*, 2010). Information of molecular characterization of rapeseed-mustard germplasm will make benefit for future breeding program.

Objectives: to know the genetic diversity among the studied mustard germplasm

Methodology: Total genomic DNA was isolated from young actively growing fresh leaf tissues following SDS extraction, phenol: chloroform: isoamyl alcohol purification and ethanol precipitation method. DNA quality was checked by electrophoresis in a mini-gel and quantified using a spectrophotometer (Spectronic® Genesis™, New York, USA). All of the DNA samples were found to be in good quality in this study.

Key findings: All the primers selected for this study has been responded to SSR marker selection study. Among them tested 06 (six) microsatellite markers were found to be polymorphic conferring to previous study. Genetic diversity was found among the germplasm.

Key words: SSR, Polymorphism, Diversity, Mustard

12.4. Bangladesh Jute Research Institute

12.4.1. Title: Collection of Jute and Allied fibre (JAF) crop germplasm

Background: Jute is a tropical bast fibre crop next to cotton in use with its high socio-economic importance in Bangladesh. It is now in great threatening of erosion and replacement by modern agricultural system. Emphasis has been given since 1970 with an approach to collect and conserve the genetic resources of jute (*Corchorus* spp.), Kenaf (*Hibiscus cannabinus*) and mesta (*H. sabdariffa*) germplasm including their wild relatives for utilization in genetic improvement program (Roy & Ghoshdastidar, 2006). The numbers of land races collected at that time were very few and collection processes were not extensive. From 1951 to 1971 the collection of landraces was 892 of *C. capsularis*, 644 of *C. olitorius*, 15 of kenaf and 35 of mesta. After a long gap, an expedition was made in the 1978 and 1979 to collect landraces in and around Chattogram Hill Tracts, St. Martin Island and Sylhet. During that period 169 *C. capsularis*, 128 *C. olitorius* and 16 *H. sabdariffa* were collected. At present BJRI Gene Bank conserves 6012 accessions comprising 4180 accessions of *Corchorus* (15 species), 1461 accessions of *Hibiscus* (22 species), 252 accessions of allied genera (15 species) and 119 accessions of interspecific hybrids derivatives through different formal and informal collection missions. The necessity of a comprehensive collection mission for preventing the extinction of bio-diversity from their native is always keep deep attention to the breeders. It provides the wider scope of crop improvement by supplying desirable gene pool to them. Unfortunately, the collection approach for jute and allied fibre has not kept pace with the time being due to lack of required manpower, fund and other facilities.

Objectives: i. to rescue endangered PGR of JAF,
ii. to enrich gene pool of BJRI genebank and
iii. to collect germplasm from unexplored areas of Bangladesh

Methodology: Germplasm were collected from Rangpur, Kurigram, Nilphamary, Panchagarh, Dinajpur, Bogura, Cumilla, Patuakhali, Barguna and Barishal districts during February 2018 to January 2020. Random population samples of fruits and seeds at wide intervals (5-10 km) were collected from farmers' field, road side, stores and market place followed by intensive sampling demands in specific area depending on the records of past evaluation of materials collected previously from the area. Special sampling of disjunction populations, peripheral population and those occupying geographically remote and often peculiar or distinct ecological niches were given special importance for collection with the help of local Agricultural Officers, forest officers and community leaders. Samples were collected as seed and fruits from individual plant or population along with sufficient passport information. For each sample, there was a single collection number with its set of recordings of locality and habitat data as per descriptor. Cultivated species was determined from farmers' field and wild species was determined in relation to the variation observed in the population. At least 60, 40, 400 and 400 g of seeds were collected for deshi, tossa, kenaf and mesta samples respectively. In case of fruits sample collection, at least 555, 120, 1000 and 1000 number of fruits were collected for deshi, tossa, kenaf and mesta respectively. Sample collection site was varied from as small as 5m x 5m to as large as 50m x 50m according to the colony size and the density of individuals. The collected samples were cleaned, dried, registered and conserved in active collection for further activities.

Key findings: A total of 35 germplasm were collected from Rangpur, Barishal, Chattogram and Khulna division. Out of 35 germplasm 23 was deshi jute (*C. capsularis*), 9 was tossa jute (*C. olitorius*) and 3 was mesta (*Hibiscus sabdariffa*).

Key words: JAF crops, Germplasm, Collection.

