Sub-Project ID-020

Program Based Research Grant (PBRG)

Sub-project Completion Report

on

Development of Production Package for Export and Processing Potatoes to Sustain Productivity and Food Security in Bangladesh

Sub-project Duration

10th December, 2018 to 2nd December, 2022

Coordinating Organization
Tuber Crops Research Centre
Bangladesh Agricultural Research Institute
Joydebpur, Gazipur-1701

Project Implementation Unit
National Agricultural Technology Program-Phase II Project
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215

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Implementing Organization

Tuber Crops Research Centre
Bangladesh Agricultural Research Institute
Joydebpur, Gazipur-1701

Department of Agronomy
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Giant Agro Processing Limited
Giant Business Tower, Uttara, Dhaka-1230

Quasem Food Products Limited
Baimail, Konabari, Gazipur-1346



Project Implementation Unit
National Agricultural Technology Program-Phase II Project
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Abbreviation and Acronyms

AFE	=	Action for Enterprise
AYT	=	Advenced Yield Trial
BARC	=	Bangladesh Agricultural Research Council
BARI	=	Bangladesh Agricultural Research Institute
CIPC	=	Chlorpropham is Isopropyl-N-(3-Chlorophenyl) Carbamate
CONVEN.	=	Conventional
Co-PI	=	Co-Principal Investigator
^{0}C	=	Degree Celsius
DM	=	Dry Matter
GAPL	=	Giant Agro Processing Limited
GoB	=	Government of Bangladesh
IFAD	=	International Fund for Agricultural Development
LoA	=	Letter of Agreement
NATP	=	National Agricultural Technology Project
PVS	=	Perticipatory Variety Secelction
PYT	=	Preliminary Yield Trial
PI	=	Principal Investigator
PBRG	=	Program Based Research Grant
PIU	=	Project Implementation Unit
QFPL	=	Quasem Food Products Limited
RS	=	Reducing Sugar
RYT	=	Regional Yield Trial
SAU	=	Sher-E-Bangla Agricultural University
SCA	=	Seed Certification Agency
SG	=	Specific Gravity
SYT	=	Secondary Yield Trial
TCRC	=	Tuber Crops Research Centre
TPS	=	True Potato Seed
USG	=	Urea Super Granule
WB	=	World Bank

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Executive Summary

Potato is one of the most important crops of Bangladesh due to its high production, short duration and good nutrition. Now it is the second largest food crop in Bangladesh in respect of total production per year. Its acreage, yield and production are increasing day by day. At present, Bangladesh is the 7th largest potato producing country in the world. But lately, high potato production has become a big headache for the producers, because Bangladesh is unable to utilize all the produced potatoes in time which results price fall in the market. Every year, 3 to 4 million tons of potatoes remain unutilized or being under-utilized resulting heavy loss to the farmers and traders.

Export and processing are two important options for utilization of excess potatoes, but the potato tubers produced in Bangladesh are less demanding in the world market due to their smaller size and lower dry matter content. These undesirable qualities the resultant effects of variety, climate and traditional methods of cultivation. In order to improve these demerits, the tuber qualities must be improved based on the needs of the demanding countries and kinds of the process products.

This project was designed with a view to identifying some means of enhancing need based tuber qualities and its methods of utilization. The activities included 1) variety introduction and selection for immediate use, 2) development of breeding lines and varieties through hybridization for quality variety development suitable for long term use, 3) testing of existing varieties and advanced lines for processing and export qualities, 4) some agronomical studies for production of larger tubers with higher dry matter content, 5) enzymatic and biochemical analysis for testing the quality of the fresh and processed products, 6) the use of sprout suppressant to reduce the storage costs and longtime uninterrupted supply of raw materials to the processing industries, and 7) testing the quality of the commercial products.

The project activities were aimed at some basic studies relating to raw material production, quality study of the products, value addition, value chain development, industry involvement and foreign exchange earnings.

Tuber Crops Research Centre (TCRC), Bangladesh Agricultural Research Institute (BARI) had taken the responsibility of the leading activities as the coordinating body. The component Sher-e-Bangla Agricultural University (SAU) has done some agronomical studies and chemical analysis on processing qualities; Giant Agro Processing Ltd (GAPL) worked on the field production and cost reduction using CIPC at the Giant Agro Cold storage at Thakurgaon; and Quasem Food Products Ltd. (QFPL) studied the quality of the output (dry matter, reducing sugar, French fries and chips).

TCRC had started the project activities in 2018-19, but not in full swing due to the financial constraints. The 2nd year field experiments were set up in time and the other activities were continued as per project upto November, 2021. However, for proper completion of the project activities, TCRC requested for extension of the project for one more year with the existing fund, and accordingly, it was extended up to December, 2022.

The project activities went on in time according to the program, and all activities were completed in time Based on the objectives, we conducted trials on introduction and variety selection, hybridization and clonal selection, and agronomical studies. In total we produced 1255-gram

hybrid TPS through hybridization under extended photoperiod and brick planting method at Joydebpur and Debigonj, followed by 1705 kg seedling tuber production in the next generation. During the total period 123 clones were evaluated and 04 varieties were released out of the locally developed hybrids. From the exotic sources, 125 varieties were evaluated and 05 were released out of those. Moreover, 24, 33, 62 and 54 existing released varieties were re-evaluated in four seasons, and 16, 8, 12 and 13 varieties were identified as suitable for export, chips, French fries and flakes/powder production, respectively.

Among the locations, Thakurgao, Rangpur and Bogura are good places for export potato production; Central region (Faridpur, Sariatpur and Munshigonj) and Jashore are good for French fry and Chips production. November 1 to 30 is the best time for sowing seed for processing or export potatoes. Larger seeds are more suitable for larger tuber production; 65 cm row to row spacing and 20 cm plant to plant spacing are most suitable for quality exportable tuber production.

Application of Urea Super Granule (USG) instead of prilled Urea + Biochar (8 t/ha); K_2SO_4 or KCl and vermi-compost (8 to 12 t/ha); and 42.55 kg P_2O_5 and K_2SO_4 (288.6kg/ha) as a source of potassium instead of KCL were found better for export and processing, but the use of Biochar and Vermi-compost might not be economic due to high cost. Studies conducted at GAPL showed excellent results of tuber storage at 10-12^{0}C instead of 2 to 3^{0}C in the cold storage at Thakurgaon. QFPL did the quality studies (dry matter, reducing sugar and starch) for chips and French fries in all available varieties at Kashempur. In addition to those, all project items were procured by BARI Central Procure Department; Training, workshop and meetings were organized as per program.

Keywords: Potato, export, processing, chips, French fry, CIPC, Biochar, Vermicompost, USG.

PBRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the PBRG sub-project:** Development of Production Package for Export and Processing Potatoes to Sustain Productivity and Food Security in Bangladesh

2. **Implementing organization (s):**

a) Tuber Crops Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur
b) Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka
c) Giant Agro Processing Limited, Giant Business Tower, Uttara, Dhaka
d) Quasem Food Products Limited, Baimail, Konabari, Gazipur

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4. Sub-project budget (Tk.):

4.1 Total: 33983990.00 (Tk. Three crore thirty-nine lakh eighty-three thousand nine hundred ninety)

4.2 Latest Revised: 33983990.00 (Tk. Three crore thirty-nine lakh eighty-three thousand nine hundred ninety)

5. Duration of the sub-project:
5.1 Start date (based on LoA signed): 10th December, 2018
5.2 End date: 2nd December, 2022

6. Background of the sub-project:
Bangladesh is a small country, but holds the 7th position in world potato production (FAOSTAT, 2020). It is an important food crop for Bangladesh because of its high yield, sort duration and good nutrition. Its acreage, yield and production are increasing day by day. But, its high production is becoming a big problem to the farmers of the country due to its low price at the time of harvest. For the last few years more than three million tons of potato remains unsold or under-utilized per year. So farmers face huge loss and get discouraged in potato cultivation. This problem must be solved and potato production has to be increased through proper utilization such as use of potato as a staple food, export of big sized tubers to neighboring countries, and utilization of high dry matter containing tubers in the production of processing items like Chips, French fries, powder, flakes, starch and canned items. Scientists and extension workers tried earlier in different ways to adopt potato as a staple food, but a little were gained. Thus, export and processing might be two best ways for proper utilization of excess potatoes, but again there are some obstacles in those means. The local tubers are small in size and low in dry matter content due to climatic factors and traditional method of cultivation, so don't quite fit for export and processing.

The project was designed with a set of activities to develop new varieties and improved agro-techniques relating to potato production suitable for export and processing. The activities included (1) variety introduction and selection for immediate use, (2) development of breeding lines and new varieties through hybridization suitable for long term use, (3) testing of existing varieties and advanced lines for processing and export qualities, (4) agronomical studies for large tuber production and high accumulation of dry matter in the tubers, (5) enzymatic and biochemical analysis for testing the quality of the exportable tubers and process products, and (6) the use of sprout suppressant to reduce the storage cost and longtime supply of raw materials to the industries.

7. Sub-project general objectives:
a) Development of processing and export quality potato through in-country hybridization and exotic variety selection.
b) To identify suitable locations for the production of export and processing quality potato tubers.
c) To standardize agro-techniques for the production of export and processing quality potato tubers.
d) To minimize the cost of processed products through appropriate storage techniques and use of CIPC (Isopropyl N - (3-chlorophenyl) carbamate).

8. Sub-project specific objectives (component wise):
Component-1 (BARI):
a) To develop breeding lines/varieties through hybridization suitable for export and processing.
b) Introduction and selection of exotic varieties for export and processing purposes.
c) To find out the suitable locations for the production of export and processing quality potatoes.
d) To standardize suitable agro-techniques for the production of export and processing quality potatoes under Bangladesh condition.

Component-2 (SAU):
a) To ascertain the post-harvest qualities of the developed potatoes through chemical and enzymatic tests.

b) To standardize the fertilizer, manure and irrigation doses for the production of export and processing quality potatoes.
c) To identify the best time of planting and harvesting, and optimum seed size and spacing for the production of export and processing quality potatoes.
d) To determine the length of the shelf life of the processed products.

Component-3 (GAPL):
a) To find out the possibility of using CIPC in the cold storage in order to reduce electricity consumption.
b) To find out the best method and duration of storage for quality processed products.
c) To find out the possibility of using cold-stored potatoes for export and processing.

Component-4 (QFPL):
a) To find out the processing qualities of different potato varieties at a commercial scale.
b) To find out the consumer preferences of the processed products of different potato varieties.
c) To find out the commercial values of the processed products of different potato varieties.

9. Implementing locations:
Component-1 (BARI): Barishal, Bogura, Debigonj, Faridpur, Gazipur, Jamalpur, Jessore, Madaripur, Munshigonj, Patuakhali, Rangpur and Thakurgaon. The principal field activities were done at Joydebpur and Debigonj. The other locations were used for multi-location tests and agronomical studies.
Component-2 (SAU): Research field of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.
Component-3 (GAPL): Field production and CIPC application were done in the Giant Agro Cold storage at Thakurgaon
Component-4 (QFPL): Commercial values of the processed products were assessed at Konabari, Gazipur (Quasem Food Products Lab).

10. Methodology in brief (with appropriate pictures):
Component-1 (BARI): Systematic research on potato variety development has been in practice in Bangladesh since 1960 (Rashid et al., 1987), but until 2012 not a single variety was developed in this country through conventional breeding method, mainly due to the short day climatic factors which are not congenial for potato plants to flower. Due to the intensive efforts, TCRC scientists were able to make a breakthrough of these climatic barriers (Rashid et al., 1990). HYV potatoes were made to set flowers and produce berries since the year 2000 (Rashid & Hoque, 2009). Systematic hybridization was started at Joydebpur and Debigonj in 2001 following brick-planting metod under 16-18 hours' photoperiod (Rashid & Hoque, 2009). After hybridization, continuous selection is done for 6-9 years before release of a variety (Kundu et al., 2013). By 2019, 12 varieties were released by TCRC out of locally crossed hybrids. These varieties have low rate of degeneration and less yield reduction in subsequent generations, and so thoseare more stable. On the other hand, introduced varieties come from different climates, so have high degeneration rate and variable yield reduction. But these are good for immediate use, because it takes only 3 to 4 years for release. Under the project activities, the imported varieties were tested at different locations for 3 to 5 years according to some set rules (Kundu et al., 2013; Rashid et al., 1987). By 2019, 79 varieties were released by TCRC from introduced materials (TCRC, 2021-22). These varieties were released mostly based on tuber yield, disease resistance and consumer qualities, but not on export and processing qualities.

Need for export and processing quality potatoes was felt since the beginning of this century. After the year 2010, sincere efforts were given on the development of export and processing quality potato varieties as because Bangladesh was unable to utilize all the produced potatoes. So farmers were facing a big problem in selling their produce (Rabbani et al., 2010). Based on the need of export and processing an important workshop was organized jointly by AFE and TCRC (Hussain, 2012). The workshop came out with several important suggestations, but none was applied completely. Especially for export, no coordinated effort was undertaken. Among the processing units none was following the track except only the Bombey Sweets. In both the cases, most of the export and processing companies were dependent on market available potatoes, which have already made lots of ups and down in export market and processing products.

The Exporters Association, private seed producers and even BADC were asking for new varieties all the time as if variety is the only solution for export and processing in Bangladesh, but in reality, variety has little to do with, because of the climatic limitations under the short day conditions of Bangladesh. Due to the climatic factors and the traditional method of cultivation, Bangladeshi produced tubers are very small, deshaped, scab infected and green and low in drymatter content, and thus unfit for export and processing (Akhter et al., 2012). As the climatic factors are not quite congenial for quality tuber production, both improved varieties and modern method of cultivation have to be applied in order to produce exportable and processing quality tubers (Ahsan et al., 2012; Kundu et al., 2012).

The project was designed to conduct some studies to identify suitable varieties, suitabe location, fertilization, and agro-practices relating to expotable and processing quality tuber production. The study was conducted at the TCRC stations, namely Joydebpur, Bogura, Munshigonj, Jamalpur, Jashore and Debigonj, and some BARI stations of Rangpur, Burirhat, Thakurgonj, Faridpur, Madaripur, Barisal and Patuakhali including some OFRD research sites where ever necessary. Standard experimental procedures including appropriate designs and standard agro-practies were followed according to TCRC recommendations (Kundu et al., 2013; Rashid et al., 1987). At the end of each season the results were analyzed and critically reviewed, and necessary amendments/ modifications were made as per comments/suggestions of the experts. Suitable locations were identified through multi-location trials, PVS trials and on-farm demonstration trials. In search of exportable and processing qualities, 91 released varieties and few advanced lines were tested at ten locations throughout the country in replicated yield trials for export and processing quality. These trials also helped in the identification of suitable locations for processing and export potatoes. To find out the appropriate planting and harvesting time, trials were conducted at Rangpur, Thakurgaon and Barishal. Of all the above trials, tubers for processing and export were tested at TCRC, Joydebpur and Debigonj. Dry matter content and chips quality were also tested at the Bombay Agro Ltd. of Bombay Agro at Debigonj.

Component-2 (SAU): The studies were conducted at the Research Field of Sher-e-Bangla Agricultural University. Standard experimental procedures including appropriate designs (RCBD factorial, Split-plot) were followed under all studies.

Experiment-1 (Yield and Grading of Potato Tuber for Processing Purposeas Affected by Vermicompost and Potassium Sources): The potato variety BARI Alu-25 (Asterix) was used as test crop. The present experiment comprised of two factors viz., Factor A: 3 sources of Potassium; i. K_1: KCl (260 kg KCl ha^{-1} @130 kg K ha^{-1}); ii. K_2: KNO_3 (336.09 kg KNO_3 ha^{-1} @130 kg K ha^{-1}); iii. K_3: K_2SO_4 (309.2 kg K_2SO_4 ha^{-1} @130 kg K ha^{-1}) and Factor B: 4 Levels of vermicompost; i. Vm_0: 0 ton vermicompost ha^{-1}; ii. Vm_1: 4 ton vermicompost ha^{-1}; iii. Vm_2: 8 ton vermicompost ha^{-1}; iii. Vm_2: 8 ton vermicompost ha^{-1}. iv. Vm_3: 12 ton vermicompost ha^{-1}. The experiment was laid out in a

split plot design with three replications. Different sources of potassium were assigned to the main plot and vermicompost level to sub-plot.

Experiment-2 (Influence of nitrogen form and biochar level on the yield and processing quality of potato): The experiment consisted two factors viz., factor A: Nitrogen form (2): Up= Prilled urea and Us= Urea Super Granule; factor B: Biochar Level (6): B_0 = Control, B_1 = 2 t ha^{-1}, B_2 = 4 t ha^{-1}, B_3 = 6 t ha^{-1}, B_4 = 8 t $ha^{-1}$and B_5 = 10 t ha^{-1}. All the fertilizers were applied as per their recommended doses. The experiment was laid out in split-plot design with nitrogen form treatment in the main plot and biochar level in the subplot having 3 replications.

Experiment-3 (Phosphorus dose and potassium source on export and processing quality of Potato): The experiment consisted dose of 4 phosphorus doses (P_1 = 200 kg ha^{-1} TSP @ 42.55 kg ha^{-1} P, P_2 = 220 kg ha^{-1} TSP @ 46.81 kg ha^{-1} P, P_3 = 240 kg ha^{-1} TSP @ 51.06 kg ha^{-1} P and P_4 = 260 kg ha^{-1} TSP @ 55.32 kg ha^{-1} P), and 3 potassium sources (K_1 = KCl (250 kg ha^{-1} KCl @130 kg ha^{-1} K), K_2 = KH_2PO_4 (452.19 kg ha^{-1} KH_2PO_4 @130 kg ha^{-1} K) and K_3 = K_2SO_4 (288.6 kg ha^{-1} K_2SO_4 @130 kg ha^{-1} K). The 2 factorial experiment was arranged in a split-plot design with 3 replications. The phosphorus treatments were assigned in the main plot and sources of potassium in the sub-plot.
Tuber quality analyses (dry matter, starch, reducing sugar, polyphenols, and anti-oxidants) were done at Department of Agronomy, SAU. TCRC also conducted trials on seed size, spacing and fertilizer. Trials were conducted at Joydebpur, Bogura, Rangpur and Thakurgaon.

Component-3 (GAPL): Development of storage techniques for cost reduction using CIPC was done by Giant Agro at the Himadri Cold Storage in Thakurgao (Ahmed et al, 2012). Tubers of different varieties were stored in separate chambers maintaining 2-4^{0}C, 10-12^{0}C and at room temperature. Tuber qualities were tested at every 15 days.

Component-4 (QFPL): Processing quality of the varieties was estimated by Quasem Food Products Limited, Konabari, Gazipur. All the samples were tested for tuber size, shape, color, flesh color, eye depth, mealiness, chips quality and French fry quality. Post-harvest quality (Akhter et al., 2012) of the varieties was done at the respective locations where the trial was conducted.

11. Results and discussion: (with appropriate pictures):

Component-1 (Bangladesh Agricultural Research Institute)

Objective-1: Development ofbreeding lines/varieties through hybridization

11.1. Hybridization and breeding line development (six experiments)

The fundamental principle for crop improvement is the creation of variability mainly by introduction of materials from exotic sources and making hybridization among the available variabilities within the country. In case of potato, materials from exotic sources are not available free of cost. So hybridization is the best option for creating variability, although it takes longer time for selection of a variety. At the TCRC both the metods are being followed. Introduction is being used for sort term and immediate use, while hybridization is done for long term use and permanent solution.

During the four yearsof crop period (1st starting time was late and the 4th year was on extention) both the activities were done separately. Hybridization facilities were developed earlier both at Joydebpur and Debigonj. Selected varieties were planted on bricks under 16 hours extended photoperiod to induce flowering. Potato plants generally do not flower under the climatic conditions of Bangldesh. During the project period 1255g hybrid seeds were produced in 3,156 combinations

(Table 1). Each year hybrid seeds were sown in soil under a net-house after treating with 1500 ppm GA_3. During harvest, one tuber of desirable size, shape and color was collected per plant and bagged separately per cross. In total, 1,705 kg seedling tubers were sampled for following generations. During the next four years 12,607 kg hybrid seeds were selected based on the desirable characters (Table 2).

Table 1. Hybridization and seedling tuber production, 2018-19 to 2021-22

Year	Number of successful crosses	Quantities of hybrid seed obtained	Seedling tubers produced and selected, F_1C_0
2018-19	874	360 g	300 kg
2019-20	914	255 g	400 kg
2020-21	726	275 g	520 kg
2021-22	642	365 g	485 kg
Total	3156	1255 g	1705 kg

Table 2. Clonal selection in subsequent generations (only selected ones; wt. in Kg)

Generation	2018-19	2019-20	2020-21	2021-22	Total (kg)
F_1C_0	230	860	200	-	1290
F_1C_1	196	150	140	350	836
F_1C_2	417	124	320	500	1361
F_1C_3	720	295	1515	315	2845
F_1C_4	-	-	2465	1430	3895
F_1C_5	-	-	-	2380	2380
Total	1563	1429	4640	4975	12,607

1st Year (2018-19)

11.2. PRELIMINARY YIELD TRIAL WITH CLONAL POTATO HYBRIDS (F_1C_5)

Eleven hybrid clones were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady-Rosetta) at Debiganj and Gazipur. Combined analysis was done to see the genotype and location interactions. Significant influence was observed for different environmental factors of different locations on the expression of different characters of the potato hybrids. During final harvest, clone 15.117 gave the highest tuber yield (48.95 t/ha) at Gazipur. Clone 15.36 gave highest average yield (47.47 t/ha). Clone 15.156 gave significantly higher average yield (45.79 t/ha) than the four checks followed by 15.117 (45.14 t/ha), 15.38 (44.87 t/ha), 15.139 (43.93 t/ha), 15.126 (43.66 t/ha) and 15.136 (42.34 t/ha). These seven clones (15.36, 15.117, 15.38, 15.139, 15.126, 15.136 and 15.156) can be selected for their higher tuber yield potentialities. In case of dry matter, the clones 15.156 (21.11%), 15.126 (20.99%) and 15.139 (20.83%) were suitable for processing purpose. No early mature clone was found than the checks BARI Alu-13 (Granola) and BARI Alu-28 (Lady Rosetta). Considering marketable tuber yield, dry matter and tuber characteristics (shape, size, colour, scoring) these seven clones (15.36, 15.117, 15.38, 15.139, 15.126, 15.136 and 15.156) were selected for SYT.

Table 3. Marketable yield (t/ha) of the clones in PYT at different environments, 2018-19

Hybrid clones	Location		
	Debiganj	Gazipur	Mean
15.36	48.64 ab	46.30 cd	47.47 a
15.38	46.84 c	42.89 fg	44.87 bc
15.92	31.43 k	27.99 o	29.71 hi

Hybrid clones	Location		
	Debiganj	Gazipur	Mean
15.112	28.13 no	34.08 j	31.11 fg
15.115	29.48 mn	30.99 kl	30.24 gh
15.117	41.32 hi	48.95 a	45.14 b
15.126	42.42 gh	44.90 de	43.66 d
15.134	28.03 o	34.08 j	31.06 fg
15.136	43.73 efg	40.95 i	42.34 e
15.139	41.25 hi	46.62 c	43.93 cd
15.156	44.21 ef	47.37 bc	45.79 b
BARI Alu-7 (Diamant)	25.71 p	31.97 k	28.84 i
BARI Alu-13 (Granola)	23.59 q	28.13 no	25.86 k
BARI Alu-25 (Asterix)	28.85 mno	33.63 j	31.24 f
BARI Alu-28 (L. Rosetta)	25.73 p	29.88 lm	27.80 j
CV (%)	2.35		

Table 4. Dry matter (%) of the genotypes at different environments, 2018-19

Variety/clone	Location		
	Debiganj	Gazipur	Mean
15.36	19.45 d-i	20.24 cde	19.85 c
15.38	18.80 g-l	20.67 bcd	19.74 c
15.92	18.97 f-k	19.83 d-h	19.40 cd
15.112	17.85 j-m	19.81 d-h	18.83 d
15.115	18.47 i-m	18.82 g-l	18.64 d
15.117	17.27 m	17.73 klm	17.50 e
15.126	20.103 def	21.88 ab	20.99 b
15.134	19.27 e-i	19.61 d-i	19.44 cd
15.136	18.50 i-m	19.99 d-g	19.25 cd
15.139	20.16 def	21.50 abc	20.83 b
15.156	20.65 bcd	21.57 ab	21.11 b
BARI Alu-7 (Diamant)	19.03 e-j	19.70 d-i	19.37 cd
BARI Alu-13 (Granola)	17.74 klm	17.65 lm	17.70 e
BARI Alu-25 (Asterix)	19.94 d-g	18.61 h-l	19.27 cd
BARI Alu-28 (L. Rosetta)	22.82 a	22.00 a	22.41 a
CV (%)	3.91		

11.3. SECONDARY YIELD TRIAL WITH CLONAL POTATO HYBRIDS (F_1C_6)

Six hybrid clones of potato were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) at Debiganj, Gazipur and Jamalpur. Combined analysis was done to see the genotype and location interactions. The significant influence was observed for different environmental factors of different locations on the expression of different characters of potato. The highest average marketable yield (52.54 t/ha) was observed in clone 14.11 followed by clones 14.70 (48.36 t/ha), 14.10 (45.15 t/ha) and 14.44 (44.36 t/ha). Clones 14.11, 14.10, 14.44 and 14.70 were selected for AYT due to their higher tuber yield. Average dry matter percent of 14.70 was 20.51% and found suitable for processing purpose. Clones 14.44 and 14.70 performed better than checks regarding taste, appearance and texture. Considering the marketable tuber yield, dry matter, organoleptic taste and tuber characteristics (shape, size, colour, scoring) these four clones (14.10, 14.11, 14.44 and 14.70) were selected for next year AYT.

Table 5. Marketable Tuber yield (t/ha) at 95 DAP at different environments, 2018-19

Variety	Location			
	Debiganj	Gazipur	Jamalpur	Mean
14.10	43.63 d	43.12 d	48.70 c	45.15 c
14.11	47.73 c	51.72 b	58.16 a	52.54 a
14.12	34.15 ghi	33.87 hi	37.71 ef	35.24 d
14.31	38.44 ef	32.73 ij	32.42 ij	34.53 de
14.44	43.52 d	40.38 e	49.17 bc	44.36 c
14.70	44.06 d	49.61 bc	51.41 b	48.36 b
BARI Alu-7 (Diamant)	25.75 n	29.17 kl	35.99 fgh	30.30 f
BARI Alu-13 (Granola)	26.77 lmn	26.28 mn	32.62 ij	28.55 g
BARI Alu-25 (Asterix)	30.14 jk	32.35 ij	36.79 fg	33.10 e
BARI Alu-28 (L.Rosetta)	28.42 k-n	28.94 klm	32.48 ij	29.94 fg
CV (%)	4.28			

Table 6. Dry matter content (%) of the tubers at different environments, 2018-19

Variety	Location			
	Debiganj	Gazipur	Jamalpur	Mean
14.10	18.45 g-k	19.66 d-h	19.50 e-i	19.21 cde
14.11	19.56 e-i	19.42 e-i	19.67 d-h	19.55 cd
14.12	18.19 ijk	20.59 b-e	21.03 bcd	19.94 bc
14.31	17.79 k	18.42 g-k	18.33 h-k	18.18 f
14.44	18.29 h-k	19.17 f-k	19.15 f-k	18.87 def
14.70	19.80 c-g	20.60 b-e	21.13 bc	20.51 b
BARI Alu-7 (Diamant)	19.72 d-g	19.66 d-h	19.04 f-k	19.47 cd
BARI Alu-13 (Granola)	18.42 g-k	17.89 jk	19.07 f-k	18.46 ef
BARI Alu-25 (Asterix)	19.22 e-j	19.02 f-k	19.94 c-f	19.39 cd
BARI Alu-28 (L.Rosetta)	21.87 ab	21.78 ab	22.75 a	22.13 a
CV (%)	4.33			

Table 7. Grade of tubers (Average of three locations) by weight, 2018-19

Genotypes	% Grade by Weight			
	<28 mm	28-40mm	40-55mm	>55mm
14.10	2.36	21.67	51.67	24.30
14.11	1.99	32.47	48.59	16.95
14.12	4.35	38.55	46.92	10.18
14.31	2.59	23.12	50.79	23.49
14.44	3.90	31.50	52.64	11.96
14.70	2.30	39.75	43.80	14.15
BARI Alu-7 (Diamant)	3.50	38.69	50.45	7.36
BARI Alu-13 (Granola)	5.24	53.88	34.22	6.67
BARI Alu-25 (Asterix)	4.47	31.74	52.94	10.86
BARI Alu-28 (L.Rosetta)	2.86	46.33	37.81	13.00

11.4. ADVANCED YIELD TRIAL WITH CLONAL POTATO HYBRIDS (F_1C_7)

Three 7th generation clonal hybrids of potato were evaluated with three check varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady-Rosetta) at six locations during 2018-

19. Clone 13.7 was selected for RYT due to its higher tuber yield (31.23 t/ha). No early mature clone was found than check BARI Alu-28(Lady-Rosetta). At final harvest, clones 13.7 and 13.17 were selected for RYT due to their higher tuber yield potential (47.75 t/ha) and (44.30 t/ha), respectively. No entry performed better than BARI Alu-28 (Lady-Rosetta) in case of dry matter percent. Therefore, none of the clones were suitable for processing purpose. Clones 13.7 performed best regarding taste, appearance and texture of boiled potato. Clones 13.7 and 13.17 were selected for next year RYT Trial due to their performance regarding marketable tuber yield, organoleptic taste, less disease infection and insect infestation and tuber characteristics (shape, size, colour, scoring) etc.

Table 8. Marketable tuber yield (t/ha) at 95 DAP in different environments, 2018-19

Variety	Location						
	Bogura	Debi	Gazi	Jamal	Jashor	Munshi	Mean
13.7	46.76 d-g	55.61 a	47.69 c-f	50.02 bc	46.88 d-g	39.54 jk	47.75 a
13.17	45.85 e-h	49.16 cd	44.44 ghi	48.66 cde	44.29 ghi	33.40 mn	44.30 b
13.19	43.28 hi	52.55 b	42.01 ij	44.76 f-i	30.68 no	31.36 no	40.77 c
BARI Alu-7 (Diamant)	38.93 k	38.10 k	35.02 lm	37.36 kl	30.97 no	29.68 op	35.01 d
BARI Alu-25 (Asterix)	37.27 kl	42.49 ij	27.21 pq	33.35 mn	33.14 mn	30.98 no	34.07 d
BARI Alu-28 (L.Rosetta)	31.21 no	40.22 jk	23.02 r	30.04 op	23.25 r	24.45 qr	28.70 e
CV(%)	4.73						

Table 9. Dry matter (%) of potato genotypes at different environments, 2018-19

Variety	Location						
	Bogura	Debi	Gazi	Jamal	Jashore	Munshi	Mean
13.7	18.72 h-l	19.78 f-i	20.82 def	20.33 efg	18.62 h-l	19.38 g-j	19.61 b
13.17	18.05 jkl	18.61 h-l	18.72 h-l	19.60 f-i	17.99 jkl	17.57 l	18.42 de
13.19	17.55 l	18.05 jkl	18.63 h-l	18.43 i-l	17.72 kl	18.46 i-l	18.14 e
BARI Alu-7 (Diamant)	18.05 jkl	19.72 f-i	20.45 efg	18.77 h-l	18.73 h-l	19.50 f-i	19.20 bc
BARI Alu-25 (Asterix)	18.05 jkl	19.22 g-j	17.43 l	19.97 e-h	18.55 i-l	19.73 f-i	18.82 cd
BARI Alu-28 (L.Rosetta)	19.05 g-k	21.87 bcd	21.33 cde	22.97 ab	22.34 abc	23.66 a	21.87 a
CV(%)	4.48						

Table 10. Average grade (%) of tubers by weight, 2018-19 (average of six locations)

Genotypes	% of Tuber Grading by Weight			
	<28 mm	28-40mm	40-55mm	>55mm
13.7	4.76	29.20	47.11	18.93
13.17	4.86	30.59	43.57	20.98
13.19	5.08	27.01	49.68	18.23
BARI Alu-7 (Diamant)	5.88	29.21	48.68	16.24
BARI Alu-25 (Asterix)	4.16	29.48	52.09	14.27
BARI Alu-28 (L.Rosetta)	4.56	30.09	52.44	12.91

11.5. PARTICIPATORY VARIETY SELECTION OF ADVANCED CLONAL HYBRIDS

Three clonal hybrids with three check varieties were evaluated at farmer's field under participatory variety selection to understand the performance as well as farmers opinion. In case of average yield of all locations the highest yield (44.34 t/ha) was recorded in 13.7 followed by 13.17 (43.36 t/ha),

and the lowest average yield was found in check variety BARI Alu-28 (Lady Rosetta) (28.95 t/ha). Considering tuber yield, tuber size, shape and colour, farmers of all locations showed their keen interest to the clones 13.7 and 13.17, but varied from location to location. Therefore, these two clones were selected for next generation.

Table 11. Marketable tuber yield (t/ha) of clonal hybrids under PVS at 95 DAP, 2018-19

Variety	Bogura	Debiganj	Gazipur	Jashore	Munshiganj	Mean
13.7	46.50	38.34	52.08	41.81	42.99	44.34
13.17	46.38	40.02	45.24	38.94	46.20	43.36
13.19	42.20	25.09	47.5	29.17	38.53	36.50
BARI Alu-7 (Diamant)	35.87	35.33	36.8	36.97	39.71	36.94
BARI Alu-25 (Asterix)	39.13	35.85	37.69	35.69	40.61	37.79
BARIAlu-28(L.Rosetta)	32.32	31.09	31.46	27.78	22.09	28.95

11.6. REGIONAL YIELD TRIAL OF CLONAL HYBRIDS

Two clonal hybrids of potato namely 12.13 and 12.20 along with three check varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at six agro-ecological locations during 2018-19 cropping season in RYT. Clone 12.13 gave the highest tuber yield (33.68 t/ha) at 65 DAP. No early mature clone was found than check variety BARI Alu-28 (Lady Rosetta). The average yield for the highest was in clone 12.20 (50.19 t/ha) which was statistically similar with clone 12.13 (49.15 t/ha). These two Clones were recommended for release as commercial varieties due to their higher tuber yield. Average dry matter percent of two tested clones were not suitable for processing purpose. Considering tuber yield, organoleptic taste, disease infection, insect infestation and tuber characteristics (shape, size, colour, scoring) these two clones were recommended for release as commercial varieties.

Table 12. Tuber yield of the genotypes in RYT at different locations, 2018-19

Variety	Location						
	Bogura	Debi	Gazi	Jamal	Jashore	Munshi	Mean
12.13	59.13 ab	34.84 k	43.02 efg	60.72 a	40.60 ghi	56.60 bc	49.15 a
12.20	49.07 d	41.43 f-i	56.80 bc	58.00 ab	41.35 f-i	54.50 c	50.19 a
BARI Alu-7 (Diamant)	42.42 f-i	24.68 m	35.96 jk	42.51 fgh	34.68 k	46.02 de	37.71 b
BARI Alu-25 (Asterix)	42.24 f-i	27.99 lm	39.24 hij	44.63 ef	35.35 k	38.95 ij	38.07 b
BARI Alu-28 (L.Rosetta)	36.32 jk	28.52 l	29.56 l	34.96 k	31.15 l	40.65 ghi	33.53 c
CV%	5.10						

Table 13. Dry matter (%) of the genotypes under RYT during 2018-19

Variety\Location	Bogura	Debi	Gazipur	Jamalpur	Jashore	Munshi	Mean
12.13	18.72	17.37	17.09	18.10	18.47	18.78	18.08 c
12.20	20.63	18.38	20.23	19.23	21.59	19.36	19.90 b
BARI Alu-7 (Diamant)	18.80	19.72	19.64	20.07	18.81	19.21	19.38 b
BARI Alu-25 (Asterix)	19.88	19.22	19.30	20.93	20.92	18.65	19.82 b
BARI Alu-28 (L.Rosetta)	21.22	21.87	22.58	23.16	23.26	22.37	22.41 a
CV%	5.49						

Table 14. Average tuber grades (of six locations) by weight under RYT, 2018-19

Genotypes	Tuber Grading by Weight (%)			
	<28 mm	28-40mm	40-55mm	>55mm
12.13	4.76	32.27	43.62	19.36
12.20	7.25	38.85	40.12	13.78
BARI Alu-7 (Diamant)	3.02	33.26	47.01	16.70
BARI Alu-25 (Asterix)	2.28	25.90	60.20	11.63
BARI Alu-28 (L.Rosetta)	3.14	31.01	47.57	18.28

11. 7. PARTICIPATORY VARIETY SELECTION (RYT HYBRIDS)

Two clonal hybrids with check varieties were evaluated at farmer's fields under participatory variety selection to understand the performance as well as farmers opinion. On the average of all locations, both the tested hybrid clones produced higher yield than check varieties. The highest average tuber yield (44.77 t/ha) was recorded in 12.13 followed by 12.20 (37.03 t/ha) and lowest average yield was found in check varieties BARI Alu-28 (Lady Rosetta) (30.91 t/ha). Farmers were very much interested in both the clonal hybrids 12.13 and 12.20 for their yield, tuber size, shape, color but varied location to location. Therefore, these two clones were recommended for release as commercial varieties.

Table 15 Tuber Yield (t/ha) of clonal hybrids under PVS at 95 DAP in farmers' fields, 2018-19

Variety	Loctiuon					
	Bogura	Debi	Jamal	Jashore	Munshiganj	Mean
12.13	54.32	43.07	20.13	51.11	55.22	44.77
12.20	44.50	39.69	18.63	37.12	45.22	37.03
BARI Alu-7 (Diamant)	42.95	22.45	21.22	31.16	44.11	32.38
BARI Alu-25 (Asterix)	38.94	31.51	23.35	35.74	38.04	33.52
BARI Alu-28 (L.Rosetta)	28.2	30.56	27.57	34.07	34.16	30.91

2nd Year (2019-2020)

11.8. PRELIMINARY YIELD TRIAL WITH CLONAL POTATO HYBRIDS (F_1C_5)

The study was carried out at TCRC, BARI, Joydebpur, Gazipur and BSPC, Debigonj, Panchagarh with the 11 genotypes (16.7,16.9, 16.12, 16.16, 16.19, 16.28, 16.33, 16.34, 16.39, 16.62 and 16.92) selected from last four consecutive years (TCRC, 2016-2019) along with three checks: BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu 28 (Lady-Rosetta). The unit plot size was 3.0 × 3.0 m. Whole tubers were planted with a spacing of 60 x 25 cm. Planting was done on 22th November, 2019 at Gazipur and 15th November, 2019 at Debigonj.

Significant variations among the genotypes exhibited through the measured parameters. The highest days to emergencewas found in the genotype 16.12 and the lowest value was found in 16.33. Among the studied genotypes, most of them gave more than 90% emergence. The highest plant height was found in 16.39 (98.40cm) followed by the genotype 16.34(95.90cm) and that of the lowest was found in the genotype 16.19 (38.97cm). Maximum foliage coverage was found in hybrid clone 16.9 (80.00 %) whereas the lowest value was found in check variety BARI Alu-25 (Asterix) (60.00%). Number of stem per plant varied significantly and ranged from 3.53 to 8.23. The highest number of stem per plant was produced by the check variety BARI Alu-7 (Diamant) (8.23) and the lowest by 16.92 (3.53) (Table 16). Yield is the ultimate goal of selecting any new genotypes of potato. Among the 11 genotypes 16.9 gave the highest yield (31.08 t/ha) whereas the lowest yield was found from genotype 16.16 (8.06 t/ha) at 65 DAP. Most of the genotypes of hybrid clones gave

higher yields over the three checks variety BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu 28 (Lady-Rosetta) at 95 DAP. The highest yield was observed in the variety 16.9 (57 t/ha) whereas the lowest yield was obtained from 16.28 (8.34.49 t/ha) at 95 DAP. In case of dry matter content all of the genotype showed significant variation with the check variety. Eleven hybrid clones with three checks variety BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu-28 (L. Rosetta) were tested at BSPC, Debiganj, Panchagarh. Most of the genotypes produced higher yield over the check varieties. Thus, all the hybrid clones were selected for next year trial (SYT).

Table 16. Performances of hybrid clones under PYT at BSPC, Debiganj during 2019-20

Hybrid Clones	Days to Emergence	% Emergence at 30 DAP	Plant height at 60 DAP (cm)	No. of stem/hill at 60 DAP	% Foliage coverage at 60 DAP	Tuber yield (t/ha) at 65 DAP	Tuber yield (t/ha) at 95 DAP	% Dry matter
16.7	12.00b	93.51a	82.37a	5.00bc	78.33ab	24.79bc	56.71ab	17.9abcd
16.9	11.67b	96.29a	77.77ab	4.83bc	80.00a	31.08a	57a	17.38bcd
16.12	15.00a	66.66b	67.33ab	3.58c	73.33abc	15.46g	-	15.21ef
16.16	12.00b	91.66a	74.83ab	4.33c	76.67abc	8.06h	35.51cd	19.11ab
16.19	11.33b	95.37a	38.97b	4.60c	76.67abc	20.85de	55.55ab	17.06cd
16.28	11.67b	96.29a	77.70ab	4.40c	78.33ab	19.86e	34.49d	16.81de
16.33	11.00b	99.07a	72.87ab	8.17a	68.33abcd	26.59b	55.46ab	16.8de
16.34	12.00b	96.29a	95.90a	4.87bc	73.33abc	21.23de	53.69ab	18.65abc
16.39	11.33b	88.14ab	98.40a	4.70c	78.33ab	18.63ef	46.66bcd	17.62bcd
16.62	14.00a	83.33ab	74.83ab	3.83c	66.67bcd	16.62fg	53.15abc	16.62de
16.92	15.00a	80.55ab	59.17ab	3.53c	65.00cd	26.84b	-	13.66f
BARI Alu-7 (Diamant)	11.33b	98.89a	80.23ab	8.23a	76.67abc	23.33cd	42.48bcd	19.56a
BARI Alu-25 (Asterix)	14.00a	96.66a	79.67ab	6.43b	60.00d	25.36bc	41.99bcd	16.75de
BARI Alu-28 (L. Rosetta)	14.00a	97.77a	73.30ab	4.10c	66.67bcd	27.51b	35.24cd	18.79abc
CV (%)	2.76	8.73	18.42	10.58	5.60	21.87	25.91	6.20

11.9. SECONDARY YIELD TRIAL WITH CLONAL HYBRIDS (F_1C_6)

Eight hybrid clones of potato were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) at Debigonj, Gazipur and Jamalpur. Combined analysis was done to see the genotype and location interactions. The significant influence was observed for different environmental factors of different locations on the expression of different characters of potato. No early bulker clone was selected from this study. No early mature clone was found than checks BARI Alu-13 (Granola) and BARI Alu-28 (Lady Rosetta). The highest average marketable yield (47.05 t/ha) was observed in clone 15.156 followed by clones 15.126 (44.93 t/ha) and 15.139 (44.82 t/ha). Clones 15.126, 15.139 and 15.156 were selected for AYT due to their higher tuber yield potentialities. In case of dry matter check variety BARI Alu-28 (Lady Rosetta) gave highest result but average dry matter percentage of clones15.92 (20.98), 15.112 (20.52) and 15.156 (20.88) were also satisfactory andwould be suitable for processing purpose. Clone 15.92 gave higher percentage (73.65) of larger size tuber which is important for processing and export purpose. Clones 15.92, 15.126 and 15.156 performed better than checks regarding taste, appearance and texture of boiled potato. Considering the marketable tuber yield, dry matter, organoleptic taste, disease infection, insect infestation and tuber characteristics (shape, size, colour, scoring) five clones 15.92, 15.112, 15.126, 15.139 and 15.156 were selected for next year AYT.

