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Preface

The Anual Research Report 2021-22 was published with great pleasure on the research and development activities of Citrus Research Station, Bangladesh Agricultural Research Institute, Jaintapur, Sylhet. Citrus Research Station (CRS), Jaintapur Sylhet conducts different types of research activities on horticultural and spices crops. The aim of the research activities is to increase crop production to meet up local demand, provide nutrition, and ensure food security in the region along with other parts of Bangladesh through the development of improved varieties and technologies.

Natural resources like Agricultural land, soil fertility, and underground water are decreasing day by day. On the other hand, soil erosion, land degradation, and urbanization are increasing rapidly creating challenges for agricultural researchers to ensure food and nutritional security for the ever-increasing population. On the other hand, natural hazards include drought, cyclones, heavy rainfall, hail storms, and flush flood; changes in the climatic conditions including high temperature, sudden high rainfall, short winter, fluctuations in the day-night length, sun shine hour, low temperature during winter, as well as the abiotic stresses like drought, salinity, extreme temperature, metal toxicity, soil acidity, and alkalinity, and biotic stresses like diseases, insects, mites and nematodes infestation decrease crop production. Therefore, the researchers of CRS conduct research activities for mitigating these problems.

The CRS scientists are involved in the development of high-yielding varieties, improving crop production technologies for increased yield and productivity, increasing cropping intensity as well as proper utilization of soil, water, and climatic condition. Citrus Research Station has developed 7 varieties viz., BARI Komala-1, BARI Komala-3, BARI Malta-1, BARI Satkara-1, BARI Batabilebu-5, BARI Toikor-1, and BARI Golmorich-1. Besides, some advanced lines (Mandarin-3, Sweet orange-3, Pummelo-2, Burmese grape-1, Indian Olive-1, Indian Dellinia-1, Bael-1, Seedless lemon-1, Jara lemon-2, Bay leaf-1, Cinnamon-1, Naga chili-1) are awaiting for release as new modern crop varieties. Scientists also work to disseminate BARI-released varieties and technologies through adaptive trials and demonstrations in the farmer's field. CRS, Jaintapur also organize training, seminar, and workshop to inform the latest varieties and technologies, which are helpful for the farmers and ultimately increase the socio-economic condition of the country. The present report contains research achievements of CRS, Jaintapur during 2021-2022. This report will be helpful for researchers, extension personnel, NGOs, farmers, and others who are involved in agricultural development.

I am grateful to the BARI authority for its overall support in implementing the research program. I express my sincere appreciation and thanks to all scientists of CRS, Jaintapur for their hard work in conducting research and reporting. I also thank the field and office staff for their sincere efforts in completing the research and publishing the report.

Dr. Shah Md. Luthfur Rahman
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At a glance

Citrus Research Station, BARI, Jaintapur, Sylhet

Establishment

Jaintapur is a historically rich Upazila of Sylhet District. Anciently it is popular for citrus and spices crops. Due to its favorable climatic condition, a fruit orchard was established in 1960 to conduct research on different fruit crops, especially citrus to develop suitable varieties as well as to generate sustainable and profitable production technologies. After the Liberation War, the fruit orchard was named as Citrus Research Station under the supervision of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, and later on, it had been expanded for research activities with different fruits and spices crops. The land area of the research station is 118.64 acres, of which 50 acres were acquired in 1961 for the establishment of the Orange Orchard Scheme, and the rest of 68.64 acres were acquired in 1965 for strengthening the research activities.

Location and extent

The research station is located near Jaintapur Upazila head quarter about 44 km away from Sylhet city in the north-east direction. The area enjoys a tropical climate at 25°8 North latitude and 92°8 East longitude along with about 22m elevation from the sea level under AEZ 22 and 29. The land type is hilly and there are many tillas (hillocks) within and around the farm. The Khasi-Jaintia Hill of India is standing as a wall about two kilometers away from this station surrounding the north and east. The soil is stony containing abundant stones, boulders, and small and big rocks underneath the soil surface.

Land area

Total area : 118.64 acres
Researchable area : 70 acres

Climate

Rainfall (yearly) : 6000 mm
Temperature (°c)
Maximum : 31.21
Minimum : 10.96
Average : 23.63

Scientific personnel

Designation		Existing manpower
Principal Scientific Officer	:	1
Scientific Officer	:	3

Scientific associates

Designation		Existing manpower
Scientific Assistants	:	4

Contents

HYBRIDIZATION IN SATKARA

S.M.L. RAHMAN, F. AHMED, M.S. ZAMAN AND M.H.M.B. BHUYAN

Abstract

A hybridization program satkara was conducted in the flowering season of 2020-21 at Citrus Research Station (CRS), Jaintapur, Sylhet and Regional Agricultural Research Station (RARS), Akbarpur, Mouluvibazar. A total of 350 flowers were emasculated and pollinated. Four hybrid fruits were obtained from different crosses. These citrus fruits will be harvested at mature stage and seeds of the fruits were sowed in the soil for germination. After germination, seedlings of hybrid fruits will be transplanted in the main field and will be evaluated.

Introduction

Citrus fruits play an important role in the fruit world for its availability period and high market price. In Bangladesh, we have a good number of citrus species, which can certainly contribute to the nutritional improvement. We have already released one (1) satkara variety, which have slow growing tendencies Recently there has been an increasing demand for quick growing insects pest resistant satkara variety. Keeping these points in mind an inter-specific hybridization program has been undertaken.

Materials and Methods

The experiment was conducted at Citrus Research Station (CRS), Jaintapur,Sylhet and Regional Agricultural Research Station (RARS), Akbarpur, Moulvibazar during January to February 2022 to develop new satkara hybrids having desirable characters like quick growing tendency and having resistance to pest and diseases. The existing citrus germplasm of CRS, Jaintapur and RARS Akbarpur were used as parents. Cultural management and other practices were done as per schedule.

The cross combinations with specific objectives were as follows:

Cross Combinations	Main objetives
BARI Satkara-1 (♀) x BARI Batabilebu-3(♂)	Transfer of quick growing habit
BARI Satkara-1(♀) x Ashkar Lebu (♂)	Transfer of quick growing habit with pest and disease resistance.

A brief description of the parents:

BARI Satkara-1: It is a variety developed from chance seedling by selection method in 2004 with regular bearing habit. Harvesting period Sept-Nov, average fruit weight 330g having yield 10 t/ha.

BARI Batabilebu-3: It is a variety developed from chance seedling by selection method with regular bearing habit. Harvesting period Sept-Oct, average fruit weight 1000-1150g. It has pinkish juice sac with TSS (%) 8.6, very juicy, bitterless.

Ashkar Lebu: It is an extraordinary citrus fruit, resistant to all types of disease and pests which is known as citron with non edible characteristics having profuse regular bearing habit.

Techniques of Crossing

Crossing was carried out between two parents with prospective hermaphrodite flowers. Flowering start opening from 10 A.M in the morning and complete the anthesis generally in the 12 P.M. After emasculation female flowers were bagged with perforated polyethene bags to avoid unwanted pollen contamination. This perforated polyethylene bags were found superior for this purpose (Mukherjee et al. 1961; Singh and Thimmappain, 1982). All open flowers were removed from the respective branch after bagging.

Results and Discussion

A total of 350 flowers were emasculated and pollinated for the hybridization program. Combinations of parents along with relevant data were presented in the table-1.Total number of fruits retention at 20,40,60,80,100 and 110 days after pollination were 30, 20, 12, 09, 06 and 04 respectively.

Table 1. Number of flowers emasculated and pollinated in each cross combination

Cross Combinations	Number of flowers emasculated	Number of flowers pollinated
BARI Satkara-1 (♀) x BARI Batabilebu-3(♂)	200	200
BARI Satkara-1(♀) x Ashkar Lebu (♂)	150	150
Total	350	350

Table 2. Number of fruit retention after 20,40,60,80 days intervals from each cross combination

Cross Combination	Fruits retention after 20 days intervals				No. of Fruits obtained
	20 Days	40 Days	60 Days	80 Days	
BARI Satkara-1 (♀) x BARI Batabilebu-3(♂)	20	15	9	4	4
BARI Satkara-1(♀) x Ashkar Lebu (♂)	10	05	02	0	0
Total	30	20	11	4	4

Conclusion

Developed hybrid fruits will be harvested at proper mature stage and kept in the laboratory. After collecting seeds it will be sowed in the soil for germination. After germination one year old hybrid seedlings will be transplanted in the main field and will be evaluated in the following season.

References

Mukherjee, S. K., P. K. Mojumdar and S. S. Chatterjee. 1961. An improved technique of mango hybridization, Indian J. Hort., 18:302.

Singh, H and Thimmappain. 1982. Effect of bagging materials on success of mango hybridization, Indian J. Hort., 39(1&2),pp 64-66.

HYBRIDIZATION IN MANDARIN

S.M.L. RAHMAN, F. AHMED, M.S. ZAMAN AND M.H.M.B. BHUYAN

Abstract

A hybridization program was conducted in the flowering season of 2021-22 at Citrus Research Station (CRS), Jaintapur, Sylhet and Regional Agricultural Research Station (RARS), Akbarpur, Mouluvibazar. A total of 200 flowers were emasculated and pollinated. Two hybrid fruits were obtained from different crosses. These hybrid fruits will be harvested at mature stage and seeds of the fruits were sown in soil for germination. After germination, seedlings of hybrid fruits will be transplanted in the main field and will be evaluated.

Introduction

Citrus fruits play an important role in the fruit world for its availability period and high market price. In Bangladesh, we have a good number of citrus species, which can certainly contribute to the nutritional improvement. We have already released 3 mandarin varieties, which have sweetness not up to the consumers demand. Recently there has been an increasing demand for quality mandarin having desirable sweetness. To meet such demand it is urgently needed to produce quality fruits with desirable sweetness quick through hybridization. Keeping these points in mind an inter-specific hybridization program has been undertaken.

Materials and Methods

The experiment was conducted at Citrus Research Station (CRS), Jaintapur,Sylhet and Regional Agricultural Research Station (RARS), Akbarpur, Moulvibazar during February to March 2022 to develop new mandarin hybrids having desirable characters like very sweet in taste. The existing citrus germplasm of CRS, Jaintapur and RARS Akbarpur were used as parents. Cultural management and other practices were done as per schedule.

The cross combinations with specific objectives were as follows:

Cross Combinations	Main objetives
BARI Komala-1(♀) × BARI Malta-1(♂)	Transfer of sweetness

A brief description of the parents:

BARI Komala-1: It is a variety developed from chance seedling by selection method in 1996 with regular bearing habit. Harvesting period Nov-Dec with TSS (%) 10.2 having 300 to 400 fruits per tree at an average fruit weight 190-200g.

BARI Malta-1: It is a variety developed in 2004 by selecting exotic germplasm with regular bearing habit. Harvesting period Nov-Dec with TSS (%) 7.8 having 400 to 500 fruits per tree at an average fruit weight 160-200g.

Techniques of Crossing

Crossing was carried out between two parents with prospective hermaphrodite flowers. Flowering start opening from 10 A.M in the morning and complete the anthesis generally in the 12 P.M. After emasculation female flowers were bagged with perforated polyethene bags to avoid unwanted pollen contamination. This perforated polyethylene bags were found superior for this purpose (Mukherjee et al. 1961; Singh and Thimmappain, 1982). All open flowers were removed from the respective branch after bagging.

Results and Discussion

A total of 250 flowers were emasculated and pollinated for the hybridization program. Combinations of parents along with relevant data were presented in the table-1.Total number of fruits retention at 20,40,60,80,100 and 110 days after pollination were 15, 10, 10, 6, 4, 2 and 2 respectively.

Table 1. Number of flowers emasculated and pollinated in each cross combination

Cross Combination	Number of flowers emasculated	Number of flowers pollinated
BARI Komala-1(♀) × BARI Malta-1(♂)	250	250
Total	250	250

Table 2. Number of fruits retention after 20,40,60,80 days intervals from each cross combination

Cross Combination	Fruits retention after 20 days intervals				No. of fruits obtained
	20 Days	40 Days	60 Days	80 Days	
BARI Komala-1(♀) × BARI Malta-1(♂)	15	8	4	2	2
Total	15	8	4	2	2

Conclusion

Developed hybrid fruits will be harvested at proper mature stage and kept in the laboratory. After collecting seeds it will be sowed in the soil for germination in the hybrid seedling plot. After germination one year old hybrid seedlings will be transplanted in the main field and will be evaluated in the following season.

References

Mukherjee, S. K., P. K. Mojumdar and S. S. Chatterjee. 1961. An improved technique of mango hybridization, Indian J. Hort., 18:302.

Singh, H and Thimmappain. 1982. Effect of bagging materials on success of mango hybridization, Indian J. Hort., 39(1&2),pp 64-66.

COLLECTION AND EVALUATION MANDARIN GERMPLASM UNDER NORTH-EASTERN HILLY AREA OF BANGLADESH

F. AHMED, J. C. SARKER, M. H. M. B. BHUYAN AND S. M. L. RAHMAN

Abstract

The experiment was conducted to study the performance of mandarin germplasm at Citrus Research Station (CRS), Jaintapur, Sylhet during 2021-2022 to identify suitable genotypes for this high rainfall areas. BARI komala-1 and BARI komala-3 used as check. Plant height ranges from 101.33 cm to 60.67 cm. The tallest plant was recorded at CR Jai-303 while the shortest plant at CR Jai-302. The plant CR Jai-304 spreads maximum (76×88 cm). On the other side CR Jai-302 had the lowest canopy (42.66×25.33cm). BARI Komala- , BARI Komala-3 and CR Jai-303 had maximum base girth (2 cm) but CR Jai-302 had the lowest base girth (0.9 cm). Maximum leaf lamina length was found at CR Jai-304 whereas shortest leaf was found at CR Jai-303. Wider leaf was noticed at CR Jai-305 but narrower leaf was noted at CR Jai-303. Leaf length breadth ratio found maximum at CR Jai-304 but lowest at BARI Komala-3.

Introduction

Citrus fruits in all the shapes, sizes and colors are the most attractive, fragrant and appetizing with high nutritional values. It is one of the richest sources of vitamin A, B, C and contains 3-4% sugar and minerals such as calcium and magnesium and phosphorus in appreciable amounts, essential for proper health and vigor. Mandarin orange (*Citrus reticulata* Blanco.) is consumed fresh or in the form of juice, jam, squash and syrup. It is the main source of peel, oil, citric acid and cosmetics which have international value (Meena et al. 2014). Mandarin orange grows successfully in all frost free tropical and subtropical regions up to 1500m altitude. Annual 100-120cm rainfall and temperature ranging from 10-35ºC are suitable for mandarin cultivation. Mandarin orange is one of the most common citrus fruits grown in Bangladesh. Although the soil and climatic condition of Bangladesh is favorable for mandarin orange cultivation, but the production is very low. As a result a huge amount of mandarin orange is imported from China, India, Bhutan, Pakistan and other countries every year. In recent years, the government of Bangladesh has given attention for increasing production of this fruit. The Chottagram hill tracts and Sylhet regions have the potentialities to increase production of mandarin orange by increasing the productivity besides bringing more area under fruits crops (BARI 2014). But the problem is lack of improved mandarin varieties. Although farmers produced a very small amount of local mandarin genotypes commercially, those are not characterized systematically. Moreover, after characterization these genotypes will facilitate hybridization program which is a primary thirst of HRC, BARI. Moreover the superior genotypes from the characterization and evaluation program could be released as variety. Keeping these view in mind the present study was undertaken.

Materials and Methods

The experiment was conducted at Citrus Research Station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet (25.13562º N latitude, 92.13217º E longitude and 36 m of elevation from mean sea level) during 2021 to 2022. Five mandarin germplasm viz. CR Jai-301, CR Jai-302, CR Jai-303, CR Jai-304 and CR Jai-305 were used as the study material along with BARI Komala-1 and Komala-3 as check. The germplasm were collected from different places of Bangladesh and are of same ages (1 year), enjoying same management levels. The plants were nourished with manures and fertilizers at a rate of cow dung 15 kg, N 90 g, P 45 g, K 75 g, and Zn 3 g. Fertilizers were applied in three equal splits, during February, May and September. Light pruning was done where necessary. Data were recorded on tree characters, Leaf characters (IPGRI, 1999) and the results were analyzed using Statix 10 computer package program and the analysis of variance were separated for significant difference by Tukey's HSD at 5%level of probability.

Results and Discussion

There is a significant variation among the treatments for plant height. Plant height ranges from 101.33 cm to 60.67 cm. The tallest plant was recorded at CR Jai-303 while the shortest plant at CR Jai-302. The plant CR Jai-304 spreads maximum (76 cm × 88 cm). On the other side CR Jai-302 had the

lowest canopy (42.66×25.33cm). BARI Komala-1, BARI Komala-3 and CR Jai-303 had maximum base girth (2 cm), but CR Jai-302 had the lowest base girth (0.9 cm).

Table 1. Growth characteristics of mandarin germplasm

Variety/Accession	Plant height (cm)	Canopy spreading (cm)		Base girth (cm)	Tree shape	Tree growth habit	Branching density
		E-W	N-S				
BARI Komala-1	89.33 c	51.00 c	54.00 cd	2.00 a	Ellipsoid	Erect	Dense
BARI Komala-3	85.33 d	35.33 f	49.00 d	2.00 a	Ellipsoid	Erect	Dense
CR Jai-301	65.00 f	39.00 e	31.00 e	1.36 c	Ellipsoid	Erect	Dense
CR Jai-302	60.67 g	42.66 d	25.33 f	0.90 d	Ellipsoid	Spreading	Dense
CR Jai-303	101.33 a	45.33 d	66.66 b	2.00 a	Ellipsoid	Erect	Sparse
CR Jai-304	95.67 b	76.00 a	88.00 a	1.80 b	Spheroid	Spreading	Dense
CR Jai-305	75.67 e	60.00 b	58.000 c	1.30 c	Spheroid	Spreading	Dense
CV (%)	1.42	2.11	3.46	2.51			

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test.

Significant variation has been noticed on leaf characters. Maximum leaf lamina length was found at CR Jai-304 whereas shortest leaf was found at CR Jai-303. Wider leaf was noticed at CR Jai-305 but narrower leaf was noted at CR Jai-303. Leaf length breadth ratio found maximum at CR Jai-304 but lowest at BARI Komala-3. Other lead characteristics found similar among the germplasm.

Table 2. Growth characteristics of mandarin germplasm

Accessions	Leaf lamina length (cm)	Leaf lamina width (cm)	Length: width	Leaf area (cm^2)	Leaf lamina shape	Leaf lamina margin	Leaf apex
BARI Komala-1	7.50 a-c	3.40 ab	2.21 ab	10.5 b-d	Elliptic	Dentate	Obtuse
BARI Komala-3	6.50 cd	3.56 a	1.82 b	10.66 a-c	Elliptic	Dentate	Obtuse
CR Jai-301	6.60 cd	3.23 ab	2.04 ab	9.83 cd	Elliptic	Dentate	Obtuse
CR Jai-302	7.10 b-d	3.46 ab	2.06 ab	10.33 b-d	Elliptic	Dentate	Obtuse
CR Jai-303	5.86 d	3.00 b	1.95 b	9.50 d	Elliptic	Entire	Obtuse
CR Jai-304	8.40 a	3.40 ab	2.47 a	11.66 a	Elliptic	Dentate	Obtuse
CR Jai-305	8.16 ab	3.70 a	2.20 ab	11.33 ab	Elliptic	Dentate	Obtuse
CV (%)	6.08	5.80	8.46	3.46			

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test.

Conclusion

All the plants are now in vegetative stage and showed better growth performance. So after flowering and fruiting the final evaluation and conclusion can be made.

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PERFORMANCE OF EXOTIC SWEET ORANGE GERMPLASM

J.C. SARKER, M.H.M.B. BHUYAN, F AHMED AND S.M.L. RAHMAN

Abstract

A study was conducted with four exotic sweet orange germplasm to evaluate their performance at Citrus Research Station, Jaintapur, Sylhet during 2021 to 2022. BARI Malta-1 was used as check. Significant differences were recorded among the studied germplasm in terms of growth, yield and yield contributing characteristics. Maximum fruit weight (460.1g) was recorded in CS Jai-051 while minimum (152.2g) in CS Jai-051. Fruit size also attained maximum (9.9×9.8 cm) in CS Jai-051. High juice content and the highest TSS (13.6%) were recorded in CS Jai-003, while CS Jai-209 attained the lowest TSS (10%). Edible portion was recorded maximum (78.67%) in CS Jai-051 which was followed by CS Jai 012 (77.13%) and CS Jai-209 (76.74%). Fruit color at maturity of exotic sweet orange germplasm CS Jai-051, CS Jai-003, CS Jai-012, CS Jai-209 and BARI Malta-1were found pale green, bright yellow and greenish yellow respectively. Pulp colors of studied germplasm were found off white to orange, whereas BARI Malta-1was light yellow.

Introduction

Citrus fruits play an important role in the fruit world for its nutritive value, availability period and high market price. In Bangladesh, we have a good number of exotic citrus species, which can certainly contribute to the nutritional improvement. Sweet orange is one of the most important citrus fruits in Bangladesh. Bangladesh Agricultural Research Institute has released two sweet orange varieties named BARI Malta-1 and BARI Malta-2, Among them BARI Malta-1 is becoming popular to grower for commercial cultivation in Bangladesh and some plants are found scattered in homesteads also. Moreover, GO & NGOs already established a significant number of orchards of BARI Malta-1 across the country and these efforts are continuing. It produces tasty fruits having high nutritional value with immense economic importance. But every year we have to import a lot of sweet oranges from different countries. Due to the thirst of growing demand day by day, we have to develop more improved varieties of sweet orange to fulfill the needs. Hence the study has been under taken.

Methods and Materials

The experiment was conducted at Citrus Research Station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet (25.13562º N latitude, 92.13217º E longitude and 36m of elevation from mean sea level) during 2020 to 2021. Four exotic sweet orange germplasm viz. CS Jai-003, CS Jai-012, CS Jai-051and CS Jai-209 were used as the study material along with BARI Malta-1 as check. The germplasm were collected from different exotic sources and are of same ages (4 years), enjoying same management levels. Among the variety/germplasm BARI Malta-1 was grafted on pummelo. Based on rootstock trial CS Jai-003 was grafted on sweet orange; and CS Jai-012 was grafted on Karun Jamir (sour orange), while others were grafted on pummelo rootstocks. The plants were nourished with manures and fertilizers at a rate of cow dung 15 kg, N 169 g, P 79 g, K88 g, S18 g, B 1g and Zn 3.2 g. Fertilizers were used in two splits; one before rainy season at May and another after rainy season at September (Mandol *et al.,* 2014). Insecticides were used to reduce the infestation of leaf minor when new flushes immerged. Cupravit 50WP (Copper oxichloride + Mancozeb) with 7g L^{-1} of water were applied to control canker and other fungal disease. Bordeaux paste was used twice in a year to control lichen infestation. Bordeaux paste was applied first after rainy season and second before the rain starts. Light pruning was done where necessary. The experiment was laid down in a randomized complete block design with 3 replications (single plant per replication). Data were recorded on tree characters, vegetative life cycle, Leaf characters, fruiting season, yield, fruit quality characters (IPGRI, 1999). Scion trunk surface was observed according to citrus descriptor (IPGRI, 1999). All the collected data were further subjected to statistical analysis for interpretation of the results (Gomez and Gomez, 1984).

Result and Discussion

In respect of growth characteristics a significant variation was found among the germplasm. Plant height, base girth and canopy spread (NS-EW) ranged from 167 cm to 223 cm, 7.5 cm to 15.7 cm and (87×103 cm^2 to 112×132 cm^2) respectively. Scion trunk surface was found smooth in all the

germplasm. Tree shape was found ellipsoid in all the germplasm except CS Jai-051 which was found spheroid shape. All the germplasm exhibited upright growth habit except CS Jai-051, which was exhibited spreading growth habit. Among the germplasm BARI Malta-1, CS Jai-003 and CS Jai-012 were found dense branching habit while CS Jai-051and CS Jai-209 were sparse. Shoot tip color was found green to purple and shoot tip surface was recorded glabrous in all the germplasm (Table 1).

Table 1. Growth characteristics of sweet orange germplasm

Variety/ Accession	Rootstock	Plant height (cm)	Base girth (cm)	Scion trunk surface	Canopy spread (cm)		Tree shape
					E-W	N-S	
BARI Malta-1	Pummelo	223	7.5	Grooved and ridged	87	103	Ellipsoid
CS Jai-003	Sweet orange	189	15.7	Grooved and ridged	98	126	Ellipsoid
CS Jai-012	Karun Jamir	176	9.3	Grooved and ridged	101	113	Ellipsoid
CS Jai-051	Pummelo	167	7.8	Grooved and ridged	98	116	Spheroid
CS Jai-209	Pummelo	185	7.9	Grooved and ridged	112	132	Ellipsoid
SD	-	23.32	3.45	-	7.81	23.72	-
CV(%)	-	15.03	35.87	-	8.58	24.91	-

Table 1. Continued

Variety/ Accession	Tree growth habit	Density of branches	Spine density	Shoot tip color	Shoot tip surface
BARI Malta-1	Upright	Dense	Absent	Green	Glabrous
CS Jai-003	Upright	Dense	Absent	Green	Glabrous
CS Jai-012	Upright	Dense	Absent	Green	Glabrous
CS Jai-051	Spreading	Sparse	Absent	purple	Glabrous
CS Jai-209	Upright	Sparse	Absent	purple	Glabrous

In case of leaf characteristics leaf type was found simple, vegetative life cycle was exhibited evergreen, color of leaf blade was shown dark green in all the germplasm. Length and width of leaf lamina ranged from 21 mm to 38 mm and 7 mm to 23 mm, respectively. In case of leaf or leaflet shape, there was found much variation among the germplasm. Lanceolate and obovate shape was found in CS Jai-003 and CS Jai-051 respectively whereas CS Jai-012 attained ovate shape leaflets and rest two germplasm had elliptic leaflets. Leaf lamina margin was found entire in all the germplasm, except CS Jai-003 which was found dentate leaf margin. All the germplasm had the acuminate leaf apex. In case of presence of petiole wing was found narrow in all the germplasm except BARI Malta-1 and CS Jai-003 which were found absent (Table 2).

Table 2. Leaf characteristics of sweet orange germplasm

Variety/ Accession	Vegetative life cycle	Type of leaf	Leaf blade color	Leaf lamina length (mm)	Leaf lamina width (mm)
BARI Malta-1	Evergreen	Simple	Dark green	27	8
CS Jai-003	Evergreen	Simple	Dark green	21	7
CS Jai-012	Evergreen	Simple	Dark green	37	17
CS Jai-051	Evergreen	Simple	Dark green	38	23
CS Jai-209	Evergreen	Simple	Dark green	29	8
SD	-	-	-	7.46	6.58
CV%	-	-	-	26.30	62.07

Table 2. Continued

Variety/ Accession	Leaf/leaflet shape	Leaf lamina margin	Leaf apex	Petiole wing
BARI Malta-1	Elliptic	Entire	Acuminate	Absent
CS Jai-003	Lanceolate	Dentate	Acuminate	Absent
CS Jai-012	Ovate	Entire	Acuminate	Narrow
CS Jai-051	Obovate	Entire	Acuminate	Narrow
CS Jai-209	Elliptic	Entire	Acuminate	Narrow

All the germplasm bore fruits in this season. All the exotic sweet orange lines were found late maturing (November -December) while BARI Malta-1 matured within October. The highest number of fruits was harvested from CS Jai-003 (42) whereas lowest (19) from CS Jai-209. Maximum yield plant^{-1} (10.46 kg) was obtained in CS Jai-003 while minimum (2.89 kg) in CS Jai-209 (Table 3).

Table 3. Yield and yield contributing characters sweet orange germplasm

Variety/ Accession	Fruiting season		Fruits plant^{-1} (no.)	Yield plant^{-1} (kg)
	Start	End		
BARI Malta-1	February	October- December	35	8.33
CS Jai-003	February	November -December	42	10.46
CS Jai-012	February	November -December	33	6.48
CS Jai-051	February	November -December	21	9.66
CS Jai-209	February	November -December	19	2.89
SD	-	-	2.88	0.94
CV%	-	-	25.27	33.67

The heaviest fruit (460.1 g) was harvested from CS Jai-051, while the lightest (152.2 g) was from CS Jai-209. Fruit size attained maximum (9.9×9.8 cm) in CS Jai-051. Edible portion was recorded maximum (78.67%) in CS Jai-051 which was followed by CS Jai-003 (77.13%) and CS Jai-209 (76.74%) while minimum (63.42%) in CS Jai-012. Maximum TSS content (13.6%) was recorded in CS Jai-003 while CS Jai-209 attained minimum TSS (10.0%). The highest rind thickness (4.1 mm) was found in CS Jai-003 while the lowest (3.2 mm) in CS Jai-051. Maximum number of segments was recorded in CS Jai-051 (12) while rest of the line was exhibited similar number of segment fruit^{-1} (11). Maximum seeds fruit^{-1} (33) was found in CS Jai-051 whereas CS Jai-003 produced fruits with no seed. Weight of 100 seed was recorded the highest (31.8g) in BARI Malta-1 whereas it was the lowest (21.3 g) in CS Jai-051 (Table 4).

Table 4. Quantitative and qualitative characteristics of fruits of sweet orange germplasm

Variety/ Accession	Fruit weight (g)	Fruit size (cm)		Pulp Weight (g)	Rind Weight (g)	Edible portion (%)	TSS (%)
		Length	Breadth				
BARI Malta-1	238.0	7.9	7.4	174.5	57.0	73.32	11.2
CS Jai-003	249.2	8.3	7.9	192.2	63.5	77.13	13.6
CS Jai-012	196.3	6.7	7.0	124.5	46.2	63.42	12.0
CS Jai-051	460.1	9.9	9.8	362.0	97.0	78.67	11.0
CS Jai-209	152.2	6.2	6.5	116.8	38.5	76.74	10.0
SD	118.20	1.54	1.22	98.91	22.17	5.63	2.10
CV (%)	46.10	19.73	15.78	51.35	37.81	7.59	18.14

Table 4. Continued

Variety/ Accession	Rind thickness (mm)	Segments fruit^{-1} (no.)	Seeds fruit^{-1} (no.)	Seed size (mm)		100 seed weight (g)
				Length	Breadth	
BARI Malta-1	3.4	11	14	10.3	7.0	31.8
CS Jai-003	4.1	11	Nil	-	-	-
CS Jai-012	3.7	11	8	10.4	5.3	27.4
CS Jai-051	3.2	12	33	11.4	4.2	21.3
CS Jai-209	3.9	11	12	11.0	3.3	24.6
SD	0.39	0.54	12.99	1.29	1.67	4.44
CV (%)	11.25	5.26	82.52	12.26	36.99	17.59

In case of fruit color, BARI Malta-1 was greenish yellow whereas CS Jai-051 was pale green, rest of the germplasm attained bright yellow fruits upon maturity. All the germplasm exhibited fruits having smooth surface. Pulp color was found light yellow in BARI Malta-1 while pulp color of other germplasm recorded off white except CS Jai-012, this germplasm produce fruits contained orange in pulp color. High juice content was recorded in all the exotic sweet orange line whereas medium in BARI Malta-1 (Table 5).

Table 5. Qualitative characteristics of fruits of sweet orange germplasm

Variety/ Accession	Fruit color at maturity	Surface texture of fruit	Color of pulp	Juice content in endocarp	Pest and disease reaction	Juice taste (According to evaluator)
BARI Malta-1	Greenish yellow	Smooth	Light yellow	Medium	Leaf minor	Very good
CS Jai-003	Bright yellow	Smooth	Off white	High	Lichen	Very good
CS Jai-012	Bright yellow	Smooth	Orange	High	Sooty mould	Pleasant
CS Jai-051	Pale Green	Smooth	Off white	High	Sooty mould	Very good
CS Jai-209	Bright yellow	Smooth	Orange	High	Sooty mould	Pleasant

Conclusion

Among the germplasm, CS Jai-003 and CS Jai-051 are promising and can be released as new sweet orange (Malta) variety.