12.4.2. Title: Characterization of Jute (*C. capsularis* and *C. olitorius*) germplasm in 2018 to 2020

Background: Jute is a tropical bast fibre crop next to cotton in use with its high socio economic importance in Bangladesh. Genetic Resources of JAF crops play a vital role for its improvement among the jute growing countries of the world, Bangladesh ranks second in respect of production. Jute is produced in about 0.75 million hectares of land in Bangladesh (BBS 2018-19). The crop is a versatile and environmental friendly bio-degradable natural fibre. It is mainly grows for fibre. Jute leaves also used as vegetable (Furumuto *et al.*, 2002). Genetic variability is the pre-requisite for any plant breeding program. The gene Bank of Bangladesh Jute Research Institute (BJRI) has conserved about 6012 germplasm. The number of germplasm is declining in jute growing areas (Choudhary *et al.*, 2013 and Heywood *et al.*, 2007). Before exploration of these germplasm, they should be systematically evaluated to assess the genetic diversity. Therefore, the experiment was undertaken to study the genetic diversity salient feature that distinguish germplasm from one another.

Objectives: i. to study the genetic diversity in jute germplasm,
ii. to realize JAF species potential value for genetic improvement,
iii. to identify salient features, which distinguish germplasm from one another,
iv. to identify germplasm having desirable traits

Methodology: The experiments were conducted at the Jute Agriculture Experimental Station, Manikganj of Bangladesh Jute Research Institute from 2018 to 2020 growing season. The altitude of the experimental field was 4 m in the Active Brahmaputra-Jamuna Floodplain (AEZ 7) with a silt loam soil, pH 6.7. Single row of 4 m length for each germplasm was maintained. Row to row distance was 30 cm and about 5-6 cm between plants. The soil was plowed in two directions and smoothed. The soil received urea, triple superphosphate, muriate of potash, gypsum and zink @ 200, 25, 30, 45 and 12 kg/ha. Half of the urea and all other materials were applied during final land preparation. The remaining urea was top dressed at 20 days after sowing. All cultural operations were according to Chowdhury and Hasan (2013). Three times manual weeding were done at 10-15, 25-30 and 40-50 days after sowing. Morphological data such as plant stem color, leaf color, vein color, petiole color, stipule color, were recorded at 60 days of plant. Leaf shape and branching habit were recorded at pre bud stage of plant. Quantitative characters such as plant technical height, node number, plant base diameter, mid-diameter, top diameter, basal core diameter, dry fibre weight and dry stick weight recorded at harvesting time. The plant was harvested at 120 days. Ten plants were selected randomly from each line and data were recorded. Twenty one observations on qualitative and quantitative characters were recorded as per descriptors.

Key findings:

- i. Merha red (Collector's no. RS-4) and Birol red (Collector's no. RS-8) of two wild germplasm collected from Kurigram and Bogura were primarily identified as vegetable type jute. Acc. no. 742 collected from Rangpur was important for fibre and stick yield.
- ii. Wide variations were observed among the studied genotypes of deshi jute in respect of qualitative and quantitative characters. Considering yield contributing characters the accession no. 2143, 2061, 2122, 2090 and 2193 can be selected for crop improvement program.
- iii. Considering the yield contributing characters the accession no. 5038, 4792, 5163, 4851, 5145, 4794 and 5121 of tossa jute were selected for crop improvement program.

Key words: Jute, Characterization, Morphological diversity.

12.4.3. Title: Molecular characterization of jute germplasm through DNA fingerprinting in 2018, 2019 and 2020 growing season

Background: Closely related cultivars with low genetic variability can't readily be distinguished by morphological traits like pigmentation pattern, leaf shape, stipule shape, seed coat color and so on that are very difficult to identify in jute and allied fibregermplasm characterization. DNA fingerprinting for cultivar or varietal identification has become an important tool for genetic identification in germplasm management and plant breeding. When planning of DNA fingerprinting, one of the most important decision is the marker system and molecular technique to be used. Various system and their related techniques are currently available, and those are based on polymerase chain reaction (PCR). PCR based techniques or molecular markers such as Randomly Amplified Polymorphic DNA (RAPDs), Simple Sequence Repeats (SSRs) or, microsatellites and Amplified Fragment Length Polymorphisms (AFLPs), have an apparent advantage as cultivar descriptors. SSRs have become a powerful and popular tool for determining unique genetic identity or fingerprint, and establishing genetic relatedness as well as diversity among various crop cultivars. The present piece of work is undertaken to develop genetic fingerprints and to estimate genetic relatedness of 22 jute germplasm using some SSR markers.

Objectives: to develop genetic fingerprints and to estimate genetic relatedness of 22 jute germplasm using some SSR markers.

Methodology: The jute genotypes studied in this experiment was collected from the Gene Bank of Bangladesh Jute Research Institute (BJRI). Molecular characterization was done following standard protocol.