Table 17. Marketable Tuber yield (t/ha) at 95 DAP of the hybrid genotypes as influenced by different environments, 2019-20

Variety	Location			
	Debigonj	Gazipur	Jamalpur	Mean
15.8	40.98 jk	25.11 rs	42.26 hij	36.12 d
15.38	39.51 k	27.42 q	37.04 m	34.66 e
15.92	45.47 efg	26.22 qrs	44.18 fgh	38.62 c
15.112	45.20 efg	27.69 q	46.22 def	39.70 c
15.126	46.72 de	32.01 op	56.08 a	44.93 b
15.136	50.80 c	27.74 q	39.40 kl	39.31 c
15.139	50.45 c	36.28 m	47.71 d	44.82 b
15.156	53.60 b	33.02 no	54.53 ab	47.05 a
BARI Alu-7 (Diamant)	37.21 lm	27.54 q	43.88 gh	36.21 d
BARI Alu-13 (Granola)	30.60 p	24.78 s	43.31 ghi	32.90 f
BARI Alu-25 (Asterix)	36.11 m	27.34 qr	41.56 ijk	35.00de
BARI Alu-28 (L.Rosetta)	35.47 m	25.75 qrs	35.14 mn	32.12 f
CV (%)	3.56			

Table 18. Dry matter content (%) of tubers at harvest under different environments, 2019-20

Variety	Location			
	Debigonj	Gazipur	Jamalpur	Mean
15.8	19.01 g-l	20.54 c-g	20.40 c-h	19.98 cde
15.38	19.70 c-j	18.92 h-l	18.38 jkl	19.00 fg
15.92	21.04 cde	19.27 f-l	22.63 ab	20.98 b
15.112	20.44 c-h	19.85 c-j	21.27 bc	20.52 b-e
15.126	20.02 c-i	19.25 f-l	20.30 c-h	19.86 def
15.136	18.60 i-l	20.37 c-h	20.63 c-f	19.86 def
15.139	20.60 c-f	21.13 bcd	20.36 c-h	20.70 bcd
15.156	20.88 cde	19.54 e-k	19.61 d-k	20.01 cde
BARI Alu-7 (Diamant)	21.22 bc	20.17 c-h	21.26 bc	20.88 bc
BARI Alu-13 (Granola)	19.92 c-j	18.10 kl	18.53 i-l	18.85 g
BARI Alu-25 (Asterix)	20.78 c-f	17.80 l	20.68 c-f	19.75 ef
BARI Alu-28 (L.Rosetta)	22.61 ab	20.24 c-h	23.46 a	22.10 a
CV (%)	4.75			

Table 19. Tuber grade at 95 DAP, 2019-20 (average of three locations)

Genotypes	Tuber Grades by Weight (%)			
	<28 mm	28-40mm	40-55mm	>55mm
15.8	6.19	24.41	56.51	12.89
15.38	2.96	26.13	61.64	9.27
15.92	2.72	23.63	51.72	21.93
15.112	3.69	37.35	54.00	4.95
15.126	2.89	36.32	54.82	5.97
15.136	3.51	37.76	51.54	7.19
15.139	2.29	29.56	48.44	19.71
15.156	1.91	35.32	48.69	14.08
BARI Alu-7 (Diamant)	5.20	39.47	49.62	5.71
BARI Alu-13 (Granola)	4.19	39.06	51.44	5.31
BARI Alu-25 (Asterix)	3.36	38.50	54.74	3.40
BARI Alu-28 (L.Rosetta)	2.59	35.00	55.04	7.37

11.10. ADVANCED YIELD TRIAL WITH CLONAL HYBRIDS (F_1C_7)

Five clones of potato along with BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) as checks were evaluated during 2019-20 at six locations (Joydebpur, Munshigonj, Bogura, Jashore, Jamalpur and Debigonj) in RCB design with three replications. The unit plot size was 3m×3m.

Five 7th generation clonal hybrids of potato were evaluated with three check varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu-28(Lady-Rosetta) at six locations during 2019-20. Tuber yield at 65 DAP was recorded to identify the early bulker genotypes. No early bulker clone was selected from this study. No early mature clone was found than checks BARI Alu-13 (Granola). At final harvest, Clone 14.11, 14.10 and 14.44 can be selected for RYT due to their higher tuber yield potential (43.23 t/ha), (40.59 t/ha) and (39.30 t/ha), respectively. In case of dry matter check variety BARI Alu-28 (Lady Rosetta) gave highest result but average dry matter percentage of clone 14.11 (20.04) was also satisfactory, which is suitable for processing purpose. Clone 14.10 gave higher percentage (68.42) of larger sized tuber which is important for processing and export purpose. Clone 14.44 performed best regarding taste, appearance and texture of boiled potato. Clones 14.10, 14.11 and 14.44 were selected for next year RYT Trial due to their performance regarding tuber yield, dry matter, organoleptic taste performance, disease infection and insect infestation and tuber characteristics (shape, size, colour, scoring) etc.

Table 20. Tuber yield (t/ha) of the genotypes at 95 DAP under different environments, 2019-20

Variety\ location	Location						
	Bogura	Debi	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
14.10	29.99 vw	31.75 uv	53.42 b	33.38 stu	51.89 b	43.13 gh	40.59 b
14.11	34.23 rst	35.60 pqr	48.27 cd	38.24 lmn	62.10 a	40.95 ij	43.23 a
14.12	21.32 z	35.56 pqr	44.55 fg	30.59 vw	49.86 c	36.17 opq	36.34 d
14.31	29.18 w	29.68 w	31.63 uv	25.00 x	40.53 jk	45.56 ef	33.60 e
14.44	30.57 vw	35.20 qrs	46.20 ef	35.57 pqr	51.99 b	36.29 opq	39.30 c
BARI Alu-7 (Diamant)	29.30 w	37.20 m-p	38.73 klm	29.55 w	46.94 de	39.74 jkl	36.91 d
BARI Alu-13 (Granola)	23.41 xy	37.97 l-o	39.58 jkl	20.29 z	35.74 pqr	35.25 qrs	32.04 f
BARI Alu-25 (Asterix)	24.92 x	30.27 vw	42.62 hi	20.98 z	44.54 fg	34.91 qrs	33.04 e
BARI Alu-28 (L.Rosetta)	21.70 yz	36.74 n-q	38.45 lmn	19.99 z	33.96 rst	32.94 tu	30.63 g
CV (%)	3.21						

Table 21. Dry matter (%) of the potato genotypes as influenced by different environments, 2019-20

Variety	Location						
	Bogura	Debi	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
14.10	18.71 m-r	19.63 h-n	19.18 k-p	20.72 d-i	22.07 b-e	18.58 n-r	19.81 bc
14.11	21.49 c-g	18.47 n-r	18.91 l-q	22.31 abc	20.67 e-j	18.38 n-r	20.04 b
14.12	20.74 d-i	18.72 m-r	18.60 n-r	21.36 c-g	18.40 n-r	18.75 m-r	19.43 c
14.31	20.58 f-k	20.38 f-k	18.53 n-r	20.42 f-k	20.40 f-k	17.82 pqr	19.69 bc
14.44	21.66 c-f	19.22 j-p	18.44 n-r	15.22 s	22.40 abc	18.75 m-r	19.28 c
BARI Alu-7 (Diamant)	21.14 c-g	18.63 m-r	21.11 c-g	20.07 g-m	20.33 f-l	17.76 pqr	19.84 bc
BARI Alu-13 (Granola)	18.69 m-r	18.05 o-r	19.29 i-o	19.63 h-n	17.50 qr	18.06 o-r	18.54 d
BARI Alu-25 (Asterix)	21.24 c-g	17.30 r	18.89 l-q	21.36 c-g	21.50 c-g	18.91 l-q	19.87 bc
BARI Alu-28 (L.Rosetta)	22.15 a-d	20.72 d-i	21.49 c-g	23.60 a	23.50 ab	21.00 c-h	22.08 a
CV (%)	4.55						

Table 22. Average grade of tubers by weight, 2019-20 (average of six locations)

Genotype	% of Tuber Grading by Weight			
	<28 mm	28-40mm	40-55mm	>55mm
14.10	4.52	27.07	57.69	10.73
14.11	7.00	32.04	52.88	8.08
14.12	7.45	31.71	53.13	7.70
14.31	5.49	30.00	52.91	11.60
14.44	5.51	30.00	49.99	14.50
BARI Alu-7 (Diamant)	8.84	33.46	51.33	6.38
BARI Alu-13 (Granola)	7.49	34.91	50.55	7.04
BARI Alu-25 (Asterix)	10.41	33.06	49.85	6.67
BARI Alu-28 (L.Rosetta)	6.61	34.20	55.29	3.90

11.11. PARTICIPATORY VARIETY SELECTION OF ADVANCED CLONAL HYBRID (F_1C_7)

Participatory variety selection trial was conducted in the farmer's fields to know the farmers reaction and opinion as well as their acceptance about the new potato varieties. The experiment was conducted in the farmer's fields at six locations viz. Bogura, Debigonj, Gazipur, Jamalpur, Jashore and Munshigonj during 2019-20. Five clonal potato hybrids namely 14.10, 14.11, 14.12, 14.31 and 14.44 selected for last six consecutive years (2014-2019) along with check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated in this trial. The unit plot size for each variety was 3m x 3m. Whole tubers were planted with a spacing of 60 cm x 25 cm. Planting was done in the last week of November 2019. Fertilizers were applied and management practices were done as per TCRC recommendations. Harvesting was done in first week of March 2020.Yield data and mainly opinion/comments from the farmers/ end users were collected and presented. In case of average yield of all locations the highest yield (39.14 t/ha) was recorded in 14.11 followed by 14.44 (38.72 t/ha) and the lowest average yield was found in check variety BARI Alu-13 (Granola) (33.45 t/ha). Considering tuber yield, tuber size, shape and colour, farmers of all locations showed their keen interest to all the clones, but varied from location to location. Therefore, further evaluation would be needed for confirmation

Table 23. Performances of clonal hybrids under PVS at 95 DAP in farmers' fields, 2019-20

Variety	Bogura	Debigonj	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
14.10	34.27	31.64	26.67	36.70	46.39	32.39	34.68
14.11	43.93	25.00	33.34	38.78	58.33	35.47	39.14
14.12	42.58	-	29.70	23.89	36.31	35.96	33.69
14.31	31.90	28.37	22.22	40.00	45.00	31.70	33.20
14.44	43.33	35.97	35.76	48.65	-	29.87	38.72
BARI Alu-7 (Diamant)	45.08	21.48	30.31	31.66	46.11	37.87	35.42
BARI Alu-13 (Granola)	41.78	27.48	27.78	28.98	39.24	35.42	33.45
BARI Alu-25 (Asterix)	43.09	28.84	27.78	28.98	34.12	39.81	33.77
BARI Alu-28 (Lady Rosetta)	38.30	-	31.52	39.87	29.21	33.46	34.47

11.12. REGIONAL YIELD TRIAL OF CLONAL HYBRIDS (F_1C_8)

Three clonal potato hybrids namely 13.7, 13.17 and 13.19 selected from last six consecutive years (2012-2018) along with check varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at Bogura, Debigonj, Gazipur, Jamalpur, Jashore and Munshiganj during 2019-2020 cropping season in RCB design with three replications. The unit plot size was 3m × 3m. Whole tubers (BSPC, Debigonj source) were planted with a spacing of 60 cm × 25 cm. Planting was done on 21.11.19, 21.11.19, 24.11.19, 26.11.19, 27.11.19 and 01.12.19 at Jashore, Bogura, Munshigonj, Jamalpur, Debigonj and Gazipur, respectively. No early bulker clone was selected from this study. No early mature clone was found than check variety BARI Alu-28 (Lady Rosetta). The highest average yield was found in clone 13.7 (42.81 t/ha) followed by clone 13.19 (42.07 t/ha). Average dry matter percentages of tested clones were not suitable for processing purpose. Clone 13.19 gave higher percentage (70.86 %) of larger sized tuber which is important for export purpose. Considering tuber yield, organoleptic taste performance, disease, insect infestation and tuber characteristics (shape, size, color, scoring) these two clones (13.7 and 13.19) were recommended for release as commercial varieties.

Table 24. Tuber yield (t/ha) of thegenotypes in different locations at 95 DAP during 2019-20

Variety	Location						
	Bogura	Debigonj	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
13.7	49.40 c	40.65i	29.46qr	52.32 b	54.17 a	30.86pq	42.81 a
13.17	47.59ef	36.11 kl	35.20 lm	40.09ij	49.26 cd	27.68st	39.32 c
13.19	45.67gh	39.07ij	31.44 op	50.33 c	48.98cde	36.94 k	42.07 b
BARI Alu-7 (Diamant)	44.84 h	32.53 no	31.48 op	39.33ij	47.80def	27.43st	37.24 d
BARI Alu-25 (Asterix)	47.15fg	33.96mn	24.35 u	44.93 h	38.70 j	28.95rs	36.34 e
BARI Alu-28 (L. Rosetta)	38.93 j	30.89pq	21.53 v	36.54 kl	35.68 kl	26.21 t	31.63 f
CV%	2.56						

Table 25. Dry matter (%) of the tested genotypes under RYT during 2019-20

Variety	Bogura	Debigonj	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
13.7	19.51 hij	19.28 h-k	23.78 a	15.61 o	21.00 efg	18.99 i-l	19.70 c
13.17	19.18 h-l	19.43 h-k	20.97 efg	21.67 b-e	19.50 h-k	17.37 n	19.69 c
13.19	17.50 mn	18.22 j-n	18.60 j-n	20.54 e-h	18.50 j-n	18.06 k-n	18.57 d
BARI Alu-7 (Diamant)	19.26 h-l	20.12 f-i	21.85 b-e	19.62 g-j	22.50 a-d	19.08 i-l	20.40 b
BARI Alu-25 (Asterix)	17.83 lmn	19.36 h-k	21.48 c-f	21.25 def	19.40 h-k	18.91 i-m	19.71 c
BARI Alu-28 (L. Rosetta)	21.93 b-e	22.72 abc	22.98 ab	23.56 a	23.90 a	20.20 f-i	22.55 a
CV%	4.39						

Table 26. Average grading by number and weight of potato (average of six locations), 2019-20

Genotypes	% of Tuber Grading by Weight			
	<28 mm	28-40mm	40-55mm	>55mm
13.7	8.33	22.02	42.68	26.97
13.17	12.24	20.95	41.55	25.26
13.19	7.49	21.65	47.32	23.54
BARI Alu-7 (Diamant)	11.34	27.97	34.07	26.62
BARI Alu-25 (Asterix)	11.56	29.09	36.85	22.49
BARI Alu-28 (L. Rosetta)	11.66	27.10	32.83	28.41

11.13. PARTICIPATORY SELECTION OF RYT CLONAL HYBRIDS

Three clonal hybrids with check varieties were evaluated at farmer's fields under participatory variety selection to understand the performance as well as farmers opinion. The highest average tuber yield (41.44 t/ha) was recorded in 13.19 followed by 13.7 (35.99 t/ha) and lowest average yield was found in 13.17 (28.88 t/ha). Tuber yield at farmers' field varied among the varieties between the location and within location. The highest yield (48.86 t/ha) was recorded in 13.19 at Bogura and the lowest yield 21.48 t/ha was observed in BARI Alu-7 (Diamant) at Debigonj. The highest average tuber yield (41.44 t/ha) was recorded in 41.44 followed by 13.7 (35.99 t/ha) and lowest average yield was found in another clone 13.17 (28.88 t/ha) (Table 1). Farmers were very much interested in the clonal hybrids 13.7 and 13.19 for their yield, tuber size, shape, color but varied location to location. Therefore, these two clones could be recommended for the release as commercial varieties.

Table 27. Tuber yield (t/ha) of clonal hybrids under PVS in farmers' fields during 2019-20

Hybrid clone	Location						
	Bogura	Debigonj	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
13.7	38.29	25.89	33.34	31.34	43.97	43.09	35.99
13.17	38.85	24.25	22.78	26.52	34.4	26.45	28.88
13.19	48.86	-	31.52	48.09	38.94	39.79	41.44
BARI Alu-7 (Diamant)	45.08	21.48	25.31	31.66	33.94	39.68	32.86
BARI Alu-25 (Asterix)	43.09	28.84	27.78	28.98	34.12	39.81	33.77
BARI Alu-28 (L.Rosetta)	38.30	-	31.52	39.87	29.21	33.46	34.47

3rd Year (2020-21)

11.14.PRELIMINARY YIELD TRIAL WITH CLONAL POTATO HYBRIDS (F_1C_5)

Field evaluation was donefor twelve hybrid clones of potato along with four check varieties BARI Alu-7, BARI Alu-13, BARI Alu-25 and BARI Alu-28 at TCRC, BARI, Gazipur and BSPC, Debigonj, Panchagarh during the last year2020-21. Clone 17.432 gave the highest yield (56.27 t/ha) imitated by 17.12a (54.77 t/ha) and 17.159 (53.77 t/ha) at Debiganj and the clone 17.24 (23.31%) and 17.167 (22.95%) achieved the highest dry matter at Gazipur. Considering the performance towards the studied parameters, eight hybrid clones were selected for next year SYT trial.

Table 28. Tuber yield and Dry matter content of the potato genotypes as influenced by different environments, 2020 -21

Variety/clone	Yield (t/ha) at 95 DAP			Tuber Dry matter (%)		
	Gazipur	Debiganj	Mean	Gazipur	Debiganj	Mean
17.5	44.42 b-f	22.87 m	33.64 e-h	19.98 g-j	19.53 ijk	19.76 ef
17.12a	44.46 b-f	54.77 ab	49.62 a	21.13 c-f	20.66 d-h	20.89 cd
17.18	34.52 f-l	39.69 d-j	37.11 d-g	18.88 k-m	18.81 k-m	18.85 g
17.19	42.09 d-g	47.88 a-e	44.99 a-c	20.65 d-h	18.31 l-n	19.48 fg
17.24	31.43 h-m	48.33 a-d	39.88 c-f	23.31 a	21.40 cd	22.36 a
17.66	44.20 b-f	49.37 a-d	46.79 a-c	17.91 mn	20.70 d-h	19.31 fg
17.128	29.71 j-m	31.73 g-m	30.72 gh	21.52 cd	20.70 d-h	21.11 bc
17.159	42.23 d-g	53.77 abc	48.00 ab	21.79 bc	20.36 e-i	21.08 bcd
17.167	40.67 d-i	44.03 c-f	42.35 a-d	22.95 a	21.31 cde	22.13 a
17.172	37.40 e-k	44.79 b-f	41.09 b-e	22.71 ab	20.77 d-g	21.74 ab
17.432	29.70 j-m	56.27 a	42.99 a-d	17.62 n	18.24 lmn	17.93 h
17.578	23.37 m	29.92 j-m	26.65 h	19.17 jkl	19.98 g-j	19.58 f

Variety/clone	Yield (t/ha) at 95 DAP			Tuber Dry matter (%)		
	Gazipur	Debiganj	Mean	Gazipur	Debiganj	Mean
BARI Alu-7 (Diamant)	29.52 j-m	36.59 f-k	33.05 fgh	21.07 c-f	19.71 h-k	20.39 de
BARI Alu-13 (Granola)	25.94 lm	41.72 d-h	33.83 e-h	16.14 o	17.55 n	16.85 i
BARI Alu-25 (Asterix)	31.05 i-m	40.94 d-i	35.99 d-g	20.26 f-i	18.18 lmn	19.22 fg
BARI Alu-28 (L.Rosetta)	25.02 lm	28.84 klm	26.93 h	21.80 bc	20.83 c-g	21.32 bc
CV %	16.97			3.03		

11.15. SECONDARY YIELD TRIAL WITH CLONAL HYBRIDS

Six hybrid clones of potato were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) at Debigonj, Gazipur and Jamalpur research station of BARI. Combined analysis was done to see the genotype and location interactions. The significant influence was observed for different environmental factors of different locations on the expression of different characters of potato. No early bulker clone was selected from this study. The clone 16.9 gave highest marketable yield (39.73 t/ha) at 65 DAP in Jamalpur and this genotype also gave highest average marketable yield (31.44 t/ha) which could be a suitable candidate for early bulker. The clone 16.16 gave average highest tuber yield (56.15 t/ha) followed by the clones 16.9 (53.18 t/ha), 16.28 (52.36 t/ha) and 16.62 (51.13 t/ha). In case of dry matter check variety BARI Alu-28 (Lady Rosetta) gave the highest result but average dry matter content of clones 16.7 (21.22), 16.28 (20.28), 16.33 (20.52) and 16.62 (20.44) were also satisfactory (>20%) and were suitable for processing purpose. Clone 16.7 (70.19%) gave larger (>40mm dia) size tubers which is important for processing and export purpose. Considering the marketable tuber yield, dry matter, organoleptic taste, disease, insect infestation and tuber characteristics (shape, size, colour, scoring) the Clones 16.9,16.7, 16.16, 16.28, 16.33 and 16.62 were selected for next year AYT.

Table 29. Marketable Tuber yield (t/ha) at 95 DAP at different environments, 2020-21

Variety\clone	Location			
	Debigonj	Gazipur	Jamalpur	Mean
16.7	68.98 a	32.49 j-n	48.34 e-h	44.4 bc
16.9	52.37 d-g	36.43 h-n	54.14 c-f	53.18 ab
16.16	67.94 ab	48.38 e-h	52.13 d-g	56.15 a
16.28	66.75 abc	42.57 f-k	47.78 e-i	52.36 ab
16.33	55.37 b-e	42.76 e-k	38.79 h-l	45.64 bc
16.62	62.48 a-d	43.81 e-j	47.11 e-i	51.13 ab
BARI Alu-7 (Diamant)	31.02 k-n	25.16 mn	37.7 h-m	31.29 d
BARI Alu-13 (Granola)	35.45 i-n	23.73 n	34.21 j-n	31.13 d
BARI Alu-25 (Asterix)	39.91 g-k	26.84 lmn	42.65 e-k	36.47 cd
BARI Alu-28 (L.Rosetta)	34.35 j-n	24.03 n	31.96 j-n	30.11 d
CV (%)	17.99			

Table 30. Dry matter (%) under different environments, 2020-21

Variety	Location			
	Debigonj	Gazipur	Jamalpur	Mean
16.7	24.16 ab	22.4 b-e	17.1 l-p	21.22 ab
16.9	19.37 g-m	22.73 bcd	17.53 l-p	19.88 a-d
16.16	19.14 h-m	21.37 c-i	14 q	18.17 cd
16.28	21.87 b-f	21.63 c-g	17.33 l-p	20.28 abc
16.33	23.28 bc	22.19 b-e	16.1 opq	20.52 abc
16.62	21.72 c-g	21.91 b-e	17.7 k-o	20.44 abc
BARI Alu-7 (Diamant)	20.25 e-j	20.52 d-j	20.1 e-k	20.29 abc
BARI Alu-13 (Granola)	19.07 i-m	16.99 m-p	15.17 pq	17.08 d
BARI Alu-25 (Asterix)	21.28 c-i	19.46 f-l	16.43 nop	19.06 bcd
BARI Alu-28 (L.Rosetta)	26.51 a	21.56 c-h	18.73 j-n	22.27 a
CV (%)	7.42			

11.16. ADVANCED YIELD TRIAL WITH CLONAL HYBRIDS

Five 7th generation clonal hybrids of potato were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) at six locations during 2020-21. Tuber yield at 65 DAP was recorded to identify the early bulker genotypes. No early bulker clone was selected from this study. At final harvest, clone 15.139, 15.156, 15.126, 15.112 and 15.92 were selected for RYT due to their higher tuber yield (44.76 t/ha), (42.57 t/ha), (39.82 t/ha), (39.00 t/ha) and (37.64 t/ha), respectively. In case of dry matter check variety BARI Alu-28 (Lady Rosetta) gave highest result but the average dry matter content of clone 15.156 (21.73%), 15.112 (21.63%), 15.139 (20.53%) and 15.92 (20.33%) was also satisfactory. Clone 15.139, 15.156, 15.92, 15.126 and 15.112 gave higher percentage of larger sized tuber (84.17%), (79.52%), (77.06%), (75.27%) and (72.97%), respectively which is important for processing and export purpose. Clone 15.92, 15.126 and 15.156 performed best regarding taste, appearance and texture of boiled potato. Clones 15.92, 15.112, 15.126, 15.139 and 15.156 were selected for next year RYT Trial due to their performance regarding tuber yield, dry matter, organoleptic taste, disease and insect infestation and tuber characteristics (shape, size, colour, scoring) etc.

Table 31. Tuber yield (t/ha) potato genotypes at 95 DAP at different environments, 2020-21

Variety/clone	Location						
	Gazipur	Debigonj	Bogura	Jamal	Jashore	Munshi	Mean
15.92	28.66 vwx	39.83 h-k	43.42 d-g	43.77 d-g	34.23 o-s	35.90 m-p	37.64 d
15.112	32.04 stu	37.18 k-o	42.78 e-h	47.11 c	36.62 l-o	38.28 j-m	39.00 c
15.126	32.85 q-u	34.85 n-s	46.19 cd	43.00 efg	34.46 n-s	47.55 bc	39.82 c
15.139	40.98 g-j	42.32 e-i	50.73 a	44.96 cde	42.55 e-h	47.05 c	44.76 a
15.156	36.8 l-o	39.39 i-l	50.50 ab	45.21 cde	38.67 j-m	44.83 c-f	42.57 b
BARI Alu-7 (Diamant)	28.27 v-y	39.85 h-k	27.41 v-y	41.94 f-i	35.11 n-r	35.83 m-q	34.74 e
BARI Alu-13 (Granola)	21.48 A	33.15 p-t	30.15 uvw	33.56 p-s	26.16 xyz	30.21 tuv	29.12 g
BARI Alu-25 (Asterix)	27.95 v-y	33.24 p-s	28.00 v-y	37.39 k-n	32.23 r-u	35.10 n-r	32.32 f
BARI Alu-28 (L.Rosetta)	23.28 zA	25.29 yz	27.21 wxy	35.10 n-r	28.8 vwx	32.02 stu	28.62 g
CV(%)	5.06						

Table 32. Dry matter (%) of potato genotypes as influenced by different environments, 2020-21

Clone	Location						
	Gazipur	Debigonj	Bogura	Jamalpur	Jashore	Munshiganj	Mean
15.92	19.95 k-s	20.13 i-q	20.46 h-o	20.73 g-o	20.67 g-o	20.04 j-r	20.33 cd
15.112	21.78 d-j	19.63 m-s	22.34 b-g	21.53 e-l	24.67 a	19.84 l-s	21.63 b
15.126	20.14 i-q	17.05 v	22.31 b-g	18.50 p-v	21.00 g-n	19.79 l-s	19.80 de
15.139	21.93 c-i	19.22 n-t	20.48 h-o	20.07 j-q	21.33 f-m	20.16 i-p	20.53 cd
15.156	23.27 a-e	19.47 n-s	22.42 b-g	22.93 a-f	21.33 f-m	20.97 g-n	21.73 b
BARI Alu-7 (Diamant)	20.03 j-r	20.05 j-q	21.70 d-k	19.20 n-t	22.00 c-h	20.70 g-o	20.61 c
BARI Alu-13 (Granola)	16.90 v	18.22 r-v	19.81 l-s	17.60 tuv	17.33 uv	19.38 n-t	18.21 f
BARI Alu-25 (Asterix)	18.54 p-v	19.63 m-s	20.08 j-q	18.20 s-v	18.33 q-v	20.94 g-n	19.29 e
BARI Alu-28 (L.Rosetta)	23.02 a-f	19.05 o-u	24.04 ab	21.70 d-k	23.67 abc	23.50 a-d	22.50 a
CV(%)	5.49						

11.17. PARTICIPATORY VARIETY SELECTION WITH ADVANCED CLONAL HYBRIDS

Five clonal hybrids with three checks varieties were evaluated at farmer's field under participatory variety selection to understand the performance as well as farmers opinion. In case of average yield of all locations the highest yield was recorded in 15.139 (47.14 t/ha) followed by 15.92 (41.59 t/ha), 15.126 (41.01 t/ha) and 15.112 (40.77 t/ha) and lowest average yield was found in check variety BARI Alu-28 (Lady Rosetta) (34.95 t/ha). Considering tuber yield, tuber size, shape and colour, farmers of all locations showed their keen interest to all the clones, but varied from location to location. Therefore, further evaluation is needed for confirmation.

Table 33. Tuber yield (t/ha) of the clonal hybrids in AYT at 95 DAP in farmers' fields, 2020-21

Hybrid clone	Bogura	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
15.92	37.44	45.56	38.09	37.68	49.17	41.59
15.112	53.05	39.96	37.2	40.42	33.22	40.77
15.126	53.69	46.32	41.17	33.20	30.69	41.01
15.139	43.21	59.54	48.62	45.96	38.39	47.14
15.156	45.75	32.19	28.0	46.82	38.16	38.18
BARI Alu-7 (Diamant)	49.55	32.26	42.68	38.06	32.12	38.93
BARI Alu-13 (Granola)	46.15	29.76	34.34	34.59	30.44	35.06
BARI Alu-25 (Asterix)	38.98	33.90	48.57	39.15	35.97	39.31
BARI Alu-28 (Lady Rosetta)	43.99	24.49	45.09	30.14	31.02	34.95

11.18. REGIONAL YIELD TRIAL WITH CLONAL HYBRIDS OF POTATO

Three clonal hybrids of potato namely 14.10, 14.11 and 14.44 along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at six agro-ecological locations during 2020-21 cropping season. Clone 14.11 selected as aearly bulker from this study. The highest average yield was found in clone 14.11 (54.31 t/ha) followed by the clone 14.10 (40.19 t/ha) and 14.14 (38.94 t/ha). Average dry matter percentages of tested clones was lower than the popular processing variety BARI Alu-28 (Lady Rosetta) but satisfactory drymatter percent was observed in Bangladesh Condition. Clone 14.10 gave higher percentage (52.09% in no. & 79.25% in wt.) of larger sized tuber which is important for export purpose. Rest two colnes also produced satisfactory larger sized tuber. In case of organoleptic taste, the clones 14.44 performed better regarding taste, appearance and texture of boiled potato. Considering tuber yield, organoleptic taste performance, disease, insect infestation and tuber characteristics (shape, size, colour, scoring) these three clones (14.10, 14.11 and 14.44 were recommended for release as commercial varieties.

Table 34. Tuber yield (t/ha) at 95 DAP of the exotic varieties under RYT, 2020-21

Variety	Location						
	Bogura	**Debi**	**Gazipur**	**Jamalpur**	**Jashore**	**Munshiganj**	**Mean**
14.10	39.09 g-j	39.39 ghi	39.22 g-j	43.79 cd	32.55 pqr	47.17 b	40.19 b
14.11	45.77 bc	31.27 rs	47.22 b	53.28 a	54.31 a	43.30 cde	45.86 a
14.44	42.07 def	33.45 o-r	36.94 i-l	37.10 i-l	42.47 def	41.63 d-g	38.94 c
BARI Alu-7 (Diamant)	37.53 i-l	32.99 pqr	36.36 k-n	36.23 k-n	36.66 j-m	38.03 h-k	36.30 d
BARI Alu-13 (Granola)	33.26 pqr	41.05 efg	27.92 tu	33.87 n-r	25.07 v	34.22 m-q	32.57 e
BARI Alu-25 (Asterix)	35.97 k-o	32.39 qr	32.77 pqr	33.99 n-q	28.66 st	35.16 l-p	33.16 e
BARI Alu-28 (L. Rosetta)	33.38 o-r	28.10 tu	27.83 tu	29.51 st	25.97 uv	40.55 fgh	30.89 f
CV%	4.38						

Table 35. Dry matter (%) of the genotypes at different location, 2020-21

Variety	Location						
	Bogura	**Debi**	**Gazipur**	**Jamalpur**	**Jashore**	**Munshi**	**Mean**
14.10	18.47 pqr	20.78 d-j	21.18 c-f	19.20 l-p	21.33 cd	20.22 g-k	20.20 c
14.11	18.73 opq	19.87 j-m	20.98 d-h	17.37 tu	19.67 k-n	19.65 k-o	19.38 d
14.44	18.38 p-s	19.98 i-m	21.35 cd	17.70 rst	20.67 d-j	19.99 i-m	19.68 d
BARI Alu-7 (Diamant)	20.88 d-i	20.49 d-k	21.33 cd	20.10 g-l	20.67 d-j	20.49 d-k	20.66 b
BARI Alu-13 (Granola)	20.38 e-k	18.63 pqr	17.48 stu	17.73 rst	18.00 q-t	19.08 m-p	18.55 e
BARI Alu-25 (Asterix)	20.30 f-k	18.81 n-q	20.05 h-l	16.77 u	21.00 d-g	20.82 d-i	19.63 d
BARI Alu-28 (L. Rosetta)	21.30 cde	24.59 a	22.88 b	21.17 c-f	24.00 a	22.01 bc	22.66 a
CV%	2.85						

11.19. PARTICIPATORY VARIETY SELECTION OF CLONAL HYBRIDS (RYT)

Three clonal hybrids along with three check varieties were evaluated at farmers' fields under participatory variety selection to understand the performance as well as farmers opinion. The highest average tuber yield was found in 14.11 (48.42t/ha) followed by 14.10 (42.16 t/ha) and 14.44 (41.11 t/ha) and lowest average yield was found in BARI Alu-7 (Diamant) (34.51 t/ha). Farmers were very much interested in all the clonal hybrids for their yield, tuber size, shape, color but varied location to location. Therefore, these two clones were recommended for release as commercial varieties.

Table 36. Tuber Yield (t/ha) of clonal hybrids under PVS at different location, 2020-21

Hybrid clone	Location						
	Bogura	**Debigonj**	**Gazipur**	**Jamalpur**	**Jashore**	**Munshiganj**	**Mean**
14.10	47.11	-	32.52	35.29	51.67	44.22	42.16
14.11	59.19	41.24	50.74	44.57	34.72	60.08	48.42
14.44	52.92	34.20	40.00	45.71	39.59	34.21	41.11
BARI Alu-7 (Diamant)	49.55	23.16	32.26	42.68	38.06	32.12	36.31
BARI Alu-13 (Granola)	46.15	31.78	29.76	34.34	34.59	30.44	34.51
BARI Alu-25 (Asterix)	38.98	-	33.90	48.57	39.15	35.97	39.31
BARI Alu-28 (L.Rosetta)	43.99	34.33	24.49	45.09	30.14	31.02	34.84

4th Year (2021-2022)

11.20. PRELIMINARY YIELD TRIAL WITH CLONAL POTATO HYBRIDS (F_1C_5)

Eleven hybrid clones of potato were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady-Rosetta) at Debigonj and Gazipur. Combined analysis was done to see the genotype and location interactions. Significant influence was observed for different environmental factors of different locations on the expression of different characters of the potato hybrids. During final harvest, clone 18.117 gave highest average yield (42.05 t/ha) followed by 18.19 (39.23 t/ha), 18.102 (38.4 t/ha), 18.8 (37.88 t/ha), 18.46 (35.50 t/ha) and 18.13 (35.02 t/ha). These six clonescan be selected for their higher tuber yield potentialities. In case of dry matter, the clones 18.37 (22.37%), 18.11 (21.62%) and 18.102 (20.97%) were suitable for processing purpose. No early mature clone was found than the checks. Clone 18.8, 18.13 and 18.19 gave higher percentage of larger tuber size and weight which is important for processing and export purpose. Considering marketable tuber yield, dry matter, disease, insect and tuber characteristics (shape, size, colour, scoring) these eight clones (18.8, 18.11, 18.13, 18.19, 18.37, 18.46, 18.102 and 18.117) were selected for SYT.

Table 37. Tuber yield and dry matter percentage at harvest of genotypes as influenced by different environments of potato during 2021-22

Variety	Tuber yield (t/ha)			Dry matter (%)		
	Debigonj	Gazipur	Mean	Debigonj	Gazipur	Mean
18.8	51.45 ab	24.3 jkl	37.88 bcd	19.33 ghi	19.53 gh	19.43 e
18.11	43.89 d	26.11 ijk	35 de	22.67 a	20.58 def	21.62 bc
18.12	29.89 hi	19.59 mn	24.74 i	19 hi	22.05 ab	20.52 d
18.13	43.82 d	26.21 ijk	35.02 de	17 lmn	16.25 n	16.62 g
18.19	52.58 a	25.88 ijk	39.23 ab	18 jk	20.07 efg	19.03 e
18.37	38.43 ef	23.02 klm	30.72 fgh	22.67 a	22.08 ab	22.37 a
18.40	44.81 cd	22.55 klm	33.68 ef	16.67 mn	17.63 jkl	17.15 fg
18.43	36.42 fg	19.95 m	28.19 gh	18 jk	17.6 j-m	17.8 f
18.46	42.8 d	28.2 ij	35.5 cde	19.67 fgh	21.34 bcd	20.51 d
18.102	42.72 d	34.08 gh	38.4 bc	20 fg	21.94 abc	20.97 cd
18.117	48.25 bc	35.85 fg	42.05 a	19.33 ghi	18.42 ij	18.88 e
BARI Alu-7 (Diamant)	43.63 d	14.67 o	29.15 gh	19.67 fgh	21 cde	20.34 d
BARI Alu-13 (Granola)	41.5 de	20.13 lm	30.82 fg	16.33 n	17.04 k-n	16.69 g
BARI Alu-25 (Asterix)	41.47 de	15.54 no	28.51 gh	18 jk	19.53 gh	18.77 e
BARI Alu-28 (L.Rosetta)	34.76 fg	20.74 lm	27.75 hi	22.67 a	21.31 bcd	21.99 ab
CV (%)	7.92			3.00		

Table 38. Grade of tubers by number and weight of potato, 2021-22 (average of two locations)

Genotypes	% of Tuber Grading by Number				% of Tuber Grading by Weight			
	<28mm	28-40 mm	40-55 mm	>55 mm	<28 mm	28-40 mm	40-55 mm	>55 mm
18.8	26.32	36.99	33.41	3.28	4.43	26.99	57.15	11.43
18.11	20.92	27.53	46.43	5.11	3.34	16.61	61.22	18.83
18.12	24.22	30.93	38.26	6.60	5.29	21.28	52.66	20.77
18.13	17.99	29.00	45.20	7.81	2.98	13.02	58.43	25.57
18.19	21.89	24.07	39.93	14.11	2.02	14.90	45.05	38.03
18.37	23.19	29.16	42.79	4.86	2.85	17.03	61.83	18.29
18.40	13.01	33.85	41.13	12.01	1.48	12.71	48.62	37.19
18.43	32.73	35.35	30.97	0.95	6.68	29.50	58.57	5.25
18.46	23.20	28.63	41.10	7.07	3.14	14.44	56.46	25.95

Genotypes	% of Tuber Grading by Number				% of Tuber Grading by Weight			
	<28mm	28-40 mm	40-55 mm	>55 mm	<28 mm	28-40 mm	40-55 mm	>55 mm
18.102	10.62	23.74	46.91	18.72	0.39	11.11	44.30	44.20
18.117	18.22	24.05	43.20	14.53	1.05	9.96	41.78	47.21
BARI Alu-7 (Diamant)	26.15	34.79	36.60	2.46	4.63	27.59	59.38	8.40
BARI Alu-13 (Granola)	22.59	37.35	36.65	3.41	4.29	23.75	58.19	13.77
BARI Alu-25 (Asterix)	19.19	36.36	41.84	2.61	3.25	26.51	62.29	7.95
BARI Alu-28 (L.Rosetta)	9.25	26.06	55.78	8.90	0.89	16.13	64.93	18.04

11.21. SECONDARY YIELD TRIAL WITH CLONAL HYBRIDS (F_1C_6)

Eleven hybrid clones of potato were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) at Debigonj, Gazipur and Jamalpur. Combined analysis was done to see the genotype and location interactions. The significant influence was observed for different environmental factors of different locations on the expression of different characters of potato. Clone 17.19 (34.45 t/ha) and 17.5 (29.5 t/ha) can be selected from this study as early bulker. Clone 17.578 can be selected as early mature (74.67 days). The highest average yield (47.57 t/ha) was observed in clone 17.159 followed by clones 17.18 (45.04 t/ha), 17.167 (45.01 t/ha), 17.172 (43.31 t/ha) and 17.12a (43.17 t/ha). Clones 17.159, 17.18, 17.167, 17.172 and 17.12a can be selected for AYT due to their higher tuber yield potentialities. In case of dry matter check variety BARI Alu-28 (Lady Rosetta) gave the highest result. Therefore, no clone was selected for processing purpose. Clone 17.5 and 17.159 gave higher percentage of larger tuber size and weight which is important for processing and export purpose. Clones 17.578 and 17.159 performed better than checks regarding taste, appearance and texture of boiled potato. Considering the tuber yield, dry matter, organoleptic taste, disease, insect infestation and tuber characteristics (shape, size, colour, scoring) these eight clones (17.5, 17.12a, 17.18, 17.19, 17.159, 17.167, 17.172 and 17.578) were selected for next year AYT.

Table 39. Tuber yield and dry matter content at harvest as influenced by different environments, 2021-22

Variety	Tuber yield (t/h)				Dry matter (%)			
	Debi	Gazi	Jamal	Mean	Debi	Gazi	Jamal	Mean
17.5	42.28 e-h	32.36 n-q	45.86 de	40.16 de	14 tu	19.93 fgh	18.22 i-l	17.38 d
17.12a	41.21 f-i	32.34 n-q	55.97 ab	43.17 bc	14.67 rst	21.2 de	17.02 mno	17.63 d
17.18	41.1 f-j	40.67 f-j	53.34 bc	45.04 b	13.33 u	18.92 h-k	15.51 p-s	15.92 g
17.19	43.24 efg	29.61 pqr	44 ef	38.95 e	13.33 u	19.6 gh	15.7 pqr	16.21 fg
17.24	40.02 f-k	32.43 n-q	49.34 cd	40.6 de	15.33 qrs	23.35 a	16.65 nop	18.45 c
17.66	39.61 g-k	34.64 l-o	50.75 c	41.67 cd	14 tu	18 j-m	16.27 opq	16.09 fg
17.159	41.68 e-i	41.76 e-i	59.26 a	47.57 a	15.33 qrs	21.92 bcd	19.17 ghi	18.81 c
17.167	44.13 ef	37.64 i-l	53.25 bc	45.01 b	14 tu	22.96 ab	18.07 i-m	18.34 c
17.172	36.95 j-m	34.68 l-o	58.3 a	43.31 bc	15 rst	22.38 abc	15.33 qrs	17.57 d
17.432	41.14 f-j	31.42 opq	51.38 c	41.31 cde	13.33 u	17.71 lmn	14.36 stu	15.13 h
17.578	31.95 n-q	24.2 s	39.03 g-k	31.73 f	15.67 pqr	19.16 ghi	16.62 nop	17.15 de
BARI Alu-7 (Diamant)	38.53 h-l	19.89 t	34.4 l-o	30.94 f	19.67 gh	20.94 def	19.12 g-j	19.91 b
BARI Alu-13 (Granola)	23.99 st	22.56 st	32.82 m-p	26.45 g	16.33 opq	16.26 opq	17.28 l-o	16.62 ef
BARI Alu-25 (Asterix)	36 k-n	25.74 rs	35.98 k-n	32.57 f	18 j-m	20.24 efg	17.33 l-o	18.52 c
BARI Alu-28 (L.Rosetta)	28.46 qr	26.27 rs	37.77 i-l	30.83 f	22.67 abc	21.65 cd	17.9 klm	20.74 a
CV (%)	6.74				4.02			

Table 40. Grade of tubers by number and weight, 2021-22 (average of three locations)

Genotypes	% of Tuber Grade by Number				% of Tuber Grade by Weight			
	<28 mm	**28-40 mm**	**40-55 mm**	**>55 mm**	**<28 mm**	**28-40 mm**	**40-55 mm**	**>55 mm**
17.5	8.27	38.01	38.30	15.42	1.12	24.65	41.80	32.43
17.12a	15.03	46.00	33.53	5.44	2.19	33.87	47.14	16.80
17.18	16.44	52.76	29.99	0.81	2.74	41.59	52.71	2.95
17.19	10.89	47.16	38.47	3.48	1.48	29.38	58.35	10.79
17.24	12.09	38.99	41.20	7.72	1.68	26.13	52.30	19.88
17.66	12.29	41.75	40.87	5.10	1.52	28.85	55.31	14.32
17.159	13.53	43.01	37.88	5.58	1.87	26.35	54.85	16.93
17.167	13.02	44.27	41.24	1.47	1.85	31.42	62.14	4.60
17.172	18.94	41.39	33.54	6.13	2.18	28.87	47.53	21.42
17.432	18.02	51.25	28.47	2.26	4.08	36.65	50.41	8.86
17.578	9.23	37.96	49.04	3.78	1.25	26.47	62.27	10.01
BARI Alu-7 (Diamant)	15.20	48.49	34.76	1.55	4.25	38.79	51.51	5.45
BARI Alu-13 (Granola)	18.65	48.46	31.68	1.21	4.00	37.16	53.97	4.87
BARI Alu-25 (Asterix)	13.74	48.45	36.30	1.50	2.13	34.07	57.76	6.04
BARI Alu-28 (L.Rosetta)	7.86	47.12	43.60	1.42	1.24	37.18	56.24	5.34

11.22. ADVANCED YIELD TRIAL WITH CLONAL POTATO HYBRIDS (F_1C_6)

Six 7th generation clonal hybrids of potato were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) at six locations during 2021-22. Tuber yield at 65 DAP was recorded to identify the early bulker genotypes. Clone 16.9 was selected from this study. At final harvest, clone 16.9, 16.16 and 16.28 were selected for RYT due to their higher tuber yield (44.06 t/ha) (42.54 t/ha) and (42.45 t/ha), respectively. The average dry matter content of clone 16.16 (20.68%) and 16.62 (20.48%) were suitable for processing purpose. 16.9 and 16.16 gave larger (>40mm dia) tubers size and weight and higher dormancy 70-75 days and 95-100 days, accordingly which is important for export purpose as well as some cases processing purpose. Clones 16.9, 16.16, 16.28 and 16.62 were selected for next year RYT due to their performance regarding tuber yield, dry matter, organoleptic taste, disease and insect infestation and tuber characteristics (shape, size, colour, scoring) etc.