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COLLECTION AND EVALUATION OF LOCAL PUMMELO GERMPLASM

J.C. SARKER, F. AHMED, M.H.M.B. BHUYAN AND S.M.L. RAHMAN

Abstract

Evaluation of local pummelo germplasm was conducted at Citrus Research Station, Jaintapur, Sylhet to study their performance. All the germplasm showed significant variation in respect of plant height, base girth and canopy spreading attributes. The highest plant height (4.45m) was recorded in CG Jai-061 followed by CG Jai-055 (4.19m) as well as CG Jai-054 (4.12m) and the lowest in CG Jai-064 (3.15m). Maximum base girth was also found from CG Jai-053 (23.00cm) followed by CG Jai-061 (21.34m) and CG Jai-054 (20.12cm). Canopy size was biggest in CG Jai-054 and smallest in CG Jai-055.

Introduction

Pummelo or shaddock (*Citrus maxima* (Burm.) Merr.) is a crispy citrus fruit which is a native to South and Southeast Asia (Morton, 1987). It is usually pale green to yellow at ripen stage, with sweet white or pink or red flesh and very thick rind. It is the largest citrus fruit, 15–25 centimeters in diameter, and usually weighing 1-2 kilograms. Pummelo is one of the most important citrus fruits in terms of availability and nutritional status. It contains vitamin C more than twice those of other citrus fruits. In case of table purpose use, it can easily substitute mandarin which is being imported by foreign currency. In our country, there exists a great variability of pummelo which is an opportunity to develop high quality and high yielding pummelo varieties. The study was therefore, undertaken to select promising line(s) to develop as variety.

Materials and Methods

The experiment was conducted at Citrus Research Station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet during 2021 to 2022 in the pummel orchard established 5 years back established by line planting method considering 3×3m spacing. Each plant was fertilized with 10 kg well rotten cow dung, 200g urea, 150 g TSP, 150 g of MoP in two splits before and after rainy season. Imidachloprid (Imitaf 0.24 mL L^{-1}) was applied to reduce leaf miner infestation during new leaf emergence. Weeding was done regularly so that weeds cannot retard the growth of the sapling. Mulching was done in the winter. Data were recorded on plant height, base girth canopy spreading and growth condition. All the data collected were processed and analyzed for the interpretation of the results (Gomez and Gomez, 1984).

Results and Discussion

All the lines showed significant variation among plant height, base girth and canopy spreading. The highest plant height (4.45m) was recorded in CG Jai-061 followed by CG Jai-055 (4.19m) as well as CG Jai-054 (4.12m) and the lowest in CG Jai-064 (3.15m). Maximum base girth was also found from CG Jai-053 (23.00cm) followed by CG Jai-061 (21.34m) and CG Jai-054 (20.12cm). Canopy size was biggest in CG Jai-054 and smallest in CG Jai-055 (Table 1).

Table 1. Growth characteristics of pummelo germplasm

Lines	Plant height (m)	Base girth (cm)	Canopy Spreading (cm)		Growth condition
			E/W	N/S	
CG Jai-053	3.79	23.23	59.30	46.62	Good
CG Jai-054	4.12	20.12	62.33	44.64	Good
CG Jai-055	4.19	18.45	28.67	27.33	Good
CG Jai-061	4.45	21.34	47.32	53.43	Good
CG Jai-062	3.74	19.00	27.67	27.27	Good
CG Jai-063	3.26	19.25	43.23	24.25	Good
CG Jai-064	3.15	18.75	56.25	33.16	Good
LSD	0.791	2.16	13.27	9.78	-
CV (%)	30.06	12.93	30.68	27.94	-

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by DMRT.

Conclusion

The plants are at vegetative stage and the growth is satisfactory. Final conclusion can be made after 3-5 years of fruit quality evaluation.

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MORPHOPHYSIOLOGICAL CHARACTERIZATION AND EVALUATION OF SEEDLESS LEMON GERMPLASM

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Abstract

An effort has been made for the morphological characterization and evaluation of collected seedless lemon germplasm. Variability was observed in different characters between the germplasm studied. Among the germplasm, CL Jai-102 was superior with maximum individual fruit weight, large fruit size, highest number of fruits plant^{-1}, fruit yield plant^{-1} as well as ha^{-1} yield followed by Cl Jai-101. On the other hand the genotype CL Jai-105 poduced the lowest yield. The fruit quality attributes also varied among the gremplasm tested. Interestingly the genotype CL Jai-101 was found with no seed. But in the other genotypes, not all but some fruits were found with one or two seeds .

Introduction

Among the citrus fruits, lemon plays an important role in the fruit world for their availability period and high market value. In Bangladesh, we have a good number of citrus species, which can certainly contribute to the nutritional improvement of the people. Seedless lemons are very important among the citrus fruits of Bangladesh. Every year Bangladesh exports a good amount of seedless lemon to the main stream market of other countries. Bangladesh Agricultural Research Institute has already released five lemon varieties for farmer's cultivation, but no one is seedless. Although many popular seedless lemon varieties are cultivated thoroughout the country, not all are truly seedless. Therefore it is an urgent need to develop a true seedless lemon varieties.

On the other hand morphophysiological characterization is one of the primary tools for developing new varieties and hybrids from existing inbreed lines and/or land races. Therefore, from the study the detailed characteristics of collected seedless varieties will be recorded, which will further facilitate new vreital release. In these circumstances, characterization is a prime need for the seedless lemon germplasm. Hence the study has been undertaken.

Materials methods

Morphological characterization of seedless lemon germplasm were conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet during 2021-22. Six seedless lemon germplasm were included in the study and was characterized. Characterization has been done following the descriptor published by IPGRI. But the similar characters among the germplasm were excluded.
Descriptors State:

A. Plant descriptors:

1.	Plant height	
2.	Plant shape	1 Ellipsoid 2 Spheroid 3 Obloid
3.	Plant growth habit	1 Erect 2 Spreading 3 Drooping
4.	Density of branches	3 Sparse 5 Medium 7 Dense
5.	Spine density on adult tree	0 Absent 3 Low 5 Medium 7 High
6.	Shoot tip colour	1 Green 2 Purple

B. Leaf Descriptors

1.	Vegetative life cycle	1 Evergreen 2 Deciduous 3 Semi-persistent
2.	Leaf division	1 Simple 2 Bifoliate 3 Trifoliate 4 Pentafoliate
3.	Intensity of green colour of leaf blade	1 Light 2 Medium (green) 3 Dark
4.	Leaf lamina attachment	1 Sessile (petiole absent) 2 Brevipetiolate (petiole shorter than leaf lamina) 3 Longipetiolate (petiole longer than or same length as leaf lamina)
5.	Leaf lamina length [mm]	Recorded from petiole base to lamina tip. Average of 10 fully developed leaves taken from three different adult trees.
6.	Leaf lamina width [mm]	Recorded at the widest point. Average of 10 fully developed leaves taken from three different adult trees.
7.	Leaf lamina shape	1 Elliptic 2 Ovate 3 Obovate 4 Lanceolate 5 Orbicular 6 Obcordate
8.	Leaf lamina margin	1 Crenate 2 Dentate 3 Entire 4 Sinuate
9.	Leaf apex	1 Attenuate 2 Acuminate 3 Acute 4 Obtuse 5 Rounded 6 Emarginate

C. Flower Descriptors

1.	Pedicel length [mm]	
2.	Calyx diameter	3 Small 5 Medium 7 Large
3.	Length of anthers relative to stigma	3 Shorter 5 Medium 7 Longer
4.	Flower type	1 Hermaphrodite 2 Male 3 Female
5.	Color of open flower	1 White 2 Light yellow 3 Yellow 4 Purple
6.	Color of anthers	1 White 2 Pale yellow 3 Yellow
7.	Number of petals per flower	
8.	Petal length [mm]	
9.	Petal width [mm]	
10.	Number of stamens	1 < 4 per petal 2 4 per petal 3 > 4 per petal

D. Fruit Descriptors

1.	Fruit weight	An average of 10 fruits was recorded
2.	Fruit diameter [mm]	

3.	Fruit length [mm]	
4.	Fruit shape	1 Spheroid 2 Ellipsoid 3 Pyriform 4 Oblique (asymmetric) 5 Obloid 6 Ovoid
5.	Shape of fruit base	1 Necked 2 Convex 3 Truncate 4 Concave 5 Concave collared 6 Collared with neck
6.	Shape of fruit apex	1 Mammiform 2 Acute 3 Rounded 4 Truncate 5 Depressed
7.	Fruit skin (epicarp) colour	1 Green 2 Green-yellow 3 Light yellow 4 Yellow 5 Dark yellow 6 Light orange 7 Orange 8 Dark orange 9 Pink-yellow 10 Pink-orange 11 Red 12 Red-orange
8.	Width of epicarp at equatorial area [mm]	
9.	Fruit surface texture	1 Smooth 2 Rough 3 Papillate 4 Pitted 5 Bumpy 6 Grooved
10.	Adherence of albedo (mesocarp) to pulp (endocarp)	3 Weak 5 Medium 7 Strong
11.	Fruit rind (mesocarp) thickness [mm]	Measured in the equatorial area
12.	Albedo colour	1 Greenish 2 White 3 Yellow 4 Pink 5 Orange 6 Reddish
13.	Fruit attachment to stalk	3 Weak 5 Medium 7 Strong
14.	Segments	Average of well-developed segments observed on 30 fruits taken from three adult trees
15.	Number of segments per fruit	1 < 5, 2 5–9, 3 10–14, 4 15–18, 5 >18
16.	Adherence of segment walls to each other	3 Weak 5 Medium 7 Strong
17.	Fruit axis	1 Solid 2 Semi-hollow 3 Hollow
18.	Diameter of fruit axis [mm]	

E. Pulp Descriptors

1.	Pulp (flesh) colour	1 White 2 Green 3 Yellow 4 Orange 5 Pink 6 Light red 7 Orange–red 8 Red 9 Purple
2.	Pulp colour intensity	3 Light 7 Dark
3.	Pulp colour uniformity	0 No (streaked) 1 Yes
4.	Pulp firmness	3 Soft 5 Intermediate 7 Firm
5.	Pulp texture	1 Crispy 2 Fibrous 3 Fleshy
6.	Juice content	
7.	Vesicle length	3 Short 5 Medium 7 Long
8.	Vesicle thickness	3 Thin 5 Medium 7 Thick
8.	Juice content in endocarp (Quantity related to total fruit weight)	3 Low 5 Medium 7 High
9.	Titratable acids content (%)	
10.	Total soluble solids content (% brix)	
11.	Ratio of total soluble solids to titratable acids	

F. Seed Descriptors

1.	Average number of seeds per fruit (Observed only fully developed seeds)	0 None 1 1 – 4 2 5 – 9 3 10 – 19 4 20 – 50 5 > 50
2.	Seed shape	1 Fusiform 2 Clavate 3 Cuneiform 4 Ovoid 5 Semi-deltoid 6 Spheroid 7 Semi-spheroid
3.	Seed surface	1 Smooth 2 Wrinkled 3 Hairy
4.	Seed colour	1 White 2 Cream 3 Yellowish 4 Green 5 Brown
5.	Seed length (mm)	
6.	Seed width (mm)	

7.	Cotyledon colour	1 White 2 Light yellow–cream 3 Light green 4 White and green 5 Green (medium) 6 Dark green 7 Purple 8 Pinkish
8.	100 seed weight (g)	

Results and discussion

A wide variation was observed in different parameters studied. However the results have been presented in the following tables.

Table 1. Passport Descriptor

Name of Crop (English)	:	Lemon	Lemon	Lemon	Lemon	Lemon	Lemon
Name of Crop (Bengali)	:	লেবু	লেবু	লেবু	লেবু	লেবু	লেবু
Scientific Name	:	*Citrus limon*	*Citrus limon*	*Citrus limon*	*Citrus limon*	*Citrus limon*	*Citrus limon*
Collecting Institute	:	CRS, BARI, Jaintapur	CRS, BARI, Jaintapur	CRS, BARI, Jaintapur	CRS, BARI, Jaintapur	CRS, BARI, Jaintapur	CRS, BARI, Jaintapur
Country of Origin	:	Bangladesh	Bangladesh	Bangladesh	Bangladesh	Bangladesh	Bangladesh
Accission/Cultivar	:	CL Jai-101	CL Jai-102	CL Jai-103	CL Jai-104	CL Jai-105	CL Jai-106
Commercial value	:	High	High	High	High	High	High
Cultivation practices	:	Homestead/ commercial orchard	Homestead/ commercial orchard	Homestead/ commercial orchard	Homestead/ commercial orchard	Homestead/ commercial orchard	Homestead/ commercial orchard
Area coverage	:	N/A	N/A	N/A	N/A	N/A	N/A

Table 2. Plant Descriptors

Accessions	Plant hight (m)	Plant shape	Plant growth habit	Density of branches	Spine density	Shoot tip color	Parts of plant used
CL Jai-101	1.4	Ellipsoid	Spreading	Medium	Medium	Purple	Fruit
CL Jai-102	2.5	Obloid	Spreading	Medium	Medium	Green	Fruit
CL Jai-103	1.6	Spheroid	Erect	Medium	Medium	Green	Fruit
CL Jai-104	2.3	Obloid	Drooping	Sparse	High	Purple	Fruit
CL Jai-105	1.2	Obloid	Erect	Sparse	Medium	Purple	Fruit
CL Jai-106	1.5	Obloid	Erect	Sparse	Medium	Purple	Fruit

Table 3. Leaf descriptors

Accessions	Vegetative life cycle	Leaf division	Intensity of green color of leaf blade	Leaf lamina attachment
CL Jai-101	Evergreen	Simple	Dark	Sessile
CL Jai-102	Evergreen	Simple	Medium	Sessile
CL Jai-103	Evergreen	Simple	Medium	Sessile
CL Jai-104	Evergreen	Simple	Medium	Sessile
CL Jai-105	Evergreen	Simple	Dark	Sessile
CL Jai-106	Evergreen	Simple	Medium	Sessile

Table 3. Continued

Accessions	Leaf lamina Length (mm)	Leaf lamina width (mm)	Leaf lamina shape	Leaf lamina margin	Leaf apex
CL Jai-101	13.34	4.52	Elliptic	Entire	Acute
CL Jai-102	15.45	6.54	Elliptic	Entire	Attenuate
CL Jai-103	12.25	5.43	Elliptic	Entire	Attenuate
CL Jai-104	12.32	5.67	Elliptic	Entire	Acuminate
CL Jai-105	11.25	5.65	Elliptic	Entire	Obtuse
CL Jai-106	13.68	5.42	Elliptic	Entire	Obtuse

Table 4. Flower Descriptors

Accessions	Pedicel length (mm)	Calyx diameter	Length of anthers relative to stigma	Flower type	Color of Open flower
CL Jai-101	5	Medium	Medium	Hermaphrodite	White
CL Jai-102	6	Medium	Medium	Hermaphrodite	White
CL Jai-103	5	Medium	Medium	Hermaphrodite	White
CL Jai-104	5	Medium	Medium	Hermaphrodite	White
CL Jai-105	5	Small	Medium	Hermaphrodite	White
CL Jai-106	5	Medium	Medium	Hermaphrodite	White

Table 4. Continued

Accessions	Number of petals per flower	Petal length (mm)	Petal width (mm)	Number of stamens	Color of anthers	Fruit setting (%)
CL Jai-101	5	13.5	8.0	> 4 per petal	Yellow	54.3
CL Jai-102	5	17.0	9 .1	> 4 per petal	Yellow	53.4
CL Jai-103	5	14.2	7.9	> 4 per petal	Yellow	47.1
CL Jai-104	5	12.3	8.0	> 4 per petal	Yellow	48.3
CL Jai-105	5	13.5	7.8	> 4 per petal	Yellow	43.1
CL Jai-106	5	12.8	7.9	> 4 per petal	Yellow	42.8

Table 5. Fruit Descriptors

Accessions	Fruit weight (g)	Fruit diameter (mm)	Fruit length (mm)	Fruits plant^{-1} (no.)	Yield plant^{-1} (Kg)	Yield (t ha^{-1})
CL Jai-101	98.5	60.5	90.2	100.15	9.86	10.96
CL Jai-102	115.0	65.4	94.5	112.31	12.92	14.36
CL Jai-103	92.6	54.3	65.4	86.38	7.99	8.88
CL Jai-104	97.3	62.7	66.4	76.3	7.42	8.24
CL Jai-105	82.6	52.1	70.2	55.13	4.55	5.05
CL Jai-106	83.9	56.3	74.2	67.40	5.65	6.28

Table 5. Continued

Accessions	Fruit shape	Shape of fruit base	Shape of fruit apex	Fruit Skin color	Fruit surface texture	Adherence of albedo to pulp	Fruit rind thickness (mm)	Albedo color
CL Jai-101	Ellipsoid	Convex	Rounded	Green	Smooth	Strong	3.4	White
CL Jai-102	Ellipsoid	Convex	Rounded	Green	Smooth	Strong	3.5	White
CL Jai-103	Ellipsoid	Convex	Rounded	Green	Smooth	Strong	3.4	White
CL Jai-104	Ellipsoid	Convex	Rounded	Green	Smooth	Strong	3.6	White
CL Jai-105	Ellipsoid	Convex	Rounded	Green	Smooth	Strong	3.2	White
CL Jai-106	Ellipsoid	Convex	Rounded	Green	Smooth	Strong	3.3	White

Table 5. Continued

Accessions	Fruit attachment to stalk	Number of segments per fruit	Adherence of segment walls to each other	Fruit axis	Diameter of fruit axis
CL Jai-101	Strong	10-11	Strong	Solid	2.5
CL Jai-102	Strong	11-12	Strong	Solid	2.6
CL Jai-103	Strong	10-11	Strong	Solid	2.3
CL Jai-104	Strong	10-11	Strong	Solid	2.4
CL Jai-105	Strong	10-11	Strong	Solid	2.1
CL Jai-106	Strong	10-11	Strong	Solid	2.3

Table 6. Pulp descriptors

Accessions	Pulp color	Pulp color intensity	Pulp color uniformity	Pulp firmness	Pulp texture	Juice content (%)
CL Jai-101	White	Light	Yes	Intermediate	Crispy	36.3
CL Jai-102	White	Light	Yes	Intermediate	Fibrous	35.5
CL Jai-103	White	Light	Yes	Intermediate	Fibrous	36.2
CL Jai-104	White	Light	Yes	Intermediate	Fibrous	36.7
CL Jai-105	White	Light	Yes	Intermediate	Crispy	35.3
CL Jai-106	White	Light	Yes	Intermediate	Fibrous	35.4

Table 6. Continued

Variety	Vesicle length	Vesicle thickness	Titratable acids content (%)	Total soluble solids content (% brix)	Ratio of total soluble solids to titratable acids
CL Jai-101	9.1	1.1	5.52	6.85	1.24
CL Jai-102	10.3	1.4	5.45	6.54	1.22
CL Jai-103	9.3	1.2	5.45	6.68	1.22
CL Jai-104	9.6	1.3	5.65	6.32	1.12
CL Jai-105	7.3	1.0	5.43	6.89	1.27
CL Jai-106	8.7	1.1	5.48	6.98	1.27

Table 7. Seed descriptors

Variety	Number of seeds per fruit	Seed surface	Seed color	Seed shape
CL Jai-101	0	--	-	-
CL Jai-102	1.2	Smooth	Cream	Clavate
CL Jai-103	1.2	Smooth	Cream	Clavate
CL Jai-104	1.3	Smooth	Cream	Clavate
CL Jai-105	2.1	Smooth	Cream	Clavate
CL Jai-106	1.4	Smooth	Cream	Clavate

Table 7. Continued

Variety	Seed length (mm)	Seed width (mm)	Cotyledon Color	100 seed weight (g)
CL Jai-101	-	-	-	-
CL Jai-102	32	13	White	12.75
CL Jai-103	35	12	White	10.66
CL Jai-104	34	12	White	11.32
CL Jai-105	34	13	White	12.34
CL Jai-106	32	12	White	12.32

Table 8. Biotic and abiotic stress susceptibility

Indicators	Major insect-pests	Major diseases
CL Jai-101	B, D, F	B, D, F, G
CL Jai-102	B, D, F	B, D, F, G
CL Jai-103	B, D, F, G	B, D, F, G
CL Jai-104	B, D, F, H	B, D, F, G, H
CL Jai-105	B, D, F, G	A, B, D, F, G
CL Jai-106	B, D, F	B, D, F, G

Legends:

Insect and Mits: Green citrus aphid (A), Black citrus aphid (B), Brown citrus aphid (C), Citrus leaf miner (D), Citrus thrips (E), Citrus psylla (F), Trunk borer (G), Red spider mites (H)

Diseases and Nematods: Dieback (A), Gummosis (B), Stem end rot (C), Anthracnose (D), Greening (E), Lichen (F), Canker (G), Scab (H), Nematods (I)

Conclusion
In this study, seedless lemon genotypes showed wide variation both in qualitative and quantitative characteristics. Therefore it can be concluded that these germplasm could further be used for varietal development programs. This is the first year of study. Next year this study will be focused on the yield potential of the germplasm to find out the superior genotypes.

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EVALUATION OF ORGANIC FERTILIZERS FOR SAFE LEMON (*Citrus limon* (L.) OSBECK CV. BARI LEBU-5) PRODUCTION

M.H.M.B. BHUYAN, M.M. RAHMAN, F. AHMED, J.C. SARKER AND S.M.L. RAHMAN

Abstract
The experiment was conducted from December 2020 to December 2021 on five years old BARI Lebu-5 orchard planted in 3×3m spacing during the year 2016 at Citrus Research Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a Randomized Complete block design (RCBD) with six treatments, each replicated three times. The total number of plant units subjected to the study was eighteen (18). The treatments include T_1=Native nutrients (soil without manures and fertilizers), T_2=Farmers practice (RDF according to FRG from chemical fertilizers), T_3=Farmyard manure (10 t ha^{-1}), T_4=Vermicompost (6 t ha^{-1}), T_5= Poultry manure (5 t ha^{-1}), T_6=Mustard oil cake (4 t ha^{-1}). Although from the experiment it was found that T_2 (farmers practice) performed best compared to the organic treatments, but the organic treatments are very closer to the farmers practice. Among the organic treatments T_4 (Vermicompost) performed best regarding growth, yield contributing characters, yield and fruit quality attributes of BARI Lebu-5

Introduction
Lemon [*Citrus limon* (L.) Osbeck] is one of the most popular fruits in citrus group in Bangladesh and around the world as well. Lemon is the leading acid citrus fruit and the third most favoured citrus species next to Orange and Mandarin. There are number of diverse form of lemon, which may slightly differ from each other. It has wide adaptability, which makes it one of the most promising fruit crops in the world. A possible connection between the health of soils, plants, animals, and people is an idea that traces to ancient times. In ancient Greece, Hippocrates is famously quoted as saying, "Let food be the medicine and medicine be the food," and this idea still resonates, especially among the growing section of the public interested in the role of natural foods in promoting health. Despite the increasing popularity of this concept, the part of healthy soils in plant and animal health is mainly unexplored by the scientific community (Doran et al., 1996). After modest beginnings in the early 20th century, since the 1980s, organic agriculture has gained increasing scientific and consumer recognition.

Lemon cv. BARI Lebu-5 is an important variety of lemon and is widely grown in the central and north-eastern parts of Bangladesh, which is a tall cultivar, suitable for high density planting as well as exportable. It is locally known as 'kolombo Lebu' in Narshingdhi and other parts of Bangladesh. The lemon is found to be comparatively bigger in size than the normally grown lemon and hence, contain higher amount of juice. The peel is also edible. BARI Lebu-5 has the character of being able to bear fruits in many flushes making it available throughout the year. The lemon also has export potentiality and currently exported to different EU countries. Accordingly, to sustain the whole year fruiting and obtain the best quality fruits with maximum yield, it is necessary to maintain the nutrient status of the soil at a peak level from where the plant receive nutrients. Moreover, citrus fruits are prune to deficiency of different micro nutrients, hence, proper application of organic fertilizers should be practiced to reduce nutrient deficiency as well as keeping the healthy and sturdy growth of

plants, on which the yield and quality fruit production depends. Thus, the optimized standards of fertilizer application are of great importance to get good growth. Therefore, the present study were undertaken to find out the best possible organic fertilizers dose, which can stimulate the lemon production without adversely affecting the quality of soils. Keeping these view in mind the experiment was undertaken.

Materials and Methods

The study was executed with the aim of evaluating and standardizing the influence of organic nutrient sources on growth and yield of BARI Lebu-5. The experiment was conducted from December 2020 to December 2021 on five years old BARI Lebu-5 orchard planted in a 3×3m spacing during the year 2016 at Citrus Research Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a Randomized Complete Block Design (RCBD) with six treatments, each replicated three times. The total number of plant units subjected to the study was eighteen (18). The treatments include T_1=Native nutrients (soil without manures and fertilizers), T_2=Farmers practice (RDF according to FRG from chemical fertilizers), T_3=Farmyard manure (10 t ha^{-1}), T_4=Vermicompost (6 t ha^{-1}), T_5= Poultry manure (5 t ha^{-1}), T_6=Mustard oil cake (4 t ha^{-1}). The treatments were prepared on weight basis. The treatments were incorporated in a ring basin made around each tree at 45 cm away from the trunk. Other intercultural operations like watering, stalking the plants, spraying pesticides were done when necessary. Data were recorded on increment in plant height (%), increment in base girth (%), increment in canopy spreading (%), leaf size (cm), fruits $plant^{-1}$ (no.), fruit weight (g), fruit size (mm), yield $plant^{-1}$ (Kg), yield (t ha^{-1}), rind thickness (mm), seed $fruit^{-1}$ (no.), weight of 100 seeds (g), juice (%) and acidity (%). The collected data were tabulated and statistically analyzed for the interpretation of the result (Gomez and Gomez 1984).

Result and Discussion

There were significant differences in respect of increment in plant height (%), increament in base girth (%), inclement in canopy spreading (%), leaf size (cm) among the treatments (Table 1). Maximum increament in plant height (12.45%) was recorded in the treatment T_2 followed by treatment T_3 (9.05%), while the lowest increament was found from T_1 (5.02%). In a similar way T_2 showed maximum increament in base girth (4.4%), while T_1 showed the lowest (2.4%). Treatment T_2 also superior with maximum increament in canopy spreading (23.5×23.8%) and maximum leaf size (12.23×6.56 cm). But the lowest increament in canopy spreading and leaf size was found from T_1 [(12.4 ×16.4%) and (10.11.23×5.92 cm) respectively].

Table1. Effect of organic manures on growth characteristics of BARI Lebu-5

Treatments	Inclement in plant height (%)	Inclement in base girth (%)	Inclement in canopy spreading (%)		Leaf size (cm)	
			N/S	E/W	Length	Width
T_1	5.02 d	2.4 c	12.4 c	16.4 d	10.11c	5.92 e
T_2	12.45 a	4.4 a	23.5 a	23.8 a	12.23 a	6.56 a
T_3	9.05 b	3.6 b	19.5 b	19.8 b	12.45 a	6.43 b
T_4	8.45 b	3.5 b	18.7 b	17.6 c	12.32 a	6.51 a
T_5	8.67 b	3.4 b	18.5 b	16.5 c	12.54 a	6.34 c
T_6	7.54 c	3.4 b	18.2 b	16.7 c	11.23 b	6.12 d
Level of significance	**	**	**	**	**	**
CV (%)	4.54	6.56	5.47	4.38	4.64	2.15

Legend: T_1=Native nutrients (soil without manures and fertilizers), T_2=Farmers practice (RDF according to FRG from chemical fertilizers), T_3=Farmyard manure (10 t ha^{-1}), T_4=Vermicompost (6 t ha^{-1}), T_5= Poultry manure (5 t ha^{-1}), T_6=Mustard oil cake (4 t ha^{-1})

The results indicated that maximum fruits $plant^{-1}$ (No.), fruit weight (g), Fruit size (mm), yield $plant^{-1}$ (Kg), and yield (t ha^{-1}) was found from T_2 (106.00, 210.45 g, 12.49×5.62 mm, 22.30 Kg and 24.54 t ha^{-1} respectively). Whereas T_1 exhibited the lowest. Among the organic ptreatments T_4 (vermicompost, 6 t ha^{-1}) exhibited better yield contributing characters and yield in BARI Lebu-5.

Table 2. Effect of organic manures on yield contributing characteristics of BARI Lebu-5

Treatments	Fruits plant^{-1} (No.)	Fruit weight (g)	Fruit size (mm)		Yield plant^{-1} (Kg)	Yield (t ha^{-1})
			Length	Diameter		
T_1	76.40 c	145.76 c	9.45 c	4.67 b	11.13 c	12.25 d
T_2	106.00 a	210.45 a	12.49 a	5.62 a	22.30 a	24.54 a
T_3	100.20 b	202.67 ab	11.34 ab	5.54 a	20.30 b	22.34 c
T_4	106.14 a	200.67 ab	11.46 ab	5.47 a	21.30 a	23.43 b
T_5	105.21 a	200.54 ab	11.33 ab	5.51 a	21.10 a	23.21 b
T_6	104.85 a	198.98 b	10.45 b	5.38 a	20.86 b	22.95 c
Level of significance	**	**	**	*	**	**
CV (%)	3.45	4,56	6.78	7.89	6.54	6.78

Legend: T_1=Native nutrients (soil without manures and fertilizers), T_2=Farmers practice (RDF according to FRG from chemical fertilizers), T_3=Farmyard manure (10 t ha^{-1}), T_4=Vermicompost (6 t ha^{-1}), T_5= Poultry manure (5 t ha^{-1}), T_6=Mustard oil cake (4 t ha^{-1})

The fruit quality attributes also influenced by the application of organic manures. Although there were no significant differences among the treatments regarding rind thickness (mm) and number of seeds per fruit, but 100 seed weight (g), Juice (%) and acidity (%) varied significantly. Organic treatments increased increased 100 seed weight, juice (%) and reduced the acidity (%) in BARI Lebu-5, thus increased the fruit quality of BARI Lebu-5.

Table 3. Effect of organic manures on fuit quality attributed of BARI Lebu-5

Treatments	Rind thickness (mm)	Seed fruit^{-1} (No.)	Weight of 100 seeds (g)	Juice (%)	Acidity (%)
T_1	58.50	8.34	14.10 a	32.40 b	7.60 a
T_2	61.34	8.54	13.40 b	34.56 a	6.45 b
T_3	59.42	8.56	14.44 a	34.76 a	6.54 b
T_4	60.32	8.43	14.33 a	34.62 a	6.75 b
T_5	60.42	8.43	14.32 a	34.54 a	6.65 b
T_6	59.43	8.54	14.56 a	34.54 a	6.54 b
Level of significance	NS	NS	*	NS	*
CV (%)	7.88	12.43	7.90	13.45	6.56

Legend: T_1=Native nutrients (soil without manures and fertilizers), T_2=Farmers practice (RDF according to FRG from chemical fertilizers), T_3=Farmyard manure (10 t ha^{-1}), T_4=Vermicompost (6 t ha^{-1}), T_5= Poultry manure (5 t ha^{-1}), T_6=Mustard oil cake (4 t ha^{-1})

Conclusion

Based on the results of the experiment, it may be inferred that organic manures have positive impact on the growth, yield contributing characters, yield and fruit quality characters of BARI Lebu-5. The experiment should be repeated for further confirmation of the result.