Key findings:

- i. Molecular characterization of 22 jute germplasm including 9 varieties were done during 2018. In this experiments 33 SSR primer were used, where 14 polymorphic primer were found respectively. Based on Nei's Genetic distance of the *C. olitorius* germplasm were subdivided into two sub-clusters in the UPGMA dendrogram.
- ii. Molecular characterization of 22 jute germplasm including 2 varieties was done during 2019. In the experiment 32 SSR primer were used, where 18 polymorphic primer were found respectively. Based on Nei's Genetic distance of the *C. capsularis* and *C. olitorius* germplasm is subdivided into two sub-clusters in the UPGMA dendrogram.
- iii. Molecular characterization of 22 jute germplasm including 4 varieties was done during 2020. In the experiments 31 SSR primer were used, where 16 polymorphic primer were found respectively. Based on Nei's Genetic distances, two different species were divided in two mainclusters. The tossa jute germplasm cluster was further subdivided into two sub-clusters in the UPGMA dendrogram.

Key words: SSR primer, Genetic diversity, Jute.

12.5. Bangladesh Sugarcrop Research Institute

12.5.1. Title: Morphological diversity of PBRG-PGR collected sugarcane germplasm

Background: Modern sugarcane varieties that are cultivated for sugar production are complex interspecific hybrids (*Saccharum* spp.) that have arisen through intensive selective breeding of species within the *Saccharum* genus primarily involving crosses between the species *Saccharum officinarum* L. and *S. spontaneum* L. (Cox *et al.*, 2000).

An essential first step in varietal development program is to come up with sugarcane germplasm which has sufficient genetic variability. Accurate assessment of genetic diversity is very important in crop breeding as it helps in the selection of desirable genotypes, identifying diverse parental combination for further improvement through selection in the segregating populations, and introgressing desirable genes from diverse germplasm into the available genetic base (Mohammadi *et al.*, 2003). Therefore, genetically diverse germplasm is needed in breeding programs to enhance the productivity and diversity of cultivars. Utilization of introduced germplasm and the knowledge of genetic remoteness among them are vital for their manipulation in crop improvement program (Malik *et al.*, 2010).

In order to obtain the wide spectrum of variation among the segregants the genotypes belonging to the distant clusters could be incorporated in hybridization program. Therefore keeping in view the importance of sugarcane in the country and use of genetic diversity in crop improvement, 51 genotypes were investigated for determining genetic diversity based on quantitative traits for planning future germplasm management and utilization.

Objectives:

- i. to investigate genetic diversity in landraces of sugarcane based on qualitative and quantitative traits for planning future germplasm management and utilization and
- ii. to exploit genetic diversity of sugarcane germplasm in crop improvement program

Methodology: Collected sugarcane germplasm under PBRG-PGR sub-project were grown at replicated plot for diversity study. Ten representative plants from each replication (30 plants from each variety) were randomly selected for recording data on Number of millable cane, Length of leaf blade (cm), Width of leaf blade (cm), Length of bud (mm), Width of bud (mm), Plant height (cm), Stalk length (cm), Number of internode, Internode length (cm), Internode diameter (cm), Single cane weight (kg) and Brix %. The analysis of variance, clustering and principal component were statistically analyzed as randomized complete block design using the R-software. Characters with count data were log transformed before analysis. All the genotypes were clustered on the basis of agglomerative cluster analysis, where specifications were made based on Euclidean distance.

Key Findings:

One promising clone has been released as early maturing chewing sugarcane variety named BSRI Akh 47. Three flowering germplasm can be utilized in hybridization program of BSRI. Five promising clones and two new traits (attractive pink and variegated color) can be utilized in future.

Key words: Genetic diversity, landraces, Sugarcane



BSRI Akh-47

12.6. Bangladesh Institute of Nuclear Agriculture

12.6.1. Title: Collection, Conservation and Characterization of Important Plant Genetic Resources from Mymensingh and Sylhet Region Including Tangail

Background: Genetic resources provide basic material for selection and improvement through breeding to ensure food security needs of the world's rapidly rising population. Conservation and utilization of plant genetic resources are important components of ex-situ collections. To conserve valuable genetic resources, collection of germplasm had been started since 2008 at BINA. Systematic and mission oriented collection programme have not yet been started at BINA. So that in BINA the existing collections are poor and there is continuing need to collection germplasm of different crops. We need to collect local germplasm of different crops from several areas such as hilly area, coastal, Barind tract, Haor areas, Northern and southern parts of Bangladesh. Characterization for agronomic and morphological traits is necessary to facilitate utilization of germplasm by breeders. To achieve this, germplasm accessions of all crops are characterized for morphological and agronomic traits. Information on the genetic diversity within and among closely related crop varieties is essential for a rational use of genetic resources. The analysis of genetic variation both within and among the landraces is of fundamental interest to plant breeders.