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Table 41. Tuber yield (t/ha) potato genotypes at 95 DAP as influenced by different environments, 2021-22

Genotype	Bogura	Debigonj	Gazipur	Jamalpur	Mean
16.7	49.49 cd	28.9 mn	32.48 klm	42.02 fgh	38.22 b
16.9	61.1 a	41.01 gh	32.98 jkl	41.14 fgh	44.06 a
16.16	49.44 cd	39.8 hi	36.25 ij	44.66 efg	42.54 a
16.28	57.05 b	39.67 hi	27.12 no	45.96 de	42.45 a
16.33	48.19 cde	33.5 jk	40.63 h	36.61 ij	39.73 b
16.62	46.39 cde	30.62 k-n	31.62 klm	44.7 ef	38.33 b
BARI Alu-7 (Diamant)	40.54 h	33 jkl	22.55 pq	29.64 lmn	31.43 d
BARI Alu-13 (Granola)	44.76 ef	24.99 op	23.86 opq	33.77 jk	31.84 d
BARI Alu-25 (Asterix)	49.73 c	33.51 jk	22.08 pq	31.41 klm	34.18 c
BARI Alu-28 (L.Rosetta)	41.2 fgh	27.05 no	20.22 q	29 mn	29.37 e
CV(%)	6.07				

Table 42. Dry matter (%) of potato genotypes as influenced by different environments, 2021-22

Genotype	Bogura	Debigonj	Gazipur	Jamalpur	Mean
16.7	19.29 h-m	21.67 a-e	22.38 ab	19.14 h-m	20.62 a
16.9	16.5 q-t	18.33 k-o	22.73 a	18.31 l-o	18.97 bc
16.16	20.19 f-j	20.33 e-j	21.41 a-f	20.81 c-g	20.68 a
16.28	17.67 n-q	21 b-g	21.54 a-f	18.38 k-o	19.65 b
16.33	16.69 p-s	19.67 g-l	22.24 abc	16.19 rst	18.7 c
16.62	18.96 i-n	22.33 ab	21.97 a-d	18.66 k-n	20.48 a
BARI Alu-7 (Diamant)	17.63 n-r	19.67 g-l	20.57 d-h	20.42 e-i	19.57 b
BARI Alu-13 (Granola)	15.09 t	16.33 q-t	16.99 o-s	15.91 st	16.08 d
BARI Alu-25 (Asterix)	18.39 k-o	18 m-p	18.9 j-n	18.01 m-p	18.32 c
BARI Alu-28 (L.Rosetta)	20.6 d-h	22.67 a	21.55 a-f	19.79 g-k	21.15 a

Table 43. Processing Quality parameters studied by Quasem Food Products Ltd|.

Name of the Sample	Specific gravity	Dry Matter (DMC) %	Reducing Sugar (Glucose) mg/dl	Lab fry test	Suitability For Chips/French Fry
16.7	Could not be performed due to lower quantity	Could not be performed due to lower quantity	Below 9 mg/dl	Creamish=100%, Light brown = 0%, Deep brown = 0%	-.
16.9	1.077	19.60	12	Creamish=100%, Light brown = 0%, Deep brown = 0% V.Ring = 1.0%	This variety not suitable for processing.
16.16	1.081	20.42	Below 9 mg/dl	Creamish=100%, Light brown = 0%, Deep brown = 0%	This variety can be suitable for processing..
16. 28	1.074	18.98	68.40	Creamish=54%, Light brown = 35%, Deep brown = 11%	This variety not suitable for processing..
16.33	1.080	20.20	61.20	Creamish=26%, Light brown = 74%, Deep brown = 00%	This variety not suitable for processing..
16.62	1.090	22.30	Below 9 mg/dl	Creamish=100%, Light brown = 0%, Deep brown = 0% V.Ring = 1.0%	This variety can be suitable for processing.
BARI Alu-28 (L. Rosetta)	1.090	22.30	12.60	Creamish=100%, Light brown = 0%, Deep brown = 0%	This variety can be suitable for processing.

Table 44. Tuber characteristics at harvest during 2021-22 at Gazipur

Clone/ Variety	Tuber Shape	Color of skin	Depth of Eyes
16.7	Oval	Deep Red	Shallow
16.9	Long oval	Light Red	Shallow
16.16	Short oval	Yellow	Shallow
16.28	Oval to Long Oval	Red	Shallow
16.33	Oval to Long Oval	Yellow	Shallow
16.62	Oval to Long Oval	Deep Red	Shallow
BARI Alu-7 (Diamant)	Oval to long oval	Yellow	Medium
BARI Alu-13 (Granola)	Round	Yellow	Shallow
BARI Alu-25 (Asterix)	Oval to long oval	Red	Shallow
BARI Alu-28 (L.Rosetta)	Round	Red	Shallow

Table 45. Performance of potato genotypes under Natural Storage Condition, at Gazipur during 2020-21

Clone/ Variety	Days to milk inatiation (days)	Days to sprout inatiation (days)	Days to sprouting (days)
16.7	85	101	116
16.9	100	115	135
16.16	75	101	116
16.28	55	88	101
16.33	86	101	148
16.62	63	86	101
BARI Alu-7 (Diamant)	69	86	116
BARI Alu-13 (Granola)	101	117	133
BARI Alu-25 (Asterix)	69	86	118
BARI Alu-28 (L. Rosetta)	86	101	116

Stability analysis

AMMI biplot

The AMMI biplot provides a visual expression to determine the differences among the environments, to evaluate stable and wide adaptable line. Since the PC2 scores plays a significant role in explaining the genotype-environment interaction; the PC1 scores are being plotted against the PC2 scores for exploring adaptation. According to Fig 1, the genotypes, Clone 16.16 high yielder and more stable across the environments since these varieties tends to centre.

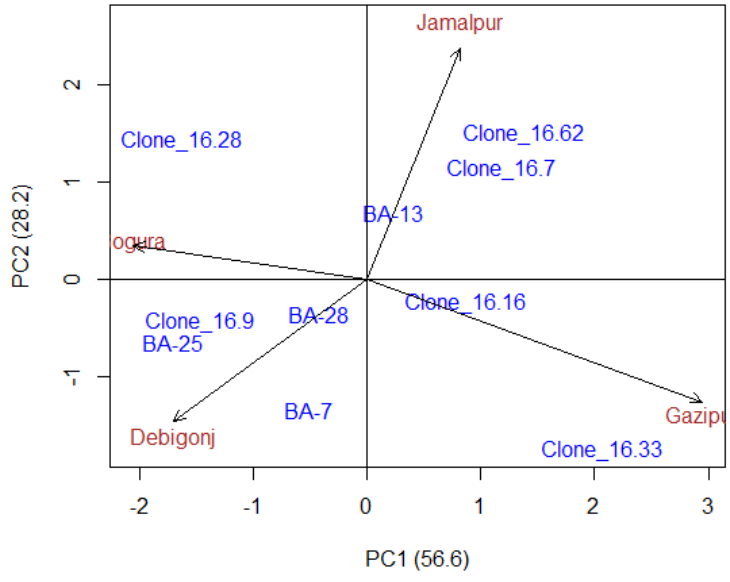


Figure1. Biplot of the first AMMI interaction (PC2) score (Y-axis) plotted against AMMI interaction (PC1) (X-Axis) of eleven potato genotypes over six locations.

Therefore, these four clones (16.9, 16.16, 16.28 and 16.62) were selected for RYT.

11.23. PARTICIPATORY VARIETY SELECTION WITH ADVANCED CLONAL HYBRIDS

Six clonal hybrids with three checks varieties were evaluated at farmer's field under participatory variety selection to understand the performance as well as farmers opinion. In case of average yield of all locations the highest yield was recorded in 16.28 (42.54 t/ha) followed by 16.16 (40.69 t/ha) and lowest average yield was found in check variety BARI Alu-28 (Lady Rosetta) (25.79 t/ha). Considering tuber yield, tuber size, shape and colour, farmers of all locations showed their keen interest to all the clones, but varied from location to location. Therefore, further evaluation is needed for confirmation.

Table 46. Tuber yield (t/ha) of the clonal hybrids in AYT at farmers' fields, 2021-22

Clone/ Variety	Bogura	Gazipur	Jamalpur	Mean
16.7	39.60	22.22	37.80	33.21
16.9	43.47	28.79	31.52	34.59
16.16	59.06	35.20	27.80	40.69
16.28	55.33	43.04	29.25	42.54
16.33	41.20	21.09	29.56	30.62
16.62	39.33	19.33	39.71	32.79
BARI Alu-7 (Diamant)	44.77	20.82	29.50	31.70
BARI Alu-13 (Granola)	46.80	14.97	29.39	30.39
BARI Alu-25 (Asterix)	42.26	21.40	31.95	31.87
BARI Alu-28 (Lady Rosetta)	27.20	17.85	32.33	25.79

11.24. REGIONAL YIELD TRIAL WITH CLONAL HYBRIDS

Three clonal hybrids of potato namely 15.112, 15.139 and 15.156 along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at six agro-ecological locations during 2021-22 cropping season. Clone 15.139 and 15.156 selected as early bulker from this study. The highest average yield was found in clone 15.139 (50.10 t/ha) followed by the clone 15.156 (42.88 t/ha) and 15.112 (42.08 t/ha). These two clones can be recommended for release as commercial varieties. Average dry matter percentages of clone 15.112 (21.45) and 15.156 (20.77) were suitable for processing purpose. 15.156 and 15.139 gave larger (>40mm dia) tubers size and weight and dormancy 70 and 100 days which is important for export purpose as well as some cases processing purpose. In case of organoleptic taste, the clones 15.156 performed better regarding taste, appearance and texture of boiled potato. Considering tuber yield, organoleptic taste performance, disease, insect infestation and tuber characteristics (shape, size, colour, scoring) these three clones (15.112, 15.139 and 15.156) could be recommended for release as commercial varieties.

Table 47.Combined analysis of variance (ANOVA) of yield and other characters under RYT, 2021-22

Source of variation	df	MSS						
		Plant height (cm) at 60 DAP	No. of stem/hill at 60 DAP	Tuber yield (t/ha) at 65 DAP	Tuber number/ hill	Tuber weight / hill (kg)	Tuber yield (t/ha) at 95 DAP	Dry matter % at 95 DAP
Location	3	3135.27***	7.8994***	447.85***	21.7133***	0.280006***	1158.22***	14.2573**
Error-I	8	14.37	0.4393	4.18	0.6373	0.004938	5.21	1.4978
Genotypes	6	1415.64***	3.7336***	38.525***	8.0481***	0.139709***	669.47***	29.7464***
LxG	18	119.25***	1.4948***	50.376***	4.2297***	0.010551***	35.83***	5.1191***
Error-II	48	6.82	0.2301	6.234	0.368	0.002436	8.26	0.3949

***Significant at 0.001% level of probability **Significant at 0.01% level of probability

Table 48.Tuber yield (t/ha) of the genotypes in different locations at 95 DAP, 2021-22

Variety\location	Bogura	Debiganj	Gazipur	Jamalpur	Mean
15.112	46.05 de	42.96 efg	37.94 h-k	41.15 fgh	42.03 b
15.139	56.78 a	47.99 cd	39.36 ghi	56.27 ab	50.1 a
15.156	51.8 bc	39.38 ghi	35.18 i-l	45.16 def	42.88 b
BARI Alu-7 (Diamant)	48.92 cd	25.42 op	23.73 pq	38.38 g-j	34.11 c
BARI Alu-13 (Granola)	45.7 def	32.89 lmn	22.42 pq	33.4 k-n	33.6 c
BARI Alu-25 (Asterix)	41.59 e-h	32.03 lmn	23.12 pq	34.07 j-m	32.7 c
BARI Alu-28 (L. Rosetta)	35.7 i-l	28.84 no	20.68 q	29.62 mno	28.71 d
CV%	7.61				

Table 49. Dry matter (%) of the genotypes under RYT, 2021-22

Variety	Bogura	Debiganj	Gazipur	Jamalpur	Mean
15.112	19.66 ef	21.67 bc	21.82 bc	22.66 ab	21.45 a
15.139	18.3 gh	16.33 k	21.91 bc	17.1 ijk	18.41 e
15.156	19.13 fg	20.33 de	22.98 a	20.61 de	20.77 b
BARI Alu-7 (Diamant)	18.55 gh	19.67 ef	20.45 de	20.51 de	19.79 c
BARI Alu-13 (Granola)	18.55 gh	16.33 k	16.89 jk	17.76 hij	17.38 f
BARI Alu-25 (Asterix)	17.8 hij	18 hi	20.21 de	20.19 de	19.05 d
BARI Alu-28 (L. Rosetta)	21.22 cd	22.67 ab	21.95 bc	20.16 ef	21.5 a
CV%	3.18				

Table 50. Processing Quality parameter studied by Quasem Food Products Ltd|.

Name of the Sample	Specific gravity	Dry Matter (DMC) %	Reducing Sugar (Glucose) mg/dl	Lab fry test	Suitability For Chips/French Fry
15.112	1.087	21.70	Below 9 mg/dl	Creamish=100%, Light brown = 0%, Deep brown = 0%	This variety can be suitable for processing.
15.139	1.084	21.08	Below 9 mg/dl	Creamish=100%, Light brown = 0%, Deep brown = 0% V.Ring = 1.0%	This variety can be suitable for processing.
15.156	1.090	22.30	Below 9 mg/dl	Creamish=100%, Light brown = 0%, Deep brown = 0%	This variety can be suitable for processing.
BARI Alu-28 (L. Rosetta)	1.090	22.30	12.60	Creamish=100%, Light brown = 0%, Deep brown = 0%	This variety can be suitable for processing.

Table 51. Grade of tubers by number and weight in RYT, 2021-22 (average of four locations)

Genotypes	% of Tuber Grading by Number				% of Tuber Grading by Weight			
	<28 mm	28-40 mm	40-55 mm	>55mm	<28 mm	28-40mm	40-55mm	>55mm
15.112	15.83	40.15	39.60	4.42	2.41	27.47	56.87	13.25
15.139	18.23	33.63	40.13	8.01	1.95	20.93	50.47	26.65
15.156	18.12	30.07	45.51	6.29	2.61	22.65	54.74	20.00
BARI Alu-7 (Diamant)	21.93	45.51	30.89	1.67	4.27	35.88	53.83	6.02
BARI Alu-13 (Granola)	14.86	46.52	35.62	3.00	2.36	33.65	53.95	10.04
BARI Alu-25 (Asterix)	22.92	45.72	30.02	1.35	4.61	34.32	55.98	5.09
BARI Alu-28 (L. Rosetta)	10.29	40.43	45.89	3.39	1.70	24.18	63.74	10.37

Table 52. Performance of potato genotypes under natural storage condition at Gazipur, 2020-21

Clone/ Variety	Days to milk inatiation	Days to sprout inatiation	Days to sprouting
15.112	73	87	103
15.139	105	119	132
15.156	72	84	102
BARI Alu-7 (Diamant)	69	86	116
BARI Alu-13 (Granola)	101	117	133
BARI Alu-25 (Asterix)	69	86	118
BARI Alu-28 (L. Rosetta)	86	101	116

11.25. PARTICIPATORY VARIETY SELECTION OF CLONAL HYBRIDS (RYT)

Three clonal hybrids along with three check varieties were evaluated at farmer's fields under participatory variety selection to understand the performance as well as farmers opinion. The highest average tuber yield was found in 15.156 (42.50t/ha) followed by 15.139 (36.11 t/ha) and lowest average yield was found in BARI Alu-28 (Lady Rosetta) (25.79 t/ha). Farmers were very much interested in all the clonal hybrids for their yield, tuber size, shape, color but varied location to location. Therefore, these two clones (15.139 and 15.156) could be recommended for release as commercial varieties.

Table 53. Tuber Yield (t/ha) of clonal hybrids at 95 DAP under PVS in farmers' fields, 2021-22

Clone/ Variety clone	Location			
	Bogura	Gazipur	Jamalpur	Mean
15.112	36.26	23.48	37.76	32.50
15.139	35.47	33.21	39.66	36.11
15.156	48.00	40.45	39.06	42.50
BARI Alu-7 (Diamant)	44.77	20.82	29.50	31.70
BARI Alu-13 (Granola)	46.80	14.97	29.39	30.39
BARI Alu-25 (Asterix)	42.26	21.40	31.95	31.87
BARI Alu-28 (L.Rosetta)	27.20	17.85	32.33	25.79

Objective- 2 Introduction and selection of exotic varieties

1st Year (2018-2019)

11.26. PRELIMINARY YIELD TRIAL OF EXOTIC POTATO VARIETIES

Six exotic potato varieties including four checks were evaluated at Gazipur for yield. The variety Delia red gave the highest average marketable yield (26.03 t/ha). All the exotic varieties produced satisfactory marketable yield. All were selected for further evaluation in SYT.

Table 54. Tuber yield (t/ha) of selected potato genotypes during 2018-19

Variety\ location	Tuber yield (t/ha)
Alcander	19.23
Delia Red	26.03
Diverse Zailengence	18.23
Twinner	19.77
Twister	16.80
Prada	20.30
BARI Alu-7 (Diamant)	21.73
BARI Alu-25 (Asterix)	17.07
BARI Alu-28 (Lady Rosetta)	10.17
BARI Alu-13 (Granola)	12.07

11.27. SECONDARY YIELD TRIAL OF EXOTIC POTATO VARIETIES

Eleven exotic varieties along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (L. Rosetta) were evaluated at six different agro ecological locations of Bangladesh (Bogura, Debiganj, Gazipur, Jamalpur, Jashore and Munshigonj) during 2018-19. The significant influence was observed of different environmental factors of different locations on the expression of different characters of potato. At 65 DAP the highest yield was found (37.78 t/ha) with HZD 1249 at Jamalpur. But, Ottawa performed the best average yield (26.69 t/ha) over the locations which was statistically similar to the average yield of and AlRusset (25.84 t/ha). Exotic variety AlRusset gave the highest yield (49.19 t/ha) at Bogura. The highest average yield (34.38 t/ha) was also found in AlRusset which was statistically similar with Ottawa (32.05 t/ha). Dry matter percentage at harvest was the highest with check variety Lady Rosetta (24.96) at Munshiganj. Considering the average over locations, here check BARI Alu-28 (Lady Rosetta) again gave the statistically highest percentage of dry matter (21.58). In case of dry matter percentage, no entry performed better than checks. Therefore, no exotic variety was found good for processing. Seed tuber grade performance was satisfactory among the genotypes and over the locations. Finally, exotic varieties Al Russet, Ottawa, HZD 1249, Fontane, Tiamo and Sayada were selected for AYT on the basis of field performance and organoleptic taste.

Table 55. Tuber yield (t/ha) at 95 DAP as influenced by different environments, 2018-19

Variety	Location					
	Gazipur	Jamalpur	Jashore	Munshigonj	Bogura	Mean
Alberta	17.66	30.82	21.62	14.42	39.12	24.73f
AlRusset	34.65	40.91	43.61	30.07	49.19	39.69a
Arizona	19.65	32.21	29.21	13.33	29.09	24.7f
Dunstar	22.06	38.75	31.85	26.61	33.41	30.54cdef
Fontane	41.59	29.11	51.62	16.60	31.44	34.07abc
HZD 1249	23.25	46.46	46.62	36.50	31.65	36.9abc
Innovator	23.56	38.51	30.51	34.51	30.15	31.45bcde
Ottawa	30.22	46.37	36.94	36.83	35.45	37.16ab
Primavera	14.70	14.98	19.40	5.28	9.82	27.01ef
Sayada	17.17	33.98	24.26	26.07	33.57	33.74abcd
Tiamo	26.81	48.84	31.90	29.97	31.16	35.12abc
BARI Alu-7 (Diamant)	28.70	35.37	42.92	36.79	31.83	31.7bcde
BARI Alu-13 (Granola)	15.87	35.17	23.79	25.05	32.04	24.73f
BARI Alu-25 (Asterix)	24.00	33.80	38.24	29.89	32.60	27.46def
BARI Alu-28 (L.Rosetta)	19.00	32.09	29.86	28.04	28.29	26.39ef
CV(%)	6.39					

Table 56. Dry matter (%) of the potato varieties as influenced by different environments, 2018-19

Variety\ Location	Location					
	Gazipur	Jamalpur	Jashore	Munshignj	Bogura	Mean
Alberta	17.75	16.73	15.07	21.21	19.22	18efg
AlRusset	19.88	18.33	16.79	23.22	17.81	19.21bc
Arizona	16.64	16.07	12.71	16.66	16.38	15.69j
Dunstar	16.24	17.23	13.73	16.85	17.30	16.27ij
Fontane	18.78	18.20	17.89	22.89	20.47	19.65b
HZD 1249	15.79	17.17	13.96	20.36	17.05	16.86hi
Innovator	19.86	18.18	12.97	24.16	18.72	18.78cd
Ottawa	20.47	18.90	15.78	20.02	16.63	18.36def
Primavera	16.05	18.37	16.95	23.58	19.63	18.92bcd
Sayada	17.23	17.32	13.93	20.77	18.87	17.62fg
Tiamo	16.98	17.67	14.32	20.88	18.05	17.58gh
BARI Alu-7 (Diamant)	20.36	19.47	16.16	19.17	17.55	18.54cde
BARI Alu-25 (Asterix)	19.71	19.73	15.46	17.83	18.30	18.21defg
BARI Alu-28 (L.Rosetta)	22.55	22.10	20.53	24.96	17.80	21.59a
BARI Alu-13 (Granola)	17.65	14.63	14.58	18.66	16.63	16.43ij
CV(%)	5.72					

Table 57. Average grading of tubers of six locations by weight, 2018-19

variety	% of Tuber Grade by Weight				
	<15 mm	15-28 mm	28-40mm	40-55mm	>55mm
Alberta	3.38	9.78	34.02	41.73	11.66
AlRusset	0.55	4.52	34.30	42.20	18.97
Arizona	0.98	6.36	30.02	38.80	23.75
Dunstar	1.57	5.46	37.12	36.89	17.30
Fontane	0.85	20.72	32.93	34.58	12.33
HZD 1249	0.60	5.55	31.78	43.40	19.16
Innovator	3.38	6.66	31.22	39.51	19.07
Ottawa	0.65	7.84	32.03	42.89	17.98
Primavera	5.30	5.44	20.17	43.85	25.86
Sayada	0.76	4.79	30.44	44.62	19.09
Tiamo	6.66	5.54	33.14	39.38	15.68
BARI Alu-7 (Diamant)	0.88	9.96	38.56	37.14	13.25
BARI Alu-25 (Asterix)	5.96	5.67	35.29	37.65	15.31
BARI Alu-28 (L.Rosetta)	1.44	7.98	35.63	42.60	13.05
BARI Alu-13 (Granola)	5.97	6.31	37.39	42.07	8.37

Table 58. Tuber characteristics of exotic potato under SYT during 2018-19

Variety/Line	Tuber Shape	Colour of Skin	Depth of Eyes
Alberta	Oval to long oval	Yellow	Medium deep
Al.Russet	Oval to long oval	Yellow	Deep
Arizona	Oval to long oval	Yellow	Shallow
Dunstar	Oval to long oval	Attractive red	Medium deep
Fontane	Oval to long oval	Yellow	Shallow
HZD1249	Oval to long oval	Yellow	Deep
Innovator	Oval to long oval	Yellow	Medium deep
Ottawa	Oval to long oval	Yellow	Medium deep
Primavera	Oval to long oval	Yellow	Deep
Sayada	Round	Red	Medium deep
Tiamo	Round Oval	Attractive red	Deep

Variety/Line	Tuber Shape	Colour of Skin	Depth of Eyes
BARI Alu-7 (Diamant)	Oval to long oval	Yellow	Shallow
BARI Alu-25 (Asterix)	Oval to long oval	Red	Shallow
BARI Alu-28 (L.Rosetta)	Round	Light red	Shallow
BARI Alu-13 (Granola)	Round Oval	Yellow	Shallow

11.28. ADVANCED YIELD TRIAL OF EXOTIC POTATO VARIETIES

Six exotic potato hybrids along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at six locations during 2018-19. Mean highest yield (39.86 t/ha) and (37.57 t/ha) was observed in Sun red and Margarita, respectively. All the tested genotypes yielded more than 30 t/ha. At final harvest, dry matter percentage was the highest in the check variety Lady Rosetta (20.09%) All other tested genotypes were lower in dry matter. Finally, Sun Red, Picobella and Messi were selected for next year trial for their better performance.

Table 59. Tuber yield (t/ha) at 95 DAP as influenced by different environments, 2018-19

Variety	Location						
	Gazi	Jamal	Jashore	Munshigonj	Bogura	Debiganj	Mean
Actrice	27.83	43.95	26.71	38.78	42.65	30.93	35.14 bc
Cereza	34.37	0.00	33.15	26.27	50.31	0.00	36.02 b
Margarita	17.49	47.43	26.53	15.27	54.94	63.73	37.57 ab
Messi	19.29	41.21	26.34	24.17	38.85	41.28	31.86 cd
Picobella	20.22	29.79	18.61	17.13	43.36	51.18	30.05 de
Sun red	32.77	32.21	37.82	32.88	51.08	52.42	39.86 a
BARI Alu-7 (Diamant)	25.89	39.75	29.21	28.82	43.65	46.16	35.58 b
BARI Alu-25 (Asterix)	14.63	35.95	32.78	32.86	41.36	50.01	34.6 bc
BARI Alu-28 (L.Rosetta)	21.97	27.07	21.94	23.56	38.20	46.99	29.96 de
BARI Alu-13 (Granola)	21.12	35.73	21.25	23.57	40.35	23.57	27.6 e
CV(%)	15.35						

Table 60. Dry matter (%) of the potato varieties as influenced by different environments, 2018-19

Variety	Location						
	Gazipur	Jamal	Jashore	Munshigonj	Bogura	Debiganj	Mean
Actrice	18.28	18.63	13.91	18.03	17.30	14.37	16.75 f
Cereza	17.42	0.00	14.76	18.18	17.55	15.70	16.98 ef
Margarita	16.32	18.32	15.88	20.35	16.80	17.17	17.48 cde
Messi	17.98	18.70	15.85	20.37	18.22	15.47	17.76 cd
Picobella	16.92	17.50	15.68	18.19	17.55	15.91	16.96 ef
Sun red	17.25	19.17	14.53	19.41	17.30	13.54	16.87 ef
BARI Alu-7 (Diamant)	20.45	19.47	17.18	20.56	17.55	20.17	19.23 b
BARI Alu-25 (Asterix)	17.43	19.07	13.79	21.21	19.05	18.23	18.13 c
BARI Alu-28 (L.Rosetta)	21.33	22.07	21.37	22.19	16.88	21.57	20.9 a
BARI Alu-13 (Granola)	17.89	14.43	15.15	19.77	17.80	17.80	17.14 def
CV(%)	5.65						

Table 61. Average grading of tubers (six locations) by weight of potato, 2018-19

Variety	% of Tuber Grade by Weight			
	<28 mm	28-40mm	40-55mm	>55mm
Actrice	5.25	22.89	47.23	24.73
Cereza	5.81	25.32	40.74	10.90
Margarita	8.72	25.04	44.67	21.87
Messi	6.7	15.32	44.53	34.08
Picobella	5.31	32.12	47.75	14.99
Sun red	3.96	16.08	41.66	38.39
BARI Alu-7 (Diamant)	8.03	32.59	49.13	10.62
BARI Alu-25 (Asterix)	6.19	35.15	47.63	11.10
BARI Alu-28 (L.Rosetta)	6.96	29.46	50.35	13.30
BARI Alu-13 (Granola)	7.27	36.95	46.79	9.33

11.29. PARTICIPATORY VARIETY SELECTION (ADVANCED VARIETIES)

Six exotic potato varieties namely Actrice, Cereza, Messi, Margarita, Picobella and Sun red along with check varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at farmers' field of six different agro ecological environments during 2018-19 cropping season in PVS. Yield of six tested new exotic varieties varied significantly from location to location. In some cases more or less yield was obtained. Farmer's perception also varied. For that reason, the tested varieties need to be further evaluated for conformation.

Table 62. Tuber Yield (t/ha) at 95 DAP of exotic varieties under PVS at farmers' fields, 2018-19

Variety	Location					
	Bogura	Debiganj	Gazipur	Jashore	Munshigonj	Mean
Actrice	49.75	28.91	58.24	47.36	31.9	43.23
Cereza	52.48	27.71	35.54	42.50	31.25	37.90
Messi	40.82	28.89	55.55	38.47	21.72	37.09
Margarita	53.33	32.49	45.26	37.78	28.38	39.45
Picobella	48.38	27.73	55.74	27.99	24.70	36.91
Sun red	50.9	26.53	58.15	38.75	21.58	39.18
BARI Alu-7 (Diamant)	35.87	22.45	-	42.22	39.71	35.06
BARI Alu-25 (Asterix)	39.13	31.51	-	35.90	44.61	37.79
BARI Alu-28 (L.Rosetta)	32.32	30.45	-	28.47	22.09	28.33

11.30. REGIONAL YIELD TRIAL WITH EXOTIC POTATO VARIETIES

Two exotic potato namely Colombia and Fortus along with check varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at six different agro ecological environment/locations during 2018-19 cropping season in RYT. The significant influence was observed of different environmental factors of different locations on the expression of different characters of potato. The variety Colomba yielded the highest (44.51 t/ha) followed by Fortus (42.93 t/ha) at 95 DAP. So, considering the yield, performance in farmers' field trial, post-harvest, processing, disease and insect data both exotic varieties were recommended for release as commercial varieties.

Table 63. Tuber yield (t/ha) at 95 DAP of the potato varieties as influenced by different environments, 2018-19

Variety	Location						
	Gazipur	Jamalpr	Jashore	Munshi	Bogura	Debiganj	Mean
Colomba	35.52	59.13	36.71	48.98	55.01	31.70	44.51 a
Fortus	41.07	50.16	36.44	50.63	44.50	34.80	42.93 b
BARI Alu-7 (Diamant)	35.96	42.51	34.68	46.02	42.42	24.68	37.71 c
BARI Alu-25 (Asterix)	39.24	44.63	35.35	38.95	42.24	27.99	38.07 c
BARI Alu-28 (L.Rosetta)	29.56	34.96	31.15	40.65	36.32	28.52	33.53 d
CV (%)	4.98						

Table 64. Dry matter (%) of the potato varieties as influenced by different environments, 2018-19

Variety\ Location	Location						
	Gazipur	Jamal	Jashore	Munshigonj	Bogura	Debiganj	Mean
Colomba	17.70	18.57	17.11	19.23	17.63	17.28	17.92 c
Fortus	18.44	18.17	19.58	17.66	17.55	18.57	18.33 b
BARI Alu-7 (Diamant)	19.64	20.07	18.81	19.21	18.80	19.72	19.38 b
BARI Alu-25 (Asterix)	19.30	20.93	20.92	18.65	19.88	19.22	19.82 b
BARI Alu-28 (L.Rosetta)	22.58	23.16	23.26	22.37	21.22	21.87	22.41 a
CV (%)	4.42						

Table 65. Average grade of tubers of six locations by weight, 2018-19

Variety	% of Tuber Grading by Weight			
	<28mm	28-40mm	40-55mm	>55mm
Colomba	5.01	28.14	46.71	20.14
Fortus	4.55	28.18	48.13	19.13
BARI Alu-7 (Diamant)	3.02	33.26	47.01	16.70
BARI Alu-25 (Asterix)	2.28	25.90	60.20	11.63
BARI Alu-28 (L. Rosetta)	3.14	31.01	47.57	18.28

11.31. PARTICIPATORY VARIETY SELECTION FOR TABLE, EXPORT AND PROCESSING PURPOSES

Two exotic potato varieties namely Colomba and Fortus along with check varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at farmers' field of six different agro ecological environments/locations during 2018-19 cropping season in PVS. Yield of two tested new exotic varieties varied significantly from location to location. In some cases, more than double yield was obtained compare to another location. Farmers perception also varied.

Table- 66. Tuber Yield (t/ha) at 95 DAP under PVS, 2018-19

Variety	Location					
	Bogura	Debiganj	Munshiganj	Jashore	Jamalpur	Mean
Colomba	38.01	29.51	27.13	31.85	25.51	30.40
Fortus	49.75	32.45	43.90	32.78	24.47	36.67
BARI Alu-7 (Diamant)	42.95	22.45	44.11	31.16	21.22	32.38
BARI Alu-25 (Asterix)	38.94	31.51	38.04	35.74	23.35	33.52
BARI Alu-28 (L. Rosetta)	28.2	30.56	34.13	34.07	27.57	30.91

2nd Year (2019-2020)

11.32. SECONDARY YIELD TRIAL OF EXOTIC POTATO VARIETIES

Six exotic varieties along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (L. Rosetta) were evaluated at six different agro ecological locations of Bangladesh (Bogura, Debiganj, Gazipur, Jamalpur, Jashore and Munshigonj) during 2019-20. The significant influence was observed of different environmental factors of different locations on the expression of different characters of potato. The highest yield at 65 days after planting (DAP) was found (44.57 t/ha) with Alcander at Gazipur. But Delia Red performed the best average yield (27.88 t/ha) over the six locations which was statistically similar with the average yield of Alcander (25.87 t/ha), Twister (27.00) and Prada (25.98). Exotic variety Delia Red gave the highest yield (71.08 t/ha) at Gazipur. The highest average yield (48.15 t/ha) was found in Diverse Zailengence which was statistically similar with BARI Alu-7 (45.88), Twister (45.70), Delia Red (41.68), and Prada (41.43) (Table 9). At harvest, the average number of tuber/hill (10.62) was found in BARI Alu-25 (Asterix) followed by Twinner (10.58) over the locations. On the other hand, the average lowest number of tuber/hill (8.24) was found with Prada. In case of tuber weight/hill, the highest value was found in Diverse Zailengence (0.721 Kg/hill) while the lowest (0.499 kg/hill) was found in BARI Alu-28 (Lady Rosetta) over six locations. Varieties Diverse Zailengence, Twister, Delia Red and Prada were selected for AYT, 2021.

Table 67. Tuber yield (t/ha) at 95 DAP as influenced by different environments, 2019-20

Varieties	Location						
	Gazipur	Bogura	Debiganj	Jamalpur	Jashore	Munshiganj	Mean
Alcander	40.86	41.40	26.46	25.74	32.89	30.54	32.98 c
Delia Red	71.08	47.55	19.55	27.62	49.12	35.16	41.68 ab
Diverse Zailengence	46.19	52.98	51.35	40.37	59.35	38.64	48.15 a
Twinner	58.82	37.83	30.91	32.75	47.49	30.82	39.77 bc
Twister	55.60	54.89	41.39	41.12	37.08	44.14	45.70 ab
Prada	50.22	41.04	34.22	31.05	55.55	36.54	41.43 ab
BARI Alu-7 (Diamant)	56.15	41.77	33.83	29.90	87.91	25.71	45.88 ab
BARI Alu-25 (Asterix)	52.44	46.27	32.80	36.47	45.69	27.11	40.13 bc
BARI Alu-28 (L Rosetta)	44.23	35.16	33.70	24.79	33.77	27.73	33.23 c
BARI Alu-13 (Granola)	53.92	36.08	27.51	23.25	34.77	26.53	33.67 c
CV	27.13						

Table 68. Tuber characteristics of exotic potato varieties under SYT, 2019-20

Variety	Tuber Shape	Depth of eyes	Color of skin
Alcander	Round	Shallow	Yellow
Delia Red	oval	Shallow	Red
Diverse Zailengence	Short oval	Shallow	Yellow
Twinner	Oval (Compressed)	Shallow	Yellow
Twister	oval to Short oval	Shallow	Yellow
Prada	Long oval	Shallow	Yellow
BARI Alu-7 (Diamant)	Oval to long oval	Medium	Light Yellow
BARI Alu-25 (Asterix)	Oval to long oval	Medium Deep	Attractive Yellow
BARI Alu-28 (L.Rosetta)	Oval to long oval	Shallow	Attractive Yellow
BARI Alu-13 (Granola)	Round oval	Shallow	Light Red

11.33. ADVANCED YIELD TRIAL OF EXOTIC POTATO VARIETIES

Ten exotic varieties along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (L. Rosetta) were evaluated at six different agro ecological locations of Bangladesh (Bogura, Debiganj, Gazipur, Jamalpur, Jashore and Munshigonj) during 2019-20 for third generation trial. The significant influence was observed of different environmental factors of different locations on the expression of different characters of potato. The highest yield at 65 DAP was found (41.44 t/ha) with Fontane at Bogura and Debiganj. But, HZD 1245 performed best and produced average yield (34.54 t/ha) over the six locations which was statistically similar with the average yield Innovator and Ottawa (32.02 t/ha). HZD 1249, Ottawa and Innovator are good for early bulker. Exotic variety Ottawa gave the highest yield (71.28 t/ha) at Munshigonj. The highest average yield (55.17 t/ha) was also found in Ottawa. At harvest, the average number of tuber/hill (17.10) was found in BARI Alu-25 (Asterix) over the locations. The average lowest number of tuber/hill (10.21) was found with Alberta. In case of tuber weight/hill, the average highest tuber weight/hill was found in Arizona while the lowest weight of tuber/hill (0.601 kg) was found with Fontane over the locations. Dry matter percentage at harvest was higher with check variety Alberta (24.43) at Gazipur. Considering the average over locations, Alberta gave the highest percentage of dry matter (21.26). In the both cases of tuber grade by number (%) and weight (%), most of the exotic lines produced desired number of medium size

tubers (28-40 and 40-55mm size) at all the location. Seed tuber grade performance was satisfactory among the genotypes and over the locations. Variety Ottawa, Arizona, Al Russet, Innovator and HZD 1249 could be selected for RYT.

Table 69. Marketable tuber yield (t/ha) at 95 DAP as influenced by different environments, 2019-20

Variety	Location						
	Gazipur	Bogura	Debi	Jamal	Jashore	Munshiganj	Mean
Alberta	41.47	63.94	27.07	24.66	35.42	44.81	39.56fg
Al. Russet	48.02	67.87	44.55	30.06	52.22	66.01	51.46 abc
Arizona	67.89	52.27	54.51	29.77	56.16	63.14	53.95ab
Dunstar	56.41	54.57	52.38	27.34	42.17	66.42	49.88a-d
Innovator	55.28	64.23	37.98	29.90	45.05	63.19	49.27bcd
Fontane	38.34	51.38	30.02	21.50	26.25	47.29	35.80 g
HZD 1249	46.40	64.07	47.19	36.51	42.78	65.04	50.33a-d
Ottawa	59.08	65.30	39.25	40.70	55.42	71.28	55.17 a
Sayada	51.78	35.71	33.90	23.42	36.90	56.04	39.62fg
Tiamo	40.64	63.64	40.04	29.38	35.74	66.17	45.94 de
BARI Alu-7 (Diamant)	56.64	53.81	34.59	37.62	45.19	50.48	46.39 cde
BARI Alu-25 (Asterix)	53.85	58.33	35.09	27.28	44.63	58.51	46.28cde
BARI Alu-28 (L.Rosetta)	53.85	65.00	39.11	19.28	44.63	65.17	47.84 cd
BARI Alu-13 (Granola)	46.81	63.18	37.49	18.19	32.31	56.70	42.45 ef
CV(%)	22.84						

Table 70. Dry matter (%) of the potato varieties as influenced by different environments, 2019-20

Variety	Location					
	Gazipur	Bogura	Jamalpur	Jashore	Munshiganj	Mean
Alberta	24.43	21.61	19.39	18.68	17.93	21.26 a
Al. Russet	24.33	21.53	19.35	18.65	17.77	20.93 a
Arizona	24.31	21.4	19.3	18.64	17.73	20.35 b
Dunstar	24	20.73	19.3	18.62	17.55	20.08 bc
Innovator	23.82	20.73	19.22	18.61	17.49	19.96 bcd
Fontane	23.68	20.65	19.06	18.61	17.33	19.65 cde
HZD 1249	23.66	20	19	18.42	17.3	19.63 c-f
Ottawa	23.5	19.83	19	18.39	17.3	19.56 def
Sayada	23.22	19.83	18.89	18.33	17.3	19.37 efg
Tiamo	23	19.8	18.83	18.31	17.18	19.13 fgh
BARI Alu-7 (Diamant)	22.42	19.8	18.71	18.21	16.48	19.11 fgh
BARI Alu-13 (Granola)	21.66	19.63	18.71	18.05	15.96	18.26 i
BARI Alu-25 (Asterix)	22.38	19.8	18.71	18.13	16.23	18.95 gh
BARI Alu-28 (L.Rosetta)	21.69	19.78	18.71	18.05	16.16	18.70 hi
CV(%)	3.62					

Table 71. Average grade of tubers by weight, 2019-20

Variety	% of Tuber Grading by Weight			
	<28 mm	28-40mm	40-55mm	>55mm
Alberta	13.16	34.02	41.73	11.66
Al. Russet	5.07	34.30	42.20	18.97
Arizona	7.34	30.02	38.80	23.75
Dunstar	7.03	37.12	36.89	17.30
Innovator	21.57	32.93	34.58	12.33
Fontane	6.15	31.78	43.40	19.16
HZD 1249	10.04	31.22	39.51	19.07
Ottawa	8.49	32.03	42.89	17.98
Sayada	10.74	20.17	43.85	25.86
Tiamo	5.55	30.44	44.62	19.09
BARI Alu-7 (Diamant)	12.2	33.14	39.38	15.68
BARI Alu-25 (Asterix)	10.84	38.56	37.14	13.25
BARI Alu-28 (L.Rosetta)	11.63	35.29	37.65	15.31
BARI Alu-13 (Granola)	9.42	35.63	42.60	13.05

Table 72. Tuber characteristics of exotic potato under AYT, 2019-20

Variety/Line	Tuber Shape	Colour of Skin	Depth of Eyes
Alberta	Oval to long oval	Yellow	Medium deep
Al.Russet	Oval to long oval	Yellow	Deep
Arizona	Oval to long oval	Yellow	Shallow
Dunstar	Oval to long oval	Attractive red	Medium deep
Fontane	Oval to long oval	Yellow	Shallow
HZD1249	Oval to long oval	Yellow	Deep
Innovator	Oval to long oval	Yellow	Medium deep
Ottawa	Oval to long oval	Yellow	Medium deep
Primavera	Oval to long oval	Yellow	Deep
Sayada	Round	Red	Medium deep
Tiamo	Round Oval	Attractive red	Deep
Diamant	Oval to long oval	Yellow	Shallow
Asterix	Oval to long oval	Red	Shallow
L.Rosetta	Round	Light red	Shallow
Granola	Round Oval	Yellow	Shallow

11.34. PARTICIPATORY VARIETY SELECTION OF ADVANCED MATERIALS FOR EXPORT AND PROCESSING PURPOSES

Ten exotic potato varieties with four check varieties were evaluated at farmers' field of six different agro ecological environments/locations during 2019-20 cropping season in PVS. Yield of ten tested new exotic varieties varied significantly from location to location. Some cases more than double yield was obtained. Farmer's perception also varied. For that reason, the tested varieties need to be further evaluated for confirmation.

Table 73. Tuber Yield (t/ha) at 95 DAP under PVS, 2019-20

Variety	Location						
	Bogura	Debigonj	Gazipur	Jamalpur	Jashore	Munshigonj	Mean
Alberta	27.33	-	-	31.65	21.25	-	26.74
Al.Russet	44.86	13.42	36.37	25.06	42.61	44.49	34.47
Arizona	33.06	29.30	18.67	27.95	35.28	54.03	33.05
Dunstar	52.83	18.47	33.34	30.27	37.78	43.73	36.07
Innovator	33.66	16.21	29.63	35.05	38.47	39.86	32.15
Fontane	29.00	26.34	30.30	27.30	23.97	28.85	27.63
HZD1249	41.45	18.28	24.85	26.20	55.83	26.04	32.11
Ottawa	37.00	12.76	40.00	26.83	47.53	53.60	36.29
Sayada	43.34	-	16.30	42.59	33.94	35.51	34.34
Tiamo	45.30	-	13.32	37.38	36.39	30.27	32.53
BARI Alu-7 (Diamant)	45.08	14.72	30.31	31.66	46.11	37.87	34.29
BARI Alu-13 (Granola)	41.78	29.58	27.78	28.98	39.24	35.42	33.80
BARI Alu-25 (Asterix)	43.09	28.84	27.78	28.98	34.12	39.81	33.77
BARI Alu-28 (L.Rosetta)	38.30	-	31.52	39.87	29.21	33.46	34.47

11.35. REGIONAL YIELD TRIAL WITH EXOTIC POTATO VARIETIES

Three exotic potato varieties namely Messi, Picobello and Sunred along with three check varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at six different agro ecological environment/locations during 2019-20 cropping season in RYT. The significant influence was observed of different environmental factors of different locations on the expression of different characters of potato. No early bulker clone was selected from this study. No early mature clone was found than check variety BARI Alu-28 (Lady Rosetta). The highest average yield was found in in Messi (42.81 t/ha) followed by Sunred (39.21 t/ha) and Picobello (38.62 t/ha). Average dry matter percentages of tested exotic varieties were not suitable for processing purpose. Sunred (67.13%), Messi (65.33%) and Picobello (65.21%) gave higher percentages of larger sized tuber which is important for export purpose. In case of organoleptic taste, Picobello performed best regarding taste, appearance and texture of boiled potato. Considering tuber yield, organoleptic taste performance, disease, insect infestation and tuber characteristics (shape, size, colour, scoring) these three exotic varieties (Messi, Picobello and Sunred) could be recommended for release as commercial varieties.