Aknowledgement

This work was funded by the "**Production of Safe Fruit and Vegetables and Promotion of Their Export** (PSFVPTE)" scheme implemented in Citrus Research Station, BARI, Jaintapur, Sylhet.

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CONTROLLING DISEASE AND PEST FOR SAFE LEMON (*Citrus limon* (L.) OSBECK CV. BARI LEBU-5) PRODUCTION FOR ENHANCING THE EXPORT POTENTIALITY

M.H.M.B. BHUYAN, M.M. RAHMAN, F. AHMED, J.C. SARKER AND S.M.L. RAHMAN

Abstract

The experiment was conducted from December 2020 to December 2021 on five years old BARI Lebu-5 orchard planted in 3×3m spacing during the year 2016 at Citrus Research Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a Randomized Complete block design (RCBD) with five treatments, each replicated thrice. The total number of plant units subjected to the study was fifteen (15). The treatments include T_1=Control (Spraying only water), T_2=Farmers practice (Spraying chemical pesticides), T_3=Mahogany seed extract spray, T_4=Garlic extract spray, T_5=Neem oils spray. The results illustrated that there were significant differences among the treatments. But among the organic treatments T_5 performed better regarding all the peramnters especially individual fruit weight (202.4 g) and marketable yield (22.38 t ha^{-1}).

Introduction

Lemon [*Citrus limon* (L.) Osbeck] is one of the most popular fruits in citrus group in Bangladesh and around the world as well. Lemon is the leading acid citrus fruit and the third most favoured citrus species next to Orange and Mandarin. There are number of diverse form of lemon, which may slightly differ from each other. It has wide adaptability, which makes it one of the most promising fruit crops in the world. Lemon cv. BARI Lebu-5 is an important variety of lemon and is widely grown in the central and north-eastern parts of Bangladesh, which is a tall cultivar, suitable for high density planting as well as exportable. It is locally known as 'kolombo lebu' in Narshingdhi and other parts of Bangladesh.

As is a perinnial crop lemon is prune to many diseases, insects and mites. The losses caused by insects pest and diseases are a severe problem to higher production. Hence farmers are using chemical pesticides, which are causing health hazards as the lemons contains the chemical residues, which are directly consumed by the people. On the other hand eco-friendly pest management, such as the use of botanical extracts, offers an excellent opportunity to reducing the harmful effects of chemical pesticides, saving beneficial soil microorganisms and insects as well as are a promising source for safe lemon production, together with controlling human health hazards (Rahman et al., 2021). Alternatively, the use of botanical are cost effective and available to farmers on time. thus become the most rewarding in our existing socio-economic conditions. Therefore, considering the above circumstances, the study has been taken to find out suitable botanical product(s) for sustainable lemon cv. BARI Lebu-5 production in Bangladesh.

Materials and Methods

The experiment was conducted from December 2020 to December 2021 on five years old BARI lebu-5 orchard planted in 3×3m spacing during the year 2016 at Citrus Research Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a Randomized Complete Block Design (RCBD) with five treatments, each replicated three times. The total number of plant units subjected to the study was fifteen (15). The treatments include T_1=Control (Spraying only water), T_2=Farmers practice (Spraying chemical pesticides), T_3=Mahogany seed extract spray, T_4=Garlic extract spray, T_5=Neem oils spray. Other intercultural operations like fertilizing, watering, stalking the plants, were done when necessary. Data were recorded on increment in plant height (%), increment in base girth (%), increament in canopy spreading (%), leaf size (cm), number of infested leaves, number of infested twigs, number of infested fruits, total fruits $plant^{-1}$ (no.), marketable fruits $plant^{-1}$ (no.), marketable yield (t ha^{-1}). The collected data were tabulated and statistically analyzed for the interpretation of the result (Gomez and Gomez 1984).

Result and Discussion

The results illustrated that there were significant differences among the treatments (Table 1). Maximum increament in plant height was found from T_5 (12.48%) followed by T_2 (9.06%), while T_1 showed the lowest increament (7.54%). Maximum increament in canopy spreading was also found

from T_5 (23.54×23.83 %), while the lowest was from T_1 (18.22×16.73%). Increament in base girth was maximum in plants receiving T_1 (3.42 %) but leaf size was not significantly varied among the treatments.

Table 1. Effect of different organic plant extracts on growth characteristics of BARI Lebu-5

Treatments	Inclement in plant height (%)	Inclement in base girth (%)	Inclement in canopy spreading (%)		Leaf size (cm)	
			E-W	N-S	Length	Width
T_1	7.54 c	3.42 c	18.22 b	16.73 c	11.25	6.23
T_2	9.06 b	3.64 b	19.55 ab	19.84 b	12.46	6.46
T_3	8.44 bc	3.56 b	18.77 b	17.66 c	12.34	6.53
T_4	8.57 bc	3.44 c	18.55 b	16.57 c	12.52	6.37
T_5	12.48 a	4.45 a	23.54 a	23.83 a	12.24	6.52
Level of significance	**	**	**	**	NS	NS
CV (%)	4.54	6.56	3.33	5.47	14.64	13.15

Legends: T_1=Control, T_2=Farmers practice, T_3=Mahogany seed extract, T_4=Garlic extract, T_5=Neem oil

The organic plant extracts also influenced the number of infested leaf, twigs and fruits of BARI Lebu-5. The results illustrated the maximum number of infested leaves (105.56), twigs (27.67) and fruits (25.43) in T_1. Whereas all these perameters were minimum in T_2. Among the organic treatments T_5 showed better performance regarding number of infested leaf, twigs and fruits .

Table 2. Effect of different organic plant extracts on number of infested leaves, twigs and fruits of BARI Lebu-5

Treatments	Infested leaves (No.)	Infested twigs (No.)	Infested fruits (No.)
T_1	105.56 a	27.67 a	25.43 a
T_2	35.47 d	19.78 d	12.23 e
T_3	56.78 b	26.89 b	18.79 b
T_4	56.67 b	26.32 b	16.67 c
T_5	45.78 c	21.45 c	14.65 d
Level of significance	**	**	**
CV (%)	5.55	3.75	6.24

Legends: T_1=Control, T_2=Farmers practice, T_3=Mahogany seed extract, T_4=Garlic extract, T_5=Neem oil

From the result it was observed that maximum total number of fruit was produced from T_4 (116.14), which was statistically indifferent with T_2 (116.00) and T_5 (115.21). While the lowest number of fruit was found from T_1 (100.85). Contrary maximum number of marketable fruit was found from T_2 (103.77) followed by T_5 (100.56). As a result marketable yield was also maximum in T_2 (22.71 t ha^{-1}). Among the botanical treatments T_5 (neem oil) performed better regarding individual fruit weight (202.4 g) and marketable yield (22.38 t ha^{-1}).

Table 3. Effect of different organic plant extracts on yield of BARI Lebu-5

Treatments	Total fruits (No.)	Marketable fruits (No.)	Fruit weight (g)	Marketable yield (t ha^{-1})
T_1	104.85 c	79.42 e	145.76 c	12.73 d
T_2	116.00 a	103.77 a	198.98 a	22.71 a
T_3	110.20 b	91.41 d	185.67 b	18.66 c
T_4	116.14 a	99.47 c	185.67 b	20.31 b
T_5	115.21 a	100.56 b	202.4 a	22.38 a
Level of significance	**	**	**	**
CV (%)	6.96	5.38	8.55	3.60

Legends: T_1=Control, T_2=Farmers practice, T_3=Mahogany seed extract, T_4=Garlic extract, T_5=Neem oil

Conclusion

Based on the results of the present study, it may be concluded that all the botanicals tested significantly enhanced growth, yield and fruit quality of BARI Lebu-5. Although T_2 (Spraying chemical pesticide) showed the maximum yield but T_5 (spraying neem oil) performed very close to

the farmers practice. This is the first year of study. The experiment should be repeated for the confirmation of the results.

Aknowledgement
This work was funded by the "**Production of Safe Fruit and Vegetables and Promotion of Their Export** (PSFVPTE)" scheme implemented in Citrus Research Station, BARI, Jaintapur, Sylhet.

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EVALUATING BENEFICIAL MICROORGANISMS FOR SAFE AND QUALITY LEMON (*Citrus limon* (L.) OSBECK CV. BARI LEBU-5) PRODUCTION

M.H.M.B. BHUYAN, M.M. RAHMAN, F. AHMED, J.C. SARKER AND S.M.L. RAHMAN

Abstract
The study was executed with the aim of evaluating beneficial microorganisms (BM) on growth and yield of BARI Lebu-5. The experiment was conducted from December 2020 to December 2021 on five years old BARI lebu-5 orchard planted in 3×3m spacing during the year 2016 at Citrus Research Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a Randomized Complete block design (RCBD) with four treatments, each replicated three times. The treatments include T_1=Control (water spray), T_2=Spray of effective microorganism, T_3=Soil application of *Bacillus* sp., T_4= Spray of Clybio (Japanese formulation). The results illustrated significant differences among the treatments. Maximum increament in plant height was found from T_3 (14.45%), highest increament in base girth and canopy spreading was found from T_4 (4.4% and 22.5×22.8 % respectively). On the other hand maximum yield plant^{-1}, and yield ha^{-1} was found from T_2 (22.30 kg and 24.53 t ha^{-1} respectively) followed by T_3 (21.93 kg and 24.13 t ha^{-1} respectively).

Introduction
Lemon [*Citrus limon* (L.) Osbeck] is one of the most popular fruits in citrus group in Bangladesh and around the world as well. Lemon is the leading acid citrus fruit and the third most favoured citrus species next to Orange and Mandarin. There are number of diverse form of lemon, which may slightly differ from each other. It has wide adaptability, which makes it one of the most promising fruit crops in the world. Lemon cv. BARI Lebu-5 is an important variety of lemon and is widely grown in the central and north-eastern parts of Bangladesh, which is a tall cultivar, suitable for high density planting as well as exportable. It is locally known as 'kolombo lebu' in Narshingdhi and other parts of Bangladesh.

Yield of any crops could be enhanced through intensification or extensification of farming. The intensification efforts have focused on methods and techniques that provide economic yields without unreasonable increase in cultivation cost. Thus, the most important consideration would be the selection of new technologies that could enhance the availability of plant nutrients and their uptake by crops. One such technology is the use of microorganisms in agriculture. Banificial microorganisms (BM) appears to be a good supplement for crops, as it creates a favourable condition for crop growth by promoting the mobilization of insoluble nutrients and activating other soil microorganisms useful to the crops. Moreover, BM can be mixed with any one of the organic manures, or spray on canopy to maximize the yield. Therefore, keeping these view in mind the experiment was undertaken to find out suitable BM for maximizing yield and profitability of lemon cv. BARI Lebu-5.

Materials and Methods
The study was executed with the aim of evaluating beneficial microorganisms (BM) on growth and yield of BARI Lebu-5. The experiment was conducted from December 2020 to December 2021 on five years old BARI Lebu-5 orchard planted in 3×3m spacing during the year 2016 at Citrus Research

Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four treatments, each replicated three times. The total number of plant units subjected to the study was twelve (12). The treatments include T_1=Control (water spray), T_2=Spray of effective microorganism, T_3=Soil application of *Bacillus* sp., T_4= Spray of Clybio (Japanese formulation). Other intercultural operations like fertilizing, watering, stalking the plants, were done when necessary. Data were recorded on increment in plant height (%), increament in base girth (%), increment in canopy spreading (%), leaf size (cm), marketable fruits plant^{-1} (no.), fruit weight (g), fruit size (mm), yield plant^{-1} (Kg), yield (t ha^{-1}). The collected data were tabulated and statistically analyzed for the interpretation of the result (Gomez and Gomez 1984).

Result and Discussion

The results illustrated that there were significant differences among the treatments (Table 1). Maximum increament in plant height was found from T_3 (14.45%), which were statistically similar to T_2 (14.05%), while T_1 produced the shortest plant (8.67% of increament). Maximum increament in base girth and canopy spreading was found from T_4 (4.4% and 22.5×22.8 % respectively), while the lowest increment in canopy spreading was found from T_1 (15.5×14.5%). Leaf size did not signicantly varied among the treatments.

Table1. Effect of beneficial microorganisms on growth characteristics of BARI Lebu-5

Treatments	Inclement in plant height (%)	Inclement in base girth (%)	Inclement in canopy spreading (%)		Leaf size (cm)	
			N/S	E/W	Length	Width
T_1	8.67 c	2.4 b	15.5 b	14.5 c	12.54	6.34
T_2	14.05 a	3.6 b	18.5 b	20.8 b	12.45	6.43
T_3	14.45 a	3.5 b	17.7 b	18.6 c	12.32	6.51
T_4	12.45 b	4.4 a	22.5 a	22.8 a	12.23	6.56
Level of significance	**	**	**	**	NS	NS
CV (%)	2.76	5.32	5.67	5.24	4.45	3.54

Legend: T_1=Control (water spray), T_2=Effective microorganism, T_3=*Bacillus* sp., T_4=Clybio

From the result it was observed that statistically similar highest number of marketable fruits were produced from T_3 (106.14) and T_2 (106.00). followed by T_4 (100.21), while the lowest number of marketable fruits were found from T_1 (80.85). The beneficial microorganisms also increased the fruit size, where the maximum fruit size was recorded in T_3 (12.49×5.54 cm) followed by T_2 (11.46×5.47 cm). Maximun weight of individual fruit (210.45 g) was found from T_2, followed by T_3 (206.67 g). On the other hand maximum yield plant^{-1}, and yield ha^{-1} was found from T_2 (22.30 kg and 24.53 t ha^{-1} respectively) followed by T_3 (21.93 kg and 24.13 t ha^{-1} respectively).

Table 2. Effect of beneficial microorganisms on yield contributing characteristics of BARI Lebu-5

Treatments	Marketable Fruits plant^{-1} (no.)	Fruit size (mm)		Fruit Weight (g)	Yield (kg plant^{-1})	Yield (t ha^{-1})
		length	diameter			
T_1	80.85 c	11.33 c	5.38	188.98 d	15.27 b	16.81 b
T_2	106.00 a	11.46 b	5.47	210.45 a	22.30 a	24.53 a
T_3	106.14 a	12.49 a	5.54	206.67 b	21.93 a	24.13 a
T_4	100.21 b	11.34 c	5.51	202.54 c	20.29 a	22.32 a
Level of significance	**	**	NS	NS	**	**
CV (%)	6.25	5.38	9.13	8.21	3.78	4.98

Legend: T_1=Control (water spray), T_2=Effective microorganism, T_3=*Bacillus* sp., T_4=Clybio

Conclusion

This is the first year of study. The experiment should be repeated for the confirmation of the results.

Aknowledgement

This work was funded by the "**Production of Safe Fruit and Vegetables and Promotion of Their Export** (PSFVPTE)" scheme implemented in Citrus Research Station, BARI, Jaintapur, Sylhet.

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MOTHER ORCHARD ESTABLISHMENT OF BARI RELEASED/POPULAR CITRUS FRUIT VARIETIES

M.H.M.B. BHUYAN, S.M.L. RAHMAN, F. AHMED AND J.C. SARKER

Introduction
Citrus fruits have immense importance in the local and foreign markets. In Bangladesh, we export sour pulp citrus fruits and import sweet ones. Bangladesh Agricultural research institute has already released twenty varieties of different citrus fruits. These varieties are very popular to farmers. But there are problems with authentic saplings for the farmers. Hence, this program was initiated to establish a good number of mother orchards of BARI released citrus varieties which would be a big source of scions for mass propagation.

Materials and Methods
Saplings of BARI Malta-1 were raised using Rangpur lime and pummelo as rootstock while Rough lemon and pummelo for BARI Komala-1. Air layered saplings were used for the plantation of Jara, seedless and Kolombo lemon. The graftages and layerages were transplanted in the mother orchard by line planting method considering $3\times3m^2$ spacing. Before planting, each pit was fertilized with 10 kg well rotten cow dung, 200g urea, 150g TSP, 150g MoP, and left for 15 days (Mandol *et al*., 2014). The plantation was done in March'2018. Imidacloprid (Imitaf 0.25mL/L) was applied to reduce leaf miner infestation when a new leaf emerged. Weeding was done regularly because of the rapid growth of weeds due to high rainfall in the region. Mulching was done in the winter.

Results and Discussion
The plants are in good growth condition and scion may be collected from one month after planting. The name of the varieties and the total number of Plants are shown in Table 1.

Table 1. List of varieties with the number of plants planted in mother orchard

SL. No.	Name of crops	Accession/variety	Number of saplings planted	Present status
1.	Mandarin	BARI Komala-1	20	Satisfactory
		BARI Komala-2	20	Satisfactory
		BARI Komala-3	20	Satisfactory
2.	Pummelo	BARI Batabilebu-1	20	Satisfactory
		BARI Batabilebu-2	20	Satisfactory
		BARI Batabilebu-3	50	Satisfactory
		BARI Batabilebu-4	20	Satisfactory
		BARI Batabilebu-5	20	Satisfactory
		BARI Batabilebu-6	20	Satisfactory
3.	Sweet orange	BARI Malta-1	20	Satisfactory
		BARI Malta-2	20	Satisfactory
4.	Citron/	BARI Jara Lebu-1	20	Satisfactory
5.	Lemon	BARI Lebu-1	20	Satisfactory
		BARI Lebu-2	50	Satisfactory
		BARI Lebu-3	20	Satisfactory
		BARI Lebu-4	20	Satisfactory
		BARI Lebu-5	20	Satisfactory
6.	Satkara	BARI Satkara-1	20	Satisfactory
7.	Lime	BARI Kagzi lebu-1	20	Satisfactory
8.	Sweet lime	BARI Misti Lebu-1	20	Satisfactory

Conclusion

The plants are in good condition. The growth is satisfactory. Regular intercultural operations are going on. The orchard will serve as the source of true type citrus sapling in near future.

ADVANCED YIELD TRIAL OF BANANA CV. SABRI (MS JAI-024)

M. H. M. B. BHUYAN, J. C. SARKER, F. AHMED AND S.M.L. RAHMAN

Abstract

The experiment was conducted at the Citrus Research Station, Jaintapur, Sylhet during 2021-2022 with an advanced sabri banana line with a local check. A wide variation was observed regarding growth characteristics where MS Jai-021 was found superior with plant height, base girth, leaf size and growth condition compared to MS Jai-024. Maximum bunch weight was obtained from MS Jai-024 (11.5 kg) while minimum in MS Jai-021 (6.4 kg). Variation was also found in other characters. The highest number of hands bunch^{-1} (13), hands weight (1.6 kg), number of fingers hand^{-1} (16), finger size (13.1×3.7 cm) and finger weight (96.5 g) was found from the advanced line MS Jai-024. I a similar way, maximum yield was found in MS Jai-024 (28.75 t ha^{-1}), while minimum (16.00 t ha^{-1}) was in MS Jai-021. Furthermore, the advanced genotype MS Jai-024 exhibited the highest TSS (25.5%) and edible portion (89%).

Introduction

Bananas and plantains are the fourth most important food crop in the world after rice, maize and wheat (Picq 2000). Bananas are considered the most nutritional food source in the world and originate from south east Asia (Stover and Simmonds 1987, Jones 2000). Banana is an edible fruit produced by several kinds of large herbaceous flowering plants of the genus Musa. Sobri (Musa sp.) is one of the most popular commercial banana varieties in Bangladesh. A bunch of ripen banana attracts everyone irrespective of sexes and ages. But the shape, size, quality and yield differs widely in different areas. Sobri is successfully cultivated by farmers in different regions of Bangladesh. North eastern region of Bangladesh is blessed with different germplasm of Sobri banana which should be evaluated for getting best ones as variety. Therefore, the present study was undertaken.

Materials and Methods

The experiment was conducted at the Citrus Research Station, Jaintapur, Sylhet during 2021-2022 with one advanced Sabri banana line with a local check. Suckers were collected from the previous experiment (Evaluation of Banana germplasm cv. Sabri) and planted in the experimental plot with a spacing of 2×2 m in the month of May 2021. Each plant was fertilized with 10kg cow dung, 90g N, 30g P, and 50g K. Admire 2 mL L^{-1} was applied for reducing the infestation of banana stem weevil in April 2019. Data were recorded on plant height, base girth, leaf size and growth condition. Moreover, The fruits harvested was tested for the fruit quality perameters and the data were recorded.

Results and Discussion

The data on vegetative characteristics were shown in Table1. All the growth characters varied significantly among the germplasm tested. The highest plant height (370.1 cm) and base girth (50.3 cm) was found from MS Jai-021 and the lowest was in MS Jai-24 (362.2 cm and 43.70 cm respectively). MS Jai-021 was also superior with leaf size but the growth condition was excellent in MS Jai-024 (Table 1).

Table 1. Growth characteristics of sabri kola lines

Accessions	Plant height (cm)	Base girth (cm)	Leaf size (cm)			Growth condition
			Lamina length	Breadth	Petiole length	
MS Jai-021	370.1	48.30	136.00	57.64	35.40	Good
MS Jai-024	362.2	43.70	134.50	57.36	31.54	Excellent
Mean	366.15	46	135.25	57.50	33.47	-
SD	5.58	3.25	1.06	0.19	2.72	-
CV (%)	1.52	7.07	0.78	0.34	8.15	-

Maximum bunch weight was obtained from MS Jai-024 (11.5 kg), while minimum in MS Jai-021 (6.4 kg). Variation was also found in other characters (Table 2).. The highest number of hands bunch^{-1} (13), hands weight (1.6 kg), number of fingers hand^{-1} (16), finger size (13.1×3.7 cm) and finger weight (96.5 g) was found from the advanced line MS Jai-024. I a similar way, maximum yield was found in MS Jai-024 (28.75 t ha^{-1}), while minimum (16.00 t ha^{-1}) was in MS Jai-021. Furthermore, the advanced genotype MS Jai-024 exhibited the highest TSS (25.5%) and edible portion (89%).

Table 2. Quantitative fruit characters of sabri kola lines

Accessions	Bunch weight (Kg)	Hands weight (Kg)	Finger weight (g)	Yield (t ha^{-1})	TSS (%)
MS Jai-021	6.4	1.5	76.4	16	24.3
MS Jai-024	11.5	1.6	96.5	28.75	25.5
Mean	8.95	1.55	86.45	22.375	24.9
SD	3.60	0.07	14.21	9.02	0.84
CV%	40.29	4.56	16.44	40.29	3.41

Table 2. Continued

Accessions	Number of Hands bunch^{-1}	Number of Finger hands^{-1}	Finger size (cm)		Edible portion (%)
			Length	Diameter	
MS Jai-021	11	13	12.2	3.5	79
MS Jai-024	13	16	13.1	3.7	89
Mean	12	14.5	12.65	3.6	84
SD	1.41	2.12	0.63	0.14	7.07
CV(%)	11.78	14.62	5.03	3.92	8.41

The germplasm (MS Jai-021and MS Jai-022) were infected by Sikatoka disease, which was not observed in MS Jai-024. On the other hand banana stem weevil was observed in other germplasm except MS Jai-024 (Table 3).

Table 3. Disease and insect pest of three sabri kola germplasm

Accessions	Disease incidence	Insect pest infestation
MS Jai-021	Sikatoka	Banana stem weevil
MS Jai-024	Nil	Nil

Conclusion

Considering all the parameters MS Jai-024 could be further investigated for RYT for releasing as variety.

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EVALUATION OF PINEAPPLE GERMPLASM

S.M.L. RAHMAN, F. AHMED, J.C. SARKER, AND M.H.M.B. BHUYAN

Abstract

Three pineapple germplasm were evaluated at CRS, Jaintapur, Sylhet to identify suitable ones for this high rainfall area. The design was set in RCBD factorial arrangement with three replications. There is no significant variation among the genotypes regarding plant height. Maximum number of leaves plant^{-1} was recorded at AC Jai-011(30), while lowest number of leaves plant^{-1} in AC Jai-013(20). All the genotypes produced statistically similar leaf length but leaf breadth varied singnificantly. The widest leaf (4.16 cm) was observed at AC Jai-011 but narrowest leaf (3.26 cm) was observed at AC Jai-013.

Introduction

Pineapple (*Ananas comosus* L. Merr.) is one of the leading tropical fruits in international commerce. Biologically, it is a perennial herb and it belongs to the family Bromeliaceae. Pineapple prefers sandy loam soils of low water retention capacity, grows in places of relatively more sunshine and higher temperature and susceptible to weeds since early stage of growth. The plant is very drought resistant but the root system is shallow so that under dry conditions growth stagnates quickly. A fruit from low lands is larger, sweeter and juicier than fruits grown from mid lands. Pineapples are cultivated for their mature ripe fruits for local consumption, flesh and juice for canning and export. Pineapple cultivars show considerable variation in their plant growth and fruit size when grown in different environments (Nakasone and Paull, 1998).Therefore, this experiment was carried out with the objective of identifying the best genotype that produce optimum economic fruit yield with desirablbe quality.

Materials and methods

Three pineapple germplasm were collected from different parts of Sylhet division and planted at CRS, Jaintapur, Sylhet on November, 2021 to identify suitable ones for this high rainfall area. Side suckers were planted at a distance of 50×30cm. Fertilizers were applied as 20 t ha^{-1} cow dung, 60 kg ha^{-1} N, 25 kg ha^{-1} P, 60kg ha^{-1} K, 10 kg ha^{-1} S and 1.0 kg ha^{-1} Zn per year. All of cowdung, P, S and Zn should we applied as basal during final land preparation. N and K applied in five equal splits as side dressing at one month interval after starting and mixed thoroughly with the soil followed by irrigation. Following growth data of the germplasm i.e. plant height, productive tillers clump^{-1}, Leaves tiller^{-1}, Leaf length, Leaf breadth was recorded. Weeding and other inter-cultural operations were done when necessary and before applying fertilizer. The design was set in RCBD in factorial arrangement with three replications. Data were collected on plant height, number of leaves per plant, leaf length, leaf breadth and the results were analyzed using Statix 10 computer package program and the analysis of variance were separated for significant difference at 5% level of probabality.

Results and Discussions

There is no significant variation among the genotypes for plant height. Maximum number of leaves plant^{-1} was recorded at AC Jai-011(30) while lowest number of leaves plant^{-1} in AC Jai-013(20). All the genotypes produced statistically similar leaf length but leaf breadth varied significantly. The widest leaf (4.16 cm) was recorded at AC Jai 011 but narrowest leaf (3.26 cm) was at AC Jai 013. All the genotypes were found in good condition.

Table 1: Growth characteristics of pineapple

Accessions	Plant height (cm)	Leaves plant $^{-1}$ (No.)	Leaf length (cm)	Leaf breadth (cm)	Growth condition
AC Jai-011	47.00	30.00 a	50.00	4.16 a	Good
AC Jai-012	45.00	21.00 b	50.66	3.53 b	Good
AC Jai-013	46.00	20.00 b	49.33	3.26 b	Good
Level of significance	NS	**	NS	**	-
CV (%)	5.02	6.45	5.23	2.88	-

Conclusion
All the germplsm are now in vegetative stage. AC Jai-011 showed better growth performance among them. So after flowering and fruiting the final evaluation and conclusion could be made.

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COLLECTION AND EVALUATION OF MINOR FRUITS GERMPLASM

F. AHMED, M.H.M.B. BHUYAN, J.C. SARKER AND S.M.L. RAHMAN

Abstract
The experiment was conducted at Citrus Research Station, BARI, Jaintapur, Sylhet during the period from July 2021 to April 2022 to find out superior lines suitable for the acidic soil of the northeastern region of Bangladesh. False mangosteen recorded plant height (200 cm), spreading E-W (80 cm), N-S (76 cm), and base girth (1.9 cm). Monkey jack recorded plant height (215 cm), spreading E-W (90 cm), N-S (74 cm) and base girth (1.4 cm). Flacourtia recorded plant height (215 cm), spreading E-W (163 cm), N-S (128 cm) and base girth (3.3 cm).These three germplasm show relatively better growth performance than other minor fruits germplasm. On the other hand, wood apple is slow growing than all the other fruits germplasm. Wood apple attains the lowest plant height (58 cm), lowest spreading E-W (20 cm), N-S (18 cm), and lowest base girth (0.5 cm).

Introduction
Bangladesh is blessed with a great diversity of fruits and, in 2017, was placed sixth in world rankings for tropical fresh fruit production (FAOSTAT 2019). There are about 70 various kinds of fruits growing in Bangladesh (Hossain et al. 2011). In today's world, food must be wholesome and safe for human consumption. Fruits are an integral part of food needed to meet the mineral requirements of the human body and to strengthen immunity against various biotic and abiotic stresses. For proper health, per capita requirement of fruits is 115 g. On average, fruits have been contributing to about 4% of human nutrition (APCAEM 2007). A significant quantity of tropical fruits is underexploited generally recognized as indigenous or minor fruits. Usually, these fruits are found in home yards; year on year, these fruit trees are being destroyed. Minor fruit occupies 3.01 of the area and 8.38% of production compared to the total fruit production of Bangladesh (BBS 2011). The country spent about Tk. 8,000–10,000 million for import of fruits from other countries (Hossain and Uddin, 2005), therefore, increasing production of these indigenous fruits are time demanding for mitigating nutrient deficiency as well as reducing import. Most of the rural houses possess a home garden. It is reported that the planting intensity has increased at least 4-folds in 65% of households during the last few years. But, 34 plant species are already under severe threat of extinction from Bangladesh (Gain 2002). The loss of such species has serious implications on rural life and not only deprives people of essential nutrients but also medicinal attributes and employment opportunities (Rahman, 2003). In the country, the landholding pattern in hill tracts reveals that nearly 90% of the farmers are small and marginal; hence, the minor fruits are ideal for cultivation as they need low input requirement, less production cost comprising higher nutritive value, and high yield. Apart from nutritive value, most people are familiar with the medicinal properties of locally grown minor fruits. It emphasizes exploiting the versatile use of these tremendous resources, in combating the challenges of nutritional security as well as exploiting medicinal attributes adding income generation for the better livelihood of the tribal and rural people. Keeping this view in mind, the collection was emphasized to conserve these resources from getting extinct as well as finding out suitable varieties for the northeastern region of Bangladesh.

Materials and Methods
The experiment was conducted at Citrus research station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet during the period from May 2021 to April 2022. There are 10 types of minor fruit of different ages collected from different parts of Bangladesh. After collection, these

plants were raised in the nursery and cared for proper establishment in this high rainfall area. In the nursery, these plants were evaluated by recording data of plant height, plant spreading, base girth etc. These plants will be planted in the fruit orchard of Citrus Research Station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet in this rainy season of June to August 2022 to know the performance and adaptability of these fruit plants.

Results and Discussion

Data in the Table 1 showed that false mangos teen recorded plant height (200 cm), spreading E-W (80 cm), N-S (76 cm), and base girth (1.9 cm). Monkey jack recorded plant height (215 cm), spreading E-W (90 cm), N-S (74 cm) and base girth (1.4 cm). Flacourtia recorded plant height (215 cm), spreading E-W (163 cm), N-S (128 cm) and base girth (3.3 cm).These three germplasm show relatively better growth performance than other minor fruits germplasm. On the other hand, wood apple is slow growing than all the other fruits germplasm. Wood apple attains the lowest plant height (58 cm), lowest spreading E-W (20 cm), N-S (18 cm), and lowest base girth (0.5 cm).

Table1. Growth characteristics minor fruits at nursery

Serial No.	English name	Average Plant height (cm)	Average spreading		Average Base girth (cm)
			E-W	N-S	
1.	Hogplum	174	138	87	3.2
2.	False mangosteen	200	80	76	1.9
3.	Monkey jack	215	90	74	1.4
4.	Wood apple	58	20	18	0.5
5.	Black berry	87	37	35	1.3
6.	Avocado	143	59	57	1.9
7.	Flacourtia	215	163	128	3.3
8.	Burmese grape	102	43	42	1.1
9.	Sapota	126	158	106	1.1
10.	Apple	156	94	75	1.3

Conclusion

Considering the parameters it can be concluded that false mangosteen, Monkey jack, and Flacourtia have better growing habit than other minor fruits in nursery condition. On the other hand, wood apple is slow growing compared to all other fruits. These plants will be planted in the fruit orchard of Citrus research station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet in this rainy season to know the performance and suitability of these fruit in this region.