Objectives:

- i. to collect local germplasm of rice, oilseeds, pulses, spices and vegetables,
- ii. to characterize genetic resources including GI crops and released varieties at morphological and molecular level,
- iii. to identify germplasm with desired agronomic traits and select entries for more precise evaluation,
- iv. to document genetic resources and to protect them from piracy as well as for facilitating establishment of property rights and
- v. to estimate the extent of variation in the collection

Methodology: Local germplasm of different crops were collected from Sylhet and Mymensingh regions including Tangail district. BINA team was to collect germplasm from these areas involving farmers, different GO, NGO and private sector personnel. Both fields as well as store/harvested collection approaches were followed. During germplasm collection, passport data forms were used for documentation. After collection all germplasm, collected germplasm were multiplied in respective season and preserved in mid and short term storage room at BINA. After multiplication seeds of collected germplasm we carefully cleaned of each germplasm and grow for seed multiplication. After seed multiplication sufficient number of good qualities for a given accession has been sealed for subsequent storage. Selected germplasm were characterized using the standard descriptors. For rice 'Rice Germplasm Descriptors and Evaluation Form' and Descriptors for different crops, published by International Plant Genetic Resources Institute (IPGRI). Recommended doses of fertilizers were applied and appropriate control measures were taken for insect pests, diseases and weeds as and when necessary.

Total genomic DNA was extracted from young leaves of three-week-old plants following the simple and modified protocol of Zheng *et al.*, 1995. PCR analysis was performed in 12.5 µl reaction sample containing 5-25 ng of DNA template, 1.25 µl of MgCl₂ free 10X PCR buffer (100 mM Tris-HCl pH 9.0 at 25°C, 500 mM KCl, 0.1% Triton® X-100 and H₂O), 1.5 µl of 25 mM MgCl₂, 0.25 µl of 10mM dNTP, 0.25 µl of 5 U/µl Taq polymerase enzyme, 0.625 µl each of 10 µM forward and reverse primers using a MJ Research single 96-well thermal cycler. The mixture was overlaid with one drop of mineral oil to prevent evaporation. After initial denaturation for five minutes at 94°C, each cycle comprised one min denaturation at 94°C, one min annealing at 55°C, and two min extension at 72°C with a final extension for seven min at 72°C at the end of 35 cycles. The PCR products were mixed with bromophenol blue gel loading dye and were analyzed by electrophoresis on 8% polyacrylamide gel using mini vertical polyacrylamide gels for high throughput manual genotyping (CBS Scientific Co. Inc., CA, USA). 2.5 µl of amplification products were resolved by running gel in 1×TBE buffer for 2-2.5 hrs depending upon the allele size at around 75 volts and 180 mA current. The gels were stained in 0.5 mg/ml ethidium bromide and were documented using UVPRO (Uvipro Platinum, EU) gel documentation unit. Microsatellite or simple sequence repeat (SSR) markers were used for DNA analysis (Temnykh *et al.*, 2001; McCouch *et al.*, 2002).

Key findings:

- i. A total of 143 germplasm (73 rice, 30 sesame, 33 groundnuts, 5 chillis and 2 bitter gourd germplasm) have been characterized on the basis of morpho-agronomical characters according to standard descriptors. Ranishail, Sentu-16, Ojana birun, Paijam rice germplasm were the highest yielder (9.8-13.33g/plant) with excellent phenotypical acceptability. Sentu-17, Bashiraj, Deshi-32 rice germplasm were found having short duration (90-135 days). Among the 73 rice germplasm, Parbot jira, Kalo jira, Chinishail, Hasa sada, Hasa kalo were identified as fine and very light scented.
- ii. Among the 30 sesame germplasm, Kalo til, BD-6981 were found having higher yield (32-58g/plant) and the germplasm BD-6979 had stem, leaf hairiness. Among the 33 peanut germplasm, 7112-4-4-1, 9112-2-1-1, 7112-4-3-1 and ICGV-347 were found having higher yield (16-20 g/plant /plant). Among the 5 chilli germplasm was found having higher yield (16-20 g/plant /plant)
- iii. A total of 83 local rice germplasm from BINA genebank have been characterized on the molecular level by using SSR markers. A total of 262 alleles were detected by nine (9) polymorphic markers. The highest number alleles 34 were identified by RM336 while the lowest was 13 by RM262. The PIC value ranged from 0.951 to 0.766

Key words: Germplasm, Collection, Conservation, Characterization, Genetic Diversity