Table 74.Tuber yield (t/a) of the exotic varieties in RYT over location at 95 DAP, 2019-20

Variety	Location						
	Bogura	Debiganj	Gazipur	Jamalpur	Jashore	Munshij	Mean
Picobello	51.92 a	39.12fg	25.98 no	39.54fg	41.02 f	34.13ij	38.62 b
Messi	47.08 c	35.35 hi	31.06 k	44.39 e	46.64 cd	34.06ij	39.76 a
Sunred	44.86 de	34.97 hi	31.39 k	39.03fg	49.15 b	35.87 hi	39.21ab
BARI Alu-7 (Diamant)	44.84 de	32.53jk	31.48 k	39.33fg	47.80bc	27.43mn	37.24 c
BARI Alu-25 (Asterix)	47.15bc	33.96ij	24.35 o	44.93 de	38.70 g	28.95 lm	36.34 d
BARI Alu-28 (L. Rosetta)	38.93 g	30.89 kl	21.53 p	36.54 h	35.68 hi	26.21 no	31.63 e
CV%	3.40						

Table 75. Dry matter (%) of potato varieties under RYT, 2019-20

Variety	Location						
	Bogura	Debiganj	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
Picobello	16.35qr	15.15 s	17.33 n-q	19.93gh	18.70 i-m	17.73 l-p	17.53 c
Messi	15.64rs	17.86 l-p	18.19 k-o	19.59 g-j	17.83 l-p	18.41 j-n	17.92 c
Sunred	14.93 s	17.60 m-p	16.95pq	19.91gh	18.50 i-n	19.23 g-k	17.86 c
BARI Alu-7 (Diamant)	19.26 g-k	17.22opq	21.85cde	19.62ghi	22.50bcd	19.08 g-k	19.92 b
BARI Alu-25 (Asterix)	17.83 l-p	18.44 i-n	21.48 de	21.25ef	19.40 g-j	18.91 h-l	19.55 b
BARI Alu-28 (L. Rosetta)	21.93cde	21.21ef	22.98abc	23.56ab	23.90 a	20.20fg	22.30 a
CV%	3.80						

Table 76. Average grade of tubers by weight in RYT, 2019-20 (average of six locations)

Variety	% of Tuber Grade by Weight			
	<28 mm	28-40mm	40-55mm	>55mm
Picobello	8.88	25.92	35.23	29.98
Messi	15.11	19.55	30.91	34.42
Sunred	18.00	14.87	26.76	40.37
BARI Alu-7 (Diamant)	11.34	27.97	34.07	26.62
BARI Alu-25 (Asterix)	11.56	29.09	36.85	22.49
BARI Alu-28 (L. Rosetta)	11.66	27.10	32.83	28.41

Table 77.Tuber characteristics at harvest

Variety/Genotype	Tuber Shape	Color of skin	Smoothness of skin	Depth of Eyes
Picobello	long oval, oval	Yellow	Smooth	Shallow
Messi	long oval, oval	Yellow	Smooth	Shallow
Sunred	Oval, short oval	Red	Rough	Medium
BARI Alu-7 (Diamant)	Oval to long oval	Yellow	Medium	Shallow
BARI Alu-25 (Asterix)	Oval to long oval	Red	Smooth	Shallow
BARI Alu-28 (L.Rosetta)	Round	Red	Rough	Medium

11.36. PARTICIPATORY VARIETY SELECTION OF RYT MATERIALS

Three exotic potato varieties along with three check varieties were evaluated at farmers' field of five different agro ecological environments/locations during 2019-20 cropping season in PVS. Yield of three tested new exotic varieties varied significantly from location to location. The average highest tuber yield (37.13 t/ha) was recorded in Messi followed by Picobello (36.63 t/ha) and lowest average yield was found in check variety BARI Alu-28 (Lady Rosetta) (34.47 t/ha). Farmers were very much interested in these exotic varieties but varied location to location. Therefore, these varieties can be recommended for the release as commercial varieties.

Table-78. Tuber Yield (t/ha) of RYT materials at 95 DAP under PVS, 2019-20

Variety	Location					
	Bogura	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
Messi	34.14	37.03	36.05	34.72	43.72	37.13
Picobello	52.21	28.89	26.96	44.09	31.00	36.63
Sunred	37.40	30.46	30.70	34.97	38.97	34.50
BARI Alu-7 (Diamant)	45.08	25.31	31.66	33.94	39.68	35.13
BARI Alu-25 (Asterix)	43.09	27.78	28.98	34.12	39.81	34.76
BARI Alu-28 (L. Rosetta)	38.30	31.52	39.87	29.21	33.46	34.47

3rd Year (2020-2021)

11.37. PRELIMINARY YIELD TRIAL OF EXOTIC POTATO VARIETIES

The experiment was conducted at Gazipur and Debiganj during the rabi season of 2020-21. Fourteen exotic potato varieties namely Armin, Beyonce, Everest, Focus, Hind, Inspyra, Paradiso, Ranoni, SHC 1010, Spectra, Tiger, Vogue and Zina red received from different companies with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were included in the experiment. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The unit plot size was 3 m × 3 m. Planting was done on 23.12.20 at Gazipur, 12.12.20 and 20.12.20 at Debigonj. Planting spacing was maintaining 60 cm × 25 cm. The variety Zina red gave the highest average marketable yield and all the exotic varieties produced satisfactory marketable yield. This is the first-year trial. As the seed potato were collected from different countries, they might not expose their all characters completely. Therefore, no selection was done in this year. Seeds produced from this trial were kept for 2nd year trial for further evaluation.

Table 79. Tuber yield (t/ha) of potato varieties over location, 2020-21

Variety\ location	Gazipur	Debiganj
Armin	12.89	-
Beyonce	14.32	27.28
Everest	20.37	39.26
Focus	17.44	-
Hind	21.97	-
Inspyra	13.57	-
Paradiso	16.06	27.28
Ranoni	11.79	28.97
SHC 1010	18.54	27.14
Spectra	19.64	21.28
Tiger	19.55	-
Vogue	20.37	42.67
Zina red	20.94	44.18
Monster	-	26.32
BARI Alu-7 (Diamant)	12.66	22.00
BARI Alu-8 (Cardinal)	-	29.67
BARI Alu-13 (Granula)	11.04	-
BARI Alu-25 (Asterix)	13.06	33.90
BARI Alu-28 (L. Rosetta)	14.57	23.30
BARI Alu-29 (Courage)	13.62	-

11.38. ADVANCED YIELD TRIAL OF EXOTIC POTATO VARIETIES FOR EXPORT AND PROCESSING PURPOSES

Seven exotic varieties viz. Alcander, Delia Red, Hind, Prada, Rslin, Twinner and Twister along with four checks BARI Alu-7, BARI Alu-13, BARI Alu-25 and BARI Alu-28 were evaluated at six different agro ecological locations of Bangladesh named as Bogura, Debiganj, Gazipur, Jamalpur, Jashore and Munshiganj during 2020-21 in RCB design with three replications. The unit plot size was 3m × 3m. Whole tubers (BSPC, Debigonj source) was planted with a spacing of 60cm×25cm. Planting at different locations were done during the last week of November, 2020. Significant variation was observed due to environmental factors in different locations to the expression of different characters of potato. The exotic variety Delia Red obtained the highest yield within 65 days (30.91 t/ha) followed by Prada (30.77 t/ha). The utmost dry matter (%) was observed in the check variety BARI Alu-28 (26.00) at Jashore followed by Prada (22.86) and Alcander (22.08) at Debiganj. Considering the overall performances, exotic varieties Alcander, Hind and Rslin were selected for RYT. Twinner and Twister were selected for further late blight resistant study.

Table 80. Tuber yield (t/ha) of AYT potato varieties at 95 DAP at different locations, 2020-21

Variety	Location						
	Gazipur	Bogura	Debi	Jamal	Jashore	Munshi	Mean
Alcander	22.51 z	38.21 g-q	34.83 i-t	35.72 h-s	29.57 s-z	30.48 q-y	31.89 e
Delia Red	29.28 s-z	46.09 c-f	23.86 yz	42.33 d-i	41.29 e-k	36.09 h-s	36.49 bc
Hind	40.36 e-m	47.28 b-e	50.84 abc	56.40 a	45.42 c-g	45.34 c-g	47.61a
Prada	25.39 v-z	36.15 h-s	41.02 e-l	42.70 d-h	39.83 e-o	34.45 j-t	36.59 bc
Rslin	25.13 xyz	33.45 l-u	44.22 c-g	54.44 ab	38.15 g-r	38.52 f-p	38.98 b
Twinner	25.25 w-z	34.57 j-t	40.40 e-m	35.20 h-s	33.43 l-u	41.68 d-k	35.09 cd
Twister	33.13 m-v	33.36 l-u	41.77 d-k	44.72 c-g	40.29 e-n	44.11 c-g	39.56 b
BARI Alu-7 (Diamant)	28.92 s-z	41.70 d-k	27.13 t-z	42.15 d-j	35.90 h-s	46.07 c-f	36.98 bc
BARI Alu-13 (Granola)	19.29 z	32.97 m-w	30.12 s-z	40.02 e-o	34.40 k-t	27.22 t-z	30.67 e
BARI Alu-25 (Asterix)	25.07 xyz	36.18 h-s	25.74 u-z	40.11e-o	32.51 o-x	36.18 h-s	32.63 de
BARI Alu-28 (L.Rosetta)	21.56 AB	32.61n-x	28.61s-z	49.28 a-d	30.42 r-y	31.83 p-x	32.38 de
CV %	13.20						

Table 81. Dry matter (%) of the AYT potato varieties as influenced by different environments, 2020 -21

Variety	Location						
	Gazipur	Bogura	Debi	Jamal	Jashore	Munshi	Mean
Alcander	20.79 cde	20.30 e-h	22.08 bc	18.70 i-r	21.00 cde	17.33 r-z	20.03 b
Delia Red	16.51 w-A	18.05 l-t	18.43 k-s	15.47 AB	19.67 e-k	16.98 t-z	17.52 e
Hind	17.64 q-y	20.88 cde	20.27 e-h	16.03 zAB	20.00 e-i	17.90 n-w	18.79 c
Prada	17.24 s-z	19.37 f-l	22.86 b	15.97 zAB	19.33 f-m	17.66 q-y	18.74 c
Rslin	18.19 l-t	16.22 zab	20.69 c-f	16.37x-B	20.00 e-i	17.89 n-w	18.23 cd
Twinner	18.01 l-u	18.72 i-r	17.78 o-w	16.50 w-z	19.67 e-k	17.83 n-w	18.09 de
Twister	16.31 y-B	19.13 g-o	17.24 s-z	15.40 AB	19.00 h-q	18.03-l-u	17.52 e
BARI Alu-7 (Diamant)	20.42 efg	19.13 g-o	18.53 j-s	19.60 e-k	23.00 b	19.88 e-j	20.09 ab
BARI Alu-13 (Granola)	16.63 u-A	17.72 p-x	17.94 m-v	15.07 b	18.00 l-u	19.94 e-i	17.55 e
BARI Alu-25 (Asterix)	19.08 g-p	18.72 i-r	16.52 w-A	16.57 v-z	20.67 def	19.34 f-m	18.48 cd
BARI Alu-28 (L.Rosetta)	22.00 bcd	19.22 g-n	15.01B	20.80 cde	26.00 a	20.67 def	20.62 a
CV %	4.65						

Stability analysis

AMMI biplot

The AMMI biplot provides a visual expression to determine the differences among the environments, to evaluate stable and wide adaptable line. Since the PC2 scores plays a significant role in explaining the genotype-environment interaction; the PC1 scores are being plotted against the PC2 scores for exploring adaptation. According to Fig 2, the genotypes Alcander, Prada, Twister, Hind, Granola and Asterix were more stable across the environments since these varieties tends to centre but the varieties Twinner, Rslin, Delia Red, Diamant and Lady Rosetta were unstable due to their dispersed positions.

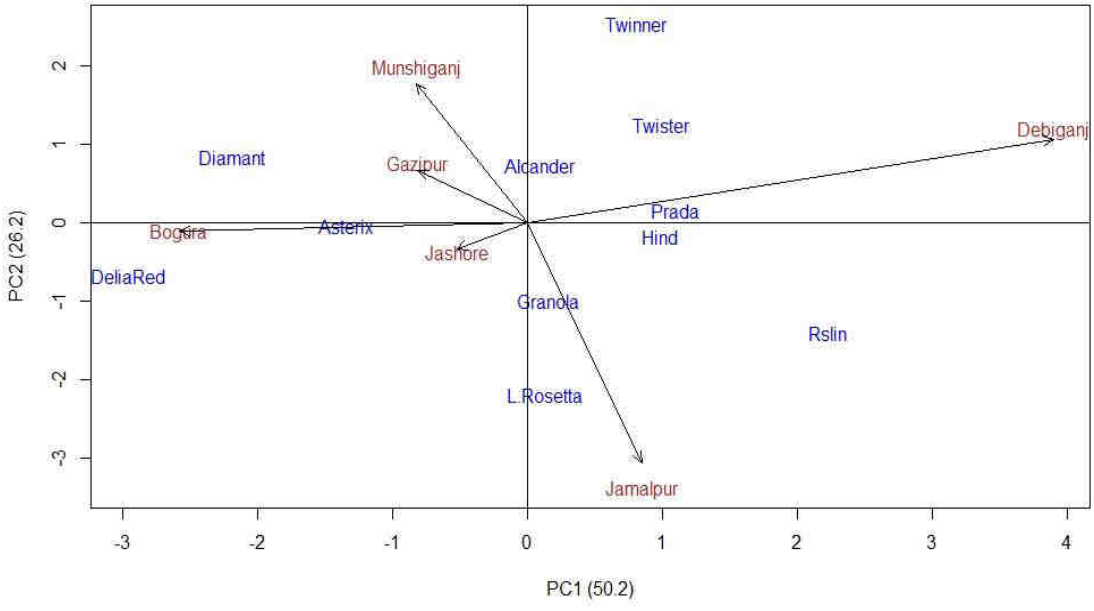


Figure2**.** Biplot of the first AMMI interaction (PC2) score (Y-axis) plotted against AMMI interaction (PC1) (X-Axis) of eleven potato genotypes over six locations.

Box plot

Box plots are used to show overall patterns of response for a group. This graph visually shows the distribution of numerical data and skewness through displaying the data quartiles (or percentiles) and averages. From the compare of yield with different locations (Fig 3), it can be said that the maximum varieties possessed highest yield at Jamalpur having a higher median and lowest yield at Gazipur location having lower median value.

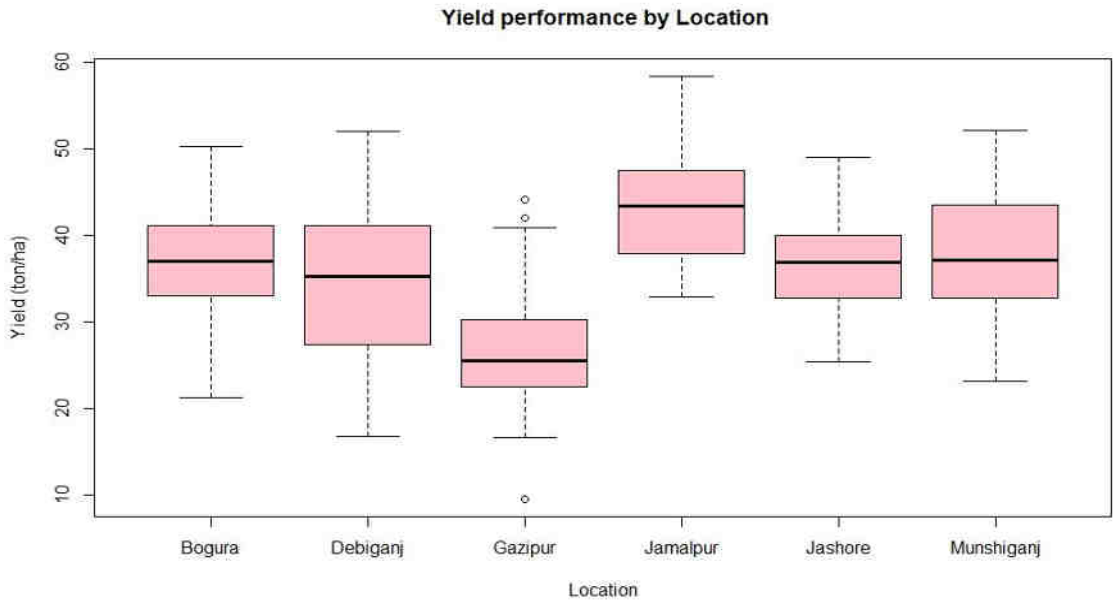


Figure3. Boxplot showing yield range of different potato genotypes

11.39. PARTICIPATORY VARIETY SELECTION (ADVANCED MATERIALS) FOR EXPORT AND PROCESSING PURPOSES

Seven exotic potato varieties with four check varieties were evaluated at farmers' field of six different agro ecological environments/locations during 2020-21 cropping season in PVS. Yield of ten tested new exotic varieties varied significantly from location to location. Farmer's perception was also varied, for that reason the tested varieties need to be further evaluation for confirmation.

Table 82. Tuber Yield (t/ha) at 95 DAP under PVS, 2020-21

Variety	Location						
	Bogura	Debigonj	Gazipur	Jamalpur	Jashore	Munshigonj	Mean
Alcander	49.91	29.61	27.58	37.02	30.00	33.00	34.52
Delia Red	49.21	26.05	45.45	47.61	39.86	31.07	39.87
Prada	47.75	36.41	27.24	52.44	40.97	34.7	39.91
Rsln	49.07	-	28.36	51.29	20.41	35.2	36.86
Hind	62.65	-	22.42	40.0	43.88	36.19	41.03
Twinner	56.26	33.3	16.66	38.88	31.11	30.8	34.50
Twister	57.85	35.85	35.63	44.76	35.55	54.12	43.96
BARI Alu-7 (Diamant)	49.55	23.16	32.26	52.68	38.05	32.12	37.97
BARI Alu-13 (Granola)	46.15	31.78	29.76	34.34	34.58	30.44	34.51
BARI Alu-25 (Asterix)	38.98	-	33.9	48.57	38.33	35.97	39.15
BARI Alu-28 (L.Rosetta)	43.99	34.33	24.24	45.09	30.13	31.02	34.80

11.40. REGIONAL YIELD TRIAL WITH EXOTIC POTATO VARIETIES

Seven exotic potato varieties namely Al. Russet, Arizona, Dunstar, HZD 1249, Innovator, Ottawa and Tiamo along with check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at Bogura, Debigonj, Gazipur, Jamalpur, Jashore and Munshigonj during 2020-21 cropping season in RCB design with three replications in each location. The unit plot size was 3m x 3m. Whole tubers (BSPC, Debigonj source) were planted with a spacing of 60 cm x 25 cm. 21.11.20, 23.11.20, 02.12.20, 25.11.20, 20.11.20 and 21.11.20 at Jashore, Bogura, Munshigonj, Jamalpur, Debigonj and Gazipur, respectively. during 2020-21 cropping season in RYT. The significant influence was observed of different environmental factors of different locations on the expression of different characters of potato. Ottawa was selected as early bulker exotic variety from this study. No early mature exotic variety was found than check variety BARI Alu-28 (Lady Rosetta). Mean yield over the locations Ottawa gave the statistically highest tuber yield (42.36 t/ha) which was sttistically similar only with HZD 1249 (41.42 t/ha) and followed by Al. Russet (39.69 t/ha), Arizona (38.85 t/ha). Among the tested exotic varieties Innovator produced acceptable average drymatter percent (20.01) for processing. Ottawa (85.01%), Innovator (81.65%) and Arizona (81.03%) gave more large (>40mm dia) size tubers which made great contribution towards percentage of tuber number and tuber weight which is important for export purpose as well as some cases processing purpose. Considering tuber yield, organoleptic taste, disease infection, insect infestation and tuber characteristics (shape, size, colour, scoring) these five exotic varieties (Ottawa, HZD 1249, Al. Russet, Arizona and Innovator) could be recommended for release as commercial varieties.

Table 83. Tuber yield (t/ha) at 95 DAP under RYT, 2020-21

Variety	Location						
	Bogura	Debiganj	Gazipur	Jamalpur	Jashore	Munshi	Mean
Al. Russet	46.63 ab	42.75 h-l	29.96 b-f	42.93 g-k	36.88 qrs	38.96 opq	39.69 b
Arizona	43.36 d-i	49.01 a	24.61 g	41.83 i-m	30.99 z-d	43.32 e-i	38.85 bc
Dunstar	34.93 s-v	40.19 l-p	30.19 b-e	46.31 bc	32.21 x-c	43.49 d-i	37.89 c
HZD 1249	45.96 bcd	40.55 j-p	33.02 u-a	43.81 c-i	40.33 k-p	44.83 b-h	41.42 a
Innovator	39.14 n-q	39.91 m-p	22.98 g	45.79 b-e	27.50 f	39.44 m-q	35.79 d
Ottawa	47.06 ab	45.42 b-g	34.86 s-w	41.62 i-n	39.63 m-p	45.56 b-f	42.36 a
Tiamo	40.46 j-p	42.99 f-j	24.41 g	27.90 ef	27.38 f	35.41 stu	33.09 e
BARI Alu-7 (Diamant)	29.60 def	31.04 y-d	29.81 c-f	40.31 l-p	38.31 pqr	41.66 i-n	35.12 d
BARI Alu-13 (Granola)	32.93 u-a	33.94 t-x	30.51 a-d	33.53 u-z	30.74 a-d	32.31 w-c	32.33 e
BARI Alu-25 (Asterix)	35.43 stu	36.28 rst	23.60 g	40.20 l-p	33.63 u-y	41.47 i-o	35.10 d
BARI Alu-28 (L. Rosetta)	32.48 v-b	31.06 y-d	22.89 g	32.49 v-b	27.41 f	32.95 u-a	29.88 f
CV%	4.41						

Table 84. Dry matter (%) of the varieties under RYT, 2020-21

Variety	Location						
	Bogura	Debiganj	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
Al. Russet	18.45 q-z	19.03 m-v	19.95 h-o	18.37 s-z	23.67 ab	19.88 h-p	19.89 c
Arizona	18.05 u-z	15.67 def	17.92 v-a	14.40 f	21.00 d-h	19.87 h-p	17.82 f
Dunstar	19.05 l-v	18.13 u-z	18.81 n-w	15.67 def	18.00 v-z	19.53 i-t	18.20 ef
HZD 1249	18.38 r-z	15.22 ef	17.60 w-a	16.20 b-e	19.67 i-r	19.78 h-p	17.81 f
Innovator	18.80 n-w	19.67 i-r	19.87 h-p	17.97 v-z	24.00 a	19.73 h-q	20.01 c
Ottawa	18.72 o-x	18.72 o-x	19.90 h-p	17.47 x-b	18.67 o-x	19.81 h-p	18.88 d
Tiamo	17.30 z-c	18.45 q-z	18.91 n-v	16.07 cde	18.33 t-z	19.60 i-t	18.11 ef
BARI Alu-7 (Diamant)	20.55 e-j	20.49 e-j	21.59 c-f	19.63 i-s	21.67 cde	20.61 e-i	20.76 b

Variety	Location						
	Bogura	Debiganj	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
BARI Alu-13 (Granola)	20.55 e-j	18.63 p-y	17.35 y-c	16.67 a-d	18.67 o-x	19.10 k-v	18.49 de
BARI Alu-25 (Asterix)	20.38 e-k	19.30 j-u	20.33 f-l	17.87 v-a	20.67 e-i	21.27 c-g	19.97 c
BARI Alu-28 (L. Rosetta)	20.30 g-m	20.07 g-n	22.24 cd	20.30 g-m	24.00 a	22.54 bc	21.57 a
CV%	4.15						

11.41. PARTICIPATORY VARIETY SELECTION OF RYT MATERIALS

The experiment was conducted in the farmer's field at six locations viz. Bogura, Debigonj, Gazipur, Jamalpur, Jashore, and Munshiganj during 2020-21. Seven exotic potato varieties namely Al Russet, Arizona, Dunstar, HZD 1249, Innovator, Ottawa, Tiamo selected from last three consecutive years (2017-2019) along with check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated in this trial. Planting was done in 21.11.2020 to 02.12.2020. Fertilizers were applied and management practices were done as per TCRC's recommendations. Harvesting was done on 95 DAP. Yield and disease & insect infestation data and mainly openion/comments from the farmers/endusers were collected and presented. Yield of seven tested new exotic varieties varied significantly from location to location. The average highest tuber yield (45.03 t/ha) was recorded in Dunstar followed by Al Russet (43.54 t/ha) and lowest average yield was found in Tiamo (33.65 t/ha). Farmers were very much interested in these exotic varieties but varied location to location. Therefore, these varieties could be recommended for release as commercial varieties.

Table 85. Tuber Yield (t/ha) at 95 DAP under PVS in farmers' fields, 2020-21

Variety	Location						
	Bogura	Gazipur	Jamal	Jashore	Munshiganj	Debigonj	Mean
Al Russet	49.67	31.96	47.47	53.89	44.49	33.78	43.54
Arizona	52.31	26.61	30.90	30.83	54.03	36.48	38.53
Dunstar	66.99	32.19	45.71	43.89	43.73	37.66	45.03
HZD 1249	52.25	35.02	50.00	37.50	26.04	30.61	38.57
Innovator	53.28	24.98	40.00	40.42	39.86	37.63	39.36
Ottawa	33.96	36.86	46.46	33.75	53.60	39.93	40.76
Tiamo	43.84	26.41	40.19	30.14	30.27	31.04	33.65
BARI Alu-7 (Diamant)	49.55	31.91	52.68	38.06	37.87	23.16	38.87
BARI Alu-13 (Granola)	46.15	30.51	36.36	30.74	35.42	31.78	35.16
BARI Alu-25 (Asterix)	38.98	25.60	48.57	33.63	40.84	34.42	37.01
BARI Alu-28 (L. Rosetta)	43.99	24.89	45.09	38.33	42.16	34.33	38.13

4th Year (2021-2022)

11.42. PRELIMINARY YIELD TRIAL OF EXOTIC POTATO VARIETIES

Three exotic potato varieties including four checks were evaluated at Gazipur and Debiganj for yield. The variety Zorba and Chenoa gave the highest average marketable yield at Gazipur and Debiganj, respectively. As the seed potato was collected from different countries, they might not expose their all characters completely in the first-year trial. Therefore, no selection was done this year. Seeds produced from this trial are kept for 2nd year trial for further evaluation.

Table 86. Tuber yield (t/ha) of PYT materials at 95 DAP, 2021-22

Variety\ location	Tuber Yield (t/ha)		Dry matter (%)	
	Gazipur	Debiganj	Gazipur	Debiganj
Alanis	13.40	30.69	19.57	16.91
Chenoa	13.99	61.57	20.53	18.83
Zorba	14.54	26.82	20.11	18.34
BARI Alu-7 (Diamant)	15.26	39.12	21.06	20.16
BARI Alu-13 (Granula)	13.33	44.73	17.31	16.74
BARI Alu-25 (Asterix)	13.12	39.94	19.63	18.16
BARI Alu-28 (L. Rosetta)	12.54	35.85	22.08	23.01

11.43. SECONDARY YIELD TRIAL WITH EXOTIC POTATO VARIETIES

Fourteen exotic varieties along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (L. Rosetta) were evaluated at Gazipur during 2021-22 for second generation trial. A significant influence was observed due to different germplasms on the expression of different characteristics of potato. Exotic variety Everest gave the highest yield (53.34 t/ha) followed by Spectra (46.14 t/ha). Dry matter percentage at harvest was the highest with check variety Lady Rosetta (21.79). Considering the average over locations, here check BARI Alu-28 (Lady Rosetta) again gave the highest percentage of dry matter (22.58) and followed by Ranoni (21.7%). Seed tuber grade performance was satisfactory among the genotypes. No selection was done from this trial and all the seeds were kept for evaluation in the next year's trial.

Table 87. Performances of the imported potato varieties in SYT, 2021-22

Variety	Characters			
	Tuber yield (t/ha) at 95 DAP	Tuber no/hill at 90 DAP	Tuber wt./hill at 90 DAP	Dry matter (%)
Armin	21.22 g	4.91 ef	0.320 g	16.62 i
Beyonce	33.02 b-g	8.75 ab	0.500 b-g	19.91 cd
Everest	53.34 a	7.34 a-e	0.800 a	20.43 bc
Focus	25.68 d-g	6.69 b-f	0.390 d-g	20.43 bc
Hind	41.05 abc	6.17 c-f	0.620 abc	18.83 ef
Inspyra	38.55 a-d	4.55 f	0.580 a-d	18.58 efg
Paradiso	38.47 a-d	7.91 abc	0.580 a-d	15.27 j
Ranoni	27.23 c-g	5.3 def	0.410 c-g	14.67 j
SHC 1010	38.07 b-e	8.79 ab	0.570 b-e	21.7 a
Spectra	46.14 ab	6.58 b-f	0.690 ab	16.37 i
Tiger	22.78 fg	5.28 def	0.340 fg	18.62 efg
Vogue	33.91 b-g	4.21 f	0.510 b-g	17.67 gh
Zina red	36.62 b-f	7.54 a-d	0.550 b-f	18.06 fgh
BARI Alu-7 (Diamant)	32.81 b-g	9.22 a	0.490 b-g	21.14 ab
BARI Alu-25 (Asterix)	31.54 b-g	7.56 a-d	0.470 b-g	17.33 hi
BARI Alu-13 (Granola)	23.12 efg	7.66 a-d	0.350 efg	19.2 de
BARI Alu-28 (L.Rosetta)	29.14 c-g	7.95 abc	0.440 c-g	21.79 a
CV(%)	21.24	17.31	21.24	2.52

Table 88. Average grade of tubers in SYT by number and weight, 2021-22

Genotypes	% of Tuber Grade by Number				% of Tuber Grade by Weight			
	15-28 mm	28-40 mm	40-55 mm	>55 mm	15-28 mm	28-40 mm	40-55 mm	>55 mm
Armin	12.77	25.05	50.77	11.41	1.59	12.65	58.02	27.75
Beyonce	15.18	27.70	43.38	13.74	1.94	14.79	47.29	35.98
Everest	7.26	18.44	42.52	31.78	0.54	6.27	35.67	57.52
Focus	14.27	35.38	39.86	10.49	2.10	16.96	49.04	31.91
Hind	7.78	23.13	46.87	22.23	0.28	10.33	44.16	45.23
Inspyra	7.88	20.98	30.20	40.95	0.44	4.20	29.04	66.32
Paradiso	10.63	19.55	53.72	16.09	0.97	6.90	55.16	36.97
Ranoni	10.85	24.83	47.48	16.84	1.21	11.24	52.92	34.63
SHC 1010	6.83	26.25	51.83	15.09	0.86	11.74	51.85	35.55
Spectra	6.70	12.32	43.16	37.81	0.45	3.45	27.15	68.95
Tiger	7.85	34.02	54.92	3.22	1.57	16.78	72.42	9.22
Vogue	8.32	13.32	37.56	40.80	0.55	2.46	28.17	68.81
Zina red	8.03	40.13	40.49	11.35	0.73	16.94	46.99	35.34
BARI Alu-7 (Diamant)	13.82	44.50	38.54	3.14	2.84	25.46	59.84	11.85
BARI Alu-25 (Asterix)	18.33	32.40	39.32	9.95	1.70	13.28	48.43	36.60
BARI Alu-13 (Granola)	16.22	49.19	34.17	0.42	4.73	39.05	53.62	2.60
BARI Alu-28 (L.Rosetta)	12.54	30.41	50.45	6.59	2.11	21.45	60.25	16.19

11.44. REGIONAL YIELD TRIAL OF EXOTIC POTATO VARIETIES

Three exotic potato varieties namely Alcander, Hind and Roslin along with check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at six different agro ecological environment/locations during 2021-22 cropping season in RYT. The significant influence was observed of different environmental factors of different locations on the expression of different characters of potato. Hind was selected as early bulker exotic variety from this study. Mean yield over the locations, Roslin gave average highest yield (43.39 t/ha) which was statistically similar with Hind (42.30 t/ha). Therefore, these two exotic varieties could be recommended for the release as commercial varieties due to their higher tuber yield potentialities. Among the tested exotic varieties Alcander was early mature exotic variety and also produced acceptable average dry matter percent (20.12) for processing. However, this variety was already released by BADC. Hind and Roslin gave more large (>40mm dia) tubers and weight and dormancy 70 to 78 days which is important for export purpose as well as some cases processing purpose. Roslin performed best regarding taste, appearance and texture of boiled potato. Considering tuber yield, organoleptic taste performance, disease infection, insect infestation and tuber characteristics (shape, size, colour, scoring) these two exotic varieties (Hind and Roslin) could be recommended for release as commercial varieties.

Dry matter percentage at harvest was the highest with check variety BARI Alu-28 (Lady Rosetta) at Debigabj (22.67). Considering the average over locations, this check again gave the highest dry matter (21.50%). Average dry matter percentages of Alcander (20.12) was suitable for processing purpose (Table 10). Additionally, processing qualities data from Quasem Food Products showed that Hind and Roslin not suitable for processed products but Alcander may be appropriate for processing.

Average tuber grading percent by number and weight over six locations presented in table 12. The mean data indicated that all the tested varieties produced satisfactory desired size (28-55 mm) tuber in both number and weight. Seed tuber grade percentage showed satisfactory performance among the genotypes and over the locations. Hind gave more large (>40mm dia) size tubers which made great contribution towards percentage of tuber number (54.50) and tuber weight (77.90). Roslin also gave more large (>40mm dia) size tubers which made great contribution towards percentage of

tuber number (48.19) and tuber weight (80.96). Large size tuber is important for export purpose (Table 12).

Table 89. Tuber yield (t/ ha) of imported potato varieties at 95 DAP at different locations, 2021-22

Variety	Location				
	Bogura	Debiganj	Gazipur	Jamalpur	Mean
Alcander	45.53 cd	24.09 lmn	24.3 lmn	35.31 fg	32.31 b
Hind	51.85 b	31.96 g-j	34.69 fg	50.7 b	42.3 a
Roslin	60.01 a	28.53 j-m	32.5 g-j	52.53 b	43.39 a
BARI Alu-7 (Diamant)	48.92 bc	25.42 k-n	23.73 mn	38.38 ef	34.11 b
BARI Alu-13 (Granola)	45.7 cd	32.89 g-j	22.42 n	33.4 ghi	33.6 b
BARI Alu-25 (Asterix)	41.59 de	32.03 g-j	23.12 n	34.07 fgh	32.7 b
BARI Alu-28 (L. Rosetta)	35.7 fg	28.84 i-l	20.68 n	29.62 h-k	28.71 c
CV%	8.31				

Table 90. Dry matter (%) of tubers at harvest, 2021-22

Variety\location	Bogura	Debiganj	Gazipur	Jamalpur	Mean
Alcander	18.88 fg	19.67 ef	20.55 cde	21.38 bc	20.12 b
Hind	17.8 ghi	17.67 hij	17.56 h-k	16.51 kl	17.38 d
Roslin	17.8 ghi	16.67 jkl	18.42 gh	18.23 gh	17.78 d
BARI Alu-7 (Diamant)	18.55 fgh	19.67 ef	20.45 cde	20.51 cde	19.79 b
BARI Alu-13 (Granola)	18.55 fgh	16.33 l	16.89 i-l	17.76 g-j	17.38 d
BARI Alu-25 (Asterix)	17.8 ghi	18 ghi	20.21 de	20.19 de	19.05 c
BARI Alu-28 (L. Rosetta)	21.22 bcd	22.67 a	21.95 ab	20.16 de	21.5 a
CV%	3.60				

Table 91. Processing Quality parameter studied by Quasem Food Products Ltd.

Name of the Sample	Specific gravity	Dry Matter (DMC) %	Reducing Sugar (Glucose) mg/dl	Lab fry test	Suitability For Chips/French Fry
Alcander	1.074	18.98	Below 9 mg/dl	Creamish=100%, Light brown = 0%, Deep brown = 0%	If DMC can be increased >20% then this variety can be suitable for processing.
Hind	1.070	18.10	39.60	Creamish=94%, Light brown =6%, Deep brown = 0%	This variety not suitable for processing.
Roslin	1.067	17.50	111.60	Creamish=0%, Light brown = 0%, Deep brown = 100%	This variety not suitable for processing..
BARI Alu-28 (L. Rosetta)	1.090	22.30	12.60	Creamish=100%, Light brown = 0%, Deep brown = 0%	This variety can be suitable for processing.

Table 92. Grade of tubers by number and weight in RYT, 2021-22 (average of four locations)

Variety	% of Tuber Grade by Number				% of Tuber Grade by Weight			
	<28 mm	28-40 mm	40-55 mm	>55 mm	<28 mm	28-40 mm	40-55 mm	>55 mm
Alcander	19.60	43.93	35.56	0.92	3.57	34.66	57.99	3.78
Hind	12.51	33.00	48.57	5.93	1.47	20.63	60.02	17.88
Roslin	16.94	34.86	39.80	8.39	1.81	17.23	55.84	25.11
BARI Alu-7 (Diamant)	21.93	45.51	30.89	1.67	4.27	35.88	53.83	6.02
BARI Alu-13 (Granola)	14.86	46.52	35.62	3.00	2.36	33.65	53.95	10.04
BARI Alu-25 (Asterix)	22.92	45.72	30.02	1.35	4.61	34.32	55.98	5.09
BARI Alu-28 (L. Rosetta)	10.29	40.43	45.89	3.39	1.70	24.18	63.74	10.37

Table 93. Performances of potato varieties under Natural Storage Condition at Gazipur, 2020-21

Clone/ Variety	Days to milk inatiation (days)	Days to sprout inatiation (days)	Days to sprouting (days)
Alcander	86	101	116
Hind	72	95	115
Roslin	78	96	109
BARI Alu-7 (Diamant)	69	86	116
BARI Alu-13 (Granola)	101	117	133
BARI Alu-25 (Asterix)	69	86	118
BARI Alu-28 (L. Rosetta)	86	101	116

11.45. PARTICIPATORY VARIETY SELECTION (RYT materials)

Three exotic potato varieties along with three check varieties were evaluated at farmers' field of six agro ecological environments during 2021-22. Yield varied significantly from location to location. The average highest tuber yield was recorded Roslin (37.62 t/ha) followed by Hind (37.36 t/ha) and lowest average yield was found in check variety BARI Alu-28 (Lady Rosetta) (25.79 t/ha). Farmers were very much interested in all these new varieties but varied from location to location. Therefore, all these varieties except Dunstar and Tiamo can be recommended for release as commercial varieties.

Table 94. Tuber Yield (t/ha) at 95 DAP of the imported varieties under PVS, 2021-22

Variety	Location			
	Bogura	Gazipur	Jamalpur	Mean
Alcander	37.33	23.33	41.76	34.14
Hind	45.73	30.48	35.88	37.36
Roslin	53.33	25.44	34.08	37.62
BARI Alu-7 (Diamant)	44.77	20.82	29.50	31.70
BARI Alu-13 (Granola)	46.80	14.97	29.39	30.39
BARI Alu-25 (Asterix)	42.26	21.40	31.95	31.87
BARI Alu-28 (L.Rosetta)	27.20	17.85	32.33	25.79

Objective-3: Screening of released varieties for processing and export qualities

1st Year (2018-2019)

11.46. SCREENING OF EXOTIC POTATO VARIETIES FOR EXPORT AND PROCESSING

Twenty-four released potato varieties were evaluated at three different agro ecological environments/locations during 2018-19 cropping season for selecting export suitability of the variety. Tuber yield and grading by percent number and weight reveled that among the tested varieties varied significantly between the locations and within location. Post-harvest data collection is not yet being completed, which is one of most important criteria for selecting exportable potato variety. This is the first-year trial; minimum three years' data needs to select suitable varieties for export.

Table 95. Tuber Yield (t/ha) of the released potato varieties at different locations, 2018-19

Variety	Location								
	Gazipur	Debiganj	Bogura	Jeshore	Munshigonj	Rangpur	Faridpur	Patuakhali	Average
Bari Alu-7	24.54	56.11	34.37	24.83	41.30	23.46	33.45	23.56	**32.70**
Bari Alu-8	21.88	50.29	33.96	26.39	37.83	20.62	31.06	16.01	**29.76**
Bari Alu-13	26.86	44.49	21.28	18.39	29.27	14.86	16.30	12.03	**22.94**
Bari Alu-21	17.85	48.27	27.31	18.97	34.88	7.03	4.03	18.75	**22.14**
Bari Alu-27	22.40	46.23	34.53	19.03	42.01	16.62	22.07	13.29	**27.02**
Bari Alu-28	19.33	57.63	25.25	25.00	33.77	14.27	20.18	15.28	**26.34**
Bari Alu-29	19.49	49.88	25.64	20.42	34.92	18.78	30.05	10.64	**26.23**
Bari Alu-31	13.09	25.69	29.01	19.44	30.30	8.61	30.05	12.00	**21.02**
Bari Alu-32	21.98	59.90	37.51	40.00	39.33	27.80	33.91	31.11	**36.44**
Bari Alu-35	23.65	49.58	36.71	29.72	37.61	31.81	43.31	33.94	**35.79**
Bari Alu-36	26.04	43.40	36.65	37.64	43.70	32.40	39.87	27.64	**35.92**
Bari Alu-37	26.92	58.58	35.34	23.06	49.70	30.94	30.48	19.73	**34.34**
Bari Alu-38	23.54	41.83	31.35	23.89	35.86	24.35	27.06	24.01	**28.99**
Bari Alu-39	19.74	45.00	33.50	0.00	33.77	19.41	23.94	15.45	**23.85**
Bari Alu-40	17.33	54.56	38.97	23.75	41.57	23.77	37.42	16.96	**31.79**
Bari Alu-41	37.48	57.49	35.87	30.14	40.34	34.93	36.97	41.07	**39.29**
Bari Alu-43	21.19	0.00	33.89	25.00	43.05	11.81	22.98	12.10	**21.25**
Bari Alu-46	30.90	55.56	35.68	28.89	38.32	30.45	36.66	19.68	**34.52**
Bari Alu-53	23.96	50.86	35.36	22.50	42.60	21.51	24.48	14.00	**29.41**
Bari Alu-63	32.29	54.41	31.38	21.67	39.64	24.63	29.09	21.09	**31.78**
Bari Alu-66	35.34	0.00	29.65	21.53	36.46	18.15	28.70	15.91	**23.22**
Bari Alu-77	27.96	51.66	35.36	22.22	38.27	15.01	22.63	18.99	**29.01**
Bari Alu-78	29.13	55.99	38.33	27.64	41.87	27.97	32.9	15.92	**33.72**
Bari Alu-79	28.02	54.23	33.89	28.75	39.70	24.78	37.29	9.57	**32.03**
Location mean	**24.62**	**46.32**	**32.95**	**24.12**	**38.59**	**21.83**	**28.95**	**19.11**	**29.56**

Comments: Top yielding varieties: BARI Alu-7 (Diamant), BARI Alu-32 (Quincy), BARI Alu-35, BARI Alu-36, BARI Alu-37, BARI Alu-41, BARI Alu-46, BARI Alu-78, BARI Alu-79

2nd Year (2019-2020)

11.47. SCREENING OF THE RELEASED POTATO VARIETIES FOR EXPORT AND PROCESSING QUALITIES

Thirty-three released potato varieties and one exotic material were evaluated at seven different agro ecological environments/locations during 2019-20 cropping season for selecting export suitability of the variety. Tuber yield and grading by percent number and weight reveled that among the tested varieties varied significantly between the locations and within location. Post-harvest data collection is not yet been completed, which is one of most important criteria for selecting exportable potato variety. This is the three-year trial; minimum three years data needs to select suitable variety for export.