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EVALUATION OF GOLDEN APPLE GERMPLASM

M. H. M. B. BHUYAN, J.C. SARKER, F AHMED AND S. M. L. RAHMAN

Abstract

The present study was conducted at CRS, Jaintiapur, Sylhet to evaluate one golden apple germplasm. Plant height was observed 7.5 m where as base girth was found 90.0 cm. Canopy size was (8.7×7.6 m). Number of fruits was 560, which yielded 51.8 kg fruit plant $^{-1}$ and 14.34 t ha $^{-1}$ with 6 m spacing. In case of fruit weight average 92.5 g of each fruit was obtained with 5.78×4.98 cm size. Rind weight was 13.5 g while stone weight and pulp weight was 11.8 g and 67.0 g respectively. On an average total soluble solid (TSS) and edible portion was recorded 11.64 and 72.43% respectively for each fruits.

Introduction

Amra (*Spondias* sp.) belongs to the family, Anacardiaceae are native to tropical Asia. They are commonly named hog plums and in some cases golden apples for their brightly colored fruit, which resemble an apple or large plum at a glance. They are deciduous or semi-evergreen trees growing to 25 m tall. About 10 species of *Spondias* bear edible fruits and have been domesticated for fruit production (USDA, 2009). Golden apple is a minor fruit in our country and cultivated in selected areas. But as this crop is originated from tropical Asia therefore more or less golden apple plants can be seen around. These plants are important member of gene pole as well as may be used as breeding purpose and variety development. Therefore, the present study was undertaken.

Materials and Methods

The study was conducted in the Citrus research station, Bangladesh Agricultural Research Institute, Jaintiapur, Sylhet during March 2021 to April 2022. One golden apple germplasm was included in the study. The plant was fertilized twice in a year one before rainy season and another after rainy season for better growth and development. The plant was fertilized with 30 kg cow dung, 500 g urea, 350g TSP, 300 g MOP, 100g Gypsum respectively. The plants were sprayed twice in the month of June-July with Cypermethrin (Cymcare 10 EC@ 2 mL L^{-1}) for controlling Hog palm beetle. The plant was irrigated in the month of February-April at an interval of 15 days for retention of flowers and maximum fruit setting. Data were collected on plant height (m), base girth (cm), canopy spreading (m), number of branches plant^{-1} and growth condition, number of fruits plant^{-1}, yield t ha^{-1} and fruit quality parameters.

Results and Discussion

Plant height was observed 7.5 m whereas base girth was found 90.0 cm. Canopy size was (8.7×7.6 m). Number of fruits plant^{-1} was recorded 560, which yielded 51.8 kg fruit plant^{-1} and 14.34 t ha $^{-1}$ with 6 m spacing.

Table 1. Growth and yield performance of golden apple germplasm

Accession	Plant height (m)	Base Girth (cm)	Canopy spreading (m)		Fruits /plant (No.)	Fruits /Plant (Kg)	Yield (t/ha)
			N/S	E/W			
SI Jai-001	7.5	90.0	8.7	7.6	560	51.8	14.34

Average fruit weight was obtained 92.5 g for each fruit with 5.78×4.98 cm size. Rind weight was 13.5 g while stone weight and pulp weight was 11.8 g and 67.0 g respectively. Total soluble solid (TSS) and edible portion was 11.64 and 72.43% respectively from each fruits.

Table 2. Quantitative characteristics of fruits of golden apple germplasm

Accession	Fruit weight (gm)	Fruit size (cm)		TSS (%)	Rind weight (cm)	Weight of Stone (g)	Weight of pulp (g)	Edible portion (%)
		Length	Diameter					
SI Jai-001	92.5	5.78	4.98	11.64	13.5	11.8	67.0	72.43

Excellent quantitative characters also found from SI Jai-001. Skin color was greenish yellow. Flesh color was yellow at ripen with crispy textured pulp. Skin was adhering to pulp.

Table 3. Qualitative characteristics of fruits of golden apple germplasm

Accession	Skin Color at ripen	Pulp Character		Adherence of Skin to pulp
		Color	Texture	
SI Jai-001	Greenish yellow	Yellow	Crispy	Adhering

The fruits of SI Jai-001 were with less fiber with good organoleptic taste. The fruits have pleasant flavor and excellent outlook.

Table 3. Continued

Accession	Fibrousness	Organoletic Taste	Flavor	Fruit attractiveness
SI Jai-001	Less fibrous	Good	Pleasant	Attractive

Conclusion

This is the first year study. Further detailed study is required for releasing this accession as a variety for north eastern region of Bangladesh.

References

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EVALUATION OF BURMESE GRAPE GERMPLASM

M. H. M. B. BHUYAN, S. M. L. RAHMAN, F. AHMED AND J.C. SARKER

Abstract

The experiment was conducted at CRS, Jaintiapur, Sylhet, with five Burmese grape germplasm. A wide variation was observed in case of growth, yield contributing characters, yield and fruit quality of the germplasm studied. Highest plant height, base girth, canopy spreading was found from BS Jai-005. Leaf size was also maximum in this line.Maximum number of fruits plant^{-1}, yield plant^{-1} and yield ha^{-1} were obtained from BS Jai-001. BS Jai-001 was also free from disease where as the others suffers from powdery mildew and sooty mould. Chaper beetle was common in case of all the germplasm and only BS Jai-001 was free from fruit borer. Fruit size was highest in BS Jai-003 (3.4×3.4 cm) followed by BS Jai-001 (3.35×3.14 cm). Flesh color and texture for all germplasm was off white and juicy. Maximum edible portion (47.5%) and per cent TSS (13.6%) was found from BS Jai-001.

Introduction

Lotkon or Burmese grape (*Baccaurea sapida* (Roxb.) Muell. Arg.) belongs to the Family Euphorbiaceae is native to Southeast Asian region and growing wild as well as under cultivation in Nepal, India, Myanmar, Bangladesh, South China, Indo-China, Thailand, the Andaman island and Peninsular Malaysia. In Bangladesh the species is grown in some pockets in Narsingdi, Manikgonj, Gazipur, Netrokona, Kishoregonj and Sylhet. Lotkon is a commercially important fruit is very popular to people of all ages in Bangladesh. Fruits contain 5.5 percent protein, 178 mg vitamin C per 100 g of pulp and among the minerals the fruit contains 169 mg calcium, 137 mg potassium, 177 mg phosphorous, and 100 mg iron per 100g of fruit pulp (Kermasha *et al.*, 1987). Fruit is generally consumed as fresh and also used to make into wine, and has been used as medicinally to treat skin disease. Seeds contain 4.8 – 6 percent annatto dye. Annatto is used for coloring silk, cotton and other textile materials for orange color (Abdullah *et al*., 2005). Lotkon is mainly available during the month of June-July and price is slightly high during the time of Rathayatra as because the fruit is profusely used by the local people for ritual. This crop prefers shade or semi shade condition for their growth. So the crop can be grown under another fruit or forest crop, where no other fruit crop can be grown successfully thus can be used for multistoried fruit garden. By growing this crop the farmers are now receiving considerable amount of money to meet their family demand, Moreover apparently vacant space can be effectively utilized for fruit production which may help to

meet dietary supplement. But still there is only one recommended variety of Lotkon which farmers can cultivate. Therefore, to reduce the demand of good varieties of lotkon this study was undertaken.

Materials and Methods

The experiment was conducted at Citrus Research Station, Bangladesh Agricultural Research Institute, Jaintapur, Sylhet. Five Lotkon germplasm was included in the study. These plants are about 25 years old and bear fruits regularly. At the beginning of the experiment the plants were rejuvenated by pruning of dead and diseased branches, freed them from parasitic plants, algae and lichen. Therefore, the trunks were painted with Bordeaux paste to avoid fungal infection. The plants were fertilized with 30 kg cow dung, 1 kg urea, 1 kg TSP, 750 g MoP, 200 g gypsum, 50 g Zinc sulphate and 20 g boric acid in two equal splits one in the month of July and another after rainy season in the month of October. The plants were infested by chaper beetle twice in the month of July and September, hence two full cover spray of Cypermethrin (Cymcare 10 EC @ 1mL L^{-1} of water) was applied. Three hand weeding was done throughout the rainy season to avoid losses of soil nutrients by weed and also to destroy the harbor of insect pests. Data were taken on growth, yield and fruit characteristics. Fruit quality data were analyzed by MSTAT-C computer programme and DMRT was performed for interpretation of results (Gomez and Gomez, 1984).

Results and Discussion

A wide variation was observed in case of growth, yield and fruit quality of the germplasm studied. Highest plant height was recorded from BS Jai-005 (9.0m) while lowest was found from BS Jai-004 (4.5 m). Base girth was highest in BS Jai-005 (1.2 m). BS Jai-005 was also superior with maximum canopy (15.0×12.0 m). Dense branching with good growth condition was found from BS Jai-005 while medium branching density with excellent growth condition was found from BS Jai-001 but BS Jai-004 was in poor growth condition with sparse branching (Table 12.1). Harvesting time for all the germplasm was June-July.

Table 1. Growth characteristics, flowering and harvesting time of the different Burmese grape germplasm

Accession	Plant height (m)	Base girth (m)	Canopy (m)		Leaf size (cm)			Branching density	Growth condition	Harvest time
			E/W	N/S	Lamina length	Lamina width	Petiole length			
BS Jai-001	7.70	1.15	9.0	10.5	16.3	6.2	3.5	Medium	Good	Jun-Jul
BS Jai-002	5.00	0.85	7.0	5.0	15.5	7.0	2.5	Sparse	Good	Jun-Jul
BS Jai-003	6.75	0.90	9.0	6.0	14.3	8.0	2.0	Sparse	Good	Jun-Jul
BS Jai-004	4.50	0.60	7.0	4.5	8.5	4.5	1.5	Sparse	Poor	Jun-Jul
BS Jai-005	9.00	1.20	15.0	12.0	13.0	6.0	2.5	Dense	Good	Jun-Jul
SD	1.87	0.24	3.29	3.42	3.07	1. 30	0.74	-	-	-
CV (%)	28.35	25.90	34.96	44.96	22.72	20.43	30.90	-	-	-

Maximum size of fruit was found in BS Jai-003 (3.4 cm ×3.4 cm) followed by BS Jai-001 (3.3 cm×3.1 cm). The other germplasm also varied significantly in respect to fruit size (Table 2). Fruit weight ranged from 8.6 g to 14.6 g . where BS Jai-004 and BS Jai-003 were found the lowest and highest respectively. Edible portion is one of the most important features of any fruit. Maximum edible portion was found from BS Jai-001 (47.5%) while minimum was from BS Jai-005 (38.6 g). Highest per cent TSS was found from BS Jai-001 (13.6%) while lowest was found in BS Jai-003 (12.4%).

Table 2. Quantitative characteristics of fruit of the different Burmese grape germplasm

Accession	Fruit size (cm)		Individual Fruit weight (g)	Stone weight (g)	Flesh weight (g)	Edible portion (%)	TSS (%)
	Length	Breadth					
BS Jai-001	3.35ab	3.14b	14.55a	1.93a	6.8a	47.5a	13.6a
BS Jai-002	3.1b	3.0b	14.2a	2.5a	6.7a	36.7b	13.2a
BS Jai-003	3.4a	3.4a	15.2a	2.4ab	5.4c	47.1a	12.4b
BS Jai-004	2.2c	2.7c	8.6b	2.4ab	2.2d	46.5a	13.5a
BS Jai-005	3.1b	3.1b	14.2a	2.4ab	6.3ab	38.6b	13.4a
LSD	0.18	0.20	0.96	0.50	0.77	3.67	0.57
CV%	3.24	3.57	3.96	19.46	7.87	6.33	2.33

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by DMRT.

Highest number of fruits plant^{-1} was obtained from BS Jai-005 (4000) while lowest was found in BS Jai-004 (600). Maximum weight of fruit plant^{-1} (38.1 kg) and yield (25.0 t ha^{-1}) was obtained from BS Jai- 001 while lowest was found from BS Jai-004 (5.2 kg plant^{-1} and 6.1 t ha^{-1} respectively).

Table 3. Yield performance of the different Burmese grape germplsm

Accession	Fruits plant^{-1} (No.)	Yield plant^{-1} (Kg)	Yield (t ha^{-1})
BS Jai 001	4000	38.1	25.0
BS Jai-002	3000	22.6	21.9
BS Jai-003	1350	11.4	12.3
BS Jai-004	600	5.2	6.1
BS Jai-005	2400	18.4	18.8
SD	1339.59	12.51	7.62
CV (%)	59.01	65.37	45.28

Qualitative characteristics of the lotkon germplasm are shown in table 4 .In respect of shape all the germplasm showed spheroid fruits.Yellow, Light yellow, Pinkish yellow fruits was found from the germplasm of BS Jai-002, BS Jai-001 and BS Jai-003 respectively.

Table 4. Qualitative characters of fruit of the different Burmese grape germplasm

Accession	Shape	Colour	Flesh color	Flesh texture
BS Jai-001	Spheroid	Light yellow	Off white	Soft Juicy
BS Jai-002	spheroid	Yellow	Off white	Juicy
BS Jai-003	spheroid	Pinkish Yellow	Off white	Juicy
BS Jai-004	spheroid	Yellowish green	Off white	Juicy
BS Jai-005	spheroid	Pale Yellow	Off white	Juicy

No disease infestation was observed in BS Jai-001 whereas the others suffer from powdery mildew and shooty mould. Chaper beetle was common in case of all the germplasm but BS Jai-001 and BS Jai-003 was free from fruit borer.

Table 5. Disease and insect pest of the different burmese grape germplasm

Accession	Disease incidence	Insect pest infestation
BS Jai 001	Nil	Chapper beetle
BS Jai-002	Powdery mildew, Shooty mould	Chapper beetle, fruit borar
BS Jai-003	Powdery mildew, Shooty mould	Chapper beetle
BS Jai-004	Powdery mildew, Shooty mould	Chapper beetle,fruit borar
BS Jai-005	Powdery mildew, Shooty mould	Chapper beetle, fruit borar

Conclusion

Considering all the parameters studied BS Jai-001 performed best among the germplasm and could be released as a variety for farmers cultivation.

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COLLECTION AND EVALUATION OF BAEL GERMPLASM

J.C. SARKER, M.H.M.B. BHUYAN, F. AHMED AND S.M.L. RAHMAN

Abstract

The experiment was conducted at Citrus Research Station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet, during 2021-22. Four germplasm of Bael viz., AM Jai-001, AM Jai-002, AM Jai-003 and AM Jai-004 were evaluated under this study. A wide variation was observed in case of different characters of the germplasm tested. Among the germplasm the highest number of fruits (139) was recorded in AM Jai-001 with maximum TSS (37.2%). The heaviest fruit was found in AM Jai-002 (830.6g) with large sized (13.2×12.3cm^2). Maximum edible portion (82.56%) was recorded in AM Jai-001 while minimum (55.77%) was in AM Jai-002.

Introduction

Bael (*Aegel marmelos*) is the only member of the monotypic genus Aegle (Sharma *et al.*, 2007; Baliga *et al.*, 2011). It is a mid-sized, slender, aromatic, armed, gum-bearing tree having a leaf with three leaflets. Bael occurs in dry forests on hills and plains of northern, central and southern India, southern Nepal, Sri Lanka, Myanmar, Bangladesh, Vietnam, Laos, Cambodia and Thailand (Jauhari *et al.* 1969). It is cultivated throughout India, as well as in Sri Lanka, but in Bangladesh its commercial cultivation is limited or nil. It has a reputation in India for being able to grow in places that other trees cannot. It grows in a wide range of soil conditions (pH range 5-10), tolerant to water logging and has an unusually wide temperature tolerance (from -7°C to 48°C). Therefore, this fruit can be a key to bring in the problem soils of Bangladesh under cultivation like north western and south eastern part where the pH level of soil is low. Bael is an indigenous fruit of Indian subcontinent and it is commonly known as Bengal quince (Johnand Stevenson, 1979), therefore, Bangladesh is believed to be one of the primary centers of origin of this fruit (Neeraj and Johar 2017) having a wide range of genetic variability, which may be used for varietal development. Keeping this view in mind the present study was undertaken.

Materials and Methods

The experiment was conducted at Citrus Research Station, Bangladesh Agricultural Research Institute, Jaintapur, Sylhet, during 2020-21. Five germplasm were initially included in the study. But one dropped due to unsatisfactory growth and nonbearing habit. The plants were of variable age range from 7-10 years. Each plant was fertilized with 20 kg cow dung, 375 g of N, 100 g of P and 200 g of K in two equal splits one before rainy season and another after rainy season (Mandol et al., 2014). Two full cover spray of carbendazim (Bavistin 50WP @ 2 g/L of water) was applied before spring in the month of February. As bael requires a pronounced dry season to give flowers and fruits therefore no irrigation was applied in winter. Weeding was done in rainy season before applying fertilizer. Data on number of fruits/plant, branching density, yield and fruit quality parameters were taken. The recorded data on different parameters were statistically analyzed (Gomez and Gomez, 1984).

Results and Discussion

In difference quantitative fruit characteristics there were found significance differences among the germplasm studied (Table 1). The heaviest (830.6 g) fruit was obtained in AM Jai-002 while the lightest (575.7g) was found in AM Jai-001. The biggest fruit (13.2×12.3 cm) was obtained in AM Jai-002 followed by AM Jai-001 (12.3×11.4cm) while the smallest (10.5×9.2cm) in AM Jai-003. Maximum TSS (37.2%) was recorded in AM Jai-001, whereas minimum (32.4%) in AM Jai-004. Number of fruits per plant was recorded the highest (139) in AM Jai-001 while the lowest (65) was in AM Jai-003. In case of rind thickness, maximum (0.35 cm) was recorded in AM Jai-004 whereas minimum (0.23 cm) in AM Jai-003.

Table 1. Quantitative fruit characteristics of bael germplasm

Accessions	Harvesting Time	Fruit weight (g)	Fruit size (cm)		TSS (%)	Fruits plant^{-1}	Rind thickness (cm)
			Length	Diameter			
AM Jai-001	Feb- March	575.7	12.3	11.4	37.2	139	0.33
AM Jai-002	May-June	830.6	13.2	12.3	33.2	79	0.31
AM Jai-003	Mar- April	673.8	10.5	9.2	33.5	65	0.23
AM Jai-004	Mar- April	744.5	10.1	11.4	32.4	94	0.35
SD	-	302.56	1.50	1.27	3.55	34.22	0.037
CV(%)	-	37.41	12.94	11.28	10.31	37.30	12.06

The highest weight of pulp (483.5g) was recorded in AM Jai-004 whereas the lowest (463.2g) in AM Jai-002. Maximum weight of fiber (45.5g) was recorded in AM Jai-003 whereas minimum (31.6g) in AM Jai-004. Number of seed per fruits was recorded maximum (63) in AM Jai-002 and minimum (52) in AM Jai-001. Maximum edible portion (82.56%) was recorded in AM Jai-001 while minimum (55.77%) in AM Jai-002. Maximum yield/plant was recorded (80.02kg) in AM Jai-001 while minimum (43.79 kg) in AM Jai-003 (Table 2).

Table 2. Quantitative fruit characteristics of bael germplasm

Accessions	Wt. of Pulp (g)	Wt. of fiber (g)	Wt. of seed (g)	Seeds fruit^{-1} (no.)	Edible portion (%)	Yield/plant (kg)
AM Jai-001	475.3	34.2	42.4	51	82.56	80.02
AM Jai-002	463.2	30.1	65.5	63	55.77	65.62
AM Jai-003	481.4	45.5	44.2	57	71.45	43.79
AM Jai-004	483.5	31.6	41.8	53	64.94	69.98
Mean	600.15	36.2	46.5	58	72.845	66.33
SD	239.41	1.65	9.25	4.96	10.35	16.23
CV(%)	39.892	4.56	19.90	8.56	14.21	24.47

Conclusion

From the above study it was found that AM Jai-001 was the best in terms of TSS (%), number of fruits plant^{-1} and edible portion with no bitterness. It may be released as new variety.

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EVALUATION OF DRAGON FRUIT GERMPLASM

J.C. SARKER, M.H.M.B. BHUYAN, F. AHMED AND S.M.L. RAHMAN

Abstract

The study was conducted at Citrus Research Station (CRS), Jaintapur, Sylhet with three germplasm of dragon fruit viz., HC Jai-001, HU Jai-002 and HM Jai-003 during 2021-22. The highest canopy spreading (315×227 cm) as well as number of side branches (43) were recorded in HU Jai-002 while the lowest (214×189 cm) in HM Jai-003. The earliest flowering was recorded in HC Jai-001 (011 May) followed by HU Jai-002 (10 May) while HM Jai-003 flowered last (25 September). The highest number of fruits was recorded in HU Jai-001 (54) and lowest (10) in HM Jai-003. The highest yield per plant (3.42 kg) in HU Jai-002 while the lowest in HM Jai-003 (2.2kg). The heaviest fruit (356.3g) was recorded in HU Jai-002 while the lightest was produced in HM Jai-003 (135.5g). The largest fruit (8.2×7.3 cm^2) was recorded in HU Jai-001 whereas the smallest (7.8×5.6 cm^2) in HM Jai-003. Maximum TSS (12.8%) was observed in HM Jai-003 while minimum (11.2%) in HC Jai-001. The highest edible portion (81.75%) was recorded in HU Jai-002 whereas the lowest (56.45%) was in HM Joy-003.

Introduction

The Dragon Fruit (also known as pitahaya or strawberry pear) is the fruit of several cactus species, especially of the genus *Hylocereus*. Dragon fruit or pitayacome in three types, all with leathery, slightly leafy skin: *Hylocereus costaricensis* (red fleshed pitaya) has red-skinned fruit with red flesh, *Hylocereus undatus* (white fleshed pitaya) has pink-skinned fruit with white flesh and *Hylocereus megalanthus* (white fleshed pitaya) has yellow-skinned fruit with white flesh. Its fruit is the most beautiful in the family Cactaceae with a bright red skin or yellow studded with green scales and white or red flesh with tiny edible black seeds. The flower is so beautiful that it is nicknamed as "Noble Woman" or "Queen of the Night". The juicy flesh of the fruit is delicious in taste. It is well established in Australia, China, Israel, Malaysia, Nicaragua, Taiwan and Vietnam. It has export potentiality, which fetches a higher price than even Durian, in south-east Asia. The agronomic practices are easy and less expensive; maintenance cost is low and aftercare is minimal due to fewer pest and disease attacks. The biggest advantage of this crop is that once planted, it will grow for about 20 years. More importantly, it is a fast return perennial fruit crop with production in the second year after planting and full production within five years. The crop dragon fruit is a species of dry tropical climates. The edible parts of raw dragon fruit consist of mostly water and carbohydrates, with some protein and fat content. It contains slight amounts of calcium, iron, phosphorus, and other nutrients. Thus the increase of production of dragon fruit may reduce the malnutrition problem of our country as well as can earn a lot of foreign currency. Thus, Dragon fruit is considered a fruit crop for the future (Gunasena and Pushpakumara, 2006; Gunasena *et al*., 2006). This fruit is being cultivated in the country for last five years by some large entrepreneurs. There is only one variety released from BARI with red flesh and these is scope to release white fleshed and more improved varieties. Hence the study was undertaken.

Materials and Methods

Three dragon fruit germplasm were supplied from different areas and abroad such as HC Jai-001 were collected from BARI headquarter, Gazipur, HU Jai-002 were collected locallyas well as HM Jai-003 were collected from Thailand and planted at research field of Citrus Research Station, Jaintapur, Sylhet with a distance of 3×3 m^2 spacing in concrete pole. Each plant was fertilized with 20 kg cow dung, 200 g urea, 250 g of TSP, 150 g of MOP, 50 g of gypsum, 20 gm Zinc sulphate and 10 of boric acid (Mandol *et al.*, 2014). The plot was irrigated twice a month in dry period. Bavistin 50 wp was applied @ 2g/liter of water to prevent foot and stem rot. Data were recorded on spreading, side branches, and flowering and fruit characteristics.

Results and Discussion

The highest canopy spreading (315×227 cm) as well as number of side branches (43) were recorded in HU Jai-002 while the lowest (214×189 cm) in HM Jai-003 (Table 1).

Table 1. Growth characteristics of dragon fruit germplasm

Accessions	Spreading (cm)		Side branches/plant (no.)
	E-W	N-S	
HC Jai-001	281	243	34
HU Jai-002	315	227	43
HM Jai-003	214	189	25
SD	51.03	29.30	3.51
CV(%)	18.99	13.44	18.16

The earliest flowering was recorded in HC Jai-001 (011 May) followed by HU Jai-002 (10 May) while HM Jai-003 flowered last (25 September). The highest number of fruits was recorded in HU Jai-001 (54) and lowest (10) in HM Jai-003. The highest yield per plant (3.42 kg) in HU Jai-002 while the lowest in HM Jai-003 (2.2kg) (Table 2).

Table 2. Yield contributing characters and yield of dragon fruit germplasm

Accessions	Flowering date during 2021			Fruits/plant	Yield/plant (Kg)
	1st	2nd	3rd		
HC Jai-001	11 May	22 June	18 August	54	3.37
HU Jai-002	10 May	28 June	23 August	43	3.42
HM Jai-003	-	-	25 September	10	2.2
SD	-	-	-	6.24	0.69
CV(%)	-	-	-	32.86	23.03

The heaviest fruit (356.3g) was recorded in HU Jai-002 while the lightest was produced in HM Jai-003 (135.5g). The largest fruit (8.2×7.3 cm^2) was recorded in HU Jai-001 whereas the smallest (7.8×5.6 cm^2) in HM Jai-003. Maximum TSS (12.8%) was observed in HM Jai-003 while minimum (11.2%) in HC Jai-001. The highest edible portion (81.75%) was recorded in HU Jai-002 whereas the lowest (56.45%) was in HM Jai-003 (Table 3).

Table 3. Quantitative fruit characteristics of dragon fruit germplasm

Accessions	Individual fruit weight (g)	Fruit Size (cm)		Rind weight (g)	TSS (%)	Edible portion (%)	Fruit Color	
		Length	Diameter				Skin	Flesh
HC Jai-001	210.5	8.2	7.3	60	11.2	71.49	Red	Red
HU Jai-002	356.3	7.4	7.7	65	11.5	81.75	Red	White
HM Jai-003	135.5	7.8	5.6	59	12.8	56.45	Yellow	White
SD	119.54	0.15	1.21	4.35	0.62	2.21	-	-
CV (%)	45.90	2.00	17.37	7.51	5.20	2.69	-	-

Conclusion

HU Jai-002 found best regarding fruit weight, fruit size and yield but in consideration of edible portion (%), TSS (%) as well as extraordinary yellow-skinned white fleshed, HM Jai-003 was best. Further evaluation may be done for releasing it as a variety.

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EFFECT OF BENEFICIAL MICROORGANISMS FOR SAFE BRINJAL (CV. BARI BEGUN-10) PRODUCTION

M.H.M.B. BHUYAN, M.M. RAHMAN, F. AHMED, J.C. SARKER AND S.M.L. RAHMAN

Abstract

The experiment was conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet, during December 2022 to May 2022 under field condition. The experiment was laid out in Randomized Complete Block Design with 4 (four) different treatments and 03 (Three) replications. The treatments include. T_1=Control (water spray), T_2=Spray of effective microorganism, T_3=Soil application of *Bacillus* sp., T_4=Spray of Clybio (Japanese formulation). The results illustrated that there were significant differences among the treatments. From the result it was observed that maximum number of marketable fruit was produced from T_3 (21.54). The effective microorganisms also increased the fruit size, where the maximum fruit size was recorded in T_2 (24.30×3.36 cm). Maximun weight of individual fruit was found from T_3 (2.61 g), maximum yield plant^{-1} (2.61 kg) and yield (70.52 t ha^{-1}) was found from T_3. But regarding BCR T_2 (3.53) was found best followed by T_3 (3.44).

Introduction

Brinjal, also known as eggplant belonging to the family Solanaceae, is a vegetable commonly and widely grown by the farmers throughout the world including Bangladesh. Brinjal occupies approximately 49 thousand hectare of the area and the total production of 0.45 million metric tons in Bangladesh. But the consumption of brinjal is lowest (62 g person^{-1} day^{-1}) compared to the FAO

recommendation (220 g person^{-1} day^{-1}). However, it is an important vegetables item in every kitchen and supplements starchy foods in addition to being good source of protein, minerals and vitamins. Again, it is a versatile crop adapted to different agro-ecological zones. Bangladesh agricultural Research Institute has already developed 12 open polinated variety of brinjal among them BARI Begun-10 is gaining popularity all over the country due to its colour, size, shape and taste. Moreover, this variety is of perennial in nature and can give a sustainable yield for 2-3 years.

Materials and Methods

The experiment was conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet, during December 2022 to May 2022 under field condition. The experiment was laid out in Randomized Complete Block Design with 4 (four) different treatments and 03 (Three) replications. The treatments include. T_1=Control (water spray), T_2=Spray of effective microorganism, T_3=Soil application of *Bacillus* sp., T_4= Spray of Clybio (Japanese formulation). Fungicide treated seeds were sown on the seedbed and 30 days old healthy seedlings were transplanted in the field. The experimental unit plot was 1×3 m in size, where each bed received 8 seedlings at a spacing of 60×60 cm. The plot was fertilized with 10 t cowdung, 90 kg N, 36 kg P, 110 kg K, 2 kg Zn and 1 kg B ha^{-1}. All the intercultural operations like watering, gap filling, staking, weeding and plant protection measures were executed carefully. The treatments were applied to the respective plots as per treatments. Data were recorded on plant height (cm), stem diameter (cm), canopy spreading (cm), number of primary branches, number of marketable fruits, fruit size (cm), individual fruit weight (g), per plant yield (Kg) and yield (t ha^{-1}). The data recorded was analyzed using Statix 10 computer package program and the means were separated for interpretation of the results (Gomez and Gomez 1984).

Result and Discussion

The results illustrated that there were significant differences among the treatments (Table 1). Maximum plant height was found from T_3 (112.32 cm), which were statistically similar to T_2 (110.34 cm), while T_1 produced shortest plant (101.45 cm). Maximum canopy spreading was also found from T_5 (66.45×64.56 cm), while the lowest spreading was found from T_1 (43.56×42.87 cm). Stem diameter was also lowest in T_1 (2.41 cm), whereas the other treatments were statistically indifferent. The number of primary branches was recorded highest in T_2 (4.45) which was statistically similar to T_3 (4.32).

Table1. Effect of beneficial microorganisms on growth characteristics of BARI Begun-10

Treatments	Plant height (cm)	Spreading		Primary branches plant^{-1} (no.)	Stem diameter (cm)
		E-W (cm)	N-S (cm)		
T_1	101.45 c	43.56 b	42.87 c	3.34 c	2.41 b
T_2	110.34 a	66.67 a	63.69 a	4.45 a	2.72 a
T_3	112.32 a	66.42 a	61.67 b	4.32 a	2.85 a
T_4	109.65 b	66.45 a	64.56 a	4.23 b	2.69 a
Level of significance	**	**	**	**	**
CV (%)	3.76	2.67	3.24	4.26	5.17

Legend: T_1=Control (water spray), T_2=Effective microorganism, T_3=*Bacillus* sp., T_4=Clybio

Table2. Effect of beneficial microorganisms on yield contributing characteristics of Naga chili

Treatments	Marketable Fruits plant^{-1}(no.)	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Yield (kg plant^{-1})	Yield (t ha^{-1})	BCR
T_1	18.56 c	18.31 c	2.93 c	110.31 b	1.32 d	35.74 d	2.86 b
T_2	20.67 ab	24.30 a	3.36 a	124.65 a	2.49 b	67.31 b	3.53 a
T_3	21.54 a	24.13 a	3.26 a	124.53 a	2.61 a	70.52 a	3.44 a
T_4	19.87 b	20.36 b	3.01 b	111.83 b	2.12 C	57.39 c	2.96 b
Level of significance	**	**	**	**	**	**	
CV (%)	5.25	2.38	2.13	5.21	4.78	8.98	2.15

Legend: T_1=Control (water spray), T_2=Effective microorganism, T_3=*Bacillus* sp., T_4=Clybio

Conclusion
This is the first year of study. The experiment should be repeated for the confirmation of the results.