Table 96. Tuber Yield (t/ha) of selected potato genotypes as influenced by different environments during 2019-20

Variety\ location	Tuber Yield (t/ha)							
	Gazipur	**Bogura**	**Rangpur**	**Faridpur**	**Munshigonj**	**Patuakhali**	**Jessore**	**Mean**
BARI Alu-7	31.96	48.07	52.06	40.07	27.19	37.23	44.91	40.21e-j
BARI Alu-8	33.18	43.77	51.59	35.53	23.58	33.91	44.18	37.96g-n
BARI Alu-13	22.11	38.20	39.80	29.07	36.88	39.43	33.37	34.12m-q
BARI Alu-25	25.36	41.66	46.16	44.87	30.65	37.58	40.70	38.14g-m
BARI Alu-28	22.94	30.92	42.28	36.72	30.41	31.32	32.21	32.4pq
BARI Alu-29	27.16	34.04	40.34	40.60	38.16	31.21	34.41	35.13lm-q
BARI Alu-31	11.66	51.75	63.69	30.36	40.77	10.69	43.76	37.35h-n
BARI Alu-35	33.36	47.17	49.35	46.38	34.77	29.58	49.44	41.44d-h
BARI Alu-36	36.79	47.64	50.94	56.10	34.16	40.29	60.62	46.65abc
BARI Alu-37	27.53	47.59	50.48	52.99	28.85	32.84	59.89	42.88c-f
BARI Alu-40	32.84	44.95	51.57	52.07	30.01	35.38	48.09	42.13d-g
BARI Alu-41	42.15	45.80	51.13	58.58	30.30	46.42	59.09	47.64ab
BARI Alu-46	43.18	50.07	54.40	49.04	27.76	31.28	55.06	44.4bcd
BARI Alu-47	36.14	47.43	50.74	32.60	21.28	37.13	49.32	39.23e-l
BARI Alu-48	41.03	45.15	44.36	47.95	34.71	40.76	48.03	43.25cde
BARI Alu-53	28.90	38.85	41.01	42.39	27.14	35.62	42.47	36.63i-o
BARI Alu-54	18.70	41.42	43.11	40.57	27.20	24.32	36.36	32.6opq
BARI Alu-59	33.84	40.62	42.47	36.22	30.10	35.01	30.68	35.56k-q
BARI Alu-61	15.69	36.10	44.13	39.20	28.81	45.47	27.99	33.91n-q
BARI Alu-62	35.39	46.23	54.67	46.00	27.45	39.34	48.34	42.49c-f
BARI Alu-63	25.88	41.56	51.15	44.07	27.33	31.79	54.39	39.45e-k
BARI Alu-72	32.71	38.81	45.40	48.77	32.20	35.11	39.90	38.66f-l
BARI Alu-73	20.89	40.37	46.00	56.49	34.63	30.39	41.00	39.19e-l
BARI Alu-77	27.40	37.40	42.46	31.44	-	24.27	30.43	32.58opq
BARI Alu-78	40.20	47.01	58.05	41.56	36.87	40.02	47.85	44.51bcd
BARI Alu-79	37.31	34.04	42.75	42.03	22.44	35.12	39.24	36.13j-q
BARI Alu 82	30.59	43.31	52.91	43.16	23.40	29.67	54.76	39.69e-k
BARI Alu 83	25.07	55.13	56.64	48.77	22.84	28.84	46.08	40.48d-i
BARI Alu 84	21.32	48.28	38.99	36.39	40.68	23.72	40.88	35.75k-q
BARI Alu 85	14.57	53.45	48.21	47.87	22.32	9.19	30.68	32.33q
BARI Alu 86	37.05	50.04	66.24	58.68	40.16	48.57	45.83	49.51a
BARI Alu 90	28.90	39.85	45.96	38.68	28.17	33.63	40.27	36.49i-p
BARI Alu 91	21.20	27.17	36.91	23.43	27.30	14.41	17.87	24.04r
Colomba	18.91	46.84	40.39	28.95	34.90	27.82	31.72	32.79opq
Location mean	**28.88**	**43.26**	**48.13**	**42.58**	**29.51**	**32.57**	**42.64**	
CV%	17.89							

Table 97. Tuber grade by weight (<40mm) at different location during 2019-20

Variety\ location	Tuber Grading % by wt. (<40mm)							
	Gazipur	Bogura	Rangpur	Faridpur	Munshigonj	Patuakhali	Jessore	Average
BARI Alu-7	32.70	42.55	16.14	30.73	13.05	20.82	31.93	26.85
BARI Alu-8	28.64	35.60	16.25	27.81	36.28	13.05	23.19	25.83
BARI Alu-13	28.63	33.22	17.92	33.33	27.22	20.07	31.92	27.47
BARI Alu-25	22.62	32.26	18.39	34.87	17.83	18.53	29.53	24.86
BARI Alu-28	26.96	30.09	17.13	29.87	15.65	15.28	36.17	24.45
BARI Alu-29	24.44	32.54	13.91	29.52	21.90	10.65	22.99	22.28
BARI Alu-31	16.98	13.12	14.02	20.82	18.54	20.86	28.35	18.96
BARI Alu-35	12.71	32.60	12.86	14.62	23.27	14.71	31.61	20.34
BARI Alu-36	22.26	31.86	15.93	22.71	19.57	18.01	38.00	24.05
BARI Alu-37	39.61	38.38	13.16	26.28	16.38	13.63	36.83	26.32
BARI Alu-40	20.30	45.38	12.65	20.60	13.04	10.44	24.80	21.03
BARI Alu-41	18.00	42.04	15.13	22.85	19.46	15.29	41.33	24.87
BARI Alu-46	15.17	45.64	12.88	32.34	25.04	13.31	29.62	24.86
BARI Alu-47	37.99	52.84	13.64	40.84	29.83	42.04	48.93	38.02
BARI Alu-48	15.79	45.21	15.79	24.60	24.51	14.30	41.02	25.89
BARI Alu-53	22.17	28.70	14.35	25.28	19.58	15.57	29.52	22.17
BARI Alu-54	30.86	34.09	13.61	27.46	15.47	20.27	25.18	23.85
BARI Alu-59	22.61	45.59	13.47	14.68	26.88	13.07	22.37	22.67
BARI Alu-61	11.37	32.30	12.96	31.12	24.68	2.14	23.12	19.67
BARI Alu-62	15.17	46.43	13.41	27.77	24.04	19.41	36.71	26.13
BARI Alu-63	18.60	19.66	12.68	24.56	20.32	6.60	23.98	18.06
BARI Alu-72	36.23	38.23	14.39	19.69	17.87	7.10	35.80	24.19
BARI Alu-73	9.85	23.57	15.45	21.57	-	11.90	22.67	17.50
BARI Alu-77	23.44	42.44	16.60	22.61	15.46	9.95	19.91	21.49
BARI Alu-78	19.79	33.68	12.33	28.33	27.99	20.77	41.10	26.28
BARI Alu-79	16.03	43.93	14.75	34.92	21.34	10.01	26.17	23.88
BARI Alu 82	15.63	39.34	13.50	26.02	26.64	0.60	41.86	23.37
BARI Alu 83	24.77	14.04	15.20	18.80	28.02	7.51	21.50	18.55
BARI Alu 84	14.45	22.67	11.85	18.99	17.85	8.13	23.23	16.74
BARI Alu 85	16.57	17.76	13.31	20.72	32.64	6.39	24.37	18.82
BARI Alu 86	23.35	28.99	11.69	21.04	21.62	16.13	31.26	22.01
BARI Alu 90	19.35	38.00	11.61	14.66	29.93	14.22	35.99	23.39
BARI Alu 91	30.18	42.39	17.58	18.30	35.42	32.65	46.48	31.86
Colomba	20.72	24.70	13.12	23.35	27.46	13.84	33.15	22.33

Table 98. Mean yield, dry matter content and tuber grades of the released varieties, 19-20

Variety	Mean yield (t/ha)	Dry matter content (%)	Tuber Grading (%)			
			Small(<40mm)	Large (40-55mm)	Very large(>55mm)	Processing type (>40 mm)
BARI Alu-7	40.2	19.50	26.85	53.06	20.09	73.15
BARI Alu-8	38.1	21.46	25.83	49.55	24.62	74.17
BARI Alu-13	34.1	18.93	27.47	53.60	18.93	72.53
BARI Alu-25	38.1	19.97	24.86	54.38	20.76	75.14
BARI Alu-28	32.4	22.09	24.45	53.46	22.09	75.55
BARI Alu-29	35.1	20.87	22.28	52.79	24.93	77.72
BARI Alu-31	37.3	20.77	18.96	49.99	**31.**06	81.05
BARI Alu-35	41.4	22.85	20.34	52.62	27.05	79.67
BARI Alu-36	46.6	23.17	24.05	50.10	25.85	75.95
BARI Alu-37	42.9	20.48	26.32	48.89	24.78	73.67
BARI Alu-40	42.1	20.05	21.03	52.49	26.48	78.97
BARI Alu-41	47.6	21.89	24.87	50.08	25.05	75.13
BARI Alu-46	44.4	23.01	24.86	44.17	30.97	75.14
BARI Alu-47	39.2	21.58	38.02	44.50	17.48	61.98
BARI Alu-48	43.3	21.25	25.89	46.91	27.20	74.11
BARI Alu-53	36.6	26.12	22.17	48.57	29.27	77.84
BARI Alu-54	32.6	17.69	23.85	49.50	26.65	76.15
BARI Alu-59	35.5	20.95	22.67	51.72	25.61	77.33
BARI Alu-61	33.9	18.75	19.67	41.69	38.64	80.33
BARI Alu-62	42.5	20.79	26.13	51.35	22.51	73.86
BARI Alu-63	39.4	19.59	18.06	45.48	36.46	81.94
BARI Alu-72	38.7	22.28	24.19	44.32	31.50	75.82
BARI Alu-73	39.2	19.49	17.50	45.60	36.90	82.5
BARI Alu-77	32.6	21.06	21.49	47.38	31.13	78.51
BARI Alu-78	44.5	20.74	26.28	46.18	27.53	73.71
BARI Alu-79	36.1	21.93	23.88	48.06	28.06	76.12
BARI Alu 82	39.7	20.59	23.37	40.58	27.54	68.12
BARI Alu 83	40.5	17.55	18.55	48.51	32.95	81.46
BARI Alu 84	35.8	18.98	16.74	45.18	38.08	83.26
BARI Alu 85	32.3	18.51	18.82	45.81	35.37	81.18
BARI Alu 86	49.5	19.38	22.01	47.43	30.56	77.99
BARI Alu 90	36.5	18.34	23.39	47.90	28.70	76.6
BARI Alu 91	24.1	18.66	31.86	44.69	23.45	68.14
Colomba	32.8	17.78	22.33	43.25	34.42	77.67

Comments: BARI Alu-7 (Diamant), BARI Alu-35, BARI Alu-37, BARI Alu-40, BARI Alu-41, BARI Alu-46, BARI Alu-48, BARI Alu-62, BARI Alu-78, BARI Alu-86.

3rd Year (2020-2021)

11.48. SCREENING OF THE RELEASED POTATO VARIETIES FOR EXPORT AND PROCESSING QUALITIES

Table 99. Yield ranking of released varieties, 20-21

Variety	Location										
	Gazip	Bogu	Rang	Farid	Mun	Madari	Thakur	Debi	Jash	Mean	Position
BARI Alu-72 (CIP-139)	36.8	46.8	50.4	51.3	47.8	42.8	43.0	54.9	49.5	47.0	1
BARI Alu-12 (Dheera)	24.9	38.5	58.3	40.8	54.4	33.1	43.9	62.5	46.8	44.8	2
BARI Alu-92	25.5	49.8	49.3	57.0	39.6	37.4	39.7	58.2	45.1	44.6	3
BARI Alu-87 (CIP-225)	24.8	40.2	53.1	53.0	46.6	36.4	50.8	-	40.1	43.1	4
BARI Alu-46	34.1	44.0	46.4	40.8	38.1	40.1	47.3	57.8	37.7	42.9	5
BARI Alu-81 (CIP-10)	26.0	43.6	46.1	45.2	43.8	26.2	51.5	43.8	55.0	42.4	6
BARI Alu-32 (Quincy)	25.2	45.4	61.1	44.6	41.2	27.3	43.1	54.9	35.9	42.1	7
BARI Alu-41	31.5	44.4	38.7	50.7	38.1	36.5	45.7	46.0	45.6	41.9	8
BARI Alu-86 (12.13)	19.9	42.6	51.0	49.0	46.0	26.2	56.2	48.7	36.8	41.8	9
BARI Alu-88 (CIP-239)	37.4	40.4	54.0	38.6	34.0	22.7	58.1	-	48.1	41.7	10
BARI Alu-40	26.4	44.1	54.8	36.0	26.8	36.3	49.9	51.3	36.4	40.2	11
BARI Alu-85 (7 four 7)	21.4	45.7	56.4	22.9	43.2	28.1	53.4	52.9	35.8	40.0	12
BARI Alu-62 (9.112)	23.6	44.2	51.5	43.9	36.2	25.1	49.3	49.1	36.2	39.9	13
BARI Alu-63 (9.125)	30.7	36.6	45.1	44.2	46.3	24.6	47.1	43.7	35.6	39.3	14
BARI Alu-7 (Diamant)	18.5	33.5	49.4	48.4	42.6	25.4	42.8	46.1	46.9	39.3	15
Sun Red	24.8	41.9	51.4	40.0	39.3	31.1	30.7	49.1	43.9	39.1	16
BARI Alu-79 (CIP-126)	27.6	39.3	52.6	34.2	34.3	32.2	46.9	46.5	37.1	39.0	17
BARI Alu-83 (Cimega)	21.2	34.9	59.8	22.1	50.8	33.3	40.3	50.9	36.4	38.9	18
BARI Alu-66 (Pamela)	20.3	43.4	46.5	43.9	35.7	24.0	45.9	51.4	38.0	38.8	19
BARI Alu-82 (11.68)	35.0	48.0	36.0	42.3	43.9	27.5	35.6	42.4	36.9	38.6	20
BARI Alu-84 (Memphis)	23.0	47.0	55.7	33.4	47.0	21.7	42.2	40.7	34.2	38.3	21
BARI Alu-89 (Fortus)	27.9	37.6	48.1	36.6	37.3	26.6	43.5	48.7	37.6	38.2	22
BARI Alu-50 (7.86)	35.0	38.1	64.1	29.4	33.4	23.8	45.3	50.2	23.6	38.1	23
BARI Alu-47	27.1	40.3	50.5	37.8	39.0	31.9	41.1	43.7	29.5	37.9	24
BARI Alu-53 (LB-6)	27.2	35.7	53.3	37.7	39.3	26.6	43.5	43.9	33.5	37.9	25
Al. Russet	19.8	42.3	50.4	44.6	29.8	28.0	42.8	42.9	39.9	37.8	26
BARI Alu-78 (CIP-112)	24.8	40.5	36.4	30.3	32.1	28.1	54.7	56.7	36.4	37.8	27
BARI Alu-21 (Provento)	19.9	48.9	51.5	39.0	33.3	27.4	36.2	53.0	28.5	37.5	28
Labela	25.6	40.2	50.1	35.7	33.2	32.4	43.3	37.5	37.8	37.3	29
BARI Alu-27 (Espirit)	18.5	40.3	47.2	21.4	44.4	24.9	44.1	54.9	36.4	36.9	30

Variety	Location										
	Gazip	Bogu	Rang	Farid	Mun	Madari	Thakur	Debi	Jash	Mean	Position
BARI Alu-73 (CIP-127)	29.8	33.5	46.0	34.8	30.8	24.6	36.2	51.9	35.8	35.9	31
Jarjina	23.1	40.3	44.5	33.4	39.5	26.9	36.4	48.3	30.1	35.8	32
BARI Alu-35	29.3	50.6	37.4	36.6	28.9	34.4	34.6	36.7	32.1	35.6	33
BARI Alu-51 (Bellarosa)	22.8	38.5	46.0	39.9	28.3	27.0	45.3	36.8	35.8	35.6	34
BARI Alu-48	21.2	41.6	51.1	24.7	29.7	22.3	50.3	45.2	31.7	35.3	35
BARI Alu-49	26.6	38.1	47.9	32.6	41.6	24.6	41.8	37.7	26.5	35.3	36
BARI Alu-36	22.0	37.1	48.4	42.2	29.4	25.7	26.7	44.0	40.4	35.1	37
BARI Alu-57	19.8	41.4	49.1	26.2	32.1	25.9	45.9	41.2	31.9	34.8	38
BARI Alu-52 (Labadia)	19.4	41.9	47.4	27.8	40.9	23.0	51.1	37.5	23.6	34.7	39
Cumbika	13.9	37.3	46.6	34.6	39.6	22.3	48.7	40.0	29.6	34.7	40
BARI Alu-90 (Alouette)	20.7	41.0	48.0	31.7	35.4	23.5	38.9	39.8	32.4	34.6	41
BARI Alu-56	27.0	36.4	53.4	31.7	34.0	19.4	36.0	40.0	31.0	34.3	42
BARI Alu-60 (Vivaldi)	21.4	42.4	47.5	35.5	32.4	24.0	44.0	32.2	28.0	34.2	43
BARI Alu-64 (Folva)	17.5	38.4	42.8	34.4	43.4	20.0	38.0	36.2	32.8	33.7	44
BARI Alu-37	22.6	33.7	44.9	36.3	33.8	26.3	33.6	34.6	34.6	33.4	45
BARI Alu-25 (Asterix)	21.1	38.3	42.0	28.5	32.2	23.5	36.7	32.9	39.6	32.8	46
BARI Alu-59 (Metro)	20.6	39.6	34.6	31.2	30.0	23.0	41.4	41.3	32.1	32.6	47
BARI Alu-8 (Cardinal)	15.3	29.8	42.0	41.2	41.1	18.7	40.3	32.4	32.4	32.6	48
BARI Alu-54 (Musica)	15.1	39.5	43.1	-	47.6	15.1	37.5	38.6	20.9	32.2	49
BARI Alu-61 (Volumia)	14.8	42.2	41.7	33.4	24.6	21.1	37.1	45.4	28.5	32.1	50
BARI Alu-34 (Laura)	12.7	34.4	41.9	28.7	30.8	21.8	37.1	33.5	32.8	30.4	51
BARI Alu-71 (Dolly)	22.2	26.8	34.6	35.2	35.9	20.5	33.3	33.9	29.5	30.2	52
BARI Alu-31 (Sagitta)	-	38.0	37.1	21.0	36.1	14.9	34.8	36.7	22.2	30.1	53
BARI Alu-68 (Atlantic)	19.9	24.3	38.3	43.1	35.4	17.6	32.7	32	22.4	29.5	54
Innovator	15.9	27.6	43.5	20.4	24.6	25.4	39.7	43.1	22.8	29.2	55
BARI Alu-58 (EIMundo)	-	-	18.1	-	-	27.1	40.3	-	-	28.5	56
BARI Alu-91 (Carolus)	15.6	32.8	32.4	27.3	33.2	24.6	31.9	33.8	22.6	28.2	57
BARI Alu-13 (Granola)	13.4	35.1	42.3	16.2	21.9	23.9	38.1	27.7	33.7	28.0	58
BARI Alu-77 (Sarpomira)	14.9	35.4	36	27.3	29.5	18.7	40.5	31.3	17.7	27.9	59
BARI Alu-29 (Courage)	17.3	29.3	30.5	17.9	27.5	45.4	29.8	32.7	20.3	27.9	60
BARI Alu-28 (L. Rosetta)	11.4	31.1	30.6	27.1	27.8	20.3	33.9	33.9	26.3	26.9	61
BARI Alu-44 (Elgar)	-	24.2	26.6	14.9	16.1	20.5	39.9	29.2	28.1	24.9	62

Table 100. Dry matter content **(%)** of released varieties, 2020-21

Variety	Location							
	Gazipur	Bogura	Rang	Madari	Thakur	Debi	Jashor	Mean
BARI Alu-7 (Diamant)	23.1	18.3	21.6	22.2	22.6	-	22.0	21.6
BARI Alu-8 (Cardinal)	23.4	20.9	21.8	25.6	23.4	20.4	21.5	22.4
BARI Alu-12 (Dheera)	27.5	21.9	22.6	23.9	25.1	20.3	26.0	23.9
BARI Alu-13 (Granola)	17.4	20.3	16.4	20.3	17.6	23.0	17.5	18.9
BARI Alu-21 (Provento)	21.9	19.8	20.4	20.5	17.0	21.1	21.5	20.3
BARI Alu-25 (Asterix)	21.5	20.1	19.3	21.0	18.9	-	19.0	20.0
BARI Alu-27 (Espirit)	17.0	18.3	19.4	17.5	16.3	16.4	19.5	17.8
BARI Alu-28 (L. Rosetta)	23.7	20.6	23.3	23.6	22.9	21.9	25.5	23.1
BARI Alu-29 (Courage)	21.5	20.6	20.8	21.6	20.9	20.6	24.0	21.4
BARI Alu-31 (Sagitta)	21.6	18.4	19.1	18.2	20.3	20.8	21.5	20.0
BARI Alu-32 (Quincy)	19.5	19.8	16.7	17.6	20.0	18.5	18.0	18.6
BARI Alu-34 (Laura)	21.3	18.4	18.8	18.9	20.2	18.6	19.0	19.3
BARI Alu-35	25.6	19.8	21.3	22.8	23.6	20.9	24.0	22.6
BARI Alu-36	23.0	20.9	22.6	21.5	20.3	20.8	21.0	21.4
BARI Alu-37	22.5	20.6	20.5	21.2	-	-	20.5	21.1
BARI Alu-40	23.6	20.3	21.6	25.6	20.1	18.8	24.0	22.0
BARI Alu-41	22.8	20.3	23.3	22.2	23.6	19.2	22.5	22.0
BARI Alu-44 (Elgar)	19.2	19.2	19.8	24.3	18.0	19.5	20.0	20.0
BARI Alu-46	25.2	20.2	20.6	23.5	22.3	24.0	23.0	22.7
BARI Alu-47	22.4	21.9	21.6	22.5	23.2	18.7	21.0	21.6
BARI Alu-48	24.6	18.1	19.9	21.1	20.5	20.2	21.0	20.8
BARI Alu-49	23.1	18.8	20.2	21.1	20.9	18.3	22.5	20.7
BARI Alu-50 (7.86)	21.7	20.8	18.9	22.1	21.0		20.0	20.8
BARI Alu-51 (Bellarosa)	21.2	19.1	18.6	20.6	18.0	17.6	20.0	19.3
BARI Alu-52 (Labadia)	19.2	20.1	17.2	19.9	17.0	20.3	20.0	19.1
BARI Alu-53 (LB-6)	27.3	20.8	23.1	25.5	23.4	20.9	25.5	23.8
BARI Alu-54 (Musica)	18.6	20.9	17.4	20.2	17.4	16.7	18.5	18.5
BARI Alu-56	21.9	18.1	21.6	17.8	16.4	19.2	21.5	19.5
BARI Alu-57	23.6	20.1	24.2	19.6	22.8	19.1	23.5	21.8
BARI Alu-58 (ElMundo)	-	19.3	13.5	20.6	19.4	16.6	-	17.9
BARI Alu-59 (Metro)	21.5	19.1	20.7	22.4	21.9	18.3	22.5	20.9
BARI Alu-60 (Vivaldi)	19.2	19.6	16.0	18.3	17.4	16.1	19.0	17.9
BARI Alu-61 (Volumia)	19.9	19.3	16.4	20.2	16.1	15.6	18.5	18.0
BARI Alu-62 (9.112)	22.2	19.3	19.2	20.5	20.6	16.6	21.0	19.9
BARI Alu-63 (9.125)	19.6	18.9	18.3	21.0	16.3	18.1	21.0	19.0

Variety	Location							
	Gazipur	Bogura	Rang	Madari	Thakur	Debi	Jashor	Mean
BARI Alu-64 (Folva)	21.9	19.8	17.8	19.7	21.8	18.4	21.5	20.1
BARI Alu-66 (Pamela)	20.5	18.8	19.5	20.9	20.9	19.0	20.0	19.9
BARI Alu-68 (Atlantic)	24.3	19.3	22.0	22.4	22.3	21.1	26.0	22.5
BARI Alu-71 (Dolly)	24.1	19.8	21.9	24.7	22.3	20.5	25.0	22.6
BARI Alu-72 (CIP-139)	23.8	21.6	22.6	20.7	25.0	20.3	23.5	22.5
BARI Alu-73 (CIP-127)	23.2	19.8	19.4	23.0	19.4	-	24.0	21.5
BARI Alu-77 (Sarpomira)	22.9	20.3	20.0	21.1	19.7	19.7	20.0	20.5
BARI Alu-78 (CIP-112)	24.0	20.3	20.6	23.5	21.1	18.8	22.5	21.5
BARI Alu-79 (CIP-126)	20.2	19.1	18.2	21.3	18.0	17.6	20.0	19.2
BARI Alu-81 (CIP-10)	26.3	20.3	20.9	20.9	20.4	-	23.0	22.0
BARI Alu-82 (11.68)	21.5	19.3	19.3	23.1	19.9	16.8	20.5	20.1
BARI Alu-83 (Cimega)	20.3	17.7	15.3	15.9	20.4	-	18.0	17.9
BARI Alu-84 (Memphis)	19.2	18.4	16.6	19.3	17.3	14.6	19.0	17.8
BARI Alu-85 (7 four 7)	17.0	19.1	14.4	17.2	16.1	17.0	18.0	17.0
BARI Alu-86 (12.13)	19.1	19.1	13.0	19.9	17.2	15.0	18.0	17.3
BARI Alu-87 (CIP-225)	18.9	20.9	17.5	17.0	18.4	-	18.5	18.5
BARI Alu-88 (CIP-239)	18.0	19.8	18.2	20.8	19.1	-	18.0	19.0
BARI Alu-89 (Fortus)	21.3	19.1	17.6	18.2	16.6	15.0	17.0	17.8
BARI Alu-90 (Alouette)	20.1	20.1	19.0	19.5	17.9	19.3	20.0	19.4
BARI Alu-91 (Carolus)	20.1	19.1	17.4	21.4	17.1	17.0	18.5	18.7
Labela	17.6	17.7	17.0	18.4	15.4	16.8	19.0	17.4
Jarjina	19.2	17.7	14.6	17.2	15.7	16.8	18.0	17.0
Cumbika	15.6	20.7	15.9	19.5	14.5	15.1	20.0	17.3
BARI Alu-92	22.8	20.3	19.6	21.7	19.9	19.4	22.0	20.8
Sun Red	17.1	19.1	16.7	16.9	15.7	14.1	16.0	16.5
Innovator	25.6	19.8	24.6	22.4	23.8	17.5	23.0	22.4
Al. Russet	23.5	20.1	19.9	20.6	20.3	20.2	19.5	20.6
Mean	21.6	19.7	19.3	20.8	19.7	18.6	20.9	**20.1**

Table 101. Proportion (%) of small sized tubers by weight (<40mm) over location, 2020-21

Variety	Location										
	Gazi	Bog	Rang	Farid	Munshi	Patua	Madari	Thakur	Debi	Jashore	Mean
BARI Alu-7 (Diamant)	51.55	29.77	16.14	22.08	19.93	8.55	36.30	24.40	21.38	43.04	27.31
BARI Alu-8 (Cardinal)	55.81	21.77	24.02	19.76	11.89	32.73	30.01	20.47	20.33	56.90	29.37
BARI Alu-12 (Dheera)	43.51	24.27	20.54	27.83	24.54	24.89	23.10	25.75	18.67	59.15	29.23
BARI Alu-13 (Granola)	52.21	19.36	18.83	64.15	29.48	17.27	47.34	19.69	24.34	61.15	35.38
BARI Alu-21 (Provento)	26.38	6.36	8.24	16.56	21.48	22.29	21.97	14.52	5.47	59.98	20.33
BARI Alu-25 (Asterix)	55.61	25.31	22.27	38.76	36.14	35.47	48.89	38.38	22.54	60.85	38.42
BARI Alu-27 (Espirit)	62.39	26.35	23.27	50.84	25.86	30.99	51.87	16.43	21.15	68.63	37.78
BARI Alu-28 (L. Rosetta)	-	13.70	18.81	23.48	21.92	29.19	28.01	22.30	9.57	62.90	25.54
BARI Alu-29 (Courage)	38.12	14.18	10.11	17.38	22.52	11.64	47.84	12.94	6.94	55.15	23.68
BARI Alu-31 (Sagitta)	22.62	16.88	6.42	13.11	27.22	7.81	16.96	14.66	10.65	40.81	17.71
BARI Alu-32 (Quincy)	28.77	23.97	38.17	20.97	21.81	26.22	31.20	-	25.20	24.29	26.73
BARI Alu-34 (Laura)	35.27	18.52	16.54	25.38	29.95	-	33.91	21.33	24.46	62.57	29.77
BARI Alu-35	33.93	26.60	29.72	24.62	18.11	3.29	14.57	17.84	23.29	64.22	25.62
BARI Alu-36	28.65	28.81	24.76	17.90	26.07	20.67	20.65	22.30	15.31	56.49	26.16
BARI Alu-37	47.90	25.01	31.48	23.28	20.22	31.55	29.37	42.65	22.02	72.55	34.60
BARI Alu-40	31.24	25.71	18.82	18.15	16.01	19.41	14.65	15.17	14.37	71.40	24.49
BARI Alu-41	35.44	33.32	38.79	21.35	17.77	52.07	28.81	28.84	24.69	64.11	34.52
BARI Alu-44 (Elgar)	47.85	39.75	36.03	53.45	28.07	39.57	54.59	23.83	20.83	88.61	43.26
BARI Alu-46	27.94	20.40	15.09	24.77	18.38	26.75	12.40	10.53	20.20	67.37	24.38
BARI Alu-47	46.56	57.10	37.44	32.94	40.48	46.18	40.12	43.68	34.40	91.06	47.00
BARI Alu-48	47.72	27.37	28.26	27.76	27.76	23.95	26.27	21.83	37.29	76.15	34.44
BARI Alu-49	38.16	32.06	25.52	23.05	21.10	27.15	40.38	22.48	33.75	86.96	35.06
BARI Alu-50 (7.86)	-	10.51	10.14	8.62	18.80	14.24	14.67	-	13.06	30.43	15.06
BARI Alu-51 (Bellarosa)	23.50	13.49	9.62	9.64	18.22	24.75	23.64	11.18	18.48	70.61	22.31
BARI Alu-52 (Labadia)	23.56	13.22	15.32	7.97	12.93	15.71	25.10	7.09	19.07	62.40	20.24
BARI Alu-53 (LB-6)	32.55	10.73	7.36	16.01	21.16	24.32	13.76	-	13.87	59.24	22.11
BARI Alu-54 (Musica)	-	17.88	14.97	17.76	16.32	9.28	27.56	20.07	22.01	66.39	23.58
BARI Alu-56	16.27	20.57	16.30	15.56	15.00	10.81	22.83	15.37	18.96	59.25	21.09
BARI Alu-57	30.09	11.51	28.64	25.62	20.68	31.10	18.64	13.62	20.45	44.93	24.53
BARI Alu-58 (EIMundo)	-	-	10.10	-	-	18.47	30.82	27.71	26.54	-	22.73
BARI Alu-59 (Metro)	47.23	22.24	30.95	23.78	15.14	16.10	43.68	12.74	13.94	50.11	27.59
BARI Alu-60 (Vivaldi)	50.10	26.03	15.28	22.89	18.70	35.93	30.26	20.51	29.72	68.22	31.76
BARI Alu-61 (Volumia)	9.61	4.75	9.39	9.37	11.71	20.83	13.37	10.06	15.09	24.33	12.85
BARI Alu-62 (9.112)	43.55	20.50	19.14	18.36	22.52	30.75	20.48	13.82	25.48	62.39	27.70
BARI Alu-63 (9.125)	17.76	14.94	7.50	7.28	8.48	20.40	14.14	11.03	7.37	43.61	15.25
BARI Alu-64 (Folva)	31.34	5.64	13.57	10.51	17.22	26.01	30.10	9.94	11.94	60.75	21.70

Variety	Location										
	Gazi	Bog	Rang	Farid	Munshi	Patua	Madari	Thakur	Debi	Jashore	Mean
BARI Alu-66 (Pamela)	15.17	13.47	11.66	14.04	17.90	24.46	18.18	10.69	17.55	40.26	18.34
BARI Alu-68 (Atlantic)	22.50	13.32	8.92	11.19	12.61	12.11	8.96	8.15	6.04	52.52	15.63
BARI Alu-71 (Dolly)	29.83	30.12	17.61	15.50	18.36	23.95	11.03	42.01	18.25	60.74	26.74
BARI Alu-72 (CIP-139)	24.29	18.17	23.62	17.18	15.56	22.20	16.04	15.16	6.51	57.11	21.58
BARI Alu-73 (CIP-127)	9.66	7.35	7.68	19.19	24.87	4.43	12.63	7.77	12.00	36.90	14.25
BARI Alu-77 (Sarpomira)	43.63	15.94	16.73	42.77	24.05	26.75	33.11	14.53	27.90	61.83	30.72
BARI Alu-78 (CIP-112)	45.48	34.58	38.75	33.46	19.84	47.34	28.99	21.29	29.88	77.51	37.71
BARI Alu-79 (CIP-126)	14.96	13.34	4.83	16.97	11.81	8.81	18.45	9.26	7.20	46.72	15.24
BARI Alu-81 (CIP-10)	19.34	14.93	15.25	12.80	16.96	26.31	18.32	17.87	10.70	38.01	19.05
BARI Alu-82 (11.68)	26.84	13.39	20.01	20.22	17.07	21.95	17.44	18.62	24.02	60.07	23.96
BARI Alu-83 (Cimega)	34.54	18.78	14.72	28.05	13.23	5.54	35.37	20.02	33.87	57.32	26.14
BARI Alu-84 (Memphis)	19.19	12.38	7.77	8.25	12.56	12.71	17.16	13.34	7.22	54.44	16.50
BARI Alu-85 (7 four 7)	24.36	10.85	8.71	15.34	16.26	32.04	34.41	9.32	9.06	57.19	21.75
BARI Alu-86 (12.13)	55.15	25.85	15.16	20.02	15.00	15.77	33.43	11.77	12.06	59.20	26.34
BARI Alu-87 (CIP-225)	39.09	38.60	45.66	28.80	35.94	31.79	25.38	31.50	-	63.35	37.79
BARI Alu-88 (CIP-239)	33.50	13.61	9.44	11.25	23.07	36.22	16.05	9.60	-	47.50	22.25
BARI Alu-89 (Fortus)	27.27	17.27	12.74	21.16	19.85	11.28	11.74	10.69	20.22	69.63	22.19
BARI Alu-90 (Alouette)	35.19	14.05	14.99	18.91	17.26	11.18	29.84	18.00	26.24	60.92	24.66
BARI Alu-91 (Carolus)	54.25	21.90	19.16	22.19	16.72	14.96	33.47	14.77	12.95	61.24	27.16
Labela	-	11.03	6.50	7.24	8.45	8.54	17.86	7.59	6.26	61.27	14.97
Jarjina	27.25	14.45	9.53	21.12	15.80	22.68	26.10	17.09	17.85	45.04	21.69
Cumbika	36.40	25.57	14.20	20.28	21.52	19.00	42.95	15.58	15.85	59.45	27.08
BARI Alu-92	21.67	6.42	14.58	15.86	24.92	10.28	16.48	12.28	17.08	60.32	19.99
Sun Red	16.38	1.00	7.45	6.75	10.24	10.70	6.25	10.78	6.42	31.60	10.76
Innovator	28.04	8.87	15.20	30.98	18.40	-	19.78	10.02	7.45	20.21	17.66
Al. Russet	31.03	15.95	10.65	24.52	17.71	8.19	12.90	14.09	24.65	36.37	19.61

Table 102. Days to sprout initiation of released potato varieties as influenced by different environments, 2020-21

Variety	Location				
	Gazipur	Bogura	Rangpur	Thakurgaon	Mean
BARI Alu-7 (Diamant)	69	75	77	78	75
BARI Alu-8 (Cardinal)	69	54	77	78	70
BARI Alu-12 (Dheera)	69	75	77	78	75
BARI Alu-13 (Granola)	69	-	77	77	74
BARI Alu-21 (Provento)	69	54	77	67	67
BARI Alu-25 (Asterix)	69	54	77	93	73
BARI Alu-27 (Espirit)	100	75	77	78	83
BARI Alu-28 (L. Rosetta)	163	-	108	77	116
BARI Alu-29 (Courage)	85	75	77	77	79
BARI Alu-31 (Sagitta)	69	54	77	77	69
BARI Alu-32 (Quincy)	70	54	77	77	70
BARI Alu-34 (Laura)	69	75	92	78	79
BARI Alu-35	85	75	-	78	79
BARI Alu-36	70	75	77	77	75
BARI Alu-37	69	54	77	77	69
BARI Alu-40	61	54	77	78	68
BARI Alu-41	53	75	-	77	68
BARI Alu-44 (Elgar)	-	-	77	77	77
BARI Alu-46	51	-	-	78	65
BARI Alu-47	69	75	77	78	75
BARI Alu-48	69	75	77	78	75
BARI Alu-49	61	-	77	77	72
BARI Alu-50 (7.86)	69	54	77	77	69
BARI Alu-51 (Bellarosa)	85	75	92	78	83
BARI Alu-52 (Labadia)	100	105	77	93	94
BARI Alu-53 (LB-6)	69	168	138	170	136
BARI Alu-54 (Musica)	69	75	77	78	75
BARI Alu-56	69	75	77	77	75
BARI Alu-57	69	54	77	78	70
BARI Alu-58 (ElMundo)	-	75	0	78	77
BARI Alu-59 (Metro)	69	54	77	77	69
BARI Alu-60 (Vivaldi)	100	75	77	78	83
BARI Alu-61 (Volumia)	70	-	77	77	75
BARI Alu-62 (9.112)	129	-	108	123	120
BARI Alu-63 (9.125)	70	75	77	78	75
BARI Alu-64 (Folva)	69	75	77	77	75
BARI Alu-66 (Pamela)	101	105	108	78	98
BARI Alu-68 (Atlantic)	100	-	108	77	95
BARI Alu-71 (Dolly)	129	105	77	123	109
BARI Alu-72 (CIP-139)	61	54	77	77	67
BARI Alu-73 (CIP-127)	53	54	77	78	66
BARI Alu-77 (Sarpomira)	101	54	77	78	78
BARI Alu-78 (CIP-112)	69	75	77	77	75
BARI Alu-79 (CIP-126)	70	75	77	79	75
BARI Alu-81 (CIP-10)	61	75	-	77	71
BARI Alu-82 (11.68)	61	54	77	77	67
BARI Alu-83 (Cimega)	69	-	77	136	94
BARI Alu-84 (Memphis)	70	105	170	78	106

Variety	Location				
	Gazipur	Bogura	Rangpur	Thakurgaon	Mean
BARI Alu-85 (7 four 7)	69	75	76	78	75
BARI Alu-86 (12.13)	70	54	77	78	70
BARI Alu-87 (CIP-225)	101	54	77	78	78
BARI Alu-88 (CIP-239)	70	54	77	77	70
BARI Alu-89 (Fortus)	70	75	77	78	75
BARI Alu-90 (Alouette)	69	75	77	77	75
BARI Alu-91 (Carolus)	69	75	77	78	75
BARI Alu-92	70	-	77	77	75
Labela	53	75	77	78	71
Jarjina	115	105	108	78	102
Cumbika	163	105	77	77	106
Sun Red	61	54	77	78	68
Innovator	-	75	77	78	77
Al. Russet	100	105	108	94	102

4th Year (2021-2022)

11.49. SCREENING OF THE RELEASED POTATO VARIETIES FOR EXPORT AND PROCESSING QUALITIES

There was huge variation among the potato genotypes over the locations for every character. As the experiment was based on the export criteria that's why export-related characters were considered for reporting. BARI Alu-64 gave the highest tuber yield (47.83 t/ha) all over the location. Considering the yield capacity, the Labela, Arizona, BARI Alu-79, BARI Alu-81, BARI Alu-12 (Dheera), BARI Alu- 92, BARI Alu-32 (Quincy), BARI Alu-83 (Cimega), and BARI Alu-21 (Provento) are higher yielders which are close to 40t/ha all over the location (Table 103). The yield of Rangpur, Thakurgaon, and Debiganj were at a satisfactory level for most of the potato genotypes.

The maximum desired weight (>40mm) for export. All produced potato more than 60% by weight. Labela, BARI Alu-84 (Memphis), Arizona, BARI Alu-85 (7 four 7), BARI Alu-68 (Atlantic), BARI Alu-72, BARI Alu-73, BARI Alu-31 (Sagitta), BARI Alu-63, BARI Alu-83 (Cimega), BARI Alu-61 (Volumia), BARI Alu-81, Ottawa, BARI Alu-88, and BARI Alu-71 (Dolly) produced more than 80% of tuber in this grade by weight (Table 3).

The dry matter content of a tuber is an important characteristic for the processing quality of a variety (Leonel et al. 2017). It is also a good indicator for the keeping and storage quality of potatoes (Lisinska and Leszczynski, 1989). Tuber dry matter must be greater than 20% for processing of a variety (Ezekiel et al., 1999) and Tuber dry matter content varies greatly between cultivars and is a highly genetically determined trait (Kellock,1995). The dry matter content of the selected germplasms in a different location is presented in table 4. All the varieties did not behave similar from location to location, might be due to the microclimatic effect of different location. BARI Alu-12 (Dheera), BARI Alu-68 (Atlantic), BARI Alu-66 (Pamela), BARI Alu-28 (L. Rosetta), BARI Alu-8 (Cardinal), BARI Alu- 92), BARI Alu-62, BARI Alu-7 (Diamant), BARI Alu-73, BARI Alu-57, BARI Alu-59 (Metro), BARI Alu-29 (Courage), Labela, BARI Alu-48, BARI Alu-47, BARI Alu-40, BARI Alu-71 (Dolly), BARI Alu-50, BARI Alu-21 (Provento), and BARI Alu-35 produced more than 20% of dry matter (Table 104).

Table 103. Tuber Yield (t/ha) of released potato genotypes as influenced by different environments, 2021-22

Variety	Location									
	Bogura	Farid	Gazi	Jashore	Rang	Thaku	Munshi	Patua	Debi	Mean
BARI Alu-7 (Diamant)	32.28	21.6	18.59	34.36	41.8	29.53	20.7	29.81	29.89	28.73
BARI Alu-8 (Cardinal)	37.22	26.29	16.53	31.11	39.27	42.79	17.43	29.28	37.39	30.81
BARI Alu-12 (Dheera)	48.28	30.32	28.58	56.67	46.67	33.99	33.28	52.61	46.5	41.88
BARI Alu-13 (Granola)	30.63	9.56	10.09	26.67	38.17	26.63	6.01	14.39	28.49	21.18
BARI Alu-21 (Provento)	40.62	28.81	23.63	23.27	56.99	37.11	60.87	43.97	45.98	40.14
BARI Alu-25 (Asterix)	34.4	23.55	18.63	35.15	37.98	26.83	16.38	29.08	30.87	28.10
BARI Alu-28 (L. Rosetta)	31.69	19.48	13.53	42.34	38.26	27.78	17.93	14.26	32.23	26.39
BARI Alu-29 (Courage)	29.77	16.86	13.44	33.34	36.09	29.26	11.8	13.88	28.44	23.65
BARI Alu-31 (Sagitta)	46.66	29.86	22.91	32.57	50.14	36.11	26.6	30.68	45.23	35.64
BARI Alu-32 (Quincy)	45.52	34.96	30.11	45.24	53.13	37.45	48.76	27.25	43.06	40.61
BARI Alu-35	42.02	27.52	30.35	22.75	52.01	34.37	29.36	36.32	38.05	34.75
BARI Alu-37	38.67	24.67	24.85	30.48	37.92	27.31	18.04	30.89	40.47	30.37
BARI Alu-40	42.42	32.41	24.93	26.91	40.89	37.32	17.26	18.67	39.52	31.15
BARI Alu-47	35.7	24.29	21.94	28.37	42.71	33.16	17.06	22.28	37.19	29.19
BARI Alu-48	38.98	28.13	16.16	21.98	52.63	30.11	21.1	30.25	34.54	30.43
BARI Alu-50 (7.86)	36.58	30.83	26.14	26.67	47.76	33.6	30.25	24.43	41.89	33.13
BARI Alu-51 (Bellarosa)	38.23	27.87	19.37	51.07	43.8	36.64	17.24	24.03	36.82	32.79
BARI Alu-52 (Labadia)	44.02	26.69	18.69	23.06	44.13	40.14	28	27.65	47.74	33.35
BARI Alu-54 (Musica)	44.71	26.93	24.61	30.37	56.22	34.94	30.04	24.97	42.66	35.05
BARI Alu-57	47.12	23.86	19.49	19.88	53.05	32.48	17.81	22.25	34.17	30.01
BARI Alu-59 (Metro)	32.75	27.43	11.98	19.95	37.86	35.03	15.32	9.88	35.13	25.04
BARI Alu-60 (Vivaldi)	37.82	30.88	19.86	16.67	37.66	34.11	24.07	32.36	24.07	28.61
BARI Alu-61 (Volumia)	44.16	32.41	20.4	23.33	44.66	35.72	17.68	22.86	37.78	31.00
BARI Alu-62 (9.112)	47.37	27.1	25.89	24	50.73	39.28	48.09	18.5	36.79	35.31
BARI Alu-63 (9.125)	42.14	29.39	17.31	30	48.31	38.75	17.2	33.5	38.49	32.79
BARI Alu-66 (Pamela)	49.76	26.74	22.31	-	35.67	39.48	20.12	27.15	36.5	32.22
BARI Alu-68 (Atlantic)	32.38	31.42	26.05	48.29	35.78	31.07	54.3	34.62	41.05	37.22
BARI Alu-71 (Dolly)	32.46	14.08	11.52	-	32.94	26.04	14.74	21.44	26.99	22.53
BARI Alu-72 (CIP-139)	43.31	40.34	27.15	39.2	49.82	40.2	25.97	44.67	38.03	38.74
BARI Alu-73 (CIP-127)	43.96	26.75	26.05	35.55	51.73	36.31	29.34	31.72	55.3	37.41
BARI Alu-77 (Sarpomira)	43.82	15.47	15.48	12.38	38.71	33.3	37.41	12.62	35.97	27.24
BARI Alu-78 (CIP-112)	75.08	26.22	25.59	46.67	49.15	35.17	21.59	23.31	41.78	38.28
BARI Alu-79 (CIP-126)	43.63	29.41	18.68	91.37	47.54	31.61	41.51	34.07	48.29	42.90

Variety	Location									
	Bogura	Farid	Gazi	Jashore	Rang	Thaku	Munshi	Patua	Debi	Mean
BARI Alu- 80	31.16	30.81	-	28.89	62.39	37.13	25.78	44.58	44.36	38.14
BARI Alu-81 (CIP-10)	52.96	31.25	31.65	51.95	53.75	44.35	43.02	30.75	42.23	42.43
BARI Alu-83 (Cimega)	43.45	50.61	32.02	-	52.21	32.17	43.4	19.05	49.71	40.33
BARI Alu-84 (Memphis)	48.76	24.95	20.39	48.34	55.7	38.9	21.83	22.17	42.54	35.95
BARI Alu-85 (7 four 7)	54.93	39.73	23.54	26.67	54.29	37.29	8.94	22.03	51.83	35.47
BARI Alu-86 (12.13)	47.06	23.47	26.4	33.08	52.98	34.93	38.97	40.75	45.67	38.15
BARI Alu-87 (CIP-225)	48.68	35.19	26.71	37.69	49.32	32.56	32.01	54.46	40.93	39.73
BARI Alu-88 (CIP-239)	45.3	37.64	18.39	34.96	50.56	34.4	23.84	24.47	51.55	35.68
BARI Alu-89 (Fortus)	45.16	34.69	26.03	36.76	43.78	39.34	31.2	33.33	38.81	36.57
BARI Alu-90 (Alouette)	41.34	29.84	20.28	30.19	41.34	28.89	25.64	27.92	29.82	30.58
BARI Alu-91 (Carolus)	28.27	13.94	13.92	30.83	27.56	31.25	22.81	33.55	20.3	24.71
BARI Alu-92	50.03	32.88	28.38	59.85	50.2	44.41	22.83	30.8	46.37	40.64
Innovator	36.38	21.41	19.15	44.13	42.46	29.98	21.29	26.01	31.1	30.21
Alrusset	46.38	28.02	23.6	32.07	46.96	35.59	24.67	30.89	45.95	34.90
HZD 1249	45.36	28.55	24.77	29.34	49.7	40.15	31.35	32.11	40.15	35.72
Ottawa	44.45	30.73	25.55	40.16	41.66	37.48	27	49.67	35.81	36.95
Picobella	46.02	24.79	14.23	13.33	44.09	38.37	21.91	14.31	36.65	28.19

Table 104. Dry matter content (%) of potato tubers at harvest as influenced by different environments, 2021-22

Variety	Location						
	Bogu	Farid	Gazi	Jash	Munshi	Patua	Mean
BARI Alu-7 (Diamant)	18.43	22.33	21.21	21.00	20.50	21.50	20.83
BARI Alu-8 (Cardinal)	18.68	22.20	22.70	20.00	22.00	21.50	21.18
BARI Alu-12 (Dheera)	20.30	21.63	23.79	24.50	23.50	21.00	22.45
BARI Alu-13 (Granola)	19.05	17.78	16.57	17.00	18.50	21.00	18.32
BARI Alu-21 (Provento)	20.05	18.83	20.62	20.50	21.00	20.50	20.25
BARI Alu-25 (Asterix)	17.68	18.94	20.84	19.00	20.00	21.50	19.66
BARI Alu-28 (L. Rosetta)	18.05	22.07	22.65	24.00	21.00	22.00	21.63
BARI Alu-29 (Courage)	19.05	20.61	21.99	23.00	22.50	16.50	20.61
BARI Alu-31 (Sagitta)	18.68	18.46	20.59	20.50	19.50	17.50	19.20
BARI Alu-32 (Quincy)	18.05	16.48	18.23	18.50	18.00	16.00	17.54
BARI Alu-35	17.68	22.96	23.15	23.00	21.00	12.50	20.05
BARI Alu-37	16.29	19.20	21.46	21.00	20.50	16.00	19.07
BARI Alu-40	19.05	20.55	22.52	24.00	20.00	16.50	20.44
BARI Alu-47	18.43	20.25	21.69	21.00	21.00	20.50	20.48
BARI Alu-48	17.30	19.45	21.27	21.00	21.50	22.50	20.50
BARI Alu-50 (7.86)	19.55	20.48	21.60	20.00	19.50	20.50	20.27
BARI Alu-51 (Bellarosa)	19.05	18.54	17.50	20.00	20.00	18.50	18.93
BARI Alu-52 (Labadia)	17.30	18.37	18.47	20.00	18.00	19.50	18.61
BARI Alu-54 (Musica)	18.05	18.03	20.33	18.50	19.00	16.50	18.40
BARI Alu-57	19.55	20.56	22.60	23.50	20.00	18.50	20.78
BARI Alu-59 (Metro)	19.05	20.38	20.51	22.00	21.50	20.50	20.66
BARI Alu-60 (Vivaldi)	17.30	17.88	18.54	18.50	19.50	17.00	18.12
BARI Alu-61 (Volumia)	18.68	18.45	17.97	19.00	16.00	17.00	17.85
BARI Alu-62 (9.112)	19.80	22.06	20.22	21.50	22.00	19.50	20.85
BARI Alu-63 (9.125)	18.05	19.91	20.55	-	20.00	20.50	19.80
BARI Alu-64 (Folva)	18.05	20.68	19.15	-	18.00	19.00	18.98
BARI Alu-66 (Pamela)	18.80	22.93	27.39	21.00	25.00	16.50	21.94
BARI Alu-68 (Atlantic)	18.80	24.20	24.52	24.50	21.00	19.00	22.00
BARI Alu-71 (Dolly)	19.80	19.18	25.68	-	22.00	15.50	20.43
BARI Alu-72 (CIP-139)	18.05	19.38	21.98	23.50	16.00	17.00	19.32
BARI Alu-73 (CIP-127)	20.55	18.87	18.96	23.00	22.00	21.50	20.81
BARI Alu-77 (Sarpomira)	17.30	19.80	19.91	20.00	22.00	20.00	19.84
BARI Alu-78 (CIP-112)	18.80	20.30	20.23	-	20.00	15.00	18.87

Variety	Location						
	Bogu	Farid	Gazi	Jash	Munshi	Patua	Mean
BARI Alu-79 (CIP-126)	17.30	18.45	-	20.00	22.00	20.00	19.55
BARI Alu- 80	19.30	21.94	23.73	20.00	20.50	13.50	19.83
BARI Alu-81 (CIP-10)	17.30	17.72	19.04	21.00	16.00	17.50	18.09
BARI Alu-83 (Cimega)	16.55	17.35	22.88	-	18.00	15.00	17.96
BARI Alu-84 (Memphis)	18.05	17.30	17.77	-	13.00	18.00	16.82
BARI Alu-85 (7 four 7)	18.05	15.88	19.89	18.00	20.50	20.50	18.80
BARI Alu-86 (12.13)	17.30	18.48	19.00	18.00	19.50	22.00	19.05
BARI Alu-87 (CIP-225)	19.80	17.01	18.79	18.00	22.50	19.00	19.18
BARI Alu-88 (CIP-239)	19.30	16.38	18.28	17.50	17.00	20.00	18.08
BARI Alu-89 (Fortus)	18.80	17.58	19.90	18.50	17.00	16.00	17.96
BARI Alu-90 (Alouette)	19.30	19.18	19.04	20.00	20.50	19.50	19.59
BARI Alu-91 (Carolus)	18.80	19.50	23.14	20.00	21.50	16.00	19.82
13.7	19.55	20.91	24.00	20.00	21.00	20.00	20.91
Labela	18.28	19.33	21.28	-	22.00	22.00	20.58
Innovator	17.30	17.42	15.73	23.00	20.50	19.50	18.91
Alrusset	19.30	18.05	20.18	22.00	20.50	15.50	19.25
HZD 1249	19.30	20.49	16.17	19.00	20.00	14.00	18.16
Ottawa	-	-	-	18.00	-	-	18.00
Picobella	-	-	-	18.00	-	-	18.00

List of the released potato varieties selected for different purposes

Based on the four years' trials conducted at different locations, the best varieties were selected for the following purposes.

1. **Export (#16):** BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-18 (Baraka), BARI Alu-24 (Dura), BARI Alu-25 (Asterix), BARI Alu-31 (Sagitta), BARI Alu-34 (Laura), BARI Alu-51 (Bellarosa), BARI Alu-59 (Metro), BARI Alu-60 (Vivaldi), BARI Alu-66 (Pamella), BARI Alu-72 (CIP-139), BARI Alu-84 (Memphis), BARI Alu-89 (Fortus), BARI Alu-92, Innovator (AYT).

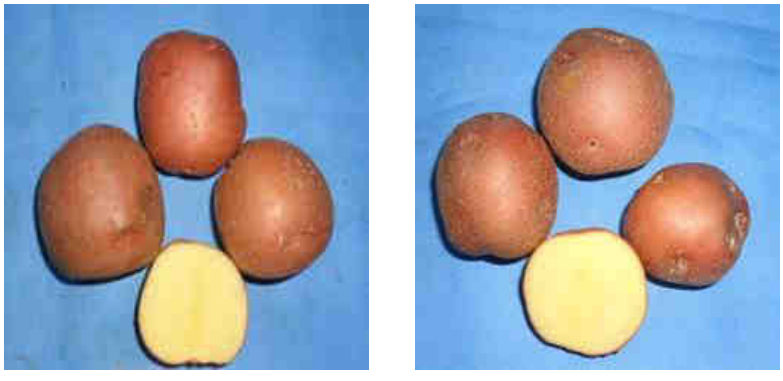
2. **French fries (#12):** BARI Alu-7 (Diamant), BARI Alu-8 (Cardinal), BARI Alu-25 (Asterix), BARI Alu-51 (Bellarosa), BARI Alu-59 (Metro), BARI Alu-66 (Pamella), BARI Alu-72 (CIP-139), BARI Alu-77 (Sarpomira), BARI Alu-84 (Memphis), BARI Alu-88 (CIP-239), BARI Alu-92, BARI Alu- 97 (Al. Russet) and Innovator (AYT).

3. **Chips (#8):** BARI Alu-28 (Lady Rosetta), BARI Alu-29 (Courage), BARI Alu-43 (Atlas), BARI Alu-68 (Atlantic), BARI Alu-70 (Destiny), BARI Alu-71 (Dolly), Alcander (SYT) and Crisp 4 all (SYT).

4. **Flakes/Starch (#13):** BARI Alu-12 (Dheera), BARI Alu-26 (Felsina), BARI Alu-35, BARI Alu-40, BARI Alu-41, BARI Alu-46, BARI Alu-53 (LB-6), BARI Alu-59 (Metro), BARI Alu-61 (Volumia), BARI Alu-63, BARI Alu-72 (CIP-139), BARI Alu-81 (CIP-10) and BARI Alu-92.

a) BARI Alu-13 (Granola) b) BARI Alu-31 (Sagitta) c) BARI Alu-89 (Fortus) d) Innovator

Figure 4. Best variety for Export



a) BARI Alu-28 (Lady Roseetta) b) BARI Alu-29 (Courage)

Figure 5. Best variety for Chips

a) BARI Alu-77 (Sarpomira) b) BARI Alu-88 c) BARI Alu- 97 (Alverstone Russet)

Figure 6. Best variety for French fry

Objective-4: Identification of best planting and harvesting time for processing and export potatoes.

1st Year (2018-2019)

11.50. EFFECT OF DATE OF PLANTING AND VARIETY ON THE QUALITY OF THE EXPORT AND PROCESSING POTATOES

An investigation was conducted to find out the effect ofplanting time in relation to some processing varieties on the production of export and processing quality potato tubers. The trial was set up in RCBD factorial design with three replications at four locations, namely Munshigonj, Debigonj, Rangpur and Faridpur with the varieties, BARI Alu-25 (Asterix) and BARI Alu-29 (Courage). Results showed that the effects of date planting were more prominent than those of varieties. The tuber yields of the four locations varied significantly due to planting time. The first planting (Oct 20) seems that it is not suitable for good yield. Rangpur and Debigonj yields are quite high, but those of Munshigonj and Faridpur are very low. This might due to the low temperature in the northern region which comes ahead of southern region of the country. It also seemed from the results the 3rd planting (November 10) is the best time yield in the northern region, while 4th planting (Nov 20) is the best for central and southern regions. When tuber grade was considered, first planting was found to produce maximum small sized tubers. P3 gave the maximum large sized tubers. Debigonj produced maximum large sized tubers during planting, Munshigonj and Faridpur produced during 3rd and 4th plantings, respectively.

Location-wise Mean tuber yield (t/ha)

Table 106.Effect of planting date

Treatment	Debigonj	Faridpur	Munshigonj	Rangpur	Mean
P_1 (Oct 20)	25.34 b	7.89 d	10.99 c	24.15 c	17.1
P_2 (Oct 20)	31.73 a	18.49 c	17.41 b	22.84 c	22.6
P_3 (November 10)	31.70 a	26.66 b	23.58 ab	38.51 a	30.1
P_4 (November 10)	26.44 b	33.29 a	25.89 a	31.59 b	29.3
CV %	9.88	22.32	32.72	12.71	

Table 107. Effect of variety

Treatment	Debigonj	Faridpur	Munshigonj	Rangpur	Mean
V_1 (BARI Alu-7, Diamant)	29.09	22.42	22.23	31.15 a	26.22
V_2 (BARI Alu-25, Asterix)	29.72	22.88	19.37	29.79 ab	25.44
V_3 (BARI Alu-29, Courage).	27.60	19.45	16.81	26.88 b	22.69
CV %	9.88	22.32	32.72	12.71	

Table 108. Interaction effects of planting date and variety.

Interaction	Debigonj	Faridpur	Munshigonj	Rangpur	Mean
P_1V_1	22.51	8.39	10.62	26.49	17.00
P_1V_2	25.81	7.14	11.89	26.84	17.92
P_1V_3	27.68	8.14	10.48	19.10	16.35
P_2V_1	31.23	17.29	19.35	23.63	22.88
P_2V_2	33.67	20.08	15.97	24.53	23.56
P_2V_3	30.28	18.12	16.91	20.36	21.42
P_3V_1	34.22	26.67	27.73	40.91	32.38
P_3V_2	31.96	30.15	24.66	39.72	31.62

Interaction	Debigonj	Faridpur	Munshigonj	Rangpur	Mean
P_3V_3	28.92	23.18	18.35	34.91	26.34
P_4V_1	28.38	37.35	31.20	33.58	32.63
P_4V_2	27.44	34.15	24.96	28.06	28.65
P_4V_3	23.52	28.38	21.50	33.13	26.63
Mean	28.8	21.59	19.47	29.27	24.78
CV %	9.88	22.32	32.72	12.71	

Location-wise grading (%) by wt.

Table 109. Effect of planting date: <40 mm

Treatment	Debigonj	Faridpur	Munshigonj	Mean
P_1	8.34 b	31.59 a	42.25 a	27.39
P_2	9.09 b	34.44 a	17.41 b	20.31
P_3	8.34 b	19.32 b	14.92 b	14.19
P_4	19.68 a	28.64 a	25.57 b	24.63
CV %	39.72	27.38	47.51	

Table 110. Effect of variety on tuber grade: <40 mm

Treatment	Debigonj	Faridpur	Munshigonj	Mean
V_1	11.84	32.26 a	20.81 b	21.64
V_2	11.91	29.77 ab	32.69 a	24.79
V_3	10.34	23.46 b	21.62 b	18.47
CV %	39.72	27.38	47.51	

Table 111. Interaction effects of planting date and variety on tuber grade: < 40mm

Interactions	Debigonj	Faridpur	Munshigonj	Mean
P_1V_1	5.43 d	36.31	33.04	24.93
P_1V_2	10.27 bcd	40.14	56.44	35.62
P_1V_3	9.32 cd	18.33	37.27	21.64
P_2V_1	6.99 cd	39.30	13.19	19.83
P_2V_2	11.12 bcd	34.82	24.46	23.47
P_2V_3	9.15 cd	29.18	14.58	17.64
P_3V_1	7.76 cd	23.42	13.14	14.77
P_3V_2	11.89 bcd	18.91	16.15	15.65
P_3V_3	5.36 d	15.61	15.49	12.15
P_4V_1	27.17 a	29.98	23.86	27.00
P_4V_2	14.34 bc	25.19	33.71	24.41
P_4V_3	17.52 b	30.72	19.15	22.46
Mean	11.36	28.49	25.04	21.63
CV%	39.72	27.37	47.51	

2nd Year (2019-2020)

11.51.EFFECT OF SEED SIZE AND SPACING ON EXPORT AND PROCESSING QUALITY POTATO PRODUCTION

An investigation was conducted to find out the effect of seed size in relation to plant spacing in order to produce export and processing quality potato tubers. The trial was set up in RCBD factorial design with three replications at three locations, namely Munshigonj, Debigonj and Barishal with the variety BARI Alu-25 (Asterix). Two sizes of tubers (40-45 mm and 28-35 mm) were used in combination with four spacing (65 cm×25 cm, 65 cm×20 cm, 70 cm×20cm, and 70 cm×15 cm). Results showed that the tuber size effects were more prominent than the spacing effects. Although the differences were not much variable in most of the cases, the tendency was to produce larger tubers and higher tuber yield with wider spacing and larger seed size. Heavy shower after planting affected the trial to some extent. So, the results seem to be not fairly conclusive.

Mean over location

Table 112. Effect of seed Size on yield (t/ha)

Treatment	Barishal	Debiganj	Munshiganj	Mean
S_1 (40-45 mm	37.47	40.87 a	21.83	33.39
S_2 (28-35 mm)	36.43	35.77 b	19.59	30.60
Mean	36.95	38.32	20.71	
CV (%)	11.64	4.09	44.71	

Table 113. Effect of plant spacing on yield (t/ha)

Treatment	Barishal	Debiganj	Munshiganj	Mean
P_1, 65 cm × 25 cm	35.79	44.79 a	23.56	34.71
P_2, 65 cm × 20 cm	36.18	39.02 b	28.01	34.40
P_3, 70 cm × 20cm	39.02	38.08 b	11.87	29.66
P_4, 70 cm × 15 cm	36.80	31.40 c	19.42	29.21
Mean	36.95	38.32	20.72	
CV (%)	11.64	4.09	44.71	

Table 114. Interaction effects of spacing×seed size on yield (t/ha)

Interaction	Barishal	Debiganj	Munshiganj	Mean
P_1S_1	38.95	48.41	24.96	37.44
P_1S_2	32.64	41.17	22.17	31.99
P_2S_1	34.56	41.68	27.82	34.69
P_2S_2	37.81	36.35	28.22	34.13
P_3S_1	39.43	39.81	11.94	30.39
P_3S_2	38.59	36.34	11.79	28.91
P_4S_1	36.95	33.59	22.63	31.06
P_4S_2	36.66	29.21	16.21	27.36
Mean	36.95	38.32	20.72	
CV (%)	11.64	4.09	44.71	

Mean tuber grade (%)by wt.

Table 115. Effect of seed Size on mean tuber grade

Treatment	<40 mm	40-55 mm	>55 mm
S_1	36.7	46.4	15.5
S_2	35.1	46.6	16.1

Table 116. Effect of plant spacing on mean tuber grade

Treatment	<40 mm	40-55 mm	>55 mm
P_1, 65 cm × 25 cm	34.1	48.6	15.8
P_2, 65 cm × 20 cm	41.0	45.2	13.0
P_3, 70 cm × 20cm	33.0	45.9	17.9
P_4, 70 cm × 15 cm	35.4	46.3	16.7

3rd Year (2020-2021)

11.52. EFFECT OF DATE OF PLANTING AND VARIETY ON THE QUALITY OF EXPORT AND PROCESSING POTATOES

An investigation was conducted to find out the effect ofplanting time in relation to some processing varieties on the production of export and processing quality potato tubers. The trial was set up in RCBD factorial design with three replications atthree locations, namely Munshigonj, Debigonj, and Rangpur with the varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix), BARI Alu-29 (Courage) and BARI Alu-62. The effects of varieties were prominent more than date planting. The tuber yields of the threelocations varied significantly due to planting time and variety. The first planting (Oct 20) seems that it is notsuitable for good yield. Last planting date showed higher yield in all locations. November 20 is the best time forall the varieties. When tuber grade was considered, first planting was found to produce maximum average smallsized tubers and 2nd planting gave the maximum average large sized tubers. Debigonj and Rangpur producedmaximum large sized tubers during November 20 but October 30 in Thakurgaon.

Table 117. Effect of date of planting

Planting time	Tuber Yield (t/ha)				Dry matter (%)			
	Debi	Thak	Rang	Mean	Debi	Thak	Rang	Mean
P_1	27.09 b	29.84 b	27.27 c	28.07	21.21 a	21.17 a	19.54	20.64
P_2	25.48 c	34.41 a	30.47 b	30.12	21.71 a	22.39 a	19.04	21.05
P_3	27.48 b	30.66 b	28.34 bc	28.83	19.82 b	18.65 b	19.33	19.27
P_4	39.14 a	33.97 a	42.85 a	38.65	19.91 b	18.47 b	19.79	19.39
CV (%)	6.41	7.34	9.42	-	6.41	7.36	6.61	-

P_1 (Oct 20), P_2 (Oct 30), P_3 (Nov 10), P_4 (Nov 20); Debi: Debigonj, Thak: Thakurgaon, Rang: Rangpur

Table 117. Continued

Planting time	% Tuber grading by weight		
	<40 mm	40-55 mm	>55 mm
P_1(Oct 20)	23.65	58.64	17.71
P_2(Oct 30)	16.96	61.75	21.29
P_3(Nov10)	22.67	65.94	11.39
P_4(Nov 20)	16.81	62.51	20.69

Table 118. Effect of variety

Variety	Tuber Yield (t/ha)				Dry matter (%)			
	Debi	Thak	Rang	Mean	Debi	Thak	Rang	Mean
V_1	26.69 c	32.45 b	32.58 b	30.57	20.61 b	21.18 a	19.91 b	20.57
V_2	30.94 b	30.27 c	32.25 b	31.15	19.87 b	19.75 b	19.08 b	19.57
V_3	23.52 d	29.23 c	25.74 c	26.16	22.25 a	20.21 ab	21.14 a	21.20
V_4	38.05 a	36.94 a	38.36 a	37.78	19.92 b	19.53 b	17.57 c	19.01
CV (%)	6.41	7.37	9.42	-	6.41	7.36	6.61	-

V_1 BARI Alu-7 (Diamant), V_2 BARI Alu-25 (Asterix), V_3 BARI Alu-29 (Courage), V_4 BARI Alu-62; Debi: Debigonj, Thak: Thakurgaon, Rang: Rangpur

Table 118. Continued

Planting time	% Tuber grading by weight		
	<40 mm	40-55 mm	>55 mm
V_1 BARI Alu-7 (Diamant)	20.98	58.41	20.61
V_2 BARI Alu-25 (Asterix)	25.49	63.12	11.39
V_3 BARI Alu-29 (Courage)	13.97	60.54	25.49
V_4 BARI Alu-62	19.65	66.77	13.59

Table 119. Interaction effects

Planting time	Tuber Yield (t/ha)				Dry matter (%)			
	Debi	Thak	Rang	Mean	Debi	Thak	Rang	Mean
$P_1 \times V_1$	22.63 gh	27.67 efg	26.4 fgh	25.57	20.20 bc	22.17 abc	20.67 ab	21.01
$P_1 \times V_2$	26.22 ef	30.09 def	26.56 fgh	27.62	20.16 bc	19.50 def	18.43 cde	19.36
$P_1 \times V_3$	22.07 gh	24.21 g	21.03 i	22.44	24.20 a	23.33 ab	21.18 a	22.90
$P_1 \times V_4$	37.45 c	37.38 ab	35.06 cd	36.63	20.27 bc	19.67 def	17.87 cde	19.27
$P_2 \times V_1$	23.44 fg	27.95 d-g	33.52 cde	28.30	21.69 b	21.04 bcd	18.38 cde	20.37
$P_2 \times V_2$	28.03 de	31.26 cde	28.96 efg	29.42	20.30 bc	22.37 abc	18.73 b-e	20.47
$P_2 \times V_3$	19.99 h	37.96 ab	24.96 ghi	27.64	24.04 a	23.85 a	21.37 a	23.09
$P_2 \times V_4$	30.48 d	40.46 a	34.43 cd	35.12	20.79 bc	22.31 abc	17.7 de	20.27
$P_3 \times V_1$	22.84 gh	34.98 bc	22.42 hi	26.75	20.05 bc	19.26 def	19.76 a-d	19.69
$P_3 \times V_2$	28.66 de	31.68 cd	31.07 def	30.47	19.72 bc	20.41 cde	19.29 a-e	19.81
$P_3 \times V_3$	21.72 gh	26.58 fg	22.57 hi	23.62	20.18 bc	17.21 fg	20.73 ab	19.37
$P_3 \times V_4$	36.72 c	29.42 def	37.30 c	34.48	19.32 c	17.72 fg	17.52 e	18.19
$P_4 \times V_1$	37.85 bc	39.18 a	47.97 a	41.67	20.49 bc	22.25 abc	20.83 ab	21.19
$P_4 \times V_2$	40.86 b	28.03 d-g	42.39 b	37.09	19.30 c	16.73 g	19.86 abc	18.63
$P_4 \times V_3$	30.29 d	28.16 d-g	34.39 cd	30.95	20.57 bc	16.46 g	21.28 a	19.44
$P_4 \times V_4$	47.54 a	40.49 a	46.64 ab	44.89	19.30 c	18.42 efg	17.19 e	18.30
CV (%)	6.41	7.37	9.42	-	6.41	7.37	9.42	-

Table 119. Continued

Interactions	Tuber Grading by Weight (%)		
	<40 mm	40-55mm	>55mm
$P_1 \times V_1$	23.66	55.55	20.79
$P_1 \times V_2$	32.90	60.09	7.00
$P_1 \times V_3$	18.33	54.16	27.51
$P_1 \times V_4$	19.72	64.75	15.53
$P_2 \times V_1$	17.49	60.80	21.71
$P_2 \times V_2$	23.81	65.80	10.39
$P_2 \times V_3$	11.50	59.42	29.08
$P_2 \times V_4$	15.05	60.97	23.98
$P_3 \times V_1$	24.70	64.66	10.64
$P_3 \times V_2$	26.66	63.79	9.55
$P_3 \times V_3$	13.78	66.32	19.90
$P_3 \times V_4$	25.53	69.01	5.46
$P_4 \times V_1$	18.08	52.64	29.29

Interactions	Tuber Grading by Weight (%)		
	<40 mm	40-55mm	>55mm
$P_4 \times V_2$	18.60	62.79	18.62
$P_4 \times V_3$	12.26	62.28	25.47
$P_4 \times V_4$	18.30	72.32	9.37

Objective-5: Standardization of agro-techniques for production of processing and export potatoes.

11.53. EFFECT OF SEED SIZE AND SPACING ON THE YIELD OF PROCESSING AND EXPORT QUALITY POTATO, 20-21

An investigation was conducted to find out the effect of seed size in relation to plant spacing in order to produce export and processing quality potato tubers. The trial was set up in RCBD factorial design with three replications atfour locations, namely Gazipur, Debigonj, Burirhat and Barishal with the variety BARI Alu-25 (Asterix). Three sizes of tubers (45-55 mm, 35-45 and 28-35 mm) were used in combination with five spacing (60 cm×25 cm, 65 cm×25 cm, 65 cm×20 cm, 70 cm×25cm, and 70 cm×20 cm). The tubers were planted during 3rd week of November, 2019. Results showed that the tuber size effects are more prominent than the spacing effects. Although the differences were not much variable in most of the cases, the tendency was to produce larger tubers and higher tuber yield with wider spacing and larger seed size. Heavy shower after planting affected the trial to some extent. So, the results seem to be not fairly conclusive.

Table 120. Effect of spacing

Spacing	Tuber Yield (t/ha)					Dry matter (%)				
	Bari	Buri	Debi	Gazi	Mean	Bari	Buri	Debi	Gazi	Mean
P_1	30.45 a	28.62 a	37.34 a	24.58 a	30.25	19.93	19.94	17.83 ab	21.18 b	19.72
P_2	28.79 b	28.61 a	37.47 a	23.30 a	29.54	20.12	20.57	17.68 b	21.44 b	19.95
P_3	27.93 b	23.79 c	33.41 bc	21.22 b	26.59	19.77	20.41	18.40 a	21.44 b	20.00
P_4	24.58 c	21.88 d	34.60 b	20.21 b	25.32	19.45	20.18	18.20 ab	22.88 a	20.18
P_5	23.48 c	25.21 b	31.65 c	23.32 a	25.92	19.70	20.74	18.24 ab	21.02 b	19.93
CV (%)	7.39	5.17	7.62	7.40	-	8.39	8.93	3.81	3.23	-

P_1 (60 cm×25 cm), P_2 (65 cm×25 cm), P_3 (65 cm×20 cm), P_4 (70 cm×20cm), P_5 (70 cm×25 cm); Bari: Barishal, Buri: Burirhat, Debi: Debigonj, Gazi: Gazipur

Table 120. Continued

Spacing	Tuber Grading by Weight (%)		
	<40 mm	40-55mm	>55mm
P_1 (60 cm×25 cm)	30.96	60.67	8.372
P_2 (65 cm×25 cm)	31.42	60.35	8.227
P_3 (65 cm×20 cm)	37.87	56.07	6.068
P_4 (70 cm×20cm)	31.69	60.28	8.032
P_5 (70 cm×25 cm)	35.79	58.20	6.011

Table 121. Effect of seed size

Spacing	Tuber Yield (t/ha)					Dry matter (%)				
	Bari	Buri	Debi	Gazi	Mean	Bari	Buri	Debi	Gazi	Mean
S_1	30.30 a	27.50 a	33.97 b	25.87 a	29.41	18.91 b	20.30	17.92	21.30 b	19.61
S_2	27.52 b	26.34 b	36.37 a	23.91 b	28.54	20.09 a	20.69	18.17	21.60 ab	20.14
S_3	23.31 c	23.03 c	34.33 b	17.80 c	24.62	20.37 a	20.11	18.11	21.88 a	20.12
CV (%)	7.39	5.17	7.62	7.40	-	8.39	8.93	3.81	3.23	-

Bari: Barishal, Buri: Burirhat, Debi: Debigonj, Gazi: Gazipur

Table 121. Continued

Spacing	Tuber Grading by Weight (%)		
	<40 mm	40-55mm	>55mm
S_1	36.30	57.10	6.602
S_2	33.24	59.52	7.237
S_3	31.10	60.72	8.187

Table 122. Interaction effect

Interaction effects	Tuber Yield (t/ha)					Dry matter (%)				
	Bari	Buri	Debi	Gazi	Mean	Bari	Buri	Debi	Gazi	Mean
$S_1 \times P_1$	34.62 a	25.91 cd	34.55 c-f	28.70 a	30.94	19.15 abc	19.86	17.87 bc	20.90 efg	19.44
$S_1 \times P_2$	31.66 bc	33.14 a	38.94 ab	25.06 bc	32.20	19.58 abc	20.22	17.50 c	20.68 fg	19.49
$S_1 \times P_3$	32.34 ab	29.89 b	31.43 fg	25.92 b	29.89	18.87 abc	20.02	18.44 abc	21.32 def	19.66
$S_1 \times P_4$	26.55 de	23.75 ef	35.53 b-e	20.63 e	26.62	18.66 bc	20.88	18.01 bc	22.47 abc	20.00
$S_1 \times P_5$	26.33 de	24.80 de	29.42 g	29.06 a	27.4	18.31 c	20.54	17.80 bc	21.13 def	19.44
$S_2 \times P_1$	30.67 bc	32.70 a	40.25 a	25.45 bc	32.27	19.42 abc	20.34	17.79 bc	21.12 def	19.67
$S_2 \times P_2$	29.81 bc	29.80 b	38.16 abc	24.03 bc	30.45	20.70 ab	21.56	17.50 c	22.49 abc	20.56
$S_2 \times P_3$	28.93 cd	22.39 fg	34.31 def	23.29 c	27.23	20.10 abc	20.90	18.49 ab	21.04 def	20.13
$S_2 \times P_4$	25.59 e	21.85 gh	35.67 b-e	23.60 bc	26.68	19.79 abc	20.17	18.02 bc	23.32 a	20.32
$S_2 \times P_5$	22.60 fg	24.98 de	33.48 def	23.16 cd	26.06	20.47 abc	20.50	19. 07 a	20.04 g	20.02
$S_3 \times P_1$	26.05 e	27.27 c	37.22 a-d	19.59 ef	27.53	21.22 a	19.62	17.85 bc	21.53 c-f	20.05
$S_3 \times P_2$	24.89 ef	22.90 fg	35.30 b-e	20.81 de	25.97	20.08 abc	19.94	18.04 bc	21.16 def	19.80
$S_3 \times P_3$	22.52 fg	19.09 i	34.49 c-f	14.46 h	22.64	20.35 abc	20.30	18.26 abc	21.97 bcd	20.22
$S_3 \times P_4$	21.60 g	20.05 hi	32.59 efg	16.39 gh	22.66	19.89 abc	19.50	18.57 ab	22.84 ab	20.20
$S_3 \times P_5$	21.50 g	25.87 cd	32.04 efg	17.75 fg	24.29	20.32 abc	21.19	17.85 bc	21.89 b-e	20.31
CV (%)	7.39	5.17	7.62	7.40	-	8.39	8.93	3.81	3.23	-

Bari: Barishal, Buri: Burirhat, Debi: Debigonj, Gazi: Gazipur

Table 122. Continued

Interaction effects	Tuber Grading by Weight (%)		
	<40 mm	40-55mm	>55mm
$S_1 \times P_1$	32.03	60.81	7.17
$S_1 \times P_2$	34.10	58.63	7.28
$S_1 \times P_3$	39.90	54.17	5.93
$S_1 \times P_4$	35.46	56.76	7.79
$S_1 \times P_5$	40.00	55.15	4.85
$S_2 \times P_1$	31.67	59.97	8.36
$S_2 \times P_2$	30.63	60.30	9.07
$S_2 \times P_3$	40.25	54.14	5.61
$S_2 \times P_4$	29.52	63.04	7.44
$S_2 \times P_5$	34.15	60.15	5.71
$S_3 \times P_1$	29.18	61.23	9.59
$S_3 \times P_2$	29.53	62.13	8.34
$S_3 \times P_3$	33.44	59.90	6.67
$S_3 \times P_4$	30.09	61.05	8.87
$S_3 \times P_5$	33.24	59.29	7.48

11.54.EFFECT OF PHOSPHORUS AND POTASSIUM ON THE YIELD OF PROCESSING AND EXPORT QUALITY POTATOES, 20-21

The present research work was conducted to evaluate the best potassium source of fertilizer in combination with different doses of phosphorus in respect of yield and tuber qualities for the purposes of potato export and processing. The trial was set up in Split Plot design with three replications at the TCRC Sub-Station Bogura with the variety BARI Alu-29 (Courage). Four doses of Phosphorus doses of P (200, 220, 240 and 260kg of TSP per hectare), and three forms of Potassium (250 kg KCl/ha, 452.19 kg KH_2PO_4/ha, and 288.6 kg K_2SO_4 /ha) were used. Planting was

done on 28 Nov, 2019 and harvesting was done on 12 March, 2020. Results showed that the P doses significantly influenced plant height and No. of stems per plant, but none of the yield contributing characters and dry matter content were significant. K forms influenced both of these characters along with the no. of tubers per plant. Combination treatment also influenced significantly on these two plant characters. Tuber grades did not vary much due to individual and combination treatments except in one case.

Table 123. Effect of phosphorus

P dose	Tuber Yield (t/ha)	Dry matter (%)	Tuber Grading by Weight (%)		
			<40 mm	40-55mm	>55mm
P_1 (P200)	32.2	19.2	27.58	70.93	0.827
P_2 (P220)	35.2	18.5	25.43	72.56	1.081
P_3 (P240)	34.2	19.1	24.12	73.59	0.768
P_4 (P260)	34.1	18.6	28.93	69.33	0.604

Table 124. Effect of potassium level

Potash dose	Tuber Yield (t/ha)	Dry matter (%)	Tuber Grading by Weight (%)		
			<40 mm	40-55mm	>55mm
K_1 (KCl) 250 kg	33.9	18.9	23.71 b	74.54	0.889
K_2 (KH_2PO_4)452.19 kg	35.3	18.9	29.52 a	69.14	1.041
K_3 (K_2SO_4)288.6 kg	32.5	18.8	26.33 ab	71.13	0.529

Table 125. Interaction effect

Interaction effects	Tuber Yield (t/ha)	Dry matter (%)	Tuber Grading by Weight (%)		
			<40 mm	40-55mm	>55mm
P_1K_1	32.2	19.2	26.63	72.36	0.629
P_1K_2	32.5	18.7	31.51	66.77	1.406
P_1K_3	31.8	19.8	24.59	73.66	0.446
P_2K_1	34.5	18.9	19.65	78.00	1.131
P_2K_2	38.1	18.6	26.82	71.76	1.360
P_2K_3	33.1	18.1	29.83	67.91	0.751
P_3K_1	34.2	18.7	21.31	76.98	0.723
P_3K_2	36.0	19.5	27.43	70.81	1.006
P_3K_3	32.5	19.1	23.61	72.98	0.576
P_4K_1	35.2	18.7	27.23	70.80	1.073
P_4K_2	34.5	18.9	32.31	67.23	0.393
P_4K_3	32.8	18.2	27.26	69.96	0.345

11.55.EFFECT OF BIOCHAR AND VERMICOMPOST ON THE YIELD AND QUALITY OF EXPORT AND PROCESSING POTATOES

The present research work was conducted to find out the effects organic manures like Biochar and Vermi-compost on the yield and qualities of the tubers for the purposes of potato export and processing. The trial was set up in RCBD factorial design with three replications at the TCRC Sub-Station Bagura with the variety BARI Alu-29 (Courage). Four doses of Biochar (0, 2, 4 and 6 t/ha) and three doses of Vermicompost (0, 2, 4 and 6 t/ha) were used. Planting was done on 28 Nov, 2020. Results showed that the Biochar induced little variation only in number of tubers, and Vermicompost only in case of of plant height. For both the cases none of the other characters was found significant. Combination effects made some variation in case of plant vigor, plant height and no. of stems. Tuber yield or dry matter content both seemed to be induced, but it may not be viable due to material availability and high cost involvement.

Table 126. Effect of Biochar

Biochar level	Tuber Yield (t/ha)	Dry matter (%)	Tuber Grading by Weight (%)		
			<40 mm	40-55mm	>55mm
B_1 (0 t/ ha)	33.51	21.67	47.92	52.08	0
B_2 (2 t/ ha)	33.49	21.46	40.32	59.68	0
B_3 (4 t/ ha)	35.47	21.01	42.55	57.45	0
B_4 (6 t/ ha)	34.23	21.26	45.11	54.89	0

Table 127. Effect of Vermicompost

Vermicompost dose	Tuber Yield (t/ha)	Dry matter (%)	Tuber Grading by Weight (%)		
			<40 mm	40-55mm	>55mm
Vm_1 (0 t/ ha)	36.12	22.29	45.18	54.82	0
Vm_2 (2 t/ ha)	33.63	21.28	42.64	57.36	0
Vm_3 (4 t/ ha)	34.32	20.82	44.07	55.94	0
Vm_4 (6 t/ ha)	32.64	20.99	44.01	55.99	0

Table 128. Interaction effects

Interaction	Tuber Yield (t/ha)	Dry matter (%)	Tuber Grading by Weight (%)		
			<40 mm	40-55mm	>55mm
B_1Vm_1	33.00	21.23	52.64	47.36	0
B_1Vm_2	35.49	21.69	49.38	50.62	0
B_1Vm_3	34.68	21.93	43.65	56.35	0
B_1Vm_4	30.87	21.82	45.99	54.01	0
B_2Vm_1	37.27	21.83	41.71	58.29	0
B_2Vm_2	31.09	22.13	36.54	63.46	0
B_2Vm_3	31.22	21.41	47.08	52.92	0
B_2Vm_4	34.41	20.46	35.93	64.07	0
B_3Vm_1	37.19	20.64	42.04	57.96	0
B_3Vm_2	33.59	20.37	38.89	61.11	0
B_3Vm_3	37.00	20.66	41.17	58.83	0
B_3Vm_4	34.09	22.36	48.11	51.89	0
B_4Vm_1	37.02	25.48	44.33	55.67	0
B_4Vm_2	34.33	20.93	45.76	54.24	0
B_4Vm_3	34.37	19.27	44.35	55.65	0
B_4Vm_4	31.18	19.35	45.99	54.00	0

11.56. EFFECT OF NITROGEN AND BIOCHAR ON THE PRODUCTION OF EXPORT AND PROCESSING QUALITY POTATOES

A study was conducted to find out the efficiencies of N forms and Biochar in order to see the effect of USG and Biochar on the quality of potato tubers for export and processing. The trial was set up in RCBD factorial design with three replications at the TCRC Sub-Station, Munshigonj with the variety was BARI Alu-25 (Asterix). Two doses of urea (prilled and USG, 350 kg/ha each) and four doses of Biochar (0, 2, 4 and 6 t/ha) were used. There was some variation in characters, variation did not seem significant. So treatments may not be viable due to high cost involvement.

Table-129. Effect of urea form

Form of urea	Tuber Yield (t/ha)	Dry matter (%)	Tuber Grading by Weight (%)		
			<40 mm	40-55mm	>55mm
Up (Prilled urea)	29.8	19.2	25.94	35.32	19.71
Us (USG, 350 kg/ha)	33.9	19.4	20.51	28.92	20.93

Table-130. Effect of Biochar level

Biochar dose	Tuber Yield (t/ha)	Dry matter (%)	Tuber Grading by Weight (%)		
			<40 mm	40-55mm	>55mm
B_0 (0 t/ha)	32.1	18.5	25.02	31.33	22.34
B_1 (2 t/ha)	31.6	19.2	20.29	32.17	22.17
B_2 (4 t/ha)	32.9	19.9	21.49	35.03	19.16
B_3 (6 t/ha)	30.7	19.5	26.11	29.95	17.61

Table-131. Interaction effects

Interactions	Tuber Yield (t/ha)	Dry matter (%)	Tuber Grading by Weight (%)		
			<40 mm	40-55mm	>55mm
UpB_0	29.6	18.2	30.49	29.65	17.98
UpB_1	29.1	20.4	27.28	33.86	22.23
UpB_2	29.5	19.3	22.76	41.63	18.61
UpB_3	31.1	18.9	23.25	36.15	20.02
UsB_0	34.6	18.9	19.56	33.02	26.69
UsB_1	34.2	17.9	13.31	30.48	22.12
UsB_2	36.4	20.5	20.21	28.44	19.70
UsB_3	30.4	20.0	28.97	23.75	15.21

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11.57. EFFECT OF DATE OF PLANTING ON THE QUALITY OF THE EXPORT AND PROCESSING POTATOES

An investigation was conducted to find out the effect ofplanting time in relation to some processing varieties on the production of export and processing quality potato tubers. The trial was set up in RCBD factorial design with three replications at three locations, namely Debigonj, Thakurgaon and Rangpur with the varieties BARI Alu-29 (Courage) and BARI Alu-62. Planting on Oct 30 and BARI Alu- 62 produced maximum yield except Nov 10 planning on Rangpur. Nov 10 planting and BARI Alu- 29 (Courage) produced maxium desired size tuber in all location.

Table-132. Effect of different planting date on tuber

Planting Date	Tuber Weight/hill (kg)	Yield (t/ha)	Tuber grading percentage by weight			
			<28 mm	28-40 mm	40-55 mm	>55 mm
P_1	0.426	28.39	2.67	20.15	59.29	17.89
P_2	0.559	37.24	2.40	14.91	58.17	24.52
P_3	0.591	39.39	1.65	12.03	63.65	22.89
P_4	0.457	30.44	4.92	28.06	59.09	7.87
P_5	0.427	28.48	2.94	16.51	62.87	17.69
P_6	0.398	26.51	3.55	17.76	66.89	11.79
P_7	0.336	22.43	4.68	29.16	57.45	8.72

Table-133. Effect of different variety on tuber

Variety	Tuber Weight/hill (kg)	Yield (t/ha)	Tuber grading percentage by weight			
			<28 mm	28-40 mm	40-55 mm	>55 mm
V_1 (Courage)	0.363	24.18	2.73	17.16	59.54	20.62
V_2 (BARI Alu- 62)	0.550	36.64	3.80	22.44	62.58	11.19

Table-134. Interaction effects of planting date and variety

Interaction	Tuber Weight/hill (kg)	Yield (t/ha)	Tuber grading percentage by weight			
			<28 mm	28-40 mm	40-55 mm	>55 mm
T_1 ($P_1 \times V_1$)	0.277	18.46	3.01	15.75	52.73	28.51
T_2 ($P_1 \times V_2$)	0.575	38.31	2.33	24.55	65.85	7.26
T_3 ($P_2 \times V_1$)	0.417	27.80	2.29	11.55	55.43	30.72
T_4 ($P_2 \times V_2$)	0.700	46.67	2.51	18.27	60.92	18.31
T_5 ($P_3 \times V_1$)	0.511	34.08	1.41	11.34	60.27	27.42
T_6 ($P_3 \times V_2$)	0.671	44.71	1.89	12.73	67.04	18.35
T_7 ($P_4 \times V_1$)	0.331	22.06	3.76	25.47	59.71	10.95
T_8 ($P_4 \times V_2$)	0.582	38.81	6.09	30.65	58.47	4.80
T_9 ($P_5 \times V_1$)	0.329	21.92	2.58	15.08	59.80	22.55
T_{10} ($P_5 \times V_2$)	0.526	35.04	3.29	17.95	65.94	12.82
T_{11} ($P_6 \times V_1$)	0.375	25.01	1.85	14.52	69.36	14.28
T_{12} ($P_6 \times V_2$)	0.420	28.01	5.27	21.01	64.42	9.31
T_{13} ($P_7 \times V_1$)	0.299	19.94	4.16	26.42	59.49	9.93
T_{14} ($P_7 \times V_2$)	0.374	24.91	5.20	31.89	55.41	7.51

11.58. EFFECT OF SEED SIZE AND SPACING ON THE YIELD OF PROCESSING AND EXPORT QUALITY POTATO

An investigation was conducted to find out the effect of seed size in relation to plant spacing in order to produce export and processing quality potato tubers. The trial was setup at four locations, namely Barishal, Burirhat, Debigonj and Gazipur with the variety BARI Alu-25 (Asterix). Three sizes of tubers (45-55 mm, 35-45 and 28-35 mm) were used in combination with five spacing (60 cm × 25 cm, 65 cm × 25 cm, 65 cm × 20 cm, 70 cm × 25 cm, and 70 cm × 20 cm). Largest seed size and 65 cm × 25 cm produced maximum yield. Largest seed size and 65 cm × 20cm produced maximum yield. A complete report after data analysis will be given in the next report.