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CONTROLLING DISEASE AND PEST FOR SAFE VEGETABLE (cv. BARI Begun-10) PRODUCTION

M.H.M.B. BHUYAN, M.M. RAHMAN, F. AHMED, J.C. SARKER AND S.M.L. RAHMAN

Abstract
The experiment was conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet, during December 2022 to May 2022 under field condition. The experiment was laid out in Randomized Complete Block Design with 5 (five) different treatments and 03 (Three) replications. The treatments include T_1=Control (Spraying only water), T_2=Farmers practice (Spraying chemical pesticides), T_3=Mahogany seed extract spray, T_4=Garlic extract spray, T_5=Neem oils spray. Maximum plant height (110.23 cm), stem diameter (2.50 cm), and canopy spreading (66.56×64.76 cm) was found from T_2, but the number of primary branches (4.5) was recorded highest in T_5. Ther were differences among the number of total leaves, infested leaves, twigs and fruits also, where lowest number of infested leaves were found from T_2 (5.47). But the lowest number of infested twigs as well as fruits were found from T_5 (2.45 and 5.65.23 respectively) In a similar way maximum number of marketable fruit (22.87) and marketable yield (61.77 t ha^{-1})was found from T_2. Among the botanical treatments T_5 (neem oil) performed better regarding individual fruit weight (105.25 g) and marketable yield (56.70 t ha^{-1}).

Introduction
Brinjal, also known as eggplant belonging to the family Solanaceae, is a vegetable commonly and widely grown by the farmers throughout the world including Bangladesh. Brinjal occupies approximately 49 thousand hectare of the area and the total production of 0.45 million metric tons in Bangladesh. But the consumption of brinjal is lowest (62 g $person^{-1}$ day^{-1}) compared to the FAO recommendation (220 g $person^{-1}$ day^{-1}). However, it is an important vegetables item in every kitchen and supplements starchy foods in addition to being good source of protein, minerals and vitamins. Again, it is a versatile crop adapted to different agro-ecological zones. Bangladesh agricultural Research Institute has already developed 12 open polinated variety of brinjal among them BARI Begun-10 is gaining popularity all over the country due to its colour, size, shape and taste. Moreover, this variety is of perennial in nature and can give a sustainable yield for 2-3 years.

As stated above brinjal is a perinnia crop and thus prune to many diseases, insects and mites. The losses caused by insects pest and diseases are a severe problem to higher production. Hence farmers are using chemical pesticides which are causing health hazards to human as the brinjal contains the residue of these chemicals. On the other hand Eco friendly pest management, such as the use of botanical extracts, offers an excellent opportunity to reducing the harmful effects of chemical pesticides, saving beneficial soil microorganisms as well as are a promising source for safe vagetable production, together with controlling human health hazards (Rahman et al., 2021). Alternatively, the use of botanical are cost effective and available to farmers on time. thus become the most rewarding in our existing socio economic conditions and an ecological threat. Therefore, considering the above

circumstances, the study has been taken to find out suitable botanical product(s) for sustainable brinjal cv. BARI begun-10 production in Bangladesh.

Materials and Methods

The experiment was conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet, during December 2022 to May 2022 under field condition. The experiment was laid out in Randomized Complete Block Design with 5 (five) different treatments and 03 (Three) replications. The treatments include T_1=Control (Spraying only water), T_2=Farmers practice (Spraying chemical pesticides), T_3=Mahogany seed extract spray, T_4=Garlic extract spray, T_5=Neem oils spray. Fungicide treated seeds were sown on the seedbed and 30 days old healthy seedlings were transplanted in the field. The experimental unit plot was 1×3 m in size where each bed received 8 seedlings at a spacing of 60×60 cm. All the intercultural operations like watering, gap filling, staking, weeding and plant protection measures were executed carefully. The treatments were applied to control of disease, insect and mites infestation. Data were recorded on plant height (cm), stem diameter (cm), canopy spreading (cm), number of primary branches, number of infested leaves, number of infested twigs, number of infested fruits, total nuber of fruits, number of marketable fruits, individual fruit weight (g), and yield (t ha^{-1}). The data recorded was analyzed using Statix 10 computer package program and the means were separated for interpretation of the results (Gomez and Gomez 1984).

Result and Discussion

The results illustrated that there were significant differences among the treatments (Table 1). Maximum plant height was found from T_2 (110.23 cm) followed by T_5 (103.23 cm), while T_1 produced shortest plant (75.12 cm). Maximum canopy spreading was also found from T_2 (66.56×64.76 cm), while the lowest was from T_1 (43.89×42.34 cm). Stem diameter was also maximum im T_2 (2.5 cm) but number of primary branches was recorded highest in T5 (4.5) which was statistically similar to T_2 (4.3).

Table 1. Effect of different organic plant extracts on growth characteristics of Brinjal cv. BARI Begun-10

Treatments	Plant height (cm)	Stem diameter (cm)	Spreading (cm)		Primary branches $plant^{-1}$ (no.)
			E-W	N-S	
T_1	75.12 d	2.10 c	43.89 c	42.34 c	2.1 c
T_2	110.23 a	2.50 a	66.56 a	64.76 a	4.3 a
T_3	98.45 c	2.30 b	62.38 b	62.87 b	3.5 b
T_4	95.67 c	2.30 b	62.54 b	61.98 b	3.6 b
T_5	103.23 b	2.35 b	65.34 a	64.78 a	4.5 a
Level of significance	**	**	**	**	**
CV (%)	3.25	4.56	5.4	5.7	9.7

Legends: T_1=Control, T_2=Farmers practice, T_3=Mahogany seed extract, T_4=Garlic extract, T_5=Neem oil

Table 2. Effect of different organic plant extracts on number of infested leaf, twigs and fruits of Brinjal cv. BARI Begun-10

Treatments	Total leaves (No.)	Infested leaves (No.)	Infested twigs (No.)	Infested fruits (No.)
T_1	21.23 c	9.56 a	5.67 a	11.43 a
T_2	29.56 a	5.47 c	3.78 b	6.23 c
T_3	25.78 b	6.78 b	3.89 c	7.79 b
T_4	26.47 b	6.67 b	3.32 c	6.67 c
T_5	26.58 b	5.78 c	2.45 c	5.65 d
Level of significance	**	**	**	**
CV (%)	3.65	2.78	3.98	2.78

Legends: T_1=Control, T_2=Farmers practice, T_3=Mahogany seed extract, T_4=Garlic extract, T_5=Neem oil

There were differences among the number of total leaves, infested leaves, twigs and fruits also (Table 2), where lowest number of infested leaves were found from T_2 (5.47), followed by T_5

(5.78), where as the maximum was found from T_1 (9.56). Similarly the lowest number of infested twigs as well as fruits were found from T_5 (2.45 and 5.65.23 respectively) followed by T_4 (3.32) and T_2 (6.23) respectively, wheras the maximum twig and fruit infestation was found from T_1 (5.67 and 11.43 respectively).

From the result it was observed that maximum total number of fruit was produced from T_2 (28.56) probably due to less infestation of diseases, insects and mites, which facilitates more fruit setting. While the lowest number of fruit was found from T_1 (19.34). The botanicals also performed better regarding number of fruits per plant which were statistically indifferent. In a similar way maximum number of marketable fruit was found from T_2 (22.87) followed by T_5 (20.67). As a result marketable yield was also maximum in T_2 (61.77 t ha^{-1}). Among the botanical treatments T_5 (neem oil) performed better regarding individual fruit weight (105.25 g) and marketable yield (56.70 t ha^{-1}).

Table 3. Effect of different organic plant extracts on number of yield of Brinjal cv. BARI Begun-10

Treatments	Total fruits (No.)	Marketable fruits (No.)	Fruit weight (No.)	Marketable yield (t ha^{-1})
T_1	19.34 c	8.56 d	68.45 c	14.68 d
T_2	28.56 a	22.87 a	104.35 a	61.77 a
T_3	24.67 b	17.98 c	101.54 b	46.35 c
T_4	24.78 b	18.56 c	100.43 b	48.60 c
T_5	25.87 b	20.67 b	105.25 a	56.70 b
Level of significance	**	**	**	**
CV (%)	4.36	4.78	3.35	4.90

Legends: T_1=Control, T_2=Farmers practice, T_3=Mahogany seed extract, T_4=Garlic extract, T_5=Neem oil

Conclusion

Based on the results of the experiment, it may be inferred that all the botanicals used significantly enhanced growth, yield and fruit quality of brinjal. Although T_2 (Spraying chemical pesticide) showed the maximum yield but the botanicals are very closer to the farmers practice. This is the first year of study. The experiment should be repeated for the confirmation of the results.

Aknowledgement

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SOIL HEALTH MANAGEMENT FOR SAFE SAFE BRINJAL (cv. BARI BEGUN-10) PRODUCTION USING ORGANIC FERTILIZERS

M.H.M.B. BHUYAN, M.M. RAHMAN, F. AHMED, J.C. SARKER AND S.M.L. RAHMAN

Abstract

The experiment was conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet, during December 2022 to May 2022 under field condition. The experiment was laid out in Randomized Complete Block Design with 6 (Six) different treatments and 03 (Three) replications. The treatments include T_1=Native nutrients (soil without manures and fertilizers), T_2=Farmers practice (RDF according to FRG from chemical fertilizers), T_3=Farmyard manure (10 t ha^{-1}), T_4=Vermicompost (6 t ha^{-1}), T_5= Poultry manure (5 t ha^{-1}), T_6=Mustard oil cake (4 t ha^{-1}). Results showed that

like the farmers practices the organic practices also increase the growth and yield of brinjal. Among the treatments vermicompost performed best followed by poultry manure ad the farmyard manure.

Introduction

Brinjal, also known as eggplant belonging to the family Solanaceae, is a vegetable commonly and widely grown by the farmers throughout the world including Bangladesh. Brinjal occupies approximately 49 thousand hectare of the area and the total production of 0.45 million metric tons in Bangladesh. But the consumption of brinjal is lowest (62 g person^{-1} day^{-1}) compared to the FAO recommendation (220 g person^{-1} day^{-1}). However, it is an important vegetables item in every kitchen and supplements starchy foods in addition to being good source of protein, minerals and vitamins. Again, it is a versatile crop adapted to different agro-ecological zones. Bangladesh agricultural Research Institute has already developed 12 open polinated variety of brinjal among them BARI Begun-10 is gaining popularity all over the country due to its colour, size, shape and taste. Moreover, this variety is of perennial in nature and can give a sustainable yield for 2-3 years.

Brinjal being a long duration crop requires a good amount of manures and fertilizers for high yield (Sharma and Dhakar 2003). They suggested 15-20 t of well-decomposed FYM for a good yield of brinjal. It is well documented that, increased dependence on agro chemicals including fertilizer has led to several ill effects on the human health as well as degrades the soil health. But organic fertilizers improve soil reaction and humus, which fundamentally shapes the physical, chemical, and biological properties of the soil (Bot and Benites, 2005). Thus, it has an indirect effect on yielding plants. Natural and organic fertilizers are also the sources of essential nutrients for plants, such as nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur, as well as microelements. The use of organic manure in such situation is a practically paying proposal. Organic system produced significant improvement in quality of soil mainly bulk density, maximum water holding capacity, infiltration rate, organic carbon (Babalad et al. 2009; Ullah et al. 2008).

Therefore, natural and organic fertilizers (including manure, compost, or slurry) for fertilizing purposes may solve the problem of nutrient storage and reduces the need for disposing of mineral fertilizers. Keeping these views in mind the present study was undertaken.

Materials and methods

The experiment was conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet, during December 2022 to May 2022 under field condition. The experiment was laid out in Randomized Complete Block Design with 6 (Six) different treatments and 03 (Three) replications. The treatments include T_1=Native nutrients (soil without manures and fertilizers), T_2=Farmers practice (RDF according to FRG from chemical fertilizers), T_3=Farmyard manure (10 t ha^{-1}), T_4=Vermicompost (6 t ha^{-1}), T_5= Poultry manure (5 t ha^{-1}), T_6=Mustard oil cake (4 t ha^{-1}). The treatments were prepared on weight basis. Fungicide treated seeds were sown on the seedbed. 30 days old healthy seedlings were transplanted in the field. The experimental unit plot was 1×3 m in size where each bed received 8 seedlings at a spacing of 60×60 cm. All the intercultural operations like watering, gap filling, staking, weeding and plant protection measures were executed carefully. Data on growth and yield contributing characters and yield were recorded. The collected data were tabulated and statistically analyzed for the interpretation of the result (Gomez and Gomez 1984). Cost and return analysis (in BDT) and benefit cost ratio were also calculated using standard formula.

Results and discussion

There were significant differences in respect of plant height, spreading (E-W and N-S) number of primary branches plant^{-1} and stem diameter among the treatments (Table 1). Maximum plant height (110 cm) was recorded in the treatment T_2 followed by treatment T_3 (103 cm) and T_4 (100 cm), while, minimum plant height (70 cm) was noticed in T_1. On the other hand canopy spreading was the maximum in T_5 (66 cm× 64 cm) but T_1 exhibited the minimum spreading. Primary branch plant^{-1} was highest in T_2, T_3 and T_4 (4), where as stem diameter was maximum in T_5 (2.19) followed by T_2 (2.17). In every case the T_1 showed the minimum.

Table1. Effect of organic manures on growth characteristics of BARI Begun-10

Treatments	Plant height (cm)	Spreading		Primary branches plant^{-1} (no.)	Stem diameter (cm)
		E-W (cm)	N-S (cm)		
T_1	70 d	43 c	42 d	2 c	1.41 c
T_2	110 a	62 b	62 b	4 a	2.17 a
T_3	95 c	66 a	61 b	4 a	2.15 ab
T_4	100 b	66 a	63 ab	4 a	2.12 b
T_5	103 bc	66 a	64 a	3 b	2.19 a
T_6	97 c	65 a	64 a	3 b	2.18 a
Level of significance	**	**	**	**	**
CV (%)	2.36	3.57	4.14	9.06	6.07

Legend: T_1=Native nutrients (soil without manures and fertilizers), T_2=Farmers practice (RDF according to FRG from chemical fertilizers), T_3=Farmyard manure (10 t ha^{-1}), T_4=Vermicompost (6 t ha^{-1}), T_5= Poultry manure (5 t ha^{-1}), T_6=Mustard oil cake (4 t ha^{-1})

Table2. Effect of organic manures on yield contributing characteristics of BARI Begun-10

Treatments	Marketable Fruits plant^{-1}(no.)	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Yield (kg plant^{-1})	Yield (t ha^{-1})	BCR
T_1	12 d	16.3 d	1.9 d	84.31 d	1.01 d	27.37 e	0.56 d
T_2	20 a	24.3 a	2.36 c	134.65 a	2.7 a	72.71 a	3.5 b
T_3	18 c	22.13 c	3.26 a	124.53 b	2.24 c	60.52 c	3.4 c
T_4	19 b	22.36 b	3.23 a	125.83 b	2.39 b	64.55 b	3.6 a
T_5	19 b	22.22 c	3.10 b	123.75 bc	2.35 b	63.48 b	3.5 b
T_6	18 c	20.18 c	2.93 b	121.14 c	2.18 c	58.87 d	3.4 c
Level of significance	**	**	**	**	**	**	
CV (%)	5.15	3.08	2.63	2.81	6.98	6.58	6.55

Legend: T_1=Native nutrients (soil without manures and fertilizers), T_2=Farmers practice (RDF according to FRG from chemical fertilizers), T_3=Farmyard manure (10 t ha^{-1}), T_4=Vermicompost (6 t ha^{-1}), T_5= Poultry manure (5 t ha^{-1}), T_6=Mustard oil cake (4 t ha^{-1})

The number of marketable fruits plant^{-1}, fruit size (length ×diameter), individual fruit weight (g), fruit yield plant^{-1} (kg), per hectare yield (t) and benefit cost ratio was also significantly influenced by different treatments (Table 2). Maximum number of fruits plant^{-1} was noticed from the T_2 (20). On the other hand, native nutrient (T_1), resulted in reduction of the total number of fruits (12). In case of fruit size, longest fruit was obtained from T_2 (24.3 cm) followed by T_5 (22.22 cm) and T3 (22.13 cm), while the shortest fruit was found in T1 (16.3 cm). Regarding fruit diameter T3 (3.26 cm) and T4 (3.23 cm) was maximum where as T1 (1.9 cm) was the lowest. The fruit yield plant^{-1} ranged 1.01 kg to 2.7 kg up to 115 DAT (Table 4). Among the treatments the highest fruit yield (2.7 kg plant^{-1}) was estimated in T_2 followed by T_4 (2.39 kg plant^{-1}) and T_5 (2.35 kg plant^{-1}). Fruit yield was the lowest (1.01 kg plant^{-1}) in treatment T_1. In a similar way per hectare yield was also highest in T_2 (72.71 t ha^{-1}) and minimum was observed in T_1 (27.37 t ha^{-1}). The expenses incurred and income generated in brinjal cultivation is an important consideration. Thus, maximum BCR was observed in treatment T_4 (3.6) followed by T_5 and T_2 (3.5), while the T_1 (0.56) showed the minimum.

Conclusion

Based on the results of the experiment, it may be inferred that all the organic manures used significantly enhanced growth, yield and fruit quality of brinjal. Although T_2 (Farmers practice) showed the maximum yield but focusing on the BCR the organic manures are very closer to the farmers practice. Therefore, farmers can produce brinjal organically but there should be different markets or atleast different sections in the markets for organic and inorganic vegetables. Then the organic farmers will be able to compete with the products produced using chemical fertilizers. The experiment should be continued for further confirmation.

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COLLECTION, CONSERVATION, AND CHARACTERIZATION OF SMALL AND LARGE CARDAMON GERMPLASM

J.C. SARKER, F. AHMED, M.H.M.B. BHUYAN AND S.M.L. RAHMAN

Abstract

Twenty one germplasm of cardamom (*Amomum subulatum* Roxb.) were collected from spices Research Center (SRC), Bogra, and planted at Citrus Research Station (CRS), Jaintapur, Sylhet in November 2020. The tallest plant was recorded in AS Jai-002 (110.33 cm) but both AS Jai-004(93.00 cm) and AS Jai-005(93.00 cm) recorded shortest plant. The maximum number of tillers clump^{-1} was found in AS Jai-005 (33.33) while the minimum was in AS Jai-001 (4.66). AS Jai-005 produced the highest (6.33) number of leaves tiller^{-1} while AS Jai-003 produced the lowest (3.33) number of leaves tiller^{-1}. Longest (36.33 cm) and widest leaf (8.33 cm) was found in AS Jai-005. On the other hand AS Jai-001 produced shortest (19 cm) and narrowest (3.66 cm) leaves.

Introduction

Cardamom (*Elettaria cardamomum* Maton), is an herbaceous, perennial monocotyledonous plant belongs to the family Zingiberaceae. It is one of the most highly priced, valuable and export oriented spice crop. It is originated from the coastal area of India. It is now grown in Guatemala, Tanzania, Sri Lanka, El Salvador, Vietnam, Laos and Cambodia. India is the main exporter of dried cardamom. It is a perennial tropical herb plant grows from a thick rootstalk up to around 6-10 feet. It is indigenously grown in the evergreen forests of the Western Ghats in South India. It is a climate sensitive crop as it strictly requires cool, moist soil, humid under shaded area (Yadav et al. 2015). There are two main types of cardamom: Small green cardamom (*Eletteria cardamomum*) and large red/black cardamom (*Amomum subulatum* Roxb). Large cardamom is known as Alaichiin in Nepal, Badi Alaichiin in India and Alachi in Bangladesh and renounced as black cardamom, black gold, and queen of spices. Small cardamom is a perennial bushy herb with mauve marked, orchid-like white flowers and very long, lance-shaped leaves. Cardamom is cross-pollinated crop and propagated through seedlings and suckers, occasionally selfing also occurs. Cardamom being cross-pollinated crop offers tremendous scope for selection of high yielding genotypes to increase the productivity (Venugopal 1999). Considerable variation is noticed in seedling progenies of cardamom (Padmini et al., 2000). So, identification of an appropriate variety suitable for specific region is an important factor in cardamom. This spice is being cultivated in the country for last few years by some large entrepreneurs. But the potentiality of this fruit is not yet defined properly. Keeping this view in mind to identify one or more suitable genotype this experiment was undertaken.

Materials and Methods

Twenty one saplings of six cardamom germplasm were supplied from Spices Research Center, BARI, Bogura and planted at CRS, Jaintapur, Sylhet on November, 2020. The saplings were planted at a distance of 3×3 m. Each plant was fertilized with 20 kg cow dung, 200 g urea, 250 g of TSP, 150 g of MOP, 50 g of gymsum, 20 gm Zinc sulphate and 10 g of boric acid (Mandol *et al*., 2014). The plot was irrigated twice a month in dry period. Bavistin 50wp was applied @ 2g L^{-1} of water to prevent foot and stem rot. The following growth data of the germplasm i.e. plant height, productive tillers clump^{-1}, Leaves tiller^{-1}, Leaf length, Leaf breadth was recorded and analyzed using Statix 10 computer package program and the analysis of variance were separated for significant difference br LSD at 5%level of probality.

Results and Discussion

The tallest plant was recorded in AS Jai-002 (110.33 cm), but both AS Jai-004 (93.00 cm) and AS Jai-005(93.00 cm) recorded shortest plant. The maximum number of tillers clump^{-1} was found in AS Jai-005 (33.33) while the minimum was in AS Jai-001 (4.66). AS Jai-005 produced the highest (6.33) number of leaves tiller^{-1} while AS Jai-003 produced the lowest (3.33) number of leaves tiller^{-1}. Longest (36.33 cm) and widest leaf (8.33 cm) was found in AS Jai-005. On the other hand AS Jai-001 produced shortest (19 cm) and narrowest (3.66) leaves Table 1.

Table 1: Growth characteristics of cardamom

Accessions	Plant height (cm)	Tillers clump^{-1} (no.)	Leaves tiller^{-1} (no.)	Leaf length (cm)	Leaf breadth (cm)	Growth condition
AS Jai-001	50.00 c	4.66 b	4.33 bc	19.00 c	3.66 d	Good
AS Jai-002	110.33 a	12.00 b	4.33 bc	29.00 b	6.66 b	Good
AS Jai-003	42.00 d	6.33 b	3.33 c	21.66 c	5.33 c	Good
AS Jai-004	93.00 b	6.66 b	5.33 ab	33.00 ab	7.33 ab	Good
AS Jai-005	93.00 b	33.33 a	6.33 a	36.33 a	8.333 a	Excellent
CV	2.41	42.36	11.57	5.17	7.14	

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test.

Conclusion

All the plants are now in vegetative stage. AS Jai-005 showed better growth performance among them. So after flowering and fruiting the final evaluation and conclusion can be made.

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EVALUATION OF BLACK PEPPER LINES

F. AHMED, M.H.M.B. BHUYAN, J.C. SARKER AND S.M.L. RAHMAN

Abstract

The experiment was conducted at spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet during the period from May 2021 to May 2022 to evaluate the new germplasm of black pepper comparison with BARI Golmorich 1. The variety BARI Golmorich-1 and PN Jai-101 were evaluated and recorded. BARI Golmorich -1 was taller (200 cm) than PN Jai- 101 (150 cm). The other characteristics are dissimilar and that are distinguish character. BARI Golmorich-1 showed longer (14 cm) and wider (8 cm) leaves. On the other hand PN Jai-101 recorded shorter (10 cm) and narrower (7 cm) leaves. PN Jai-101 noted thicker (0.5 cm) leaves than BARI Golmorich-1 (0.3 cm) leaves. BARI Golmorich-1 has ovate-elliptic leaf lamina, round leaf base and campylodromous leaf veining. Contrary PN Jai-101 has ovate leaf lamina, cordate leaf base and acrodromous leaf veining. BARI Golmorich -1 were in flowering but PN Jai-101were in vegetative condition.

Introduction

Pepper (*Piper nigrum* L.) belongs to the family Piperaceae and is one of the most valuable spices consumed throughout the world. Pepper is widely known for its peculiar favour and pungency due to the presence of alkaloid piperine in its fruits (Parthasarthy and Zachariah 2008; Gorgani et al. 2017). Pepper—black, green and white is used to describe appearance of the product, however the crop plant is popularly referred as "Black pepper" in order to distinguish from pepper of Capsicum spp. (i.e., chili) (Damanhouri and Ahmad 2014). Pepper is cultivated for its fruits (berries) and serves as a cash crop with diverse domestic and industrial uses. Pepper is a woody perennial climbing plant with numerous cultivars varying in yield, branching pattern, size, stem structure and orientation of the various parts (Hussain et al. 2017b). Te plants exhibit a dimorphic branching pattern consisting of orthotropic and plagiotropic branches. Orthotropic branches have short, thick internodes with several adventitious roots at the nodes helping the plant to climb over the supports. Plagiotropic branches have no aerial roots but produce a spike from the terminal bud as they grow. Further growth of the branches is continued by axillary buds. As the axillary buds develop, they expose the developing spike and become opposite to the leaves (Parthasarathy et al. 2007; Krishnamurthy et al. 2010). In presence of adequate soil moisture, runner shoots with aerial root initials at the nodes are produced from the base. These shoots trail on the ground but climb up when in contact with vertical supports. Te inflorescence is a catkin (spike) produced at the nodes opposite to the leaves. Its fower is sessile, bracteate, achlamydeous and uni/bisexual. Cultivated pepper has more percentage of bisexual fowers compared to wild species. Berry set highly depends upon the prevailing weather conditions of the growth season. Continued droughts, heavy or irregular rains can reduce pollination, afects the crop physiology, and also leads to failure of berry set (Ravindran et al. 2000; Srinivasan et al. 2012; Krishnamurthy et al. 2016). Citrus Research Station has two types of black pepper germplasm. One already released as a variety named BARI Golmorich-1. The other one is evaluating. Observation and recording of morphological characters/descriptors has been a typical approach for identifcation and description of various pepper germplasms (Hussain et al. 2017b; Bermawie et al. 2019; Prayoga et al. 2020).Phenotypic descriptors of a plant species that determine similarity and diversity between and within crop accessions are the bases for Morphological assessment. Phenotypic descriptors are plant traits which can be analyzed during diferent developmental stages of the crop and may appropriate used in distinguishing crop accessions (Meilawati et al. 2020; Prayoga et al. 2020). The aim of this study was to generate preliminary information on morphological characteristics of pepper types grown in Citrus Research Station, Jaintapur, Sylhet compared to released varieties.

Materials and Methods

The experiment was conducted at Jaintapur, Sylhet conducted at Spices Research Sub-station, Citrus research station; Bangladesh Agricultural Research Institute, Jaintiapur, Sylhet during the period from May 2021 to April 2022.The black pepper var. BARI Golmorich-1 and lines PN Jai-101 were used in this experiment. The mature cutting two crops were planted same time, gives same nutrition and same cultural management practice.

Results and Discussion

Data in the Table 1 showed that BARI Golmorich -1 was taller (200 cm) than PN Jai-101 (150 cm) Both plants have some similar characters i.e. climbing growth habit, dimorphic branching and even leaf margin. The other characteristics are dissimilar and that are distinguish character. BARI Golmorich-1 showed longer (14 cm) and wider (8 cm) leaves. On the other hand PN Jai-101 recorded shorter (10 cm) and narrower (7 cm) leaves.

Table1. Growth and leaf characteristics black pepper

Name	Plant height (cm)	Plant growth habit	Branching type	Lateral branch habit	Leaf length (cm)	Leaf breadth (cm)
BARI Golmorich -1	200	Climbing	Dimorphic	Erect	14	8
PN jai- 101	150	Climbing	Dimorphic	Hanging	10	7

PN Jai-101 noted thicker (0.5 cm) leaves than BARI Golmorich-1 (0.3 cm) leaves. BARI Golmorich-1 has ovate-elliptic leaf lamina, round leaf base and campylodromous leaf veining. Contrary PN Jai- 101 has ovate leaf lamina, cordate leaf base and acrodromous leaf veining. BARI Golmorich-1 were in flowering but PN Jai-101were in vegetative condition.

Table 2. Leaf characteristics black pepper

Name	Leaf thickness (cm)	Leaf lamina shape	Leaf base shape	Leaf margin	Type of veining	condition
BARI Golmorich-1	0.3	Ovate -elliptic	Round	Even	Campylodromous	Flowering
PN Jai- 101	0.5	Ovate	Cordate	Even	Acrodromous	Vegetative

Conclusion

The two genotypes are now in vegetative stage and showed better growth performance. So after flowering and fruiting the final evaluation and conclusion can be made.

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EVALUATION OF CINNAMON GERMPLASM

F. AHMED, M.H.M.B. BHUYAN, J.C. SARKER AND S.M.L. RAHMAN

Abstract

The experiment was conducted at spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet during the period from May 2021 to May 2022 to identify the best germplasm of cinnamon.Three cinnamon germplasm viz. CC Jai-001, CC Jai-002, and CC Jai-003 were evaluated. There were no significant variations among the germplasm tested except quill thickness and weight. The maximum fresh quill thickness (0.26 mm) was recorded with CC Jai-003. On the other hand, the minimum fresh quill thickness (0.11 mm) was found at CC Jai-002. Quill fresh weight found maximum (73.32 g) at CC Jai-003 but lowest (42.97 g) at CC Jai-002. The germplasm CC Jai-002 performed best among the treatments under study.

Introduction

Cinnamon (*Cinnamomum cassia* (L.) J.Presl) locally known as 'Darchini' a spice obtained from the inner bark of several tree species from the genus Cinnamomum. Cinnamon is used mainly as an aromatic condiment and flavoring additive in a wide variety of cuisines, sweet and savory dishes, breakfast cereals, snack foods, tea, and traditional foods. The aroma and flavor of cinnamon derive from its essential oil and principal component, cinnamaldehyde, as well as numerous other constituents, including eugenol. In Bangladesh, cinnamon is not very common. Some farmers are growing this spice crop on the homesteads, and don't know the processing of the bark. Therefore, quality also varied in the market. In the context of commercial agriculture, variability should be identified for the farmers, consumers, and researchers. Bangladesh Agricultural Research Institute has already released a variety of cinnamon for commercial cultivation. But still, there is an opportunity to release new varieties for farmers' uses. Moreover, location-specific variety for problem soils and extreme climatic regions should also be selected and released. Yet, it is high time to release a variety through systematic research for the northeastern part as this region is famous for growing spices crops. The Spices Research Sub-station, under Citrus Research Station, BARI, Jaintapur, is long maintaining three cinnamon germplasm collected locally, and their performance is quite impressive in this extreme climatic zone. Hence, this germplasm should be characterized and evaluated for releasing them as variety and keeping this view in mind; this experiment was undertaken.

Materials and Methods

The experiment was conducted at Spices Research Sub-station, Citrus research station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet during the period from May 2021 to April 2022. There were three types of cinnamon germplasm having almost the same ages in this station. These three types of germplasm were planted maintaining at least a 3 m distance between plants. Each plant was fertilized with 150 g N, 75 g P_2O_5 and 150 g K_2 O per plant in two equal splits during the first week of September and in March. Weeding and other inter-cultural operations were done when necessary and before applying fertilizer. Data on plant height, plant spreading, base girth were collected and analyzed using Statix 10 computer package program and the analysis of variance were separated for significant difference br LSD at 5%level of probality.

Results and Discussion

There was no significant variation among the cinnamon germplasm for growth characters under study .The maximum plant height (8.43 m) was recorded in CC Jai-002 while the shortest plant (8.12 m) was recorded in CC Jai-003. Both Primary (2) and secondary branches (4.5) found maximum at CC Jai-001.On the other hand CC jai-002 produced lowest number of secondary branches (3).Plants spreading in both directions found maximum with CC Jai-001 but lowest with CC Jai-003 Table 1.

Table 1. Growth characteristics of Cinnamon germplasm

Treatment	Plant age (years)	Plant height (m)	Base girth (cm)	Primary branches (No)	Secondary branches (No)	Spreading	
						E-W (m)	N-S (m)
CC jai-001	15	8.43	22	2	4.5	24	26
CC jai-002	15	8.63	21	2	3	22.5	20
CC jai-003	15	8.12	25	2	4	16	20

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test.

Significant variation was observed among the genotypes for leaf length. The longest leaf (13.33 cm) was recorded at CC Jai-001 but shortest leaf (9.80 cm) was found at CC Jai-003. Statistically similar leaf breadth and thickness was noticed among the genotypes. CC Jai-002 produced widest (6.63 cm) and thickest (0.23 mm) leaf among the genotypes. On the other side CC Jai-003 produced the narrowest (6.20 cm) and thinnest (0.20 mm) leaves. Fresh quill thickness had significant variation among the treatments. The maximum fresh quill thickness (0.26 mm) was recorded with CC Jai-003. On the other hand, the minimum fresh quill thickness (0.11 mm) was found at CC Jai-002. Quill fresh weight found maximum (73.32 g) at CC Jai-003 but lowest (42.97 g) at CC Jai-002 (Table 2).

Table 2. Qualitative growth characteristics of Cinnamon form 50 cm long and 4 cm thick piece of branch

Treatment	Leaf length (cm)	Leaf breadth (cm)	Leaf thickness (mm)	Fresh Quill thickness (mm)	Fresh Quill weight (g)
CC Jai-001	13.33 a	6.43	0.23	0.21 b	68.32 b
CC Jai-002	13.10 a	6.63	0.23	0.11 c	42.97 c
CC Jai-003	9.80 b	6.20	0.20	0.26 a	73.32 a
Level of significance	**	NS	NS	**	**
CV (%)	2.41	3.16		8.30	1.55

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test.

Conclusion

The maximum fresh thickness as well as fresh weight was found with CC Jai-002, which determines the best germplasm. Therefore, CC Jai-002 can be a good source of cinnamon.

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EVALUATION OF BAY LEAF GERMPLASM

M.H.M.B. BHUYAN, J.C. SARKER, F. AHMED AND S.M.L. RAHMAN

Abstract

The study was conducted at spices research sub-station, BARI, Jaintapur, Sylhet during July, 2021 to May, 2022. Three bay leaf germplasm were selected for the study. A wide variability was observed in different parameters such as pungency and size of leaf, yield, pest and diseases infestation among the germplasm studied. TM Jai-001 was superior with biggest leaf followed by TM Jai-003. Among the accessions TM Jai-001 also gave the highest yield but leaf aroma was highest in TM Jai-003.

Introduction

Bay leaf (*Cinnamomum tamala* (Buch.-Ham.) T.Nees&C.H.Eberm.), is an important spice crop in Bangladesh and also known as tejpata is a tree within the Lauraceae family which is native to Bangladesh, India, Nepal, Bhutan, and China. It can grow up to 20 m (66 ft) tall. It has aromatic leaves which are used for culinary and medicinal purposes. It is thought to have been one of the major sources of the medicinal plant leaves known in classic and medieval times as malabathrum. Bay leaves were used for flavoring by the ancient Greeks. It is a fixture in the cooking of many European cuisines (particularly those of the Mediterranean), as well as in the Americas. They are used in soups, stews, meat, seafood, vegetable dishes, and sauces. The leaves also flavor many classic French dishes. The leaves are most often used whole and removed before serving. They can be abrasive in the digestive tract. Thai cuisine employs bay leaf in a few Arab-influenced dishes, notably massaman curry. Spices Research Center under Bangladesh Agricultural Research Institute has already released 26 modern varieties of 12 different spices but still there is no variety of Bay leaves. As Bangladesh is a center of origin of bay leaf there are different unselected strains available throughout different regions of Bangladesh. Therefore, an effort has been taken to select a superior bay leaf germplasm as variety.

Materials and Methods

The experiment was carried out at spices research sub-station, BARI, Jaintapur, Sylhet from July, 2021 to May, 2022 with three germplasm of bay leaf as treatment. The plants were of about same age. At the beginning of the experiment the plants were rejuvenated by pruning of dead and diseased branches, freed them from parasitic plants, algae and lichen. The plants were fertilized with 10 kg cow dung, 500 g urea, 250 g TSP, 250 g MoP and 100 g gypsum in two equal splits one in the month of January (after harvest) and another at the beginning of rainy season in the month of May. The plants were infested by termite during November to February hence two full cover spray of Darsban @ 2mL L^{-1} of water was applied in the trunk. Omite @ 2mL L^{-1} of water and Bavistin @ 1g L^{-1} was applied in the plants for protecting the leaves from gall mites twice in the growing period when new leaves emerged. Data were taken on yield and yield contributing characters and analyzed by MSTAT-C program for interpretation of results (Gomez and Gomez, 1984).

Results and Discussion

Variation was observed in case of yield contributing characters and yield of the germplasm studied (table-1). Leaf size was bigger in CT Jai-001 (19×4.1 cm) while small sized leaf (14.8×4.4 cm) was found from CT Jai-003. Leaf thickness was also high with CT Jai-001. Dense leaf was found from CT Jai-001 with 3.55 cm long internode while sparse leaf in other germplasm. The highest leaf yield (12.4 kg $plant^{-1}$) was also found from CT Jai-001 but in case of pungency CT Jai-002 was best with strong aroma. Termite and mite was found in every germplasm, which was removed by chemicals. Leaf spot and tip blight was found in every plant and cured by applying fungicide.

Table 1. Yield contributing characters and yield of different Bay leaf germplasm

Parameters		CT Jai-001	CT Jai-002	CT Jai-003
Leaf (cm)	Length	19.0	15.0	14.8
	Breadth	4.1	5.4	4.4
Leaf thickness (mm)	Fresh	0.32	0.23	0.24
	Dry	0.22	0.16	0.19
Length of inter-node (cm)		3.55	4.53	4.12
Leaf yield $plant^{-1}$ (kg)		12.4	10.5	10.2
Fresh and dry weight ratio		1.67:1	1.89:1	2.05:1
Moisture		41.58	47.22	50.41
Pungency		Moderately strong	Very strong	Strong
Pest		Termite, Mite	Termite, Mite	Termite, Mite
Diseases		Tip blight, Leaf spot	Tip blight, Leaf spot	Tip blight, Leaf spot

Conclusion

This is the third year of study. The experiment will be continued for further confirmation and for selection of one germplasm to be proposed for releasing a variety for commercial cultivation.

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PHYSIO-MORPHOLOGICAL STUDY ON BETEL LEAF *(Piper betle* L. CV. KHASIA PAN)

J.C. SARKER, M.H.M.B. BHUYAN, F. AHMED AND S.M.L. RAHMAN

Abstract

An experiment was conducted to find out the promising genotype for commercial cultivation in the region. All the germplasm differed in their growth characters. Five khasia pan designated as PB Jai-001 through PB Jai-005 were collected from different locations of Bangladesh and found remarkable variations in vegetative growth, morphological features, yield and yield attributes. The leaf length (6.2-9.9 cm), leaf breadth (6.5-9.8 cm) remarkably varied among the cultivars. Maximum fresh weight of 100-leaves was 425 g. Highest Leaf number per meter vine (37) and leaf number per plant per year (115) were found in PB Jai-002. The highest annual per plant yield was obtained from PB Jai-002 (488 g) followed by PB Jai-001 (359 g) and PB Jai-001 (354 g). Variations were also existed among the cultivars in leaf colour, leaf shape, leaf tip and pungency of leaf. No pungency of leaf was found in PB Jai-002. So, PB Jai-002 was seemed to be a better germplasm in respect of yield and quality of betel leaf.

Introduction

Betel vine (*Piper betle* L.), vernacularly known as Pan, is a kind of dioecious perennial creeper vine belonging to the family Piperaceae. It is cultivated largely for its leaves. It is an important cash crop of Bangladesh. Betel vine leaves possessed a strong pungent aromatic flavour and are widely used as masticatory. Based on the cultivation practices betel vine can be divided into two groups, the plain land betel-leaf (boroj pan) and tree-betel-leaf (gach pan). Khasia people cultivated tree betel-leaf or gach pan in greater Sylhet districts, locally called Khasia pan. Khasia's is one of the ethnic communities out of 45 tribal communities live in Bangladesh. They live in a cluster village generally located on top of the hill or hillocks called punji. Besides Khasia people, Bengali people of adjacent areas also cultivate Khasia betel- leaf around their homesteads. Khasia Pan leaf is usually plucked throughout the year but maximum production obtained during the months of July through October. To maximize betel leaf production in the country it is essential to find out better germplasm for development of high yielding variety of the crop. From the above facts, the present investigation was undertaken to screen out suitable germplasm for better yield and quality of betel leaf in the country.

Materials and Methods

The experiment was conducted at Citrus Research Station, Bangladesh Agricultural Research Institute, Jaintapur, Sylhet. During 2021-22. The experiment comprised of five khasia pan. i.e, PB Jai-001, PB Jai-002, PB Jai-003, PB Jai-004, PB Jai-005 collected from different area of Bangladesh. The plants were planted during the year 2019 at a spacing of 5mx5m using Randomized Block Design (RBD) with four plants/treatment replicated three times. The experimental site is located at 36m above sea level, with coordinates of 25°13562' N latitude and 92°13217' E longitude. The average annual rainfall in is 3500-6000 mm, with more than 80% of it falling between June and July. The soil at the experimental site was a sandy loam texture soil with a pH of 4.8, 1.28% organic carbon. A common application of manures and fertilizers i.e. 30 kg farm yard manure, 1000g N, 250g P_2O_5 and 250 g K_2O per tree were applied in two equal splits, i.e. first in the first fortnight of June and second in the first fortnight of October. Observations on girth of vine (cm), internode length (cm), leaf size (cm), number of/meter vine, fresh weight of 100 leaf (g), number of leaf/plant/year and yield/plant/year (g) were recorded following experimental manual and used for analysis. Data collected on different parameters were analyzed by MSTAT-C program and means were separated following DMRT for further interpretation.

Results and Discussion

The vegetative growth parameters and morphological features of different germplasm of khasia pan varied remarkably (Table 1). The highest length of internode was recorded from PB Jai-001 while the minimum length was found in PB Jai-004. The vine girth of different betel vine germplasm varied from 4 to 5.5 cm. Maximum vine girth was recorded in PB Jai- 004 while the minimum vine girth was found in PB Jai-002 and PB Jai-005. The highest leaf length was recorded from PB Jai-002, while lowest in PB Jai-001. The maximum number of leaf/meter vine was found in PB Jai-002 while minimum in PB Jai-001. The highest fresh weight of 100 leaf was recorded in PB Jai-002 while lowest in PB Jai-001. The PB Jai-002 produced highest number of leaves (115) per plant per year while the lowest number (76) of leaves per plant per year was recorded from PB Jai-004. The highest yield per plant annually was obtained from PB Jai-002 while the lowest recorded from PB Jai-004.

Table 1. vegetative growth traits of khasia pan germplasm

Germplasm	Length of internode (cm)	Girth of vine (cm)	Leaf size (cm)		Leaf meter vine^{-1} (no.)	Fresh wt. of 100 leaf (g)	No. of Leaf/ plant/ year	Yield/plant/ year (g)
			Length	Breadth				
PB Jai-001	10.2	5	12	8.5	9	408	87	354.96
PB Jai-002	7.8	4	15.6	12.0	37	425	115	488.75
PB Jai-003	7.4	5	14.5	10.0	15	367	98	359.66
PB Jai-004	6.3	5.5	14.2	9.0	32	369	76	280.44
PB Jai-005	9.5	4	13.3	11.5	28	384	85	326.4
SD	1.59	0.67	1.35	1.52	10.94	25.26	14.96	77.52
CV(%)	19.27	14.27	9.71	14.95	49.28	6.46	16.22	21.41

The khasia pan germplasm varied remarkably in morphological characteristics viz. leaf colour, leaf shape and tip, leaf softness and pungency (Table 2). All the germplasm produces green leaf except PB Jai-002 which was produced light green colour leaf. The leaf shape of the five khasia pan germplasm were cordate to ovate. All most of the germplasm were cordate leaf shape but PB Jai-001 and PB Jai-004 PB were ovate shape leaves. All the germplasm were acute type leaf tip. All the germplasm were found soft leaf of the evaluated germplasm. Variation was found in pungency of betel leaf. No pungent to highly pungent leaf was found in the different germplasm. No pungent leaf was found in PB Jai-002 but less pungent leaf was found in PB Jai-001 and medium pungent was found in PB Jai-003 and PB Jai-005 and rest of PB Jai-004 was highly pungent leaves.

Table 2. Physio-morphological traits of khasia pan germplasm

Germplasm	Leaf colour	Leaf shape	Leaf tip	Leaf softness	Pungency of leaf
PB Jai-001	Green	Ovate	Acute	Soft	Less pungent
PB Jai-002	Light green	Cordate	Acute	Soft	No pungent
PB Jai-003	Green	Cordate	Acute	Soft	Medium pungent
PB Jai-004	Green	Ovate	Acute	Soft	Highly pungent
PB Jai-005	Green	Cordate	Acute	Soft	Medium pungent

Conclusion

Evaluation of five khasia pan germplasm revealed that PB Jai-001, PB Jai-002 and PB Jai-003 were promising in respect of leaf size and yield parameters.

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COLLECTION AND EVALUATION OF INDIGENOUS SPICES CROP UNDER SYLHET REGION

J.C. SARKER, F. AHMED, M.H.M.B. BHUYAN AND S.M.L. RAHMAN

Abstract

The study was conducted at Citrus research Station (CRS), Jaintapur, Sylhet. Eleven different indigenous spices crop were collected from different location of Sylhet region. These germplasm were kept in controlled condition in net house for evaluation.

Introduction

Many of the crop cultivars and in some cases, many species already extinct due to climatic change as well as anthropogenic activities. Geographically Sylhet region is surrounded by hills from all three sides. Its burgeoning economy has contributed to the regional attractions of landscapes filled with fragrant citrus, pineapple, agar, rubber, tea as well as spice crops like black pepper, Naga chili, betel leaf and bay leaf plantations. The region

has a high rainfall in monsoon with a highly acidic pH of the soil. Therefore, every year a number of germplasm are lost forever. Hence this question arises on collection, documentation and conservation of the spices germplasm. On the other hand, BARI has released black pepper variety BARI Golmorich-1 which is suitable for cultivation in acidic soil and suitable for hilly ecosystem of Sylhet. After establishment of Spices Research Sub-station, Jaintapur, Sylhet, a systematic efforts have been made periodically to collect indigenous germplasm of spices and its wild relatives. Germplasm conservatories have been established for black pepper, chuijhal (*piper chaba*), bay leaf, Naga chili, pepper, capsicum, plum (Alubukhara), allspice etc. representing the available variability. Therefore, with the thirst of more improved variety different germplasm were collected from different locations of the region and planted at CRS, Jaintapur. These germplasm will further characterized by CRS scientists for enriching gene pool and to evaluate their performance and further thirst of releasing new variety for commercial use in farmer's level. Hence the study has been under taken.

Materials methods

Collection of germplasm was done followed by survey. Farmer's homestead and field were visited from August, 2019 to April, 2022 and the germplasm were collected as seed, scion and cuttings. After collection the germplasm were taken to the CRS nursery. The germplasm were marked systematically after giving an accession number. Moreover, a germplasm collection sheet was documented and kept for future. The germplasm were grafted on different available rootstock or cuttings were planted in nursery beds. These germplasm were conserved under net house condition. Evaluation of these germplasm will be done.

Results and discussion

A lot of variability was found among the germplasm collected. The lists of the collected germplasm were presented in the Table 1.

Table 1. Spices crop germplasm collected locally

Species	Bengali/ Local Name	Scientific name	Accession number	Collecting source	Number of sapling collected
Black pepper	গোলমরিচ	*Piper nigram*	PN Jai-151	Local	10
Chui jhal	চুইঝাল	*piper chaba*	PC Jai-001	Local	05
Allspice	সর্বমসলা	*Pimenta dioica*	PD Jai-001	Local	06
Plum	আলুবোখারা	*Prunus domestica*	PD Jai-001	Local	03
Cinnamon	দারুচিনি	*Cinnamomum cassia*	CZ Jai-001	Local	04
Cubeb	কাবাবচিনি	*Piper cubeba*	PC Jai-001	Local	05
Bay leaf	তেজপাতা	*Cinnamomum tamala*	CT Jai-001	Local	100
Naga chili	নাগামরিচ	*Capsicum chinense*	CC Jai-001	Local	20
Clove	লবঙ্গ	*Syzygiumaromaticum*	SA Jai-001	Local	05
Nutmeg	জায়ফল	*Myristica fragrans*	MF Jai-001	Local	05
Curry leaf	কারিপাত	*Murraya koenigii*	MK Jai-001	Local	05

Conclusion

All the germplasm are in good growth condition. These germplasm will be characterized and evaluated in the next season.

EFFECT OF SPACING ON THE YIELD OF NAGA CHILI

M.H.M.B. BHUYAN, F. AHMED, J.C. SARKER AND S.M.L. RAHMAN

Abstract

The experiment was conducted during February 2022 to April 2022 at Spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet to determine the effect of spacing on chili production under acidic soil of north eastern region of Bangladesh. The experiment was laid out in randomized complete block design with three replications. Six different levels of spacing were used as treatments viz. T_1 (80×60 cm), T_2 (90×70 cm), T_3 (100×60 cm), T_4 (110×60 cm), T_5 (120×75 cm) and T_6 (130×60

cm).The tallest plant (73.66 cm) was recorded at both T_2 and T_4 while the shortest plant (59.00 cm) was recorded at T_1. Plants spread maximum (80 × 83 cm) at T_4 but minimum (58.33 cm × 62.33 cm) at T_1. Maximum stem diameter (2.28 cm) was found at T_4 while the lowest at T_1 (1.52 cm). Fruits plant^{-1} varied from 119 to 174. The maximum number of fruits plant^{-1} (174.00) was recorded at T_4. On the other hand, the lowest number of fruits plants^{-1} (118.67) was recorded at T_1. Longest fruit (4.93 cm) was recorded at T_3 while shortest fruit (3.40 cm) was found at T_1. Widest fruit (2.43 cm) obtained from T_4. On the other side statistically similar fruit breath (2.10 cm) was recorded at all the other treatments. Single fruit weight was maximum (5.05 g) at Treatments T_4 but minimum fruit weight (3.75 g) was noticed at T_1. The maximum yield plant^{-1} (879.08 g) was obtained at T_4 but the lowest yield (445.74 g) was obtained at T_1. Moreover Treatment T_4 produced maximum yield (8.16 t ha^{-1}) followed by T_3 (8.14 t ha^{-1}) while T_6 produced the lowest (4.42 t ha^{-1}).The highest gross return, gross margin, and BCR were recorded from T_3 (1.83) followed by T_4 (1.80) and T_2 (1.80). On the other hand, the lowest gross return, gross margin, and BCR were recorded from T_6 (0.84). Therefore, the results obtained from the study suggested that 100×60 cm spacing has a great effect for increasing yield of Naga chili and its yield attributes, and can be recommended for farmers' use in the north eastern region of Bangladesh.

Introduction

Naga Chili (*Capsicum chinense* Jacq.) is a woody perennial semi-shrub belonging to the Solanaceae family which is found mostly in the region of North East India. It is considered a spice crop among the people of North East India and northeast parts of Bangladesh. It is abundantly grown in these parts of the region due to its suitable environmental condition. The Naga Chili is known for its pungency, color, and taste. It is a rich source of Vitamin-C and Capsaicin. The people of Bangladesh and North East India especially Khasias, Manipuris, Nagas, and Assamese prefer pungent hot cuisine in their traditional food. So, Naga Chili has a local, traditional and economic importance. It is an interspecies hybrid, mostly *Capsicum chinense* with some *Capsicum frutescens* genes. Proper spacing is one of the main factors for enhancing the crop morphological and quality attributes leading to more production and productivity. Spacing had a significant effect on the growth and yield of chili. The number of branches plant^{-1}, the number of fruits plant^{-1}, and yield plant^{-1} were increased with the increasing of plant spacing but plant height and number of leaves significantly increase with the decreasing plant spacing (Sharma and Kumar, 2017). Therefore, proper research on its spacing to increase yield, as well as quality attributes, is necessary. Moreover, the proper spacing of Naga chili is not yet well documented. Keeping this view in mind the present study was undertaken.

Materials and Methods

The experiment was conducted at Spices Research Sub-station, Citrus research station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet during the period from February 2022 to April 2022. The experimental site belongs to AEZ 22 characterized by extremely acidic (pH 4.5-4.8) in nature and heavy rainfall during Kharif season. The experiment was laid out in Randomized Complete Block Design with three replications. The experiment consists of six different levels of spacing used as treatments viz. T_1= 80×60 cm, T_2=90×60 cm, T_3 = 100×60 cm, T_4 = 110×60 cm, T_5 = 120×60 cm, T_6 = 130×60 cm. A promising local line of Naga chili was used as the experimental material. The experimental field was prepared by ploughing and laddering. The entire experimental field was divided into three blocks and each block contains six units' plots. There were 18 individual plots. The treatments were randomly set in each plot. The unit plots were 3.9m×1.7 m in size having a 0.5 m drain between the blocks and plots. Fifty days old seedlings were planted in the main field maintaining the above-mentioned spacing. After final land preparation dolomite lime (2 t ha^{-1}) was applied to each plot and left for fifteen days for mixing in the soil. A full dose of Cow dung, TSP, Zn, and B was applied at final land preparation. Urea and MoP were applied in two equal splits. The rest of the fertilizers were applied in two splits; half as basal dose during final land preparation and another half as a top dressing after 40 days of transplanting. The plots were covered with blue-colored net for the partial shed as well as to control insect pests and to control cross-pollination. Irrigation, weeding, and other inter-cultural operations were done regularly. Bamboo sticks were used to support the individual plants. Harvesting green chilies started in the first week of April (after 120 days of transplanting) and continued up to May. Acaricide was applied to control mite infestation. Growth characteristics yield and yield contributing characters, the incidence of disease, insect pest data were recorded. Collected data were analyzed by using Statix 10 computer package program and the analysis of variance was separated for significant difference by LSD at 5%level of probality.

Results and Discussion

Results showed that there is a significant difference among the treatments (Table 1). Plant height varied from 59.00 cm to 73.66 cm. The tallest plant (73.66 cm) was recorded at both T_2 and T_4 while the shortest plant (59.00 cm) was recorded at T_1. The effect of treatments on plant spreading was insignificant. Plants spread maximum (80×83 cm) at T_4 but minimum (58.33×62.33 cm) at T_1. The number of primary branches remained the same in all of the treatments. Stem diameter differed significantly with the treatments. Maximum stem diameter (2.28 cm) was found at T_4 while the lowest at T_1 (1.52 cm).

Table1. Effect of spacing on growth characteristics of Naga chili

Treatment	Plant height (cm)	Spreading (cm)		Primary branches (no.)	Stem diameter (cm)
		E-W	N-S		
T_1	59.00 b	58.33 c	62.33 bc	2.00	1.52 c
T_2	73.66 a	73.66 b	61.00 c	2.00	2.03 abc
T_3	62.00 b	74.66 b	68.00 b	2.00	2.45 a
T_4	73.66 a	80.66 a	83.00 a	2.00	2.28 ab
T_5	71.33 a	73.00 b	60.66 c	2.33	2.03 abc
T_6	71.33 a	73.66 b	56.33 c	2.00	1.78 bc
Level of significance	**	**	**	NS	**
CV (%)	3.21	1.97	3.59	11.47	11.69

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test. T_1= 80×60 cm, T_2=90×60 cm, T_3 = 100×60 cm, T_4 = 110×60 cm, T_5 = 120×60 cm, T_6 = 130×60 cm

Results on fruit and yield contributing characteristics were found significant (Table 2). Fruits plant^{-1} varied from 119 to 174. The maximum number of fruits plant^{-1} (174.00) was recorded at T_4. On the other hand, the lowest number of fruits plants^{-1} (118.67) was recorded at T_1. Longest fruit (4.93 cm) was recorded at T_3 while shortest fruit (3.40 cm) was found at T_1. Widest fruit (2.43 cm) obtained from T_4. On the other side statistically similar fruit breath (2.10 cm) was recorded at all the other treatments. Single fruit weight was maximum (5.05 g) at Treatments T_4 but minimum fruit weight (3.75 g) was noticed at T_1. The maximum yield plant^{-1} (879.08 g) was obtained at T_4 but the lowest yield (445.74 g) was obtained at T_1. Moreover Treatment T_4 produced maximum yield (8.16 t ha^{-1}) followed by T_3 (8.14 t ha^{-1}) while T_6 produced the lowest (4.42 t ha^{-1}).

Table2. Effect of spacing on yield contributing characteristics of Naga chili

Treatment	Fruit length (cm)	Fruit breadth (cm)	Fruits plant^{-1} (no)	Fruit weight (g)	Yield (g plant^{-1})	Yield (t ha^{-1})
T_1	3.40 d	2.10 b	118.67 e	3.75 d	445.74 e	5.66 c
T_2	4.50 b	2.30 ab	144.33 c	4.69 b	677.92 c	7.78 b
T_3	4.93 a	2.33 ab	163.33 b	4.94 a	807.40 b	8.14 a
T_4	4.80 a	2.43 a	174.00 a	5.05 a	879.08 a	8.16 a
T_5	4.10 c	2.20 ab	135.33 d	3.89 d	526.38 d	4.53 d
T_6	4.33 bc	2.23 ab	130.67 d	4.22 c	551.36 d	4.42 d
Level of significance	**	**	**	**	**	**
CV (%)	2.33	4.11	1.58	1.94	1.86	1.88

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test. T_1= 80×60 cm, T_2=90×60 cm, T_3 = 100×60 cm, T_4 = 110×60 cm, T_5 = 120×60 cm, T_6 = 130×60 cm.

Table3. Cost-benefit analysis of Naga chili production under different plant spacing

Treatments	Gross return (TK)	Total cost (TK)	Gross margin (TK)	BCR
T_1	1131902 b	448590	683312 b	1.52 b
T_2	1242493 a	442390	800103 a	1.80 a
T_3	1235290 a	435420	799870 a	1.83 a
T_4	1212084 a	431440	780644 a	1.80 a
T_5	873712 c	428040	445672 c	1.04 c
T_6	786058 d	425105	360953 d	0.84 d
Level of significance	**	**	**	**
CV (%)	1.54		2.58	2.59

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test. T_1= 80×60 cm, T_2=90×60 cm, T_3 = 100×60 cm, T_4 = 110×60 cm, T_5 = 120×60 cm, T_6 = 130×60 cm.

Cultivation of Naga chili with varied spacing showed varied monetary return (Table 3). The highest gross return, gross margin, and BCR were recorded from T_3 (1.83) followed by T_4 (1.80) and T_2 (1.80). On the other hand, the lowest gross return, gross margin, and BCR were recorded from T_6 (0.84) (Table 3).

Conclusion

Considering all the parameters, it can be concluded that spacing has a significant effect on Naga chili. The study revealed that 100× 60 cm spacing performs best considering yield, fruit quality, and BCR.

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STANDARDIZATION OF SINGLE NODE CUTTINGFOR QUICK MULTIPLICATION OF BLACK PEPPER

M.H.M.B. BHUYAN, S.M.L. RAHMAN, F. AHMED AND J.C. SARKER

Abstract

The experiment was conducted at spices Research Sub-station, Citrus Research Station, BARI, Jaintapur, Sylhet from July 2020 to October 2020 under lath house condition. There were three treatments viz. (a) single-node cuttings, (b) double-node cuttings, (c) triple-node cuttings. Previously standardized potting media (Cocopeat + vermicompost 1:1) was used for planting the cuttings. Commercial rooting hormone cutting aid was used before planting the cuttings. There were variations among the treatments regarding days taken to first sprouting, number of shoots per cuttings, number of leaves per cuttings, length and diameter of shoots. Among the treatments, maximum success and survivability were obtained from both single and double node cuttings respectively, while the lowest success and survivability found in triple node cutting. Maximum number of shoots per cuttings, number of leaves per shoot, and shoot length were found in triple node cuttings while maximum shoot diameter (0.35 cm) was found in double node cuttings. The result revealed that both single and double node cuttings can be occupied for rapid multiplication of black pepper under nursery conditions.

Introduction

Black pepper (*Piper nigrum* L.), King of Spices, (Piperaceae) is a perennial vine grown for its berries extensively used as spices and in medicine. India is one of the major producers, consumers, and exporters of black pepper in the world. Black pepper is a climbing evergreen plant and grows to a height of 10 m or more. The climbing vines on supporting trees have been classified into five distinct types of stem portion based on the growth habits, morphological characters, and biological functions, as orthotropic, plagiotropic, geotropic, runners, and main stem. Cultivated pepper grown from cuttings produces initially one main climbing stem, but others rapidly appear and branch profusely, and mature vines have a bushy, columnar shape.

Cuttings are the simplest and cheapest method of propagation, but pepper can be grown from seed, graftages, marcottages, or plantlets grown from single-node cuttings (Gigi *et al.* 1993). Plant raised by vegetative propagation required skilled and specialized treatment, cloning allows large numbers to be raised from a selected parent (Singh and Singh 2005). After several years of research Bangladesh Agricultural Research Institute has recommended a black pepper variety JaintiaGolmorich/BARI Golmorich-1 for farmers' cultivation. As a result, an increased number of farmers are now producing black pepper on the homestead and/or commercially. Still, Bangladesh spent 12 million BDT for importing black pepper. Therefore, there is a prospect of Black pepper cultivation for reducing the import of this spice.

Mainly runner shoots at the base of selected high-yielding vine are the main propagating material for black pepper. Runners are separated from the parent vine in February –March, cut into lengths of three to four nodes, and planted in nurseries, or directly into the field. In Bangladesh, Bangladesh Agricultural Research Institute is the main source of cutting for farmers and supplies rooted pepper cuttings to growers at a subsidized price. But as the demand increasing there is a lack of runners for producing rooted cuttings for farmers. Therefore, the present study was designed to standardize the rapid multiplication of black pepper from a minimum amount of parent materials.

Materials and Methods

The experiment was conducted at spices Research Sub-station, Citrus Research Station, BARI, Jaintapur, Sylhet from July 2020 to October 2020 under lath house condition. There were three treatments viz. (a) single-node cuttings, (b) double node cuttings, (c) triple node cuttings. In every cutting one entire leaf was kept to facilitate photosynthesis and rapid growth. Previously standardized potting media (Cocopeat + vermicompost 1:1) was used for planting the cuttings. Commercial rooting hormone cutting aid was used before planting the cuttings. After planting the pot was kept under the shed in the nursery lath house and irrigated regularly.