Table 135. Effect of different seed size on tuber

Seed Size	Tuber Wt/hill (kg)	Yield (t/ha)	Tuber grading Percentage by weight		
			<40 mm	40-55 mm	>55 mm
S_1, (45-55 mm)	0.459	28.85	31.95	61.46	6.59
S_2, (35-45 mm)	0.456	28.61	31.59	61.77	6.64
S_3, (28-35 mm)	0.449	28.18	30.99	62.39	6.62

Table 136. Effect of different spacing on tuber

Spacing	Tuber Wt/hill (kg)	Yield (t/ha)	Tuber grading Percentage by weight		
			<40 mm	40-55 mm	>55 mm
P_1 (60 cm × 25 cm)	0.442	27.19	31.56	61.85	6.58
P_2 (65 cm × 25 cm)	0.498	30.25	29.23	61.95	8.82
P_3 (65 cm × 20 cm)	0.442	28.65	28.59	62.96	8.45
P_4 (70 cm × 25 cm)	0.479	29.68	30.65	62.16	7.19
P_5 (70 cm × 20 cm)	0.390	25.43	28.70	64.28	7.02

Table 137. Interaction Effects of seed size and spacing

Interaction	Tuber Weight/hill (kg)	Yield (t/ha)	Tuber grading Percentage by weight		
			<40 mm	40-55 mm	>55 mm
T_1 (S_1×P_1)	0.447	27.83	33.71	60.73	5.56
T_2 (S_1×P_2)	0.529	32.16	32.76	59.70	7.54
T_3 (S_1×P_3)	0.451	29.08	31.80	60.78	7.42
T_4 (S_1×P_4)	0.493	30.57	29.05	62.93	8.02
T_5 (S_1×P_5)	0.376	24.63	32.42	63.18	4.40
T_6 (S_2×P_1)	0.437	26.59	31.90	62.27	5.82
T_7 (S_2×P_2)	0.495	30.02	29.77	62.81	7.43
T_8 (S_2×P_3)	0.477	30.85	28.08	63.34	8.58
T_9 (S_2×P_4)	0.484	29.96	31.71	62.34	5.95
T_{10} (S_2×P_5)	0.389	25.41	23.94	67.12	8.94
T_{11} (S_3×P_1)	0.441	27.14	29.06	62.58	8.37
T_{12} (S_3×P_2)	0.469	28.58	25.17	63.34	11.49
T_{13} (S_3×P_3)	0.399	26.03	25.89	64.77	9.34
T_{14} (S_3×P_4)	0.465	28.52	31.19	61.22	7.58
T_{15} (S_3×P_5)	0.401	26.24	29.74	62.52	7.74

11.59. EFFECT OF K SOURCE AND DOSE ON THE YIELD OF PROCESSING AND EXPORT QUALITY POTATOES

The present research work was conducted to evaluate the best potassium source and dose in respect of yield and tuber qualities for the purposes of potato export and processing. The trial was set up in RCBD factorial design with three replications at two locations, namely Burirhat and Bogura with the variety BARI Alu-29 (Courage) and BARI Alu- 62. Seven doses of Potassium doses of K were used. BARI Alu-29 and 142.86 kg/ha K $_2SO_4$ accumulate maxium dry matter. BARI Alu-29 and 240 kg/ha KCl produced maximum yield. A complete report after data analysis will be given in the next report.

Table 138. Effect of different varieties on tuber yield and quality

Variety	Tuber Number/ hill	Tuber Weight/ hill (kg)	Yield (t/ha)	Dry Matter (%)	% Tuber grading by weight			
					<28 mm	28-40 mm	40-55 mm	>55 mm
V_1, (Courage)	7.44	0.377	26.78	23.39	5.17	39.90	53.87	7.05
V_2, (BARI Alu-62)	7.72	0.398	28.24	20.23	4.91	39.31	55.56	6.56

Table 139. Effect of different fertilizer on tuber

Fertilizer	Tuber Number/ hill	Tuber Weight/ hill (kg)	Yield (t/ha)	Dry Matter (%)	% Tuber grading by weight			
					<28 mm	28-40 mm	40-55 mm	>55 mm
K_1	9.00	0.483	34.05	22.60	5.23	40.11	57.69	5.57
K_2	8.56	0.458	32.37	23.53	6.13	41.00	56.55	3.82
K_3	9.11	0.543	38.38	21.17	4.71	36.87	64.25	6.06
K_4	8.58	0.474	33.49	22.57	5.51	39.93	58.39	4.51
K_5	8.72	0.504	35.62	20.48	4.37	37.52	61.83	7.48
K_6	9.09	0.490	34.59	21.43	5.67	39.02	59.82	5.37
K_7	8.81	0.474	33.35	20.92	5.70	45.70	51.16	3.92

(i) K_1= 120 kg/ha KCl (K dose: 60 Kg/ha), ii) K_2= 142.86 kg/ha K_2SO_4 (K dose: 60 Kg/ha), iii) K_3= 240 kg/ha KCl (K dose: 120 Kg/ha), iv) K_4= 285.71 kg/ha K_2SO_4 (K dose: 120 Kg/ha), v) K_5= 360 kg/ha KCl (K dose: 180 Kg/ha), vi) K_6= 428.57 kg/ha K_2SO_4 (K dose: 180 Kg/ha), vii) K_7= Control (K dose: 0 Kg/ha)

Table 140. Interaction effects of variety and fertilizer

Interaction	Tuber Number/ hill	Tuber Weight/ hill (kg)	Yield (t/ha)	Dry Matter (%)	Tuber grading (%) by weight			
					<28 mm	28-40 mm	40-55 mm	>55 mm
T_1 (V_1×K_1)	7.71	0.380	26.89	22.79	6.25	40.98	51.67	9.43
T_2 (V_1×K_2)	7.38	0.336	23.85	24.52	8.44	40.35	51.53	4.36
T_3 (V_1×K_3)	7.60	0.426	30.14	22.98	3.74	34.36	62.62	8.28
T_4 (V_1×K_4)	6.99	0.382	27.02	24.82	4.08	41.99	51.50	5.87
T_5 (V_1×K_5)	7.04	0.385	27.45	21.63	2.64	38.74	56.18	9.84
T_6 (V_1×K_6)	7.84	0.388	27.52	23.98	6.13	35.03	57.41	7.64
T_7 (V_1×K_7)	7.51	0.345	24.56	24.26	4.93	47.86	46.21	3.95
T_8 (V_2×K_1)	10.30	0.587	41.20	21.41	4.21	39.24	63.70	1.71
T_9 (V_2×K_2)	9.73	0.579	40.90	20.80	3.82	41.66	61.58	3.27
T_{10} (V_2×K_3)	10.61	0.660	46.62	18.69	5.69	39.38	65.89	3.83
T_{11} (V_2×K_4)	10.17	0.566	39.96	19.92	6.94	37.87	65.28	3.15
T_{12} (V_2×K_5)	10.39	0.623	43.79	18.73	6.10	36.29	67.49	5.11
T_{13} (V_2×K_6)	10.35	0.591	41.66	20.64	5.22	43.02	62.23	3.10
T_{14} (V_2×K_7)	10.11	0.603	42.14	21.78	6.47	43.54	56.12	3.89

11.60. EFFECT OF NITROGEN FERTILIZER ON THE YIELD AND QUALITY OF PROCESSING AND EXPORT POTATOES

The present research work was conducted to find out the nitrogen fertilizer amount and application time in order to get maximum yield and dry matter in tuber. The trial was set up in RCBD factorial design with three replications at Rangpur and Debigonj with the variety BARI Alu-7 (Diamant) and BARI Alu-62. Three doses of urea were used. BARI Alu-62 produced maxium yield and large size tuber. 50% Urea at Basal placement+ 50% top dress at 35 DAP produced maximum yield but 50% Urea at Basal placement+50% top dress at 35 DAP+50% extra top dress at 70 DAP produced maximum larger size tuber.

Table 141. Effect of different variety on tuber

Variety	Tuber Weight/hill (kg)	Yield (t/ha)	Tuber grading percentage by weight			
			<28 mm	28-40 mm	40-55 mm	>55 mm
V_1	0.427	28.44	2.88	21.00	64.52	11.60
V_2	0.536	35.74	2.08	20.63	67.61	9.68

Table 142. Effect of different fertilizer dose on tuber

Fertilizer Dose	Tuber Weight/hill (kg)	Yield (t/ha)	Tuber grading percentage by weight			
			<28 mm	28-40 mm	40-55 mm	>55 mm
U_1	0.493	32.89	2.36	20.38	65.88	11.39
U_2	0.474	31.59	2.45	23.24	65.85	8.45
U_3	0.477	31.79	2.63	18.83	66.46	12.08

Table 143.Interactioneffects of variety and fertilizer

Interaction	Tuber Weight/hill (kg)	Yield (t/ha)	Tuber grading percentage by weight			
			<28 mm	28-40 mm	40-55 mm	>55 mm
T_1 (V_1×U_1)	0.435	29.00	2.75	18.33	65.54	13.38
T_2 (V_1×U_2)	0.407	27.15	2.55	24.50	63.57	9.38
T_3 (V_1×U_3)	0.438	29.18	3.34	20.18	64.44	12.04
T_4 (V_2×U_1)	0.552	36.79	1.97	22.43	66.21	9.39
T_5 (V_2×U_2)	0.540	36.02	2.35	21.99	68.14	7.52
T_6 (V_2×U_3)	0.516	34.41	1.92	17.48	68.48	12.12

11.61. EFFECT OF FERTILIZER AND IRRIGATION FREQUENCY ON THE YIELD AND QUALITY OF PROCESSING POTATO

Fertilization and irrigation play important role in enhancing the system productivity of potato. The hypothesized is that the use of fertilizer with potassium sulfate and water with irrigation frequency/interval influence the yield, water productivity, dry matter (DM), specific gravity (SG) and quality of potato tubers.

To test this hypothesis, two field experiments were conducted at the research field of Tuber Crop Research Centre (TCRC) at Gazipur and Regional TCRC at Bogura of the Bangladesh Agricultural Research Institute and evaluated tuber yields, dry matter (DM), specific gravity, water productivity and quality of two processing potato varieties of BARI Alu-25 (V_1: Asterix) and BARI Alu-29 (V_2: Courage) in different fertilization and irrigation treatments. The treatments consisted of nine combinations of three fertilizers (F) levels and three irrigation (I) levels. Three fertilizer levels were(i)F_1: FRG 2018 (Split 2 times: N, K) (ii) F_2: FRG 2018 with combination of sulfate of potash (SOP) (Split 3 times: N, SOP, Mg), (iii) F_3: FRG 2018 with combination of SOP (20% Additional) (Split 2 times: P, 3 times: N, SOP, Mg). Three irrigation frequency/interval were (i) I_1: three irrigations (20-25 DAP, 40-45 DAP, 60-65 DAP), (ii) I_2: four irrigation (18-20 DAP, 40-42 DAP, 55-60 DAP, 70-75 DAP) and (iii) I_3: five irrigation (17-20 DAP, 32-35 DAP, 50-52 DAP, 62-65 DAP, 78-80 DAP).

The results indicated that fresh tuber yields of potatoes (V_1 and V_2) were not significantly different among the fertilizer treatments (F) in both locations. The treatment I_2 produced significantly greater tuber yield of the varieties, V_1 (22.82 t/ha) and V_2 (21.99 t/ha) compared to I_1 produced the varieties, V_1 (22.17 t/ha) and V_2 (18.69 t/ha) at Gazipur and V_1 (29.89 t/ha) and V_2 (22.26 t/ha) compared to I_1 produced V_1 (26.4 t/ha) and V_2 (20.63 t/ha) at Bogura. The interaction effect of fertilizer and irrigation (F × I) produced insignificant difference on yield of potato tuber in V_1 and V_2 in both locations. The interactive effect of fertilizer and irrigation interval treatment F_2I_2 produced tuber yield of V_1 (22.04 t/ha) and V_2 (22.24 t/ha.) at Gazipur and V_1 (30.17 t/ha) and V_2 (21.28 t/ha) at Bogura. Water productivity varied among the treatments. The fertilizer treatment (F) had no significant effect on IWP in both locations but the irrigation treatment (I) had greatly significant ($P < 0.001$) effect on IWP and CWP of potato tuber in both locations. The results also revealed that the quality parameters of tuber DM and SG were significantly influenced and improved by the treatment with sulfate of potash (SOP, K_2SO_4) than muriate of potash (MOP, KCl) with combination of I_2, while the interaction of these factors significantly influenced DM and SG. At harvesting stage, DM and SG were greater in F_2 than F_1 and F_3. In I_2 treatment, there was also significantly greater DM and SG in V_1 and V_2 compared to I_1 and I_3 in both locations. The interactive effect of fertilizer and irrigation (F_2I_2) produced greater tuber DM of V_1 (21.88%) and V_2 (23.54%) at Gazipur and V_1 (21.73%) and V_2 (24.28%) at Bogura and SG of V_1 (1.086) and V_2 (1.093) at Gazipur and V_1 (1.083) and V_2 (1.096) at Bogura than the effect of other interactive treatments (F×I) in V_1 and V_2. The SG was positively correlated with the DM content to over locations and the correlation coefficients were 0.97 in V_1 and 0.94 in V_2 in Gazipur and 0.99 in V_1 and 0.95 in V_2 in Bogura.

However, these findings are important to export and processing potato growers that SOP with combination of suitable irrigation interval and irrigation amount is an important factor in improving potato tuber quality in different environments and soils in Bangladesh. Further study is also needed to find out the influence of the optimum rate of SOP on potato tuber quality under different soil types and climatic zones.

Effect of fertilizer and irrigation on tuber yield of potato (V_1: BARI Alu-25, Asterix)

Table 144 (a) illustrates the fresh tuber yield and yield contributing characters of processing potato variety (V_1: BARI Alu-25, Asterix) at the harvest under different fertilizers and irrigation levels over two locations over two locations of Gazipur and Bogura. We observed that four irrigations at different growth stages of potato are important for better response for number of tuber and yield of potato in both environment and soils.

Table 144a. Tuber yield and yield contributing characters of export and processing potato variety of BARI Alu-25 (V_1: Asterix) under different fertilizers and irrigation intervals over two locations in 2020-2021

Treatments effect		Tuber number, no. Plant^{-1}		Tuber yield, g plant^{-1}		Tuber yield, t ha^{-1}	
		Gazipur	Bogura	Gazipur	Bogura	Gazipur	Bogura
F_1		5.68a	7.83a	280.66 a	369.1a	21.59a	28.39a
F_2		5.82a	7.93a	274.5 a	367.0a	21.12a	28.23a
F_3		5.77a	7.86a	282.2 a	372.9a	21.71a	28.67a
Mean		5.75	7.87	279.1	364.9	21.47	28.43
CV (%)		20.74	3.24	9.45	10.77	9.46	10.79
Effect of irrigation (I)							
I_1		5.55b	7.84ab	288.2 a	338.4b	22.17a	26.4b
I_2		6.28a	8.06a	296.64 a	388.7a	22.82a	29.89a
I_3		5.42b	7.72b	252.52 b	381.9a	19.43b	29.36a
Mean		5.75	7.87	279.1	369.7	21.47	28.43
CV (%)		11.91	3.96	7.64	6.94	7.65	6.96
Effect of interaction (F × I)							
F_1	I_1	5.03 c	7.74a	289.6 abc	335.0b	22.28 abc	25.79b
	I_2	6.54 a	8.06a	308.9a	383.7a	23.76 a	29.52a
	I_3	5.47 abc	7.68a	243.4d	388.7a	18.72 d	29.88a
F_2	I_1	5.90 abc	7.77a	281.9abc	333.3b	21.69 abc	25.65b
	I_2	6.05 abc	8.10a	286.5abc	392.3a	22.04 abc	30.17a
	I_3	5.50 abc	7.93a	255.1cd	375.3ab	19.63 cd	28.87ab
F_3	I_1	5.73 abc	8.01a	292.9abc	347.0ab	22.53 abc	26.69ab
	I_2	6.27 ab	8.04a	294.5ab	390.0a	22.66 ab	29.98a
	I_3	5.30 bc	7.55a	259.1bcd	381.7a	19.93 bcd	29.35a

Mean values within the treatments by different letters are significantly different at the level of 5%. Three fertilizer levels F_1: FRG 2018 (Split 2 times: N, K), F_2: FRG 2018 with combination of SOP (Split 3 times: N, SOP, Mg), F_3: FRG 2018 with combination of SOP (20% Additional) (Split 2 times: P, 3 times: N, SOP, Mg. Three irrigation interval I_1: three irrigations (20-25 DAP, 40-45 DAP, 60-65 DAP), I_2: four irrigation (18-20 DAP, 40-42 DAP, 55-60 DAP, 70-75 DAP) and I_3: five irrigation (17-20 DAP, 32-35 DAP, 50-52 DAP, 62-65 DAP, 78-80 DAP).

Effect of fertilizer and irrigation on tuber yield of potato (V_2: BARI Alu-29, Courage)

The effect of fertilizers and irrigation on fresh tuber yield and yield contributing characters of export and processing potato variety (V_2: BARI Alu-29, Courage) over two locations of Gazipur and Bogura is presented in Table 144b. Table 144b shows that tuber number of potato (V_2) in both locations had no significant ($P < 0.05$) among the fertilizer treatments (Table 144b) but the fertilizer treatment had only significantly effect on tuber yield at Gazipur.We observed that four irrigations at different growth stages of potato are important for better response for fresh tuber yield of potato in both environment and soils.

Table 144b. Tuber yield and yield contributing characters of processing potato variety of BARI Alu-29 (V_2: Courage) under different fertilizers and irrigation intervals over two locations during 2020-2021

Treatments effect		Tuber number, no. Plant^{-1}		Tuber yield, g plant^{-1}		Tuber yield, t ha^{-1}	
		Gazipur	Bogura	Gazipur	Bogura	Gazipur	Bogura
Effect of fertilizer (F)							
F_1		5.40 a	5.80 a	257.32 a	268.1a	19.79 a	20.61a
F_2		5.52 a	5.88a	249.18 b	258.0a	19.17 b	19.84a
F_3		5.40 a	6.56a	257.08 a	280.9a	19.78 a	21.61a
Mean		5.49	6.078	254.5	269	19.57	20.69
CV (%)		8.72	15.45	1.33	16.50	1.34	16.57
Effect of irrigation (I)							
I_1		5.40 a	6.42a	243.07 b	268.2b	18.69 b	20.63b
I_2		5.52 a	6.09ab	289.40 a	285.9a	22.26 a	21.99 a
I_3		5.54 a	5.72b	231.0 c	252.9c	17.77 c	19.45 c
Mean		5.48	6.07	254.5	269	19.58	20.69
CV (%)		8.72	7.17	2.69	4.84	2.7	4.82
Interaction effect of fertilizer and irrigation (F × I)							
F_1	I_1	5.10 b	6.26b	242.64c	249.3d	18.66 c	19.15 d
	I_2	6.13 a	5.78bcd	291.8a	293.6ab	22.45 a	22.58 ab
	I_3	4.97 b	5.37cd	237.48cd	261.3cd	18.26 cd	20.10 cd
F_2	I_1	5.41 ab	5.92bcd	230.43d	248.7d	17.72 cd	19.14 d
	I_2	5.87 ab	6.37ab	289.19a	276.7bc	22.24 a	21.28 bc
	I_3	5.27 ab	5.34d	227.92d	248.7d	17.53 d	19.09 d
F_3	I_1	5.51 ab	7.09a	256.14b	306.7a	19.70 b	23.59 a
	I_2	5.60 ab	6.13bc	287.19a	287.3ab	22.09 a	22.11 ab
	I_3	5.51 ab	6.45ab	227.74d	248.7d	17.52 d	19.14 d

Mean values within the treatments by different letters are significantly different at the level of 5% ($P \leq 0.05$).

Irrigation and crop water use and water productivity

Irrigation water and crop water use, irrigation and crop water use (CWU) are shown in Table 145. Irrigation water use was nearly similar but CWU was not same due to variation and contribution of soil water contribution (Table 145). The ANOVA indicates that the fertilizer treatment (F) had no significant effect on IWP but the irrigation treatment (I) had greatly significant ($P < 0.001$) effect on IWP and CWP of potato tuber in both locations (Table 145). This study revealed that proper fertilizer and timely irrigation interval is required to improve water productivity of potato (V_1 and V_2) as well as quality of potato tubers.

Table 145. Number of irrigation event, amount of applied irrigation water, crop water use (CWU) and water productivity of export and processing potato variety of BARI Alu-25 (V_1, Asterix) and BARI Alu-29 (V_2, Courage) under different fertilizers and irrigation intervals over two locations

Location	Treatment		Total irrigation water use (mm)	ΔSWC (mm)	Total CWU (mm)	Water productivity			
						IWP, kg m^{-3}		CWP, kg m^{-3}	
						V_1	V_2	V_1	V_2
Gazipur	F_1	I_1	157	87	244	14.2a	11.9b	9.1a	7.7c
		I_2	192	61	253	12.4bc	11.7bc	9.4a	8.9a
		I_3	211	52	263	8.9d	8.7d	7.1c	6.9d
	F_2	I_1	157	84	241	13.8ab	11.3c	9.0a	7.4c
		I_2	192	63	255	11.5c	11.6bc	8.7ab	8.7a
		I_3	211	51	262	9.3d	8.3d	7.5c	6.7d
	F_3	I_1	157	81	238	14.3a	12.6a	9.5a	8.3b
		I_2	192	66	258	11.8c	11.5bc	8.8ab	8.6ab
		I_3	211	50	261	9.5d	8.3d	7.7bc	6.7d
Bogura	F_1	I_1	142	79	221	19.9a	13.5b	12.8a	8.7cd
		I_2	176	58	234	16.9bc	12.9bc	12.7a	9.7b
		I_3	201	45	246	14.1d	10.0d	11.5bc	8.2de
	F_2	I_1	142	81	223	18.5ab	13.5b	11.8abc	8.6cd
		I_2	176	59	235	16.4c	12.1c	12.3ab	9.1bc
		I_3	201	47	248	13.5d	9.5d	10.9c	7.7e
	F_3	I_1	142	77	219	19.1a	16.6a	12.4ab	10.8a
		I_2	176	55	231	16.0c	12.6c	12.2ab	9.6b
		I_3	201	46	247	14.3d	9.5d	11.6abc	7.7e

Mean values within the treatments and the mean values of irrigation and crop water productivity (IWP and CWP) within the treatments by different letters are significantly different at the level of 5%.

Dry matter content of potato tubers

The dry matter (DM) of potatoes tuber (V_1: BARI Alu-25 and V_2: BARI Alu-29) (G3: 40 - < 55mm) as influenced by the treatments effect of fertilizer and irrigation in both locations are presented in Figure 7 (a, b, c, d, e, f). There was no significant effect of fertilizer on DM in V_2 at harvesting stages of potato tuber (Figure 8b) but fertilizer treatment F_2 produced greater DM than F_1 and F_3 in both locations. We observed that fertilizer (sulfate of potash) and four irrigations at different growth stages of potato are important for better response for DM of potato than MOP and three or five irrigations in both environment and soils. The results also indicate that the fertilizer treatment effects had no significant differences at the harvesting stage of V_2. DM was significantly lower in F_I than F_2 and F_3 when the number of irrigation events and the amount of applied water were reduced and greater at different growth stages of potato plants compared with control irrigation in both locations.

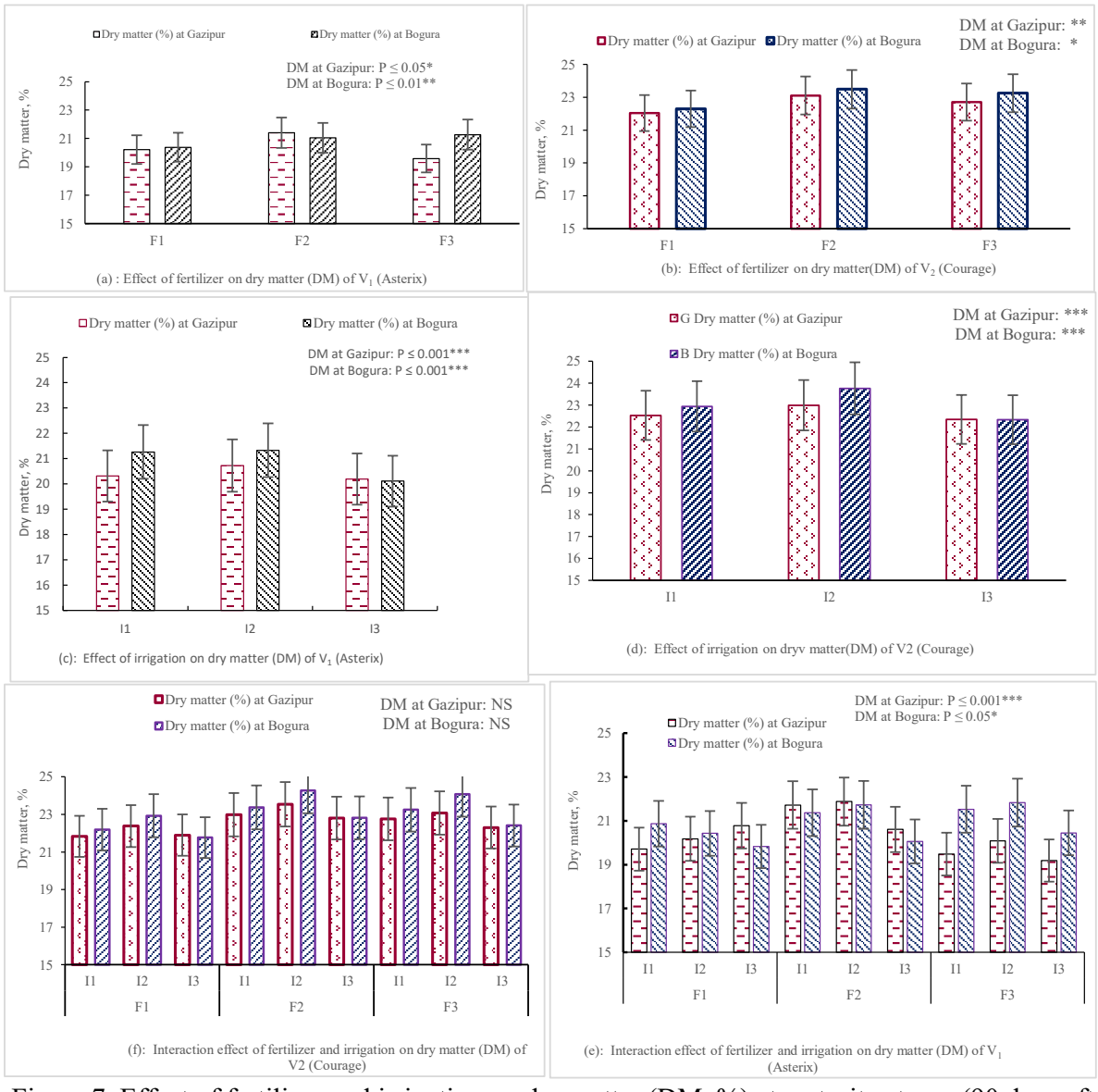


Figure 7. Effect of fertilizer and irrigation on dry matter (DM, %) at maturity stages (90 days after planting, DAP) of potato (V_1: BARI Alu-25, Asterix and V_2: BARI Alu-29, Courage).

Specific gravity of potato tubers

The effect of fertilizers and irrigation on specific gravity (SG) of G3 (40 - < 55 mm) of export and processing potato variety (V_1: BARI Alu-25 and V_2 (BARI Alu-29) over two locations of Gazipur and Bogura are shown in Table 145. There was significant effect of fertilizer on SG in V_1 at harvesting stages of potato tuber in both locations but fertilizer treatment had no significantly different in V_2 in both locations (Table 145). The results also indicate thatfertilizer treatment (sulfate of potash, K_2SO_4) and four irrigations at different growth stages of potato are important for better response for SG of potato tubers than MOP (muriate of potash, KCl) in both environment and soils.

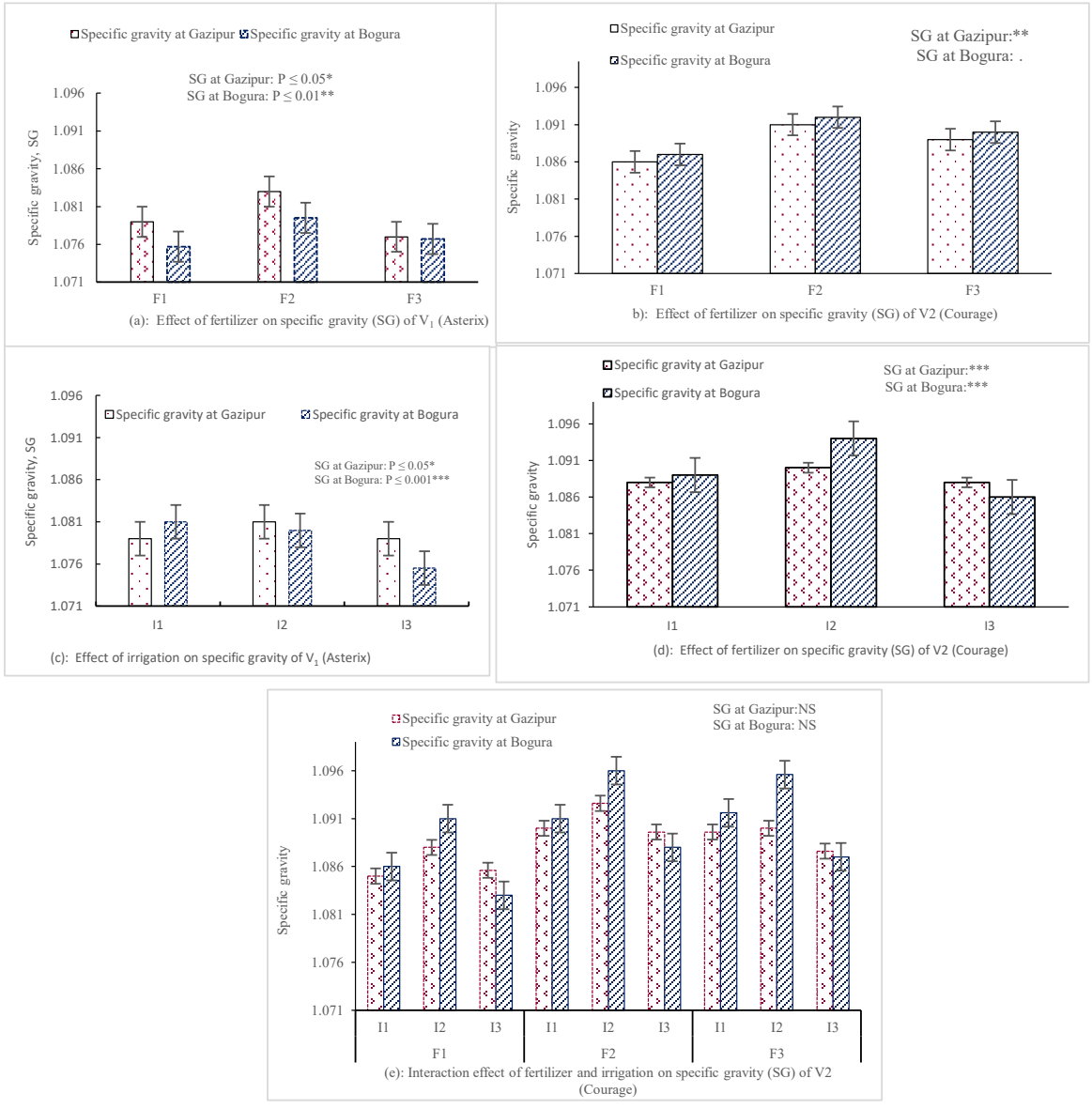


Figure 8. Effect of fertilizer and irrigation on specific gravity (SG) at maturity stages (90 days after planting, DAP) of potato (V_1: BARI Alu-25, Asterix and V_2: BARI Alu-29, Courage).

In conclusion, the combined treatments based on fertilizer level, F_2 and irrigation level, I_2 proved to be the best combination to increase tuber yield, WP, DM, specific gravity, size and weight of tuber grade 3 (40 – <55 mm) of potato tubers. There are two important novel findings from the present study. In both varieties (V_1: BARI Alu-25 and V_2: BARI Alu-29), fertilizer F_2 with SOP (Sulfate of potash, K_2SO_4) and I_2 (four irrigation interval) produced better tuber yield, quality of potato tubers like dry matter, specific gravity and tuber weight (%) of grade 3(40 – <55 mm) that could be favorable for export and processing.

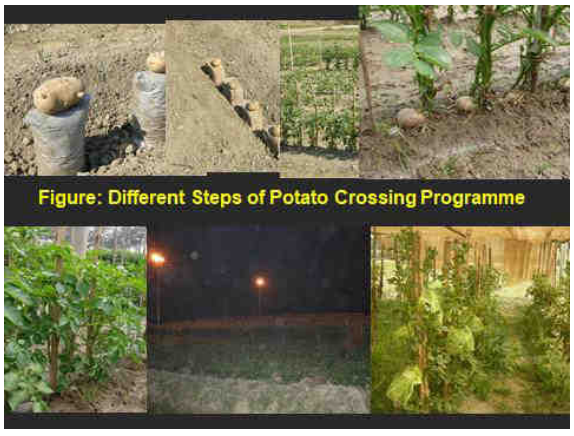


Figure 9. Pictorial view of project activities

Figure9.Continued

Component-2 (Sher-e-Bangla Agricultural University)

11.62. YIELD AND GRADING OF POTATO TUBER FOR PROCESSING PURPOSE AS AFFECTED BY VERMICOMPOST AND POTASSIUM SOURCES (EXPERIMENT-1)

Average weight of tuber (g)

Statistically significant variation was recorded in terms of average weight of tuber due to different sources of potassium (Table 146). The highest average weight of individual tuber (52.55 g) was recorded from K_3 which was statistically similar (49.64 g) to K_1, whereas, the lowest (46.29 g) was found from K_2. Different levels of vermicompost showed statistically significant differences in terms of average weight of tuber (Table 146). Average weight of tuber increased with the increasing amount of vermicompost. Average weight of tuber showed statistically significant differences due to the combined effect of various sources of potassium and levels of vermicompost (Table 147). The highest average weight of individual potato tubers (54.49 g) was found from K_3Vm_3 which was statistically similar to K_3Vm_2, K_3Vm_1, K_3Vm_0, K_1Vm_2 (52.25,51.61,51.84,51.09 g respectively) whereas, the lowest (44.86 g) was observed from K_2Vm_0 treatment combination

Yield of potato tubers (t ha^{-1})

Statistically significant variation was recorded in terms of yield of potato tubers ha^{-1} due to different sources of potassium (Table 146). The maximum yield of potato tubers (27.86 t ha^{-1}) was recorded from K_3 which was statistically similar (27.33 t ha^{-1}) to K_1, while the lowest yield (26.02 t ha^{-1}) was found from K_2. Silva *et al*. (2018) recorded no significant effect of potassium source on yield of potato Different levels of vermicompost showed statistically significant differences in terms of yield of potato tubers ha^{-1} (Table 146).Yield of tuber increased with the increasing amount of vermicompost. Ferdous *et al*. (2019a) reported that increasing vermicompost level is responsible for achieving better yield with ensuring optimum yield attributes. Yield of potato tubers ha^{-1} showed statistically significant differences due to the combined effect of various sources of potassium and levels of vermicompost (Table 147). The highest yield of potato tubers (31.17 t ha^{-1}) was found from K_3Vm_3 which is statistically almost like to K_3Vm_2, K_1Vm_2 and K_1Vm_3 (29.04, 30.18 and 29.43 t ha^{-1} respectively), whereas the lowest yield (22.09 t ha^{-1}) was observed from K_2Vm_0 treatment combination. Balanced supply of nutrients resulting more luxuriant growth, more foliage and leaf area and highest supply of photosynthesis, proliferous root growth enhancing water and nutrient absorption, activation of enzymes, starch synthesis, nitrogen uptake and protein synthesis could be responsible for highest yield (Novoa and Loomis, 1981; Tisdale *et al*., 1985).

Yield of table potato (t ha^{-1})

Statistically significant variation was recorded in terms of yield of table potato hectare^{-1} due to several sources of potassium (Table 146). The highest yield of table potato (26.36 t ha^{-1}) was recorded from K_3 which was statistically similar (24.02 t ha^{-1}) to K_1, while the lowest yield (23.03 t ha^{-1}) was found from K_2. Silva *et al*. (2018) recorded no significant effect of potassium source on yield of potato. Different levels of vermicompost showed statistically significant differences in terms of yield of table potato hectare^{-1} (Table 146). Yield of table potato increased with the increasing level vermicompost. Yield of table potato hectare^{-1} showed statistically significant differences due to the combined effect of different sources of potassium and levels of vermicompost (Table 147). The highest yield of table potato (29.30 t ha^{-1}) was found from K_3Vm_3 and statistical similar results were observed in K_3Vm_2, K_1Vm_2 and K_1Vm_3 (27.85, 27.80 and 26.52t ha^{-1} respectively), whereas, the lowest yield (18.33t ha^{-1}) was observed from K_2Vm_0 treatment combination.

Category of potato tubers for different uses

Category (Canned 20-35 mm; Flakes 35-45; Chips- 45-75 mm; and French fry- >75 mm) of potato tubers varied non-significantly due to different sources of potassium (Table 146). For Canned, Chips and French fry potato, the highest (35.56%, 31.69% and 5.25%, respectively) was observed from K_1, whereas, the lowest (34.48%, 30.43% and 5.14%, respectively) was recorded from K_2. But for flakes highest result was recorded from K_2 (29.95%) while lowest from K_1 (27.51%). Different levels of vermicompost showed statistically significant differences in terms of percentage of category of tubers for different uses (Table 146). Percentages of categories increase with the increasing level of vermicompost except canned. In case of canned, percentage decreases with the increasing level of vermicompost. Combined effect of different sources of potassium and levels of vermicompost showed statistically significant differences in terms of category (Canned 20-35 mm; Flakes 35-45mm Chips-45-75mm; and French fry- >75 mm) of potato tubers (Table 147). For Canned, highest result found from K_1Vm_0 (39.67%) and lowest was observed in K_2Vm_3 (29.73%) which was similar to K_3Vm_3 and K_1Vm_3 (31.40% and 31.39%). For flakes, highest result found in K_2Vm_0 (32.58%) which was statistically similar to K_2Vm_3 and K_3Vm_0 (32.17% and31.76%) and lowest found from K_1Vm_1 (25.52%) which was statistically similar toK_2Vm_2, K_3Vm_1 and K_1Vm_2 (27.71%, 26.55% and 25.54%) For Chips and French fry potato, the highest (34.17% and 6.08%) was found from K_1Vm_3(34.17%)which was statistically similar to K_1Vm_2,K_3Vm_1,K_3Vm_2 and K_3Vm_3(33.14%,31.33%,32.62% and 32.83%) in case of chips and in terms of french fry statistical similar result was found from K_1Vm_2, whereas, the lowest (26.59% and 3.83%) was recorded from K_2Vm_0 treatment combination.

Table146. Effect of different sources of potassium and levels of vermicompost on average weight of individual tubers, yield of potato, yield of table potato, category of potato tubers for different uses

Treatments	Average individual tuber weight (g)	Yield of potato (t ha^{-1})	Yield of table potato (t ha^{-1})	Category of potato tubers (%) for different uses			
				Canned (20-35 mm)	Flakes (35-45 mm)	Chips (45-75 mm)	French fry (>75 mm)
Source of potassium							
K_1	49.64 ab	27.33 ab	24.02b	35.56	27.51	31.69	5.25
K_2	46.29 b	26.02 b	23.03c	34.48	29.95	30.43	5.14
K_3	52.55 a	27.86 a	26.36a	35.00	28.74	31.08	5.18
Sx	1.039	0.353	0.517	0.356	0.502	0.644	0.054
Level of significance	*	*	**	NS	NS	NS	NS
CV(%)	7.27	4.52	1.84	3.52	4.28	3.61	3.61
Levels of vermicompost							
Vm_0	47.72 b	23.34 c	20.34c	37.82a	26.59b	27.45c	3.90 c
Vm_1	49.13 ab	26.44 b	23.76b	37.00a	27.30b	31.07b	5.34 b
Vm_2	50.21 a	28.89 a	26.66a	34.38b	30.83a	32.60a	5.70 a
Vm_3	50.91 a	29.61 a	27.12a	30.84c	30.21a	33.13a	5.82 a
Sx	0.655	0.459	1.170	0.456	0.520	0.494	0.061
Level of significance	**	**	**	**	**	**	**
CV(%)	3.97	5.09	4.75	3.91	3.84	4.77	3.52

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability; NS=Non-significant; * = Significant at 5% level; ** = Significant at 1% level; K_1: KCl, K_2: KNO_3, K_3: K_2SO_4, Vm_0: 0-ton ha^{-1}, Vm_1: 4-ton ha^{-1}, Vm_2: 8-ton ha^{-1}, Vm_3: 12-ton ha^{-1}

Table 147. Combined effect of different sources of potassium and levels of vermicompost on average weight of individual tubers, yield of potato, yield of table potato, Category of potato tubers for different uses

Interaction	Average individual tuber weight (g)	Yield of potato (t ha^{-1})	Yield of table potato (t ha^{-1})	Category of potato tubers (%) for different uses			
				Canned (20-35 mm)	Flakes (35-45 mm)	Chips (45-75 mm)	French fry (>75 mm)
K_1Vm_0	46.44 e	23.15 fg	20.56f	39.67a	28.15cd	28.25cd	3.93 e
K_1Vm_1	50.62 bcd	24.80 ef	21.20 f	38.19ab	25.51e	31.19b	5.11 d
K_1Vm_2	51.09 abc	30.18 ab	27.80ab	32.97de	28.02cd	33.14ab	5.87 ab
K_1Vm_3	50.40 bcd	29.43 abc	26.52bc	31.39ef	28.36cd	34.17a	6.08 a
K_2Vm_0	44.86 e	22.09 g	18.33 g	37.00bc	32.58a	26.59d	3.83 e
K_2Vm_1	45.15 e	26.34 de	23.90de	36.14bc	27.71d	30.70bc	5.45 c
K_2Vm_2	47.30 de	27.44 cd	24.34d	35.04cd	27.36de	32.03ab	5.57 bc
K_2Vm_3	47.84 cde	28.21bcd	25.56d	29.73f	32.17ab	32.39ab	5.71 bc
K_3Vm_0	51.84 ab	24.78 ef	22.12 ef	36.79bc	31.76ab	27.52d	3.93 e
K_3Vm_1	51.61 ab	28.19bcd	26.19bc	36.67bc	26.55de	31.33ab	5.45 c
K_3Vm_2	52.25 ab	29.04abc	27.85ab	35.14cd	26.54de	32.62ab	5.68 bc
K_3Vm_3	54.49 a	31.17 a	29.30a	31.40ef	30.11bc	32.83ab	5.66 bc
Sx	1.134	0.795	1.88	0.790	0.902	0.856	0.106
Level of significance	*	*	**	*	*	*	*
CV(%)	3.97	5.09	4.75	3.91	3.84	4.77	3.52

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability* = Significant at 5% level; ** = Significant at 1% level; K_1: KCl,K_2: KNO_3,K_3: K_2SO_4,Vm_0: 0 ton ha^{-1},Vm_1: 4 ton ha^{-1},Vm_2: 8 ton ha^{-1} ,Vm_3: 12 ton ha^{-1}

Plate-1: Pictorial view of field experiment (Effect of source of potassium and vermicompost on potato yield and grading)

11.63.INFLUENCE OF NITROGEN FORM AND BIOCHAR LEVEL ON THE YIELD AND PROCESSING QUALITY OF POTATO (EXPERIMENT-2)

Tuber yield (t ha^{-1})

Different nitrogen form showed significant effect on tuber yield (t ha^{-1}) of potato (data not shown). Biochar level showed significant effect on tuber yield (t ha^{-1}) of potato (data not shown). Combined effect of nitrogen form and biochar level showed significant effect on tuber yield (t ha^{-1}) of potato. From the experiment result revealed that the maximum tuber yield of potato (37.981 t ha^{-1}) was observed from U_sB_5 treatment combination which was statistically similar with U_sB_4 treatment combination followed by U_sB_3 and U_sB_2 treatment combination whereas the minimum tuber yield of potato (24.691 t ha-^{1}) was observed from U_pB_0 treatment combination which was statistically similar with U_sB_0 treatment combination followed by U_p $B_2$and U_pB_1 treatment combination (Table-148).