Results and Discussion

There were variations among the treatments regarding days taken to first sprouting, number of shoots per cuttings, number of leaves per cuttings, length and diameter of shoots (Table 1). Among the treatments, the lowest days for first sprouting were observed from double node cuttings (21.20), whereas the maximum was taken by the triple node cutting (24.26). Maximum success and survivability were obtained from both Single and double node cuttings respectively (59 and 62% respectively), while the lowest success and survivability was from triple node cutting (45%). The maximum number of shoots per cuttings was found from triple node cuttings (1.80) whereas the lowest was from single-node cuttings (1.73). Similarly the number of leaves per shoot (6.04) and shoot length (22.31 cm) was highest in the case of triple node cuttings, while maximum shoot diameter (0.37 cm) was found from double node cuttings (Table 2).

Table 1. Effect of number of nodes on days to sprout, success and survivability of black pepper cuttings

Treatments	Days took to first sprouting	Success (%)	Survivability (%)
Single node cutting	21.85	59	59
Double node cutting	21.20	62	62
Triple node cutting	24.26	45	40
SD	0.61	11.53	11.53

Table 2. Effect of number of nodes on number of shoots per cuttings, number of nodes per cuttings, length, and diameter of shoots of black pepper cuttings

Treatments	No. of shoots cutting^{-1}	Leaves shoot $^{-1}$ (No.)	Length of shoots (cm)	Diameter of Shoots (cm)
Single node cutting	1.73	4.74	14.06	0.31
Double node cutting	1.75	4.70	21.91	0.37
Triple node cutting	1.80	6.04	22.31	0.36
SD	0.036	0.69	3.43	0.026

Conclusion

Considering the above result it can be concluded that both single and double node cuttings can be occupied for rapid multiplication of black pepper under nursery conditions. The experiment should be repeated for the confirmation of the results.

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EFFECT OF DIFFERENT LIVING AND NON-LIVING STANDARDS ON THE ESTABLISHMENT, GROWTH AND YIELD OF BLACK PEPPER CV. BARI GOLMORICH-1

J.C. SARKER, F. AHMED, M.H.M.B. BHUYAN AND S.M.L. RAHMAN

Abstract

An experiment was conducted to study different living and non-living standards on the establishment, growth and yield of black pepper var. BARI Golmorich-1 at Spices Research Sub-station, BARI, Jaintapur, Sylhet. The experiment consists of three different living and non-living standards as treatment viz. T_1= Reinforced concrete posts, T_2=Bhadi tree (*Lannea coromandelica* (Houtt.) Merr.) and T_3=Mandar tree (*Erythrina variegate* L.). The experiment was conducted in Randomized Complete Block Design with four replications. The vines in Bhadi tree exhibited superior performance with respect to average height of vine (474.7cm), average number of branches/vine (58.53), number of spikes per vine (164.5) and yield (1.3 kg plant $^{-1}$).

Introduction

Black pepper (*Piper nigrum* L.) is an important and widely used spice in the world. India is the major producer and exporter of this crop. Due to the huge requirement of planting material (vine) in Bangladesh, traditional methods including runner shoot multiplication; serpentine method and bamboo multiplication technique are being used for the large scale production of planting materials (Ravindran 2000). Black pepper vines require a support for its growth & development and yield. These supports are called standards. Ideal supports play an important role in successful establishment of black pepper vines. Since the black pepper vine is productive for 15 years and more selection of standards assumes great significance. The standards used for trailing black pepper vines are of two types normally living and non-living. The non-living standards include reinforced concrete posts, granite pillars and teak poles. Such non living standards are more commonly used in Malaysia, Brazil and Indonesia (George et al. 2005). In Malaysia an parts of Indonesia, the preferred support material is the wooden pole of the Beliam tree (*Eusideroxy lonzwageri*, Lauraceac) otherwise called Borneo iron wood which is a high density, heavy, construction timber resistant to white ants. The use of reinforced concrete posts at closer spacing (2×1m) accommodated 5000 plants per hectare and recorded higher yields (Reddy et al. 1991). Cultivation of black pepper *(Piper nigrum* L.*)* is restricted in the Sylhet region and Cht. Hill tracts of Bangladesh, so the present study has been undertaken to find out suitable standards on the establishment, growth and yield of black pepper cv. BARI Golmorich-1.

Materials and Methods

The experiment was conducted at Spices Research Sub-station, Bangladesh Agricultural Research Institute, Jaintapur, Sylhet. Semi-hardwood cuttings of black pepper (cv. BARI Golmorich-1) were prepared in August 2016 and kept for rooting and served as base material for planting on different standards (treatments). The experiment consists of three treatments viz. T_1=Reinforced concrete cement (RCC) posts, T_2=Bhadi tree (*Lannea coromandelica* (Houtt.) Merr) and T_3=Mandar tree (*Erythrina variegate* L.). The experiment was conducted in a randomized complete block design and each treatment was replicated thrice. The standard plants Bhadi and Mandar was planted in August 2016 and allowed to grow up to 5 feet height. In the next year (August 2017) the rooted cuttings of black pepper was planted 20 cm apart from the base of the standards. For planting the cutting a trench of 45×30cm was dug around the standards and filled with a mixture of cow dung, soil and sand (1:1:1). The planted cuttings were irrigated regularly. No major disease and insects were observed during the experimental period. Data on growth parameters namely, vine height, number of branches/vine, canopy spreading and yield plant^{-1} were recorded (Table 1). Data collected on different parameters were analyzed by MSTAT-C program and means were separated following DMRT for further interpretation.

Results and Discussion

The mean height of vines varied from 241.3 cm in T_3 treatment to 474.7 cm in T_2 treatment. Similarly, the number of branches vine^{-1} also varied significantly from 23.65 to 58.53 in the treatments. The maximum number of spikes vine^{-1} was found in T_2 treatment followed by T_1, whereas minimum was found from T_3. Growth condition in T_2 (Bhadi tree standard) was superior over the other standards (Table 1).

Table 1. Growth and yield performance of black pepper on different standards

Treatment	Height of vine (cm)	Branches vine^{-1}(No.)	Spikes vine^{-1}(No.)	Yield (kg plant^{-1})
T_1	355.2	37.42	135.4	0.6
T_2	474.7	58.53	164.5	1.5
T_3	241.3	23.65	86.7	0.5
CV (%)	16.67	26.88	15.66	0.8
LSD (0.05)	73.75	7.11	9.42	4.22

T_1=Reinforced concrete cement (RCC) posts,
T_2=Bhadi tree (*Lannea coromandelica* (Houtt.) Merr) and
T_3=Mandar tree (*Erythrina variegate* L.).

Conclusion

In terms of the growth and yield attributes of black pepper from the present experiment, it can be concluded that Bhadi (*Lannea coromandelica (*Houtt.) Merr.) tree is the best live standard for Black pepper.

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EFFECT OF ORGANIC FERTILIZER FOR SAFE NAGA CHILI PRODUCTION

M.H.M.B. BHUYAN, F. AHMED, J.C. SARKER AND S.M.L. RAHMAN

Abstract

An increase in the application of inorganic fertilizers in the agricultural field deteriorated the soil quality. As a result, organic farming is now popular as it is eco-friendly. Organic fertilizers from plant and animal origin release vital nutrients to the plant for its development. The experiment was conducted at spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet during the period from February 2022 to April 2022 to check the significance and importance of organic manures for Naga chili cultivation. Therefore, this work examines the effect of cow dung, vermicompost, poultry manure, and mustard oil cake on the growth and yield characteristics of Naga chili. The tallest plant (72.66 cm) was recorded in T_6 while the shortest plant (53 cm) was recorded in T_1. Plants spreads maximum (75.33 cm × 68 cm) at T_6 but minimum (66.66 cm × 57.33 cm) at T_1. The number of primary branches was maximum (2.66) in T_6. Maximum stem diameter (3.29 cm) was found in T_5 followed by T_6 (3.28 cm) while the lowest (2.11 cm) was in T_1. Both fruit length (5.18 cm) and breadth (2.93 cm) were found maximum in T_6. Contrary treatments T_1 produced shortest leaf. Profuse bearing (159 number plants^{-1}) was noticed in T_6. On the other hand; T_1 bears the least number (65 numbers plants^{-1}). Individual fruit weight was maximum (5.14 g) was noted in T_6 but thinnest fruit (4.31 g) in T_1. The maximum yield plant^{-1} (817.83 g) was obtained in T_6 but the lowest yield (281.57 g) was obtained in T_1. So T_6 produced maximum yield (8.24 t ha^{-1}) while T_1 produced the lowest yield (2.83 t ha^{-1}). The highest gross return, gross margin, and BCR were recorded from T_6(1.76).Therefore, the results obtained from the study suggested that Farmers practice that means use of inorganic fertilizer has a significant effect on Naga chili and it maximize its yield compared to other organic fertilizer in the north eastern region of Bangladesh.

Introduction

Organic agriculture is the production method supportive of the environment. The application of inorganic fertilizer is a common practice, but using composts derived from various green wastes in agriculture is tardily coming back. Compost contains variable amounts of N, P, and K and it is a valuable source of plant nutrients. Inorganic fertilizers are expensive and sometimes it is not available in the market. On the other hand, organic manure is easily available to the farmers and its cost is low compared to that of inorganic fertilizers. Most often this new type of

technology (organic agriculture) is defined as a system for maintenance of the natural fertility of the soil, biological diversity of the species, and the ecological balance of the environment. Naga chili is a cultivated Solanaceous crop. It is mainly used for its pungency. India is the largest producer and consumer of Naga chili among the other major producer of the world. However, the Naga chili, which received the attention of the world scientific community due to its extremely high pungency and unique aroma. It has been acknowledged as the hottest chili in the Guinness Book of World Records (2006). Producing safe fruit and vegetable is a burning issue nowadays. On the other hand, Naga Chili is not only popular among Bangladesh people, but some foreigners also like this chili for its aroma and pungency. As a result, a considerable amount of Naga chili is exported every year. Therefore, safe production technology as well as conserving soil health is important. Keeping this view in mind the present study was undertaken

Materials and Methods

The experiment was conducted at Spices Research Sub-station, Citrus research station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet during the period from December 2020 to April 2021. The experimental site belongs to AEZ 22 characterized by extremely acidic (pH 4.5-4.8) in nature and heavy rainfall during Kharif season. The experiment was laid out in Randomized Complete Block Design with three replications. The experiment consists of five different types of organic manure used as treatments viz. T_1 = Native nutrients, T_2 = Poultry manure (1.5 t ha^{-1}), T_3 = Vermicompost (2.5 t ha^{-1}), T_4 = Mustard oil cake (10 t ha^{-1}), T_5 = Cow dung compost (10 t ha^{-1}),
T_6 = Farmers practice.

A local line of Naga chili was used as the experimental material. The experimental field was prepared by ploughing and laddering. The entire experimental field was divided into three blocks and each block contains six units' plots. There were 18 individual plots. The treatments were randomly set in each plot. A unit plot was 3.9×1.7m in size having a 0.5 m drain between the blocks and plots. 50 days old seedlings were planted in the main field maintaining 100×60 cm spacing. Organic fertilizers were applied after final land preparation. The whole field including each plot was covered with a blue-colored net to control insect pests to keep the plants free of artificial pollination. Irrigation, Weeding, and other inter-cultural operation were done when necessary. Bamboo branches were used to support the individual plants. Green chili harvesting starts in the first week of April and continues up to June. Acaricide was applied to control mite infestation. Growth characteristics yield and yield contributing characters, the incidence of disease, Insect pest data were recorded. The experimental data were analyzed by using Statix 10 computer package program and the analysis of variance was separated for significant difference by LSD at 5%level of probality.

Results and Discussion

Plant height differed significantly among the treatments. Plant height ranged from 53 cm to 72.66 cm. The tallest plant (72.66 cm) was recorded in T_6 while the shortest plant (53 cm) was recorded in T_1. Plant spreading in both directions was found significant. Plants spreads maximum (75.33 × 68 cm) at T_6 but minimum (66.66 × 57.33 cm) at T_1. The number of primary branches was maximum (2.66) in T_6. Stem diameter was statistically similar to the treatments. Maximum stem diameter (3.29 cm) was found in T_5 followed by T_6 (3.28 cm) while the lowest (2.11 cm) was in T_1 (Table 1).

Table1. Effect of Organic Manure on growth characteristics of Naga chili

Treatments	Plant height (cm)	Spreading		Primary branches (nos)	Stem diameter (cm)
		E-W (cm)	N-S (cm)		
T_1	53.00 c	63.66 c	57.33 b	2.00 a	2.11 c
T_2	63.33 b	72.00 ab	62.33 ab	2.00 a	2.87 ab
T_3	66.66 ab	66.33 bc	61.33 ab	2.33 a	2.95 ab
T_4	66.00 b	71.33 ab	63.00 ab	2.00 a	2.62 bc
T_5	62.33 b	66.00 bc	68.66 a	2.33 a	3.29 a
T_6	72.66 a	75.33 a	68.00 ab	2.66 a	3.28 a
Level of significance	**	**	**	**	**
CV (%)	3.36	3.37	6.14	19.56	6.37

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test. T_1 = Native nutrients, T_2 = Poultry manure (1.5 t ha^{-1}), T_3 = Vermicompost (2.5 t ha^{-1}), T_4 = Mustard oil cake (10 t ha^{-1}), T_5 = Cow dung compost (15 t ha^{-1}), T_6 = Farmers practice.

Results showed significant variation between fruit yield, and yield contributing characteristics. Both fruit length (5.18 cm) and breadth (2.93 cm) were found maximum in T_6. Contrary treatments T_1 produced shortest leaf. Fruits plants^{-1} varied from 65 to 159. Profuse bearing (159 number plants^{-1}) was noticed in T_6. On the other hand; T_1 bears the least number (65 numbers plants^{-1}). Individual fruit weight was maximum (5.14 g) was noted in T_6 but thinnest fruit (4.31 g) in T_1. The maximum yield plant^{-1} (817.83 g) was obtained in T_6 but the lowest yield (281.57 g) was obtained in T_1. So T_6 produced maximum yield (6.18 t ha^{-1}) while T_1 produced the lowest yield (2.83 t ha^{-1}). Results revealed that treatment T_6 produced maximum yield (8.24 t ha^{-1}) in the case of farmers practice on Naga chili, which influences the plant to maximize yield (Table 2).

Table2. Effect of Organic Manure on yield contributing characteristics of Naga chili

Treatment	Fruit length (cm)	Fruit breadth (cm)	Fruits plant^{-1} (no)	Fruit weight (g)	Yield (g plant^{-1})	Yield (t ha^{-1})
T_1	3.30 c	1.90 d	65.33 f	4.31 e	281.57 e	2.83 e
T_2	4.30 b	2.36 b	81.67 d	4.65 c	379.72 cd	3.82 cd
T_3	4.13 b	2.26 bc	102.00 b	4.53 d	462.42 b	4.66 b
T_4	4.36 b	2.23 bc	76.67 e	4.83 b	370.28 d	3.73 d
T_5	4.22 b	2.10 c	86.33 c	4.50 d	388.78 c	3.92 c
T_6	5.18 a	2.93 a	159.00 a	5.14 a	817.83 a	8.24 a
Level of significance	**	**	**	**	**	**
CV (%)	4.08	2.63	1.40	0.81	1.26	1.26

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test. T_1 = Native nutrients, T_2 = Poultry manure (5 t ha^{-1}), T_3 = Vermicompost (3 t ha^{-1}), T_4 = Mustard oil cake (4 t ha^{-1}), T_5 = Cow dung compost (15 t ha^{-1}), T_6 = Farmers practice.

Cultivation of Naga chili with varied organic fertilizer showed varied monetary return. The highest gross return, gross margin, and BCR were recorded from T_6 (1.76) (Table 3).

Table3. Cost-benefit analysis of Naga chili production under different organic manure

Treatments	Gross return (TK)	Total cost (TK)	Gross margin (TK)	BCR
T_1	494116 f	265000	229116 e	0.86 d
T_2	617645 d	280000	337645 c	1.20 c
T_3	771426 b	302500	468926 b	1.55 b
T_4	579830 e	315000	264830 d	0.840 d
T_5	652939 c	365000	287939 d	0.78 d
T_6	1202517 a	435420	767097 a	1.76 a
Level of significance	**	**	**	**
CV (%)	1.40		2.56	2.60

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test. T_1 = Native nutrients, T_2 = Poultry manure (1.5 t ha^{-1}), T_3 = Vermicompost (2.5 t ha^{-1}), T_4 = Mustard oil cake (10 t ha^{-1}), T_5 = Cow dung compost (15 t ha^{-1}), T_6 = Farmers practice.

Conclusion

Considering all the parameters it can be concluded that Farmers practice that means use of inorganic fertilizer has a significant effect on Naga chili and it maximize its yield compared to other organic fertilizer. The study revealed that inorganic fertilizer performs best. The study should be repeated in next year for further confirmation.

Acknowledgement

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EFFECT OF LIME ON THE GROWTH AND YIELD OF NAGA CHILI

F. AHMED, M.H.M.B. BHUYAN, J.C. SARKER AND S.M.L. RAHMAN

Abstract

The experiment was conducted at spices Research Sub-Station, Citrus Research Station, BARI, jaintapur, Sylhet during the period from February 2022 to April 2022 to determine the effect of lime for Naga chili production under acidic soil of north eastern region of Bangladesh. The experiment was laid out in randomized complete block design with three replications. Six different levels of lime were used as treatments viz.0, 2.0, 2.5, 3.0, 3.5 and 4.0 t/ha. There were significant variations among all the treatments. Among the treatments maximum plant height (81.00 cm), Maximum plant canopy (84×77 cm), Thickest stem (3.20 cm), heaviest fruit (5.31g), Maximum fruits/ plant (158 nos.) recorded at T_2. On the other hand treatment T_1 recorded least amount in all the parameters. That's why treatment T_2 obtained maximum yield (8.48 t ha^{-1}) but treatment T_1 obtained lowest yield 3.47 t ha^{-1}). The highest gross return, gross margin and BCR was recorded from T_2 =2.0 t ha^{-1}. The results obtained from the study showed that lime has great effect to increase the yield of Naga chili.

Introduction

Naga chili popularly known as Naga morich is the hottest chilly in the world. Naga chili is cultivated due to its extraordinary pungency level. The cultivation of Naga chili in our country is relatively low than other countries. Most of the agricultural soils of Sylhet region are acidic in nature with pH value of 4.9-6.1 (Hossain and Sattar, 2002). Dolomitic lime is calcium containing inorganic mineral increases the pH of acidic soil and improves water penetration. It also improves the uptake of major plants nutrients growing on acid soil. Soil with extreme low pH may need liming for having a good yield. On the other hand, too much addition of lime can decrease the availability of micronutrients, especially Fe, Mn, Zn and Cu sufficiently to cause deficiencies of those plant nutrients (Haynes, 1982). Also, over dose of lime application makes insoluble form of phosphate combined with Ca and Mg (Westermann, 1992; Murphy and Sims, 2012). A judicious application of lime and fertilizer may help to overcome this problem of soil acidity. Determination of an accurate lime requirement for an acid soil is important to bring soil pH in suitable range for facilitating nutrient availability to plants and thereby encourage proper growth and yield of crops. So the present investigation was undertaken to find out influence of lime on growth and yield of Naga chili.

Materials and Methods

The experiment was conducted at Spices Research Sub-station, Citrus research station, Bangladesh Agricultural Research Institute (BARI), Jaintiapur, Sylhet during the period from February 2022 to April 2022. The experimental site belongs to AEZ 22 characterized by extremely acidic (pH 4.5-4.8) in nature and heavy rainfall during Kharif season. The experiment was laid out in Randomized Complete Block Design with three replications. The experiment consists of six different levels of lime used as treatments viz. T_1=0 t ha^{-1}, T_2= 2.0 t ha^{-1}, T_3= 2.5 t ha^{-1}, T_4= 3.0 t ha^{-1}, T_5= 3.5 t ha^{-1}, T_6 = 4.0 t ha^{-1} respectively. The local lines of Naga chili were used in this experiment. The experimental field was prepared by ploughing and laddering. The entire experimental field was divided into three blocks and each block contains six units' plots. Totally there were 18 individual plots. The treatments were randomly set in each plot. The unit plots were 3.9m×1.7m in size having 0.5m drain between the blocks and plots. 50 days old seedlings were planted in the main field maintaining 100×60 cm spacing. After final land preparation dolomitic lime was applied according to the treatments in each plot and left for seven days for mixing in the soil. Other fertilizers were also applied as per requirements. Full dose of Cow dung, TSP, Zinc and Boron were applied at final land preparation. Urea and MoP were applied in two equal splits. Half at basal dose and another half are at top dressed. The whole field including each plot was covered with blue colored net to control insect pest to keep the plants free of artificial pollination. Irrigation, Weeding and other inter cultural operation were done when necessary. Bamboo branches were used to support the individual plants. Green chili harvesting starts at first week of April and continues upto June. Miticide was applied to control mite infestation. Growth characteristics yield and yield contributing characters, incidence of disease, Insect pest data was recorded. The experimental data was analyzed using Statix 10 computer package program and the analysis of variance was separated for significant difference by LSD at 5%level of probality.

Results and Discussions

The pH of the experimental plots were measured before and after liming. The results showed that the initial pH of the experimental plots ranged from 4.07 to 4.90. After 15 days the soil pH increased (Table 1).

Table1. Effect of lime on Soil pH of Naga chili

Treatments	Soil pH before liming	Soil pH after liming
T_1	4.74 ab	5.17 f
T_2	4.90 a	5.37 d
T_3	4.07 c	5.59 c
T_4	4.17 c	5.89 e
T_5	4.23 c	6.07 b
T_6	4.51 b	6.25 a

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test. .T_1=0 t ha^{-1}, T_2= 2.0 t ha^{-1}, T_3= 2.5 t ha^{-1}, T_4= 3.0 t ha^{-1}, T_5= 3.5 t ha^{-1}, T_6= 4.0 t ha^{-1}

Results showed that there were significant differences among the treatments regarding plant height. Treatment T_2 recorded maximum plant height (81 cm) but treatment T_1 produced shortest plant (67.66 cm). Maximum plant canopy (84 cm × 77 cm) was recorded at T_2 whereas treatment T_1 produced lowest spreading (55 cm × 55 cm). All the treatments recorded same number of primary branches. Thickest stem (3.20 cm) was noted at T_2 while thinnest (1.69 cm) at T_2 Table 2.

Table2. Effect of lime on growth characteristics of Naga chili

Treatments	Plant height	Spreading (cm)		Primary branches	Stem diameter
	(cm)	E-W	N-S	(no)	(cm)
T_1	67.66 c	55.66 c	55.33 c	2.00 a	1.69 c
T_2	81.00 a	84.00 a	77.66 a	2.33 a	3.20 a
T_3	78.33 ab	74.66 b	69.33 b	2.33 a	2.54 b
T_4	79.33 ab	74.00 b	70.33 b	2.00 a	2.45 b
T_5	69.66 bc	73.00 b	70.33 b	2.00 a	2.29 b
T_6	77.00 abc	74.33 b	70.00 b	2.00 a	2.45 b
Level of significance	**	**	**	**	**
CV (%)	4.93	2.97	2.05	14.12	6.06

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test. . T_1=0 t ha^{-1}, T_2= 2.0 t ha^{-1}, T_3= 2.5 t ha^{-1}, T_4= 3.0 t ha^{-1}, T_5= 3.5 t ha^{-1}, T_6= 4.0 t ha^{-1}

Table3. Effect of lime yield contributing characteristics of Naga chili

Treatments	Fruit length (cm)	Fruit breadth (cm)	Fruits $plant^{-1}$ (No)	Fruit weight (g)	Yield $plant^{-1}$ (g)	Yield (t ha^{-1})
T_1	3.10 d	1.90 d	80.00 f	4.30 e	344.29 f	3.47 f
T_2	4.70 a	2.36 a	158.33 a	5.31 a	841.27 a	8.48 a
T_3	4.13 ab	2.26 ab	150.00 b	4.68 c	702.51 c	7.08 c
T_4	4.36 ab	2.23 abc	143.00 c	5.11 b	730.70 b	7.36 b
T_5	3.53 cd	2.10 c	137.67 d	4.50 d	619.53 d	6.24 d
T_6	3.90 bc	2.16 bc	134.33 e	4.47 d	601.31 e	6.06 e
Level of significance	**	**	**	**	**	**
CV (%)	5.30	2.33	0.86	0.69	0.99	0.99

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test. T_1=0 t/ha, T_2= 2.0 t/ha, T_3= 2.5 t/ha, T_4= 3.0 t/ha, T_5= 3.5 t/ha, T_6= 4.0 t/ha.

Significant variation on fruit length among the treatments was recorded. Maximum fruit length (4.70 cm) was found from T_2 but shortest fruit (3.10 cm) was found from T_1. Fruit breadth also varied significantly among the treatments. Maximum fruit breath (2.36 cm) was recorded at T_2 which is statistically similar with T_3 and T_4. Maximum fruits $plant^{-1}$ (158 nos.) were found from T_2.On the contrary T_1 recorded lowest fruits/plant (80 nos.). Heaviest fruits (5.31g) were found from T_2. On the other hand treatments T_1 recorded thinnest fruit

(4.30 g). Yield/plant also differed significantly among the treatments. One plant maximum yielded (841.27 g) at T_2 while T_1 recorded lowest yield/plant (344.29 g). There is a significant variation among the treatments on yield of Naga chili grown at different doses of lime application. Plants yield ranges from 3.47 t ha^{-1} to 8.48 t hav. Treatments T_2 produced highest yield (8.48 t ha^{-1}) but T_1 produced lowest yield (3.47 t ha^{-1}) Table 3.

Cost benefit analysis

Cultivation of Naga chili with lime showed higher monetary return than no usage. The highest gross return, gross margin and BCR was recorded from T_2 =2.0 t/ha. On the other hand the lowest gross return, gross margin and BCR was recorded from T_1=0 t/ha in 2022.

Table4. Cost-benefit analysis of Naga chili production using different doses of lime

Treatments	Gross return (TK)	Total cost (TK)	Gross margin (TK)	BCR
T_1	605040 f	314000	291040 f	0.92 e
T_2	1197475 a	414000	783475 a	1.89 a
T_3	1134450 b	439000	695450 b	1.58 b
T_4	1081509 c	464000	617509 c	1.33 c
T_5	1041173 d	489000	552173 d	1.12 d
T_6	1015963 e	514000	501963 e	0.97 e
Level of significance	**	**	**	**
CV (%)	0.86		1.52	1.62

In a column means followed by common letters are not significantly different from each other at 5 % level of probability by Tukey's HSD test. . T_1=0 t ha^{-1}, T_2= 2.0 t ha^{-1}, T_3= 2.5 t ha^{-1}, T_4= 3.0 t ha^{-1}, T_5= 3.5 t ha^{-1}, T_6= 4.0 t ha^{-1}

Conclusion

Considering all the parameters it can be concluded that lime has significant effect on Naga chili and it increases its yield than no use. The study revealed that (2.0 t ha^{-1}) lime performs best at Spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet. The study should be repeated in next year for final confirmation.

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CONTROLLING DISEASE AND PEST FOR SAFE NAGA CHILI PRODUCTION

M.H.M.B. BHUYAN, M.M. RAHMAN, F. AHMED, J.C. SARKER AND S.M.L. RAHMAN

Abstract

The experiment was conducted at Spices Research Sub-station, Citrus research station, Bangladesh Agricultural Research Institute (BARI), Jaintiapur, Sylhet during the period from January 2022 to May 2022. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The experiment consists of five different treatments; T_1=Control (Spraying only water), T_2=Farmers practice (Spraying chemical pesticides), T_3=Mahogany seed extract spray, T_4=Garlic extract spray, T_5=Neem oils spray. The results illustrated that there were significant differences among the treatments. Maximum total number of fruit (191.33), maximum number of marketable fruit (180.10) and marketable yield (14.23 t ha^{-1}) was produced from T_2. The botanicals also performed better regarding number of marketable fruits per plant, and marketable fruit yield. Among the botanical treatments T_5 (neem oil) performed better regarding individual fruit weight (4.5 g), number of marketable fruit (170.33) and marketable yield (13.03 t ha^{-1}).

Introduction

The Naga chili (*Capsicum chinense* Jacq.), also known as Naga Morich in Sylhet is a chili pepper grown in Northeast India and Bangladesh. The Naga chili has many similarities to Bhut Jolokia, but is genetically different. It is also one of the hottest known chilli peppers and the only naturally occurring chili pepper that measures 1 million SHU on Scoville scale. This chili id very much popular to the people of Sylhet and now it is gaining popularity to the urban community. Many fast food shops are now selling Naga burger and Naga sharma to the consumers, where Naga chili is used raw. As a result the demand of this chili is increasing day by day. Naga Chili is very much prune to different insect pests, mites and diseases. The losses caused by insects pest and diseases are a severe problem to higher production. Hence farmers are using chemical pesticides which are causing health hazards to human as the chili is mainly consumed as raw. On the other hand Eco friendly pest management, such as the use of botanical extracts, offers an excellent opportunity to reducing the harmful effects of chemical pesticides, saving beneficial soil microorganisms as well as are a promising source for safe Naga chili production, together with controlling human health hazards (Rahman et al., 2021). Alternatively, the use of botanical are cost effective and available to farmers on time. thus become the most rewarding in our existing socio economic conditions and an ecological threat. Therefore, considering the above circumstances, the study has been taken to find out suitable botanical product(s) for sustainable Naga chili production in Bangladesh.

Materials and Methods

The experiment was conducted at Spices Research Sub-station, Citrus research station, Bangladesh Agricultural Research Institute (BARI), Jaintiapur, Sylhet during the period from January 2022 to May 2022. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The experiment consists of five different treatments; T_1=Control (Spraying only water), T_2=Farmers practice (Spraying chemical pesticides), T_3=Mahogany seed extract spray, T_4=Garlic extract spray, T_5=Neem oils spray. A local lines of Naga chili was used as the experimental material. The experimental field was prepared by ploughing and laddering. The entire experimental field was divided into three blocks and each block contains five unit plots. Totally there were 15 individual plots. The treatments were randomly set in each plot. The unit plots were 2.2×1 m in size having 0.5m drain inbetween the blocks and plots. 35 days old seedlings were planted in the main field maintaining 100×60 cm spacing. 15 days before final land preparation dolomitic lime (4 kg decimel^{-1}) was applied and left for proper mixing to the soil. Fertilizers were applied as per FRG. Irrigation, weeding and other inter cultural operation were done when necessary. Bamboo sticks were used to support individual plants. Green chili harvesting starts after 85 DAT and continues upto June. Data were recorded on plant height (cm), stem diameter (cm), canopy spreading (cm), number of primary branches, number of infested leaves, number of infested twigs, number of infested fruits, total nuber of fruits, number of marketable fruits, individual fruit weight (g), and yield (t ha^{-1}). The data recorded was analyzed using Statix 10 computer package program and the means were separated for interpretation of the results (Gomez and Gomez 1984).

Result and Discussion

The results illustrated that there were significant differences among the treatments (Table 1). Maximum plant height was found from T_2 (83.33 cm) followed by T_5 (82.33 cm), while T_1 produced shortest plant (43.00 cm). Maximum canopy spreading was also found from T_2 (72.00×69.33 cm), while the lowest was from T_1 (53.66×57.33 cm). Stem diameter was also maximum im T_2 (2.33 cm) but number of primary branches was recorded highest in T5 (2.89) which was statistically similar to T_2 (2.87).

Table 1. Effect of different organic plant extracts on growth characteristics of Naga chili

Treatments	Plant height (cm)	Spreading		Primary branches (no.)	Stem diameter (cm)
		E-W (cm)	N-S (cm)		
T_1	43.00 c	53.66 c	57.33 c	2.00 b	2.11 c
T_2	83.33 a	72.00 a	69.33 a	2.33 a	2.87 a
T_3	76.66 b	61.33 bc	61.33 b	2.01 b	2.65 b
T_4	76.00 b	64.33 bc	63.00 b	2.00 b	2.62 b
T_5	82.33 a	66.00 b	68.66 a	2.23 a	2.89 a
Level of significance	**	**	**	NS	**
CV (%)	3.56	3.77	6.84	9.36	6.97

Legends: T_1=Control, T_2=Farmers practice, T_3=Mahogany seed extract, T_4=Garlic extract, T_5=Neem oil

Ther were differences among the number of infested leaf, twigs also (Table 2), where lowest number of infested leaves were found from T_2 (15.47), followed by T_5 (20.78), where as the maximum was found from T_1 (35.56). Similarly the lowest number of infested twigs as well as fruits were found from T_2 (3.78 and 11.23 respectively) followed by T_5 (4.45 and 15.65 respectively), wher as the maximum twig and fruit infestation was found from T_1 (7.67 and 25.43 respectively).

Table 2. Effect of different organic plant extracts on number of infested leaf, twigs and fruits of Naga chili

Treatments	Infested leaves (No.)	Infested twigs (No.)	Infested fruits (No.)
T_1	35.56 a	7.67 a	25.43 a
T_2	15.47 d	3.78 c	11.23 d
T_3	26.78 b	6.89 b	19.79 b
T_4	26.67 b	6.32 b	18.67 b
T_5	20.78 c	4.45 c	15.65 c
Level of significance	**	**	**
CV (%)	5.78	2.98	5.78

Legends: T_1=Control, T_2=Farmers practice, T_3=Mahogany seed extract, T_4=Garlic extract, T_5=Neem oil

From the result it was observed that maximum total number of fruit was produced from T_2 (191.33) probably due to less infestation of diseases, insects and mites, which facilitates more fruit setting. While the lowest number of fruit was found from T_1 (158.01). The botanicals also performed better regarding number of fruits per plant. In a similar way maximum number of marketable fruit was found from T_2 (180.10) followed by T_5 (170.35). As a result marketable yield was also maximum in T_2 (14.23 t ha^{-1}). Among the botanical treatments T_5 (neem oil) performed better regarding individual fruit weight, number of marketable fruit and marketable yield.

Table 3. Effect of different organic plant extracts on yield of Naga chili

Treatments	Total fruits (No.)	Marketable fruits (No.)	Fruit weight (g)	Marketable yield (t ha^{-1})
T_1	158.01 d	132.57 d	3.91 d	8.81 e
T_2	191.33 a	180.10 a	4.65 a	14.23 a
T_3	179.23 c	159.21 c	4.53 b	12.26 c
T_4	177.33 c	158.66 c	4.43 c	11.94 d
T_5	186.21 b	170.35 b	4.50 b	13.03 b
Level of significance	**	**	**	**
CV (%)	6.36	5.78	8.35	3.90

Legends: T_1=Control, T_2=Farmers practice, T_3=Mahogany seed extract, T_4=Garlic extract, T_5=Neem oil

Conclusion

This is the first year study. The experiment should be repeated for further confirmation of the results.

Aknowledgement

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EVALUATION OF COFFEA IN NORTH-EASTERN HILLY REGION OF BANGLADESH

J.C. SARKER, F. AHMED, M.H.M.B. BHUYAN AND S.M.L. RAHMAN

Abstract

Evaluation of coffee genotypes was conducted at Citrus Research Station, Jaintapur, Sylhet to study their performance. Among the three genotypes, the maximum tree height was recorded in CA Jai-002 (1.50 m) whereas, minimum reported in CA Jai-001 (1.41 m). Similarly, maximum stem girth was reported in CA Jai-003 (7 cm) while the minimum reported in AO Jai-001 (6.33 cm). The maximum canopy spread in the east-west as well as north-south direction was furthermore reported in CA Jai-001 (67.67 and 63.67 cm respectively).

Introduction

In Coffea genus, only *C. arabica* (arabica coffee) and *C. canephora* (robusta coffee) are economically important worldwide. These species have been cultivated in open fields in many tropical countries worldwide despite their origin in shaded habitats (DaMATTA, 2004). In the main Brazilian area producing robusta coffee (Espírito Santo state) and Ethiopia is the primary center of origin and diversification for Arabica coffee. Commercial coffee production relies only on two species, C. arabica L. and C. canephora contributing 60% and 40%, respectively of the global market. However, the productivity of existing coffea plantation is very poor (Saroj et al. 2014). Collection of raw coffee from forest plantations and farmers' fields is an important source of livelihood in the area. However, coffee productivity persists to be low due to lack of new high yielding varieties for commercial cultivation. Low production and productivity issues can be effectively resolved by planting superior coffee varieties with high yield potential in the region. The present study was aimed to identify the superlative coffee genotypes suitable for commercial cultivation in north-eastern hilly region of Bangladesh.

Materials and Methods

The experiment was conducted at Citrus Research Station, Bangladesh Agricultural Research Institute, Jaintapur, Sylhet. During 2021-22. The experiment comprised of three coffea spp. i.e, CA Jai-001, CA Jai-002 and CA Jai-003 collected from different area of Bangladesh. The plants were planted during the year 2019 at a spacing of 5mx5m using Randomized Block Design (RBD) with four plants/treatment replicated three times. The experimental site is located at 36m above sea level, with coordinates of 25°13562' N latitude and 92°13217' E longitude. The average annual rainfall in is 3500-6000 mm, with more than 80% of it falling between June and July. The soil at the experimental site was a sandy loam texture soil with a pH of 4.8, 1.28% organic carbon. A common application of manures and fertilizers i.e. 30 kg farm yard manure, 1000g N, 250g P_2O_5 and 250 g K_2O per tree were applied in two equal splits, i.e. first in the first fortnight of June and second in the first fortnight of October. Observations on tree height (m), stem girth (cm), canopy spread (m), were recorded following experimental manual and used for analysis. Data collected on different parameters were analyzed by MSTAT-C program and means were separated following DMRT for further interpretation.

Results and Discussion

Coffee genotypes differed significantly in terms of growth characteristics (Table 1). Among the three genotypes, the maximum tree height was recorded in CA Jai-002 (1.50 m) whereas, minimum reported in CA Jai-001 (1.41 m). Similarly, maximum stem girth was reported in CA Jai-003 (7 cm) while the minimum reported in AO Jai-001 (6.33 cm). The maximum canopy spread in the east-west as well as north-south direction was furthermore reported in CA Jai-001 (67.67 and 63.67 cm respectively).

Table 1. Growth traits of coffea spp. genotypes

Accession	Tree height (m)	Stem girth (cm)	Canopy spreading (cm)	
			E-W	N-S
CA Jai-001	1.41	6.33	67.67	63.67
CA Jai-002	1.50	6.66	72	56.67
CA Jai-003	1.47	7.00	39.37	62
CV (%)	3.14	5.03	29.69	6.02
SD (0.05)	0.05	0.34	17.72	3.66

Conclusion

The plants are at vegetative stage and the growth is satisfactory. Final conclusion can be made after 3-5 years of fruit quality evaluation.

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EVALUATION OF CASHEW NUT GENOTYPES IN NORTH-EASTERN HILLY REGION OF BANGLADESH

J.C. SARKER, F. AHMED, M.H.M.B. BHUYAN AND S.M.L. RAHMAN

Abstract

An experiment was conducted to find out the promising genotype for commercial cultivation in the region. All the genotypes differed in their growth characters. Among the five genotypes, the maximum tree height was recorded in AO Jai-003 (2.08 m) whereas, minimum tree height was reported in AO Jai-004 (1.49 m). Similarly, maximum stem girth was reported in AO Jai-003 (13 cm) while the minimum reported in AO Jai-001 (10.33 cm). The maximum canopy spread in the east-west as well as north-south direction was furthermore reported in AO Jai-005 (85.67 and 83 cm respectively).

Introduction

Cashew (*Anacardium occidentale* L.) belonging to Anacardiaceae is a significant crop for many marginal and small farmers in Bangladesh's tribal areas. Cashew is known as the "gold mine of the wasteland" because it is a resilient, drought-tolerant tree that thrives on nutrient constraints soils (Ramteke et al. 2020). Cashew nuts are now positioned as one of the main cash crops, competing strongly with groundnuts and cotton in Senegal. It has enabled a growing number of households to have additional income during the dry season from production activities but also from artisanal processing, especially for women. Though, India ranks 1st in production, processing and export of kernels in the world, however, the productivity of existing cashew plantation is very poor (Saroj et al. 2014). Collection of raw cashews from forest plantations and farmers' fields is an important source of livelihood in the area. However, cashew productivity persists to be low due to lack of new high yielding varieties for commercial cultivation. Low production and productivity issues can be effectively resolved by planting superior cashew varieties with high yield potential in the region. The present study was aimed to identify the superlative cashew genotypes suitable for commercial cultivation in north-eastern hilly region of Bangladesh.

Materials and Methods

The experiment was conducted at Citrus Research Station, Bangladesh Agricultural Research Institute, Jaintapur, Sylhet during 2021-22. The experiment comprised of five genotypes, i.e, AO Jai-001, AO Jai-002, AO Jai-003, AO Jai-004, AO Jai-005 collected from different area of Bangladesh. The plants were planted during the year 2019 at a spacing of 5mx5m using Randomized Block Design (RBD) with four plants/treatment replicated three times. The experimental site is located at 36 m above sea level, with coordinates of 25°13562' N latitude and 92°13217' E longitude. The average annual rainfall in is

3500-6000 mm, with more than 80% of it falling between June and July. The soil at the experimental site was a sandy loam texture soil with a pH of 4.8, 1.28% organic carbon. A common application of manures and fertilizers i.e. 30 kg farm yard manure, 1000g N, 250g P_2O_5 and 250 g K_2O per tree were applied in two equal splits, i.e. first in the first fortnight of June and second in the first fortnight of October. Observations on tree height (m), stem girth (cm), canopy spread (m), were recorded following experimental manual and used for analysis. Data collected on different parameters were analyzed by MSTAT-C program and means were separated following DMRT for further interpretation.

Results and Discussion

Cashew genotypes differed significantly in terms of growth characteristics (Table 1). Among the five genotypes, the maximum tree height was recorded in AO Jai-003 (2.08 m) whereas, minimum tree height was reported in AO Jai-004 (1.49 m). Similarly, maximum stem girth was reported in AO Jai-003 (13 cm) while the minimum reported in AO Jai-001 (10.33 cm). The maximum canopy spread in the east-west as well as north-south direction was furthermore reported in AO Jai-005 (85.67 and 83 cm respectively).

Table 1. Growth traits of cashew genotypes

Accession	Tree height (m)	Stem girth (cm)	Canopy spreading (cm)	
			E-W	N-S
AO Jai-001	1.57	10.33	51	56.33
AO Jai-002	1.64	10	37.4	32.7
AO Jai-003	2.08	13	84.33	25.97
AO Jai-004	1.49	12	81	58.04
AO Jai-005	1.83	11.67	85.67	83
SD	0.24	1.23	22.21	22.71
CV (%)	13.734	10.83	32.72	44.35

Conclusion

The plants are at vegetative stage and the growth is satisfactory. Final conclusion can be made after 3-5 years of fruit quality evaluation.

References

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CONSERVATION OF GERPLASM IN FIELD GENE BANK

J.C. SARKER, F. AHMED, M.H.M.B. BHUYAN AND S.M.L. RAHMAN

Abstract

A total of 631 germplasm including of 37 crops both indigenous and exotic germplasm is maintaining at the field gene bank of Plant Genetic Resources Centre (PGRC), Citrus Research Station, Bangladesh Agricultural Research Institute, Jaintapur. The fruit germplasm are sweet orange, mango, mandarin, litchi, guava, jackfruit, jujube, aonla, bilimbi, bullocks heart etc. The spices crops are black pepper, bay leaf etc. The exotic germplasm are pear, coffee etc. The intercultural practices were done as and when necessary. The field gene bank has been maintained since 2007 and continued for the following years.

Introduction

Field gene bank is used to store and conserve the plant genetic resources of major crop plants and their crop wild relatives. This is a method of planting plants for the conservation of genes in field condition. For this purpose, an ecosystem is created in different environment as an *ex-*

situ conservation. Through this method, one can compare the differences among plants of different species and can study them in detail. It needs more land, adequate soil, weather, etc. Germplasm of important crops are conserved through this method. Field gene bank belongs to *ex-situ* method where genetic variation is maintained away from its original location and samples of a species, subspecies or variety are transferred and conserved as living collections; e.g. cocoa, coconut, oil palm, rubber and many tropical fruits like mango, mangosteen, jackfruit, durian and rambutan. Seeds of some recalcitrant species can only be stored without desiccation for a few days, weeks or months. Even the technology for *in-vitro* conservation of recalcitrant seeds is still being problem with the long regeneration cycle for perennial species (Hawkes, 1982). Some crops are sexually sterile and are dependent on vegetative propagation for survival; examples are yam, taro, cultivated banana, potato, sweet potato, cassava, pineapple and sugarcane. Therefore, the existing germplasm of vegetatively propagated crops are being maintained in field gene bank.

Materials and Methods

The Field Gene Bank of Plant Genetic Resources Centre, CRS, Jaintapur, Sylhet has been established with an aim to conserve vegetatively propagated and recalcitrant seeded plant germplasm. The plants were earthen up after rainy season. Fertilizer was applied by two installments per year following fertilizer recommendation guide (Azad*et al*., 2019) covering before and after rainy season. The plants were watered and weeded as and when necessary. There was no pest and disease infestation during the period. Yam, turmeric, zinger etc. germplasm were harvested in this year and these germplasm have been maintaining at field level. The other germplasm were maintained accordingly.

Results and Discussion

Intercultural operations are regular activities in a field gene bank. These activities have been done in different times of this year for different crops (Table 1 & 2). A total of 631 indigenous and exotic germplasm are conserved at field gene bank.

Table 1. Intercultural operations in field gene bank

Date	**Crop name**	**Intercultural operation**
16/06/2021 to 20/07/2021 and 20/12/2021 to 17/01/2022	Coconut, sweet orange, Mandarin, Guava, Jackfruit, Lemon, Wax jambu, Coffee plant, pummelo, Mango, Litchi etc	Weeding
10/12/2021 to 19/12/2021 and 10/03/2021 to 20/03/2021		Spading and application of fertilizer
06/01/2021	Sweet orange	BARI Malta-1 Seedling transferred to the field
12/04/2021	Sweet orange	Spading and application of fertilizer
17/04/2021	Wax jambu	Weeding
18/04/2021	Pear	Weeding
11/05/2021	Olive	Weeding
06/06/2021	Olive, Rose apple, Coffee plant, Toikor, Jackfruit, Black pepper, Pommelo, Black pepper	Fertilizer application and watering
05/ 07/ 2021	Jackfruit, Black pepper, Pommelo	Weeding
23/01/2022 to 07/03/2022	All germplasm in the field	Weeding
02/04/2022 to 11/04/2022	All citrus germplasm	Weeding

Table 2. List of germplasm maintaining in the field gene bank at PGRC upto June -2021

English name	Scientific name	Acc.	Germ.	English name	Scientific name	Acc.	Germ.
Fruit	**Fruit**						
Olive	*Olea europaea*	195		Burmese grape	*Baccaurea ramiflora*	4	
Bilimbi	*Averrhoa bilimbi*	5		Mandarin	*Citrus reticulata*	57	
Black berry	*Syzygium cumini*	53		Cocunut	*Cocos nucifera*	2	
Cowa	*Garcinia indica*	9		**Sub-Total (A)**		**589**	
Custard apple	*Annona squamosa*	1					
Date palm	*Phoenix sylvestris*	1					
Dillenia	*Dillenia indica*	2		**Spices & Medicinal**			
Elephant's foot apple	*Feronia limonia*	2		Bohera	*Terminalia belerica*	1	
Guava	*Psidium guajava*	36		Chebulic	*Terminalia bellirica*	2	
Hog plum	*Spondias mangifera*	1		Betel leaf	*Piper betle*		
Jackfruit	*Artocarpus heterophyllus*	64		Black pepper	*Piper nigram*	6	
Jujube	*Zizyphus mauritiana*	5		Muhua	*Madhuca longifolia*		
Lemon	*Citrus limon*	1		**Sub-Total (B)**		**9**	
Lime	*Citrus aurantifolia*	2					
Litchi	*Litchi chinensis*	23		**Beverage**			
Mango	*Mangifera indica*	2		Coffee	*Coffea robusta*	20	
Monkey jack	*Artocarpus lactuca*	2		**Sub-Total (C)**		**20**	
Orange	*Citrus sinensis*	92					
Pear	*Pyrus communis*	1		**Wild tree**			
Pummelo	*Citrus grandis*	5		Blackboard Tree	*Alstonia scholaris*	3	
Rose apple	*Syzygium jambos*	4		Lebbek Tree	*Albizia lebbeck*	10	
Sapota	*Achras zapota*	4		**Sub-Total (D)**		**13**	
Star goose berry	*Phyllanthus distichus*	4		**Total (A+B+C+D+E)**		**631**	
Sweet lime	*Citrus limon*	1					
Wax jambu	*Eugenia javanica*	3					
Carambola	*Averrhoa carambola*	10					

Conclusion

A total of 631 germplasm including of 37 crops both indigenous and exotic germplasm in the field gene bank up to April 2022. The field gene bank acts as a reliable source of indigenous and exotic germplasm.

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ACTIVITY # 1: Breeder's propagule production of BARI released crop varieties 2021-2022

A. Breeder's Propagule Production of BARI Released Fruit Varieties 2021-2022

Sl. #	Name of Fruit	Variety	Amount (No.)
1	Litchi	BARI Lichu-2(goottee)	2000
		BARI Lichu-3(goottee)	500
2	Banana	BARI Banana-3 (suckers)	100
3	Guava	BARI Guava-2 (Sapling)	800
4	Mandarin	BARI Mandarin-1 (Sapling)	600
		BARI Mandarin-3 (Sapling)	2500
5	Sweet orange	BARI Malta-1 (Sapling)	200
6	Lemon	BARI Lebu-5 (Sapling)	2500
7	Lime	BARI Kagji lebu-1 (Sapling)	200
8	Pummelo	BARI Pummelo-3 (Sapling)	200
		BARI Pummelo -5 (Sapling)	2100
9	Satkara	BARI Satkara-1 (Sapling)	350
10	Toikar	BARI Toikar-1 (Sapling)	700
	Total		**12750**

B. Breeder's seeds/seedlings Production of BARI Released Vegetable Varieties 2021-2022

Sl. #	Name of Spices	Variety	Amount
1	Brinjal	BARI Begun-10 (Seed)	0.5 Kg
		BARI Begun-10 (Seedlings)	5000
2	Bean	BARI Seem-6 (Seed)	5 Kg
3	Bottle Gourd	BARI Lau-4 (Seed)	1 Kg
	Total		**5000/6.5 Kg**

C. Breeder's seeds/seedlings Production of BARI Released Spices Varieties 2021-2022

Sl. #	Name of Spices	Variety	Amount
1	Eryngium	BARI Bilati dhonia-1 (Seed)	0.2 Kg
2	Onion	BARI Piaz-5 (Seedling)	1000
3	Chilli	BARI Morich-2 (Seedling)	5000
4	Black pepper	BARI Golmorich-1 (Seedling)	5000
	Total		**11000/0.2 Kg**

D. Seedlings Production of other fruit, vegetable and spices 2021-2022

Sl. #	Name of Spices	Variety	Amount
1	Local mandarin	Local	**10950** Used for grafting and planting for mother orchard
2	Pummelo	Local	
3	Rough Lemon	Local	
4	Rongpur lime	Local	
	Seedless lemon	Local	
	Citron	Local	
	Bettal nuts	Local	
	Total		**10950**

ACTIVITY # 2. Technology Transfer activities

Table 1: Sapling distribution of fruits, vegetables and spices at CRS, Jaintapur during 2021-22

Name of fruit/Spices crop	Name of variety	Distribution	Comments
Mandarin	BARI Kamala-1	370	
	BARI Kamala-3	200	
Malta	BARI Malta-1	500	
Pummelo	BARI Batabilebu-3	100	
	BARI Batabilebu-5	400	
Satkara	BARI Satkara-1	200	
Guava	Kazi Peyera	100	
	BARI Peyera 2	350	
Litchi	BARI Lichu-3	200	
Toikor	BARI Toikor-1	20	
Lemon	Seedless	200	
	BARI Lebu-5	500	
	Jara	150	
	Others	160	
Jackfruit	Local	10	
Betel nut	Local	300	
Brinjal	BARI Begun-10	10,000	
Chili	BARI Morich-2	2000	
Black pepper	BARI Golmorich-1	2000	
Total =		**17,760**	

Table 2: Seeds and seedlings distribution under Safe Fruits and Vegetables Production and Promotion of their exports scheme

Sl. no.	Crop	Variety	Amount (no./kg)
1.	Lemon	BARI Lebu-5	500
2.	Lemon	Seedless lemon	3000
3.	Citron	BARI Jara Lebu-1	2000
4.	Guava	BARI Peyera-2	2000
5.	Bottle gourd	BARI Lau-4	2 kg
6.	Hyacinth bean	BARI Seam-6	8 kg
		BARI Seam-9	250 gm
		BARI Seam-10	250 gm
7.	Brinjal	BARI Begun-10	300 gm
8.	Chili	Naga chili	5000
		BARI Chili-2	50 gm
9.	Onion	BARI Piaz-5	5 kg

Table 3: Dissemination of BARI released varieties & technologies at CRS, Jaintapur during 2021-22

A. Training organized by CRS, Jaintapur, Sylhet

Sl. No.	Type	Participants	Number of participants
1.	Farmers' Training	Farmer	180

B. Motivational tour held at CRS, Jaintapur, Sylhet

Sl. no.	Type	Participating Organization	Number of participants
1.	Motivational Tour	Ministry of Agriculture	150
2.	Motivational Tour	Department of Agriculture extension	200
3.	Study Tour	Department of Botany, M.C. College, Sylhet	100

Table 4: Demonstration Plot established

Sl. no.	Crop	Variety	Number of Demonstration plots	Comments
1.	Sweet orange	BARI Malta-1	2	
2.	Pummelo	BARI Batabilebu-5	2	
3.	Lemon	BARI Lebu-5	15	
4.	Lemon	Seedless lemon	30	
5.	Citron	BARI Jara Lebu-1	20	
6.	Guava	BARI Peyera-2	20	
7.	Bottle gourd	BARI Lau-4	18	
	Hyacinth bean	BARI Seam-6	20	
8.		BARI Seam-9	1	
		BARI Seam-10	1	
9.	Brinjal	BARI Begun-10	25	
10.	Chili	Naga chili	2	
11.		BARI Chili-2	2	
12.	Onion	BARI Piaz-5	5	
13.	Coffee	Local	4	
14.	Casewnut	Local	4	
		Total	**171**	

Activity#3. Maintenance of germplasm 2021-2022

A.Maintenance of BARI released fruits and spices varieties 2021-2022

Sl.No.	Name of fruits	Name of variety	Number of plants	Total number of plants
1.	Komala	BARI Komala-1	300	
		BARI Komala-2	10	370
		BARI Komala-3	60	
2.	Malta	BARI Malta-1	100	102
		BARI Malta-2	2	
3.	Satkara	BARI Satkara-1	150	150
4.	Pummelo	BARI Batabilebu-1	10	
		BARI Batabilebu-2	5	
		BARI Batabilebu-3	50	180
		BARI Batabilebu-4	5	
		BARI Batabilebu-5	100	
		BARI Batabilebu-6	10	
5.	Lemon	BARI lebu-1	5	
		BARI lebu-2	5	
		BARI lebu-3	5	220
		BARI lebu-4	5	
		BARI lebu-5	200	
6.	Taikor	BARI Taikor-1	200	200
7.	Black pepper	BARI Golmorich-1	200	200
8.	Mango	BARI Aam-1	15	
		BARI Aam-2	10	
		BARI Aam-3	20	
		BARI Aam-4	15	
		BARI Aam-5	05	
		BARI Aam-6	05	103
		BARI Aam-7	05	
		BARI Aam-8	05	
		BARI Aam-9	05	
		BARI Aam-10	05	
		BARI Aam-11	10	
		BARI Aam-12	03	
9.	Jackfruit	BARI Kanthal-1	10	
		BARI Kanthal-2	05	20
		BARI Kanthal-3	05	
10	Litchi	BARI Lichu-1	05	
		BARI Lichu-2	145	450
		BARI Lichu-3	300	
11.	Guava	BARI Peyara-1	30	
		BARI Peyara-2	500	555
		BARI Peyara-3	20	
		BARI Peyara-4	05	
12.	Banana	BARI Kola-1	25	
		BARI Kola-2	02	37
		BARI Kola-3	05	
		BARI Kola-4	05	
13.	Ber	BARI Kul-1	15	30
		BARI Kul-2	15	
14.	Sapota	BARI Safeda-1	05	10
		BARI Safeda-2	05	
15.	Wax Jambo	BARI Jamrul-1	05	05
		BARI Jamrul-3	02	02
16.	Golden apple	BARI Amra-1	15	15
17.	Coconut	BARI Narikel-1	30	60
		BARI Narikel-2	30	
18.	Karambola	BARI Kamranga-1	20	20
19.	Anola	BARI Aamloki-1	02	02
20.	Longon	BARI Ashfol-1	05	10
		BARI Ashfol-2	05	
21.	Carambola	BARI Kamranga-1	20	20
			Total	2761

B. Maintenance of different fruits, vegetables and spices germplasm 2021-2022

Sl. No.	Name of crop	Name of germplasm/varieties	Number of plants	Total number of plants
1.	Mandarin	Local komala	300	640
		Bhutan Komala	20	
		Indian Komala	20	
		Others (From seed)	300	
2.	Malta	Washington navel	20	92
		Variegated malta	10	
		Valencia Orange	10	
		Decibre	50	
		Thai Malta	2	
3.	Lemon	Karun Zamir	11	608
		Ashkar	12	
		Kata lebu	17	
		Guljara	87	
		Adazamir	54	
		Jara labu	120	
		Pati lebu	12	
		Shashni	15	
		Kagaji Lebu	200	
		Seedless lebu	80	
4.	Sweet orange	Sweet orange	10	
		Trifoliate Orange	03	
5.	Root stock	Rough lemon	100	138
		Tryor citrange	03	
		Rangpur lime	02	
		Cleopatra mandarin	25	
		Kalamonsi	03	
		Citrumelo	02	
6.	Pummelo	Local	100	100
7.	Mango	Langra	10	30
		Mollica	10	
		Komala sinduri	10	
8.	Jackfruit	Local	500	505
		Graftage	05	
9.	Litchi	Mongol bari	100	150
		Local	50	
10.	Banana	Sobri (Local)	20	20
11.	Guava	Sayedi Peyara	02	305
		Poly peyera	03	
		Local	300	
12.	Velvet Apple	Local	15	15
13.	Lukluki	Local	21	21
14.	Rose Apple	Local	26	26
15.	Cowa	Local	56	56
16.	Bel	Local	97	97
17.	Star goose berry	Local	02	02
18.	Lotkon	Local	100	105
		advanced line	05	
19.	Strawberry	Local	20	20
20.	Plum	Local	06	06
21.	Palm	Local	250	250
22.	Indian Dilenia (Chalta)	Local	36	36
23.	Indian Olive	Local	455	455
24.	Jamun	Local	19	19
25.	Rambutan	Local	3	3
26.	Bilimbi	Local	03	03
27.	Ber	Local	23	23
28.	Sapota	Local	35	35
29.	Bullock's heart	Local	25	25
30.	Wax jambu	Local	49	49
31.	Wood apple	Local	20	20
32.	Golden apple	Local	05	05
33.	Khirni	Local	02	02

Sl. No.	Name of crop	Name of germplasm/varieties	Number of plants	Total number of plants
34.	Aonla	Local	04	04
35.	Betel Nut	Local	6000	6000
36.	Pear	Local	02	02
37.	Longan (Ashfal)	Local	09	09
38.	Monkey Jack	Local	08	08
39.	Tamarind	Local	01	01
40.	Star Apple	Local	01	01
41.	Cassia	Local	03	03
42.	Bay Leaf	Local	385	385
43.	Chapalish	Local	01	01
44.	Neem	Local	05	05
45.	Arjun	Local	05	05
46.	Wood Apple	Local	05	05
47.	Agar	Local	250	250
48.	Eucalyptus	Local	05	05
49.	Horitoki	Local	05	05
50.	Bohera	Local	04	04
51.	Debdaru (weeping)	Local	08	110
52.	Dragon fruit	Exotic	50	50
53.	Dayfal	Local	01	01
54.	Bakul	Local	15	15
55.	Coconut	Local	25	25
56.	Black pepper	Local	05	05
57.	Cinnamon	Local	8	8
58.	Cardamom	Local	13	13
59.	All spices	Local	2	2
60.	Cubeb	Local	38	38
61.	Betel leaf	Local	9	9
62.	Chui jhal	Local	6	6
63.	Clove	Local	05	05
64.	Nutmeg	Local	05	05
65.	Curry leaf	Local	05	05
66.	Wild Brinjal	Local	50	50
67.	Bean	Local (7 genotypes)	Seed 1 Kg	Seed 1 Kg
68.	Okra	Local (2 genotypes)	Seed 0.5 Kg	Seed 0.5 Kg
69.	Naga chili	Local	20 (5lines)	20
			Total	**9535**

Appendix I. Meteorological information

Monthly average maximum and minimum temperature and total rainfall during the period from July 2021 to April 2022 at CRS, BARI, Jaintapur, Sylhet

Month	Fortnight	Temperature (°C)			Rainfall (cm)	RH (%)	Dew Point (°C)	Wind Speed ($Km\,h^{-1}$)
		Max.	Min.	Avg.				
July 2021	1st	33	26	29.5	424	84	25	5
	2nd	32	26	29	445	84	25	5
August 2021	1st	32	26	29	388.5	85	25	5
	2nd	32	26	29	421.5	84	25	5
September 2021	1st	32	25	28.5	376.5	85	25	4
	2nd	33	25	29	389.5	89	25	4
October 2021	1st	32	23	27.5	111	80	23	3
	2nd	32	21	26.5	98	80	23	4
November 2021	1st	30	19	24.5	42.5	76	19	2
	2nd	26	15	20.5	37.5	72	19	2
December 2021	1st	26	14	20	7	72	15	2
	2nd	25	12	18.5	5	68	15	2
January 2022	1st	25	13	19	7.5	70	13	3
	2nd	23	14	18.5	6.5	74	13	3
February 2022	1st	28	16	22	14	76	14	4
	2nd	28	17	22.5	11	69	14	4
March 2022	1st	32	20	26	221.5	78	17	5
	2nd	31	21	26	224.5	70	17	5
April 2022	1st	32	22	27	259	80	21	6
	2nd	33	24	28.5	262	84	21	6
Average		**29.85**	**20.25**	**25.05**	**187.6**	**78**	**19.7**	**3.95**

Appendix II. Scientists and Scientific assistants working at CRS, BARI, Jaintapur, Sylhet

A. Scientists

Sl. No.	Name	Designation	Discipline	Remarks
01.	Dr. Shah Md. Luthfur Rahman	PSO	Horticulture	In-charge
02.	Dr. M. H. M. Borhannuddin Bhuyan	SO	Soil Science	
03.	Jhutan Ch. Sarker	SO	Soil Science	
04.	Faisal Ahmed	SO	Agronomy	Farm super

B. Scientific Assistants

Sl. No.	Name	Designation	Posting
01.	Md. Yeakub	Scientific Assistant	Nursery
02.	Abaid ullah	Scientific Assistant	PGRC
03.	Md. Salahuddin Prodhania	Scientific Assistant	Farm Division
04.	Shahadat Hossain	Scientific Assistant	Spices