Category wise potato yield (t ha^{-1})

In case of Category wise potato yield (t ha^{-1}) only at Chips (45-75 mm) potato yield (t ha^{-1}) showed significant variation than Cane (25-45 mm) and French fry (>75 mm) potato yield (t ha^{-1}) due to application of nitrogen form in the experimental field (data not shown). Biochar level showed significant variation (data not shown) on category wise potato yield (t ha-^{1}). Only onto Chips (45-75 mm) and French fry (>75 mm) potato, showed significant effect on category wise potato yield (t ha-^{1}) due to combined application of nitrogen form and biochar level on the experimental field. From the experiment, result revealed that in case of cane (25-45 mm) potato, the maximum yield (5.75 t ha^{-1}) was observed from U_sB_0 treatment combination, in case of Chips (45-75 mm) potato, the maximum yield (31.550 t ha^{-1}) was observed from U_sB_5 treatment combination which was statistically similar with U_sB_4, U_sB_3 and U_sB_2 treatment combination, and in case of French fry (>75 mm) potato, the maximum yield (0.4616 t ha^{-1}) was observed from U_pB_4 treatment combination which was statistically similar with U_sB_5, and U_pB_1 treatment combination. Whereas in case of cane (25-45 mm) potato, the minimum yield (3.3034t ha^{-1}) was observed from U_pB_4 treatment combination, in case of Chips (45-75 mm) potato, the minimum yield (17.666 t ha^{-1}) was observed from U_sB_0 treatment combination which was statistically similar with U_pB_0 treatment combination, and in case of French fry (>75 mm) potato, the minimum yield (0.0000 t ha^{-1}) was observed from U_sB_2 treatment combination which was statistically similar with U_sB_5, and U_pB_1 treatment combination (Table-148).

Table 148. Combined effect of nitrogen form and biochar level on category wise potato yield cv BARI alu-29

Treatment combinations	Tuber yield (t ha^{-1})	Category wise potato yield (t ha^{-1}) for		
		Cane (25-45 mm)	Chips (45-75 mm)	French fry (>75 mm)
U_pB_0	24.691 f	4.1967	17.923 e	0.1800 e
U_p B_1	27.670 ef	4.3020	22.581 d	0.4429 a
U_p B_2	26.982 ef	3.5956	22.726 d	0.2106 de
U_p B_3	29.879 de	3.8590	24.360 cd	0.2454 cd
U_p B_4	32.972 cd	3.3034	27.507 bc	0.4616 a
U_p B_5	32.997 cd	4.2176	27.111 bc	0.2095 de
U_s B_0	25.195 f	5.7500	17.666 e	0.3700 b
U_s B_1	33.423 bcd	4.4300	27.213 bc	0.2146 de
U_s B_2	35.187 abc	4.2925	28.785 ab	0.0000 f
U_s B_3	35.263 abc	4.2891	28.685 ab	0.3981 b
U_s B_4	37.452 ab	4.3394	31.076 a	0.2565 c

Treatment combinations	Tuber yield (t ha^{-1})	Category wise potato yield (t ha^{-1}) for		
		Cane (25-45 mm)	Chips (45-75 mm)	French fry (>75 mm)
U_s B_5	37.981 a	4.4915	31.550 a	0.4585 a
LSD $_{(0.05)}$	4.1816	NS	3.4129	0.0412
CV (%)	7.76	11.63	7.83	8.43

Note: In a colums means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly.

NS= Non-significant, U_p- Prilled urea, U_s- Urea Super granules, B_0- Control, B_1- 2 t/ha, B_2- 4 t/ha, B_3- 6 t/ha, B_4-8 t/ha, B_5- 10 t/ha

Dry matter content tuber^{-1} (%)

Nitrogen form showed significant effect on dry matter content tuber-^{1} (g) of potato (data not shown). Biochar level showed significant variation (data not shown) on dry matter content tuber-^{1} (g). Combined effect of nitrogen form and biochar level showed significant effect on dry matter content tuber-^{1} (g) of potato. From the experiment result revealed that the maximum dry matter content tuber-^{1} of potato (21.80 g) was observed from U_sB_4 treatment combination which was statistically similar with U_sB_5 treatment combination. Whereas the minimum dry matter content tuber-^{1} of potato (16.700 g) was observed from U_pB_0 treatment combination (Table-149).

Specific gravity (g/cc)

Nitrogen form showed significant effect on specific gravity of potato (data not shown). Biochar level showed significant variation on specific gravity of potato (data not shown). Combined effect of nitrogen form and biochar level showed significant effect on specific gravity of potato. From the experiment result revealed that the maximum specific gravity of potato (1.0980) was observed from U_sB_4 treatment combination which was statistically similar with U_pB_5 whereas the minimum specific gravity of potato (1.0012) was observed from U_pB_0 treatment combination (Table-149).

Firmness (N)

Nitrogen form showed significant effect on firmness of potato (data not shown). Biochar level showed significant variation on firmness of potato (data not shown). Combined effect of nitrogen form and biochar level showed non-significant effect on firmness of potato. From the experiment result revealed that the maximum firmness of potato (45.367) was observed from U_sB_5 treatment combination. Whereas the minimum firmness of potato (26.480) was observed from U_pB_0 treatment combination (Table-149).

Total soluble solid (^{0}Brix) (TSS)

Nitrogen form showed significant effect on total soluble solid of potato (data not shown). Biochar level showed significant variation on total soluble solid of potato (data not shown). Combined effect of nitrogen form and biochar level showed non-significant effect on total soluble solid of potato. From the experiment result revealed that the maximum total soluble solid of potato (4.4667) was observed from U_pB_0 treatment combination. Whereas the minimum total soluble solid of potato (3.1332) was observed from U_sB_5 treatment combination (Table-149).

Table 149. Combined effect of nitrogen form and biochar level on specific gravity, total soluble solid, firmness and dry matter of potato cv BARI alu-29

Treatment	Dry matter (DM %)	Specific gravity (SG)	Firmness (N)	Total soluble solid (^{0}Brix)
U_pB_0	16.700 h	1.0012 g	26.480	4.4667
U_pB_1	19.300 f	1.0533 e	28.040	3.8667
U_pB_2	19.700 e	1.0667 cd	29.743	3.7547
U_pB_3	20.100 d	1.0767 bc	31.527	3.5333
U_pB_4	20.600 b	1.0767 bc	37.513	3.3875
U_pB_5	20.800 b	1.0867 ab	38.083	3.3667
U_sB_0	16.900 g	1.0267 f	30.423	4.1745
U_sB_1	19.700 e	1.0633 de	31.373	3.6333
U_sB_2	20.300 c	1.0699 cd	34.770	3.4578
U_sB_3	20.700 b	1.0724 cd	39.667	3.2985
U_sB_4	21.800 a	1.0980 a	43.177	3.2667
U_sB_5	21.600 a	1.0867 b	45.367	3.1332
LSD $_{(0.05)}$	0.2074	0.0105	NS	NS
CV(%)	3.61	3.58	8.29	9.28

Note: In a colums means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly.

NS= Non-significant, U_p- Prilled urea, U_s- Urea Super granules, B_0- Control, B_1- 2 t/ha, B_2- 4 t/ha, B_3- 6 t/ha, B_4-8 t/ha, B_5- 10 t/ha

Skin color tuber^{-1}

Nitrogen form showed non-significant effect on skin color tuber^{-1} {Lightness (L), Redness to greenness (a), black (b), chromaticity, and Hue Augh} of potato (data not shown). Biochar level showed non-significant effect on skin color tuber^{-1} {Lightness (L), Redness to greenness (a), black (b), chromaticity, and Hue Augh} of potato (data not shown). Combined effect of nitrogen form and biochar level showed non-significant effect on skin color tuber^{-1}{Lightness (L), Redness to greenness (a), black (b), chromaticity, and Hue Augh} of potato. But, numerically the maximum lightness (58.150) was observed in U_sB_4 treatment combination, the maximum redness to greenness (11.447) was observed in $U_sB_2$treatment combination, the maximum blackness (12.037) was observed in $U_pB_0$treatment combination, the maximum chromaticity (15.393) was observed in U_sB_0 treatment combination, and the maximum Hue Augh (52.797) was observed in U_pB_2 treatment combination. Whereas the minimum lightness (53.213) was observed in U_sB_3 treatment combination, the minimum redness to greenness (8.340) was observed in $U_pB_1$treatment combination, the minimum blackness (10.130) was observed in U_pB_1 treatment combination, the minimum chromaticity (13.123) was observed in $U_pB_1$treatment combination, and the minimum Hue Augh (43.907) was observed in U_s B_2treatment combination (Table-150).

Flesh color tuber^{-1}

Nitrogen form showed non-significant effect on flesh color tuber^{-1} {Lightness (L), Redness to greenness (a), black (b), chromaticity, and Hue Augh} of potato (data not shown). Biochar level showed significant effect on flesh color tuber^{-1} only at Lightness (L), and Hue Augh (data not shown). Combined effect of nitrogen form and biochar level showed non-significant effect on flesh color tuber^{-1}{Lightness (L), Redness to greenness (a), black (b), chromaticity, and Hue Augh} of potato. But, numerically the maximum lightness (74.597) was observed in U_pB_1 treatment combination, the maximum redness to greenness (0.6800) was observed in $U_sB_2$treatment combination, the maximum blackness (30.650) and chromaticity (30.650) were observed in U_pB_5 treatment combination, and the maximum Hue Augh (89.627) was observed in U_sB_5 treatment combination. Whereas the minimum lightness (71.877) was observed in U_sB_3 treatment combination, the minimum redness to greenness (0.3333) was observed in U_sB_0 treatment

combination, and the minimum blackness (26.917), chromaticity (26.927), and Hue Augh (88.590) were observed in U_pB_2 treatment combination (Table-151).

Table 150. Combined effect of nitrogen form and biochar level on skin color of potato cv BARI alu-29

Treatment	Skin color of potato				
	Lightness (L)	Redness to Greenness (a)	Yelloness (b)	Chromaticity	HueAugh (º)
U_pB_0	56.213	9.500	12.037	15.333	51.700
U_pB_1	53.403	8.340	10.130	13.123	50.493
U_pB_2	56.000	8.983	11.743	14.797	52.797
U_pB_3	56.007	8.447	11.257	14.293	52.070
U_pB_4	55.910	9.937	10.853	14.760	47.160
U_pB_5	56.843	9.953	11.160	14.973	48.243
U_sB_0	56.357	10.030	11.390	15.393	48.450
U_sB_1	54.620	10.170	11.430	15.327	48.427
U_sB_2	55.460	11.447	10.983	15.227	43.907
U_sB_3	53.213	8.950	10.973	14.443	51.870
U_sB_4	58.150	9.483	11.523	14.957	50.557
U_sB_5	54.427	9.017	10.767	14.057	49.547
LSD $_{(0.05)}$	NS	NS	NS	NS	NS
CV (%)	3.58	12.01	11.92	9.87	8.90

Note: In a colums means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly.
NS= Non-significant, U_p- Prilled urea, U_s- Urea Super granules, B_0- Control, B_1- 2 t/ha, B_2- 4 t/ha, B_3- 6 t/ha, B_4-8 t/ha, B_5- 10 t/ha

Table 151. Combined effect of nitrogen form and biochar level on fles color of potato cv BARI alu-29

Treatment	Flesh color of potato				
	Lightness (L)	Redness to Greenness (a)	Yellownes (b)	Chromaticity	HueAugle (º)
U_pB_0	73.300	0.3833	28.947	28.817	89.247
U_pB_1	74.597	0.4700	27.667	27.663	89.063
U_pB_2	73.567	0.6700	26.917	26.927	88.590
U_pB_3	72.890	0.6633	28.280	28.290	88.667
U_pB_4	73.307	0.5800	28.273	28.280	88.823
U_pB_5	73.993	0.5800	30.650	30.650	88.950
U_sB_0	73.640	0.3333	29.293	29.297	89.363
U_sB_1	75.117	0.3267	28.403	28.407	89.343
U_sB_2	73.220	0.6800	28.357	28.367	88.680
Treatment	Flesh color of potato				
	Lightness (L)	Redness to Greenness (a)	Yellownes (b)	Chromaticity	Hue Augle (º)
U_sB_3	71.877	0.5000	28.397	28.403	88.980
U_sB_4	73.983	0.4967	29.180	29.167	89.027
U_sB_5	74.010	0.1900	29.163	29.153	89.627
LSD $_{(0.05)}$	NS	NS	NS	NS	NS
CV (%)	1.49	39.05	5.86	5.85	0.42

Note: In a colums means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly.
NS= Non significant, U_p- Prilled urea, U_s- Urea Super granules, B_0- Control, B_1- 2 t/ha, B_2- 4 t/ha, B_3- 6 t/ha, B_4-8 t/ha, B_5- 10 t/ha

Polyphenol (GA mg 100 g^{-1} FW)

Nitrogen form showed significant effect on Polyphenol (GA mg 100 g^{-1} FW) of potato (data not shown). Biochar level showed significant variation on Polyphenol (GA mg 100 g^{-1} FW) of potato (data not shown). Combined effect of nitrogen form and biochar level showed significant effect on Polyphenol (GA mg 100 g^{-1} FW) of potato. From the experiment result revealed that the maximum Polyphenol of potato (87.523) was observed from U_sB_4 treatment combination. Whereas the minimum Polyphenol of potato (33.864) was observed from U_pB_0 treatment combination (Table-152).

Starch (%)

Nitrogen form showed significant effect on starch (%) of potato (data not shown). Biochar level showed significant variation on starch (%) of potato (data not shown). Combined effect of nitrogen form and biochar level showed significant effect starch (%) of potato. From the experiment result revealed that the maximum starch of potato (15.900 %) was observed from U_sB_4 treatment combination which was statistically similar with U_sB_5 treatment combination. Whereas the minimum starch of potato (10.400 %) was observed from U_pB_0 treatment combination (Table-152).

Non Reducing Sugar (mg g^{-1}FW)

Nitrogen form showed non-significant effect on non-reducing sugar (mg g^{-1} FW) of potato (data not shown). Biochar level showed significant variation on non-reducing sugar (mg g^{-1} FW) of potato (data not shown). Combined effect of nitrogen form and biochar level showed non-significant variation on non-reducing sugar (mg g^{-1} FW) of potato. From the experiment result revealed that the maximum non reducing sugar of potato (0.5067 mg g^{-1} FW) was observed from U_pB_0 treatment combination. Whereas the minimum non reducing sugar of potato (0.3109 mg g^{-1} FW) was observed from U_sB_4 treatment combination (Table-152).

Reducing Sugar (mg g^{-1}FW)

Nitrogen form showed significant effect on reducing sugar (mg g^{-1} FW) of potato (data not shown). Biochar level showed significant variation on reducing sugar (mg g^{-1} FW) of potato (data not shown). Combined effect of nitrogen form and biochar level showed significant variation on non-reducing sugar (mg g^{-1} FW) of potato. From the experiment result revealed that the maximum reducing sugar of potato (0.5321 mg g^{-1} FW) was observed from U_pB_0 treatment combination. Whereas the minimum reducing sugar of potato (0.1452 mg g^{-1} FW) was observed from U_sB_4 treatment combination which was statistically similar with U_sB_5 treatment combination (Table-152).

Antioxidant (µg 100 g^{-1} FW)

Nitrogen form showed significant effect on antioxidant (µg 100 g^{-1} FW) of potato (data not shown). Biochar level showed significant variation on antioxidant (µg 100 g^{-1} FW) of potato (data not shown). Combined effect of nitrogen form and biochar level showed non-significant variation antioxidant (µg 100 g^{-1} FW) of potato. From the experiment result revealed that the maximum antioxidant of potato (509.23 µg 100 g^{-1} FW) was observed from U_sB_4 treatment combination. Whereas the minimum antioxidant of potato (366.47µg 100 g^{-1} FW) was observed from U_pB_0 treatment combination (Table-152).

Table 152. Combined effect of nitrogen form and biochar level on some biochemical parameters of potato cv BARI alu-29

Treatment	Polyphenol (GA mg 100 g^{-1} FW)	Starch (%)	Non-reducing Sugar (mg g^{-1}FW)	Reducing Sugar (mg g^{-1}FW)	Antioxident (Trolox µ Mol 100 g^{-1} FW)
U_pB_0	33.864 k	10.400 g	0.5067	0.5321 a	366.47
U_p B_1	42.494 i	13.400 f	0.4500	0.3921 b	395.97
U_p B_2	48.631 h	13.700 e	0.4515	0.3616 b	417.89
U_p B_3	62.437 f	14.100 d	0.4476	0.3001 cd	480.21
U_p B_4	77.322 d	14.600 b	0.3655	0.2915 de	491.32
U_p B_5	79.123 c	14.700 b	0.3575	0.2632 e	494.79
U_s B_0	35.198 j	13.700 e	0.5001	0.3287 c	392.31
U_s B_1	42.720 i	13.500 f	0.4619	0.3065 cd	399.74
U_s B_2	57.369 g	14.300 c	0.4568	0.2877 de	432.87
U_s B_3	69.188 e	14.600 b	0.4501	0.2673 e	485.55
U_s B_4	87.523 a	15.900 a	0.3109	0.1452 f	509.23
U_s B_5	83.916 b	15.800 a	0.3541	0.1480 f	507.67
$LSD_{(0.05)}$	1.0049	0.1675	NS	0.0314	NS
CV (%)	3.98	2.90	6.52	6.11	7.11

Note: In a colums means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly.

NS= Non significant, U_p- Prilled urea, U_s- Urea Super granules, B_0- Control, B_1- 2 t/ha, B_2- 4 t/ha, B_3- 6 t/ha, B_4-8 t/ha, B_5- 10 t/ha

Plate-2: Experimental views (Effect of nitrogen form and biochar levels on potato quality)

Plate-3: Potatoes from different treatmens as affected by nitrogen form and biochar level

11.64. PHOSPHORUS DOSE AND POTASSIUM SOURCE ON EXPORT AND PROCESSING QUALITY OF POTATO (EXPERIMENT-3)

Dry matter content was affected by phosphorus dose, not for potassium source, but the interaction was significant (Table 153). The highest dry matter content in potato tubers was from P_1K_3, P_1K_1, P_1K_2, P_1K_2, P_2K_1, P_2K_2, P_2K_3, P_3K_1, and P_3K_3 treatment combination, and the lowest was recorded from P_4K_3 (Table 153). Phosphorus dose, potassium source, and the interaction affected total soluble solids (Table 153). The highest TSS in potato tubers was from P_4K_2, P_3K_2, P_4K_1, and P_4K_3 combinations, and the lowest was recorded from P_1K_1, P_1K_2, P_1K_3 and P_2K_3 (Table 153). Phosphorus dose, potassium source and the interaction affected starch content (Table 153). The highest starch content in potato tubers was from P_1K_3, P_1K_1, P_1K_2, P_2K_3, P_3K_1, and P_3K_3; the lowest was from P_4K_1, P_4K_2 and P_4K_3 (Table 153). Phosphorus dose, potassium source and the interaction affected reducing sugar content (Table 154). The highest reducing sugar content in potato tubers was recorded from P_4K_1 and P_4K_2; the lowest was from P_1K_3, P_3K_1, P_1K_1, P_1K_2, and P_2K_3 (Table 154). Phosphorus dose, potassium source and the interaction affected reducing sugar content (Table 154). The highest non-reducing sugar content in potato tubers was from P_4K_1 and P_4K_2; the lowest was from P_1K_3, P_1K_1, P_1K_2, and P_2K_3 (Table 154). Phosphorus dose, potassium source and the interaction affected antioxidants (Table 154). The highest antioxidant content in potato tubers was recorded from P_1K_3, P_1K_2 and P_3K_1; the lowest was from P_4K_1, P_2K_1, P_2K_2, P_4K_2, and P_4K_3 (Table 154). Phosphorus dose, potassium source and the interaction affected polyphenols (Table 154). The highest polyphenol content in potato tubers was from P_1K_3, P_1K_1, P_2K_1, P_2K_3, P_3K_1, and P_3K_3; thelowest was from P_4K_2, P_2K_2, P_3K_2, and P_4K_1 (Table 154). Dry matter content is an important factor for processing quality. Different processed potato products required different dry matter content. For canned (<18%), french fry (>20%), dehydrated (>20%), and chips (>20%), specific gravity (>1.050) are required. Higher dry matter content is required for good quality chip and french fry items because higher dry matter reduces oil absorption and increases crispy texture of the product (Marwaha et al., 2010). Ozturk et al. (2010) reported dry matter of potato decrease with the increase of phosphorus dose. Sharma and Sud (2001) reported potassium source does not have a significant effect on the dry matter content of potato. Specific gravity is an important factor for processing quality (Gunadi, 2009). Different processed potato products require different specific gravity. For canned (<1.07 g cm^{-3}), french fried (1.08 g cm^{-3}), dehydrated (1.08 g cm^{-3}), chips (>1.08 g cm^{-3}), specific gravity is required (Marwaha et al., 2010). Specific gravity of potato did not response to the interaction of phosphorus dose and potassium source, which was also reported by Rozo and Nustez (2011). Ozturk et al. (2010) reported starch content of potato tuber decrease with the increase of phosphorus. Reducing sugar is an essential factor for processing quality, especially for fried products. Higher reducing sugar increases dark color and bitter taste during frying. For good quality fry items, low reducing sugar (<0.1%) based on a fresh weight basis is recommended (Marwaha et al., 2010). Strong positive linear relationship occurred between specific gravity and dry matter content of potato tuber (Figure 10a) as previously reported byFerdous et al. (2020). A strong negative linear relationship occurred between non-reducing sugar content and starch content of potato tuber (Figure 10b) as previously reported by Braun et al. (2016). Starch is an important component of dry matter content. A strong positive linear relationship occurred between starch and dry matter content of potato tuber (Figure 10c) as previously reported by Abebe et al. (2012). A strong negative linear relationship occurred between starch and the total soluble solid of potato tuber (Figure 10d) as previously reported by Abbas et al. (2011). A strong positive linear relationship occurred between reducing sugar content and starch of potato tuber (Figure 10e) as previously reported by Mostofa et al. (2019). A strong positive linear relationship occurred between non-reducing sugar content and reducing sugar content of potato tuber (Figure 10f) as previously reported by Braun et al. (2016) and Ferdous et al. (2019). Use of 200 kg·ha^{-1} TSP @ 42.55 kg ha^{-1} P

and 288.6 kg ha^{-1} K_2SO_4 @130 kg ha^{-1} K can be used to produce potatoes that meet export requirements.

Table 153. Interactioneffectsofphosphorusand sourceofpotassiumon dry matter contents, total soluble solid (TSS) and starch inpotatotubers

Interaction	Dry mattercontent (%)	Total soluble solids TSS (°Brix)	Starch(%)
P_1K_1	22.15ab	3.90 e	16.834 a
P_1K_2	21.58abc	4.10 de	16.455 a
P_1K_3	22.85 a	3.90 e	17.936 a
P_2K_1	21.55abc	4.30cd	14.432bcd
P_2K_2	20.98a-d	4.60 bc	14.473bcd
P_2K_3	22.25ab	3.90 e	16.167ab
P_3K_1	21.15a-d	4.70 b	16.098abc
P_3K_2	20.58bcd	4.80ab	14.167cd
P_3K_3	21.85ab	4.60 bc	16.473 a
P_4K_1	19.15 de	4.90ab	12.136 e
P_4K_2	19.55cde	5.10 a	12.238 e
P_4K_3	17.45 e	4.80ab	13.363 de
LSD (0.05)	2.196	0.310	1.8707
CV (%)	6.69	4.52	7.80

Data in the interaction analyzed with Least Squares Means and means separated with Least Significant Differences.
P_1 = 200 kg ha^{-1} TSP @ 42.55 kg ha^{-1} P, P_2 = 220 kg ha^{-1} TSP @ 46.81 kg ha^{-1} P, P_3 = 240 kg ha^{-1} TSP @ 51.06 kg ha^{-1} P, and P_4 = 260 kg ha^{-1} TSP @ 55.32 kg ha^{-1} P; K_1 = KCl (250 kg ha^{-1} KCl @130 kg ha^{-1} K), K_2 = KH_2PO_4(452.19 kg ha^{-1} KH_2PO_4 @130 kg ha^{-1} K), and K_3 = K_2SO_4(288.6 kg ha^{-1} K_2SO_4 @130 kg ha^{-1} K).
Values in a column followed by the same letter are not statistically different, $p<0.05$.

Table154. Interactioneffects of phosphorus and source of potassium on reducing sugar, non-reducing sugar, antioxidant and polyphenol inpotato tubers

Interaction	Reducing sugar (mg·g^{-1} FW)	Non-reducing sugar (mgg^{-1} FW)	Antioxidant (Trolox µMol 100g^{-1} FW)	Polyphenol (GAmg 100 g^{-1} FW)
P_1K_1	0.1788ef	0.3399 efg	582.25 b	85.774abc
P_1K_2	0.1735ef	0.3310fg	591.14ab	73.642cde
P_1K_3	0.1713 f	0.3290 g	630.12 a	92.994 a
P_2K_1	0.1998 c	0.3655 de	512.25cde	80.771a-d
P_2K_2	0.1933cd	0.3590def	513.14cde	69.639def
P_2K_3	0.1723ef	0.3358 efg	541.12 c	87.995ab
P_3K_1	0.1725ef	0.4041 c	592.25ab	80.767a-d
P_3K_2	0.2055 c	0.3749cd	526.25cd	65.640ef
P_3K_3	0.1845 de	0.3651 de	589.12 b	83.992abc
P_4K_1	0.3558 a	0.5610 a	478.92 e	69.772def
P_4K_2	0.3505ab	0.5312ab	501.14 de	58.641 f
P_4K_3	0.3383 b	0.5121 b	511.12cde	75.993b-e
LSD (0.05)	0.0127	0.0294	39.711	12.596
CV (%)	3.66	4.70	4.60	9.86

Data in the interaction analyzed with Least Squares Means and means separated with Least Significant Differences.
P_1 = 200 kg ha^{-1} TSP @ 42.55 kg ha^{-1} P, P_2 = 220 kg ha^{-1} TSP @ 46.81 kg ha^{-1} P, P_3 = 240 kg ha^{-1} TSP @ 51.06 kg ha^{-1} P, and P_4 = 260 kg ha^{-1} TSP @ 55.32 kg ha^{-1} P; K_1 = KCl (250 kg ha^{-1} KCl @130 kg ha^{-1} K), K_2 = KH_2PO_4(452.19 kg ha^{-1} KH_2PO_4 @130 kg ha^{-1} K), and K_3 = K_2SO_4(288.6 kg ha^{-1} K_2SO_4 @130 kg ha^{-1} K).
Values in a column followed by the same letter are not statistically different, $p<0.05$.

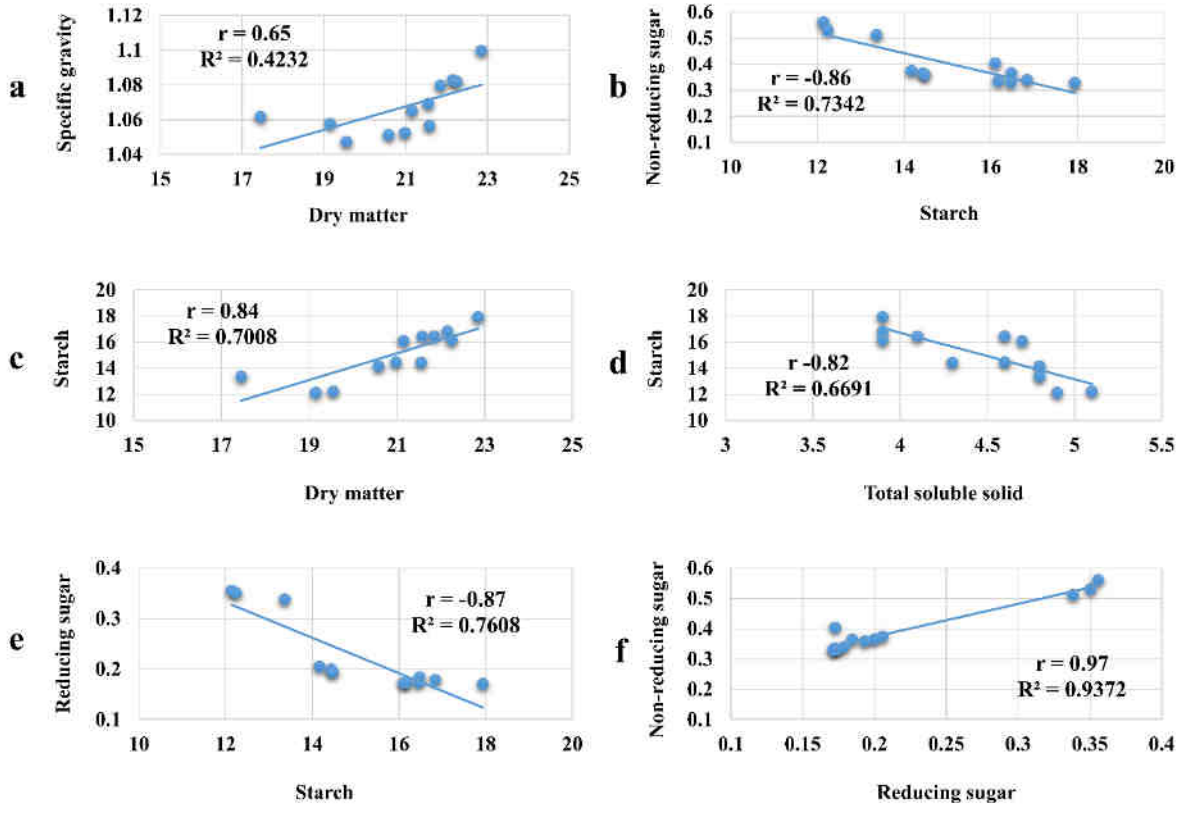


Figure 10. Linear relationships between: a) specific gravity and dry matter content of potato tuber, b) non-reducing sugar content and starch of potato tuber, c) starch and dry matter content of potato tuber, d) starch and total soluble solid of potato tuber, e) reducing sugar content and starch of potato tuber, and f) non-reducing sugar content and reducing sugar content of potato tuber.

Plate-4: Experimental views (Effect of Phosphorus and Potassium source on potato tuber quality)

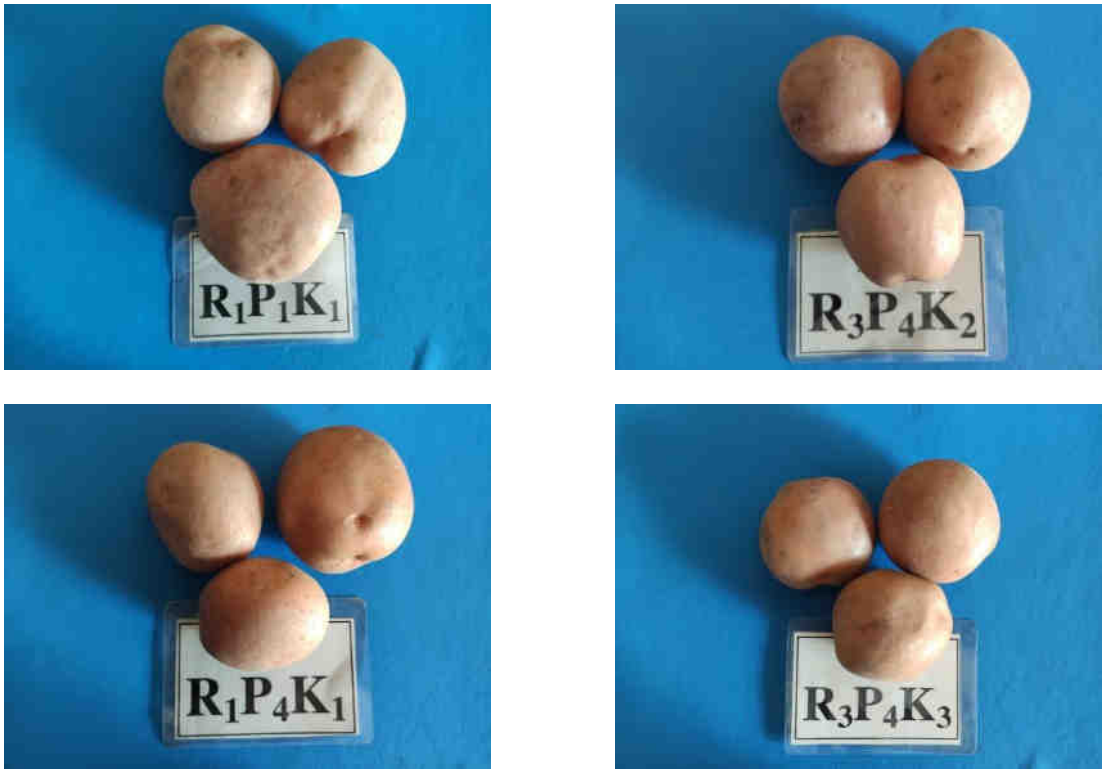


Plate-5: Potatoes from promising combinations as affected by P dose and K sources

Component-3 (Giant Agro Processing Limited)

As per objectives of the study we have collected industrial grade potatoes from contract growers and duly sorted and graded according to set size 45 mm to 90 mm in a leno mesh bags for cold storage and for conventional storage made racks of bamboo under a tin shed house (Data are presented in Table-155 to Table-160). Data showed that CIPC storage retains the quality of tubers (reduce the weight loss, delaysprouting, shrinkage and rotting of the storage tubers) and also increased the quality of potato processing for chips and French fry.

Table155. Data showing date wise physical degradation of BARI Alu- 28 (Lady Rosetta) kept under 3 different storing system in 1st year

Date	Wight (kg)			Sprout status			Shrinkage status			Rottening status		
	Normal	CIPC	Conven.	Normal	CIPC	Conven.	Normal	CIPC	Conven.	Normal	CIPC	Conven.
15.05.19	50.00	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
01.06.19	50.00	50.00	49.50	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
15.06.19	49.70	49.70	48.80	Nill	Nill	9%	Nill	Nill	8%	Nill	Nill	5%
01.07.19	49.40	49.75	47.50	Nill	Nill	17%	Nill	Nill	19%	Nill	Nill	15%
15.07.19	49.50	49.40	46.30	Nill	Nill	45%	Nill	Nill	45%	Nill	Nill	33%
01.08.19	49.10	49.20	45.80	0.5%	0.5%	75%	Nill	0.5%	85%	Nill	0.5%	90%
15.08.19	49.00	49.10	0	0.5%	0.5%	Rotten	Nill	0.5%	Rotten	Nill	0.5%	100%
01.09.19	48.60	48.60	-	0.5%	0.5%	-	0.5%	0.5%	-	0.5%	0.5%	-
15.09.19	48.10	48.20	-	1.5%	1%	-	0.5%	1%	-	0.5%	1%	-
01.10.19	47.90	47.90	-	2%	1.5%	-	0.5%	3%	-	0.5%	1%	-
15.10.19	47.40	47.50	-	2%	2%	-	0.5%	3.5%	-	0.5%	1%	-
01.11.19	47.10	47.00	-	2.5%	2.5%	-	1%	5.5%	-	0.5%	1%	-
15.11.19	46.60	46.70	-	3.5%	4.5%	-	1.5%	6.2%	-	0.5%	1%	-
01.12.19	46.30	46.20	-	3.5%	5%	-	1.5%	6.5%	-	0.5%	1%	-
15.12.19	46.00	46.10	-	3.5%	5.25%	-	1.5%	6.5%	-	0.5%	1%	-

Table 156. Data showing date wise physical degradation of BARI Alu- 29 (Courage) kept under 3 different storing system in 1st year.

Date	Wight (kg)			Sprout status			Shrinkage status			Rottening status		
	Normal	CIPC	Conven.	Normal	CIPC	Conven.	Normal	CIPC	Conven.	Normal	CIPC	Conven.
15.05.19	50.00	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
01.06.19	50.00	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
15.06.19	49.85	49.80	49.10	Nill	Nill	10%	Nill	Nill	5%	Nill	Nill	5%
01.07.19	49.80	49.75	47.90	Nill	Nill	18%	Nill	Nill	15%	Nill	Nill	15%
15.07.19	49.60	49.65	47.20	Nill	Nill	40%	Nill	Nill	35%	Nill	Nill	33%
01.08.19	49.40	49.50	46.20	0.5%	0.5%	70%	Nill	1.5%	80%	Nill	0.5%	90%
15.08.19	49.00	49.10	0	0.5%	0.5%	Rotten	Nill	2%	Rotten	Nill	0.5%	100%
01.09.19	48.90	48.80	-	1%	1%	-	0.5%	4%	-	0.5%	1.5%	-
15.09.19	48.50	48.50	-	1.2%	2%	-	1%	5%	-	0.5%	1%	-
01.10.19	48.00	48.00	-	2%	2.5%	-	1.5%	10%	-	0.5%	1%	-
15.10.19	47.80	47.50	-	2%	3%	-	1.5%	15%	-	0.5%	1%	-
01.11.19	47.50	47.00	-	2.6%	5.2%	-	3%	23%	-	0.5%	1%	-
15.11.19	47.00	46.60	-	5.2%	9.5%	-	5.5%	39%	-	0.5%	1%	-
01.12.19	46.80	46.20	-	5.5%	9.5%	-	6%	40%	-	0.5%	1%	-
15.12.19	46.50	46.00	-	5.6%	9.5%	-	6.2%	40%	-	0.5%	1%	-

Table 157.Data showing date wise physical degradation of BARI Alu- 28 (Lady Rosetta) kept under 3 different storing system in 2nd year.

Date	Wight (kg)			Sprout status			Shninkage Status			Rottening Status		
	Normal	CIPC	Conven	Normal	CIPC	Conven	Normal	CIPC	Conven	Normal	CIPC	Conven
05.03.20	50.00	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
20.03.20	49.80	49.70	49.60	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
05.04.20	49.30	49.20	49.20	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
20.04.20	49.75	48.80	48.50	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
05.05.20	48.40	48.40	47.58	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
20.05.20	48.24	48.20	46.55	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
05.06.20	48.20	48.10	46.50	Nill	Nill	5%	Nill	Nill	6%	Nill	Nill	2%
20.06.20	48.10	48.00	46.20	Nill	Nill	20%	Nill	Nill	9%	Nill	Nill	20%
05.07.20	47.80	48.00	42.60	Nill	Nill	70%	Nill	Nill	15%	Nill	Nill	21%
19.07.20	47.50	47.90	22.20	Nill	Nill	100%	Nill	Nill	85%	Nill	Nill	56%
03.08.20	47.30	47.20	0	Nill	Nill	-	Nill	Nill	85%	Nill	Nill	56%
18.08.20	47.00	47.00	-	Nill	Nill	-	Nill	Nill	100%	Nill	Nill	56%
02.09.20	46.90	46.80	-	Nill	2%	-	Nill	2%	-	Nill	1%	100%
17.09.20	46.90	46.80	-	Nill	6%	-	Nill	4%	-	Nill	3%	0%
01.10.20	46.50	46.60	-	Nill	15%	-	Nill	6%	-	Nill	3%	0%
15.10.20	46.50	46.60	-	Nill	17%	-	Nill	8%	-	Nill	5%	0%
30.10.20	46.50	46.60	-	Nill	20%	-	Nill	12%	-	Nill	7%	0%
15.11.20	46.20	46.20	-	Nill	25%	-	Nill	19%	-	Nill	12%	0%
30.11.20	46.00	46.00	-	Nill	50%	-	Nill	35%	-	Nill	25%	0%

Table 158. Data showing date wise physical degradation of BARI Alu- 29 (Courage) kept under 3 different storing system in 2nd year

Date	Wight (kg)			Sprout status			Shrinkage Status			Rottening Status		
	Normal	CIPC	Conven	Normal	CIPC	Conven	Normal	CIPC	Conven	Normal	CIPC	Conven
05.03.20	50.00	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
20.03.20	49.90	49.80	49.70	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
05.04.20	49.60	49.65	49.40	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
20.04.20	49.50	49.50	48.90	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
05.05.20	49.40	49.45	48.59	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
20.05.20	49.35	49.29	48.15	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
05.06.20	49.30	49.22	48.10	Nill	Nill	8%	Nill	Nill	Nill	Nill	Nill	10%
20.06.20	49.10	49.10	48.00	Nill	Nill	25%	Nill	Nill	6%	Nill	Nill	19%
05.07.50	49.00	49.10	46.40	Nill	Nill	72%	Nill	Nill	18%	Nill	Nill	20%
19.07.20	48.80	49.00	20.50	Nill	Nill	100%	Nill	Nill	88%	Nill	Nill	59%
03.08.20	48.50	48.70	0	Nill	Nill	-	Nill	Nill	88%	Nill	Nill	59%
18.08.20	48.20	48.40	-	Nill	Nill	-	Nill	Nill	88%	Nill	Nill	59%
02.09.20	47.80	48.00	-	Nill	3%	-	Nill	2%	100%	Nill	1%	100%
17.09.20	47.70	47.90	-	Nill	6%	-	Nill	5%	-	Nill	3%	-
01.10.20	47.50	47.60	-	Nill	12%	-	Nill	7%	-	Nill	3%	-
15.10.20	47.40	47.50	-	Nill	15%	-	Nill	9%	-	Nill	6%	-
30.10.20	47.00	47.00	-	Nill	19%	-	Nill	13%	-	Nill	9%	-
15.11.20	46.50	46.40	-	Nill	45%	-	Nill	21%	-	Nill	19%	-
30.11.20	46.20	46.10	-	Nill	55%	-	Nill	35%	-	Nill	25%	-

Table 159. Data showing date wise physical degradation of BARI Alu- 28 (Lady Rosetta) kept under 3 different storing system in 3rd year

Date	Wight (kg)			Sprout status			Shrinkage Status			Rottening Status		
	Normal	CIPC	Conven	Normal	CIPC	Conven	Normal	CIPC	Conven	Normal	CIPC	Conven
01.04.2021	50.00	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
15.04.2021	49.50	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
29.04.2021	49.30	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
11.05.2021	48.70	49.40	49.50	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
25.05.2021	48.40	49.00	40.00	Nill	Nill	10%	Nill	Nill	5%	Nill	Nill	10%
10.06.2021	48.20	48.80	33.00	Nill	Nill	80%	Nill	Nill	7%	Nill	Nill	17%
24.06.2021	48.00	48.50	30.00	Nill	Nill	90%	Nill	Nill	20%	Nill	Nill	27%
10.07.2021	47.80	48.20	25.00	Nill	Nill	100%	Nill	Nill	45%	Nill	Nill	40%
25.07.2021	47.50	47.80	20.00	Nill	Nill	-	Nill	Nill	65%	Nill	Nill	62%
09.08.2021	47.20	47.50	0	Nill	Nill	-	Nill	Nill	100%	Nill	Nill	100%
25.08.2021	47.10	47.40	-	Nill	Nill	-	Nill	Nill	-	Nill	Nill	-
09.09.2021	47.00	47.20	-	Nill	Nill	-	Nill	Nill	-	Nill	Nill	-
25.09.2021	47.00	47.00	-	Nill	Nill	-	Nill	Nill	-	5%	5%	-
11.10.2021	47.00	47.00	-	Nill	5%	-	Nill	3%	-	5%	6%	-
24.10.2021	46.80	46.70	-	Nill	7%	-	Nill	5%	-	7%	7%	-
11.11.2021	46.50	46.40	-	2%	11%	-	2%	9%	-	10%	10%	-

Table 160. Data showing date wise physical degradation of BARI Alu- 29 (Courage) kept under 3 different storing systems in 3rd year.

Date	Wight (kg)			Sprout status			Shrinkage Status			Rottening Status		
	Normal	CIPC	Conven	Normal	CIPC	Conven	Normal	CIPC	Conven	Normal	CIPC	Conven
01.04.2021	50.00	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
15.04.2021	49.40	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
29.04.2021	49.10	50.00	50.00	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
11.05.2021	48.60	49.50	49.40	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill
25.05.2021	48.10	49.10	49.00	Nill	Nill	8%	Nill	Nill	5%	Nill	Nill	5%
10.06.2021	48.00	48.90	42.00	Nill	Nill	85%	Nill	Nill	7%	Nill	Nill	14%
24.06.2021	48.00	48.50	35.00	Nill	Nill	99%	Nill	Nill	35%	Nill	Nill	37%
10.07.2021	47.70	48.20	25.00	Nill	Nill	100%	Nill	Nill	47%	Nill	Nill	47%
25.07.2021	47.30	47.90	21.00	Nill	Nill	-	Nill	Nill	62%	Nill	Nill	62%
09.08.2021	47.00	47.50	0	Nill	Nill	-	Nill	Nill	100%	Nill	Nill	100%
25.08.2021	46.10	47.40	-	Nill	Nill	-	Nill	Nill	-	Nill	Nill	-
09.09.2021	46.00	47.20	-	Nill	Nill	-	Nill	Nill	-	Nill	Nill	-
25.09.2021	46.00	47.00	-	Nill	Nill	-	Nill	Nill	-	5%	5%	-
11.10.2021	46.00	47.00	-	Nill	7%	-	1%	2%	-	6%	7%	-
24.10.2021	46.00	47.90	-	Nill	7%	-	2%	5%	-	6%	7%	-
11.11.2021	45.80	47.50	-	2%	10%	-	5%	7%	-	10%	10%	-

(a) Sprouts come out in shade storage

(b) Sprouts come out with shrinkage in shade storage

(c) Normal cold storage potatoes are still firm

(d) Normal cold storage potatoes are still firm

(e) CIPC cold storage potatoes are still firm

(f) CIPC cold storage potatoes are still firm

Figure 11. Physiological changes visual in each year kept after 2 months in different storage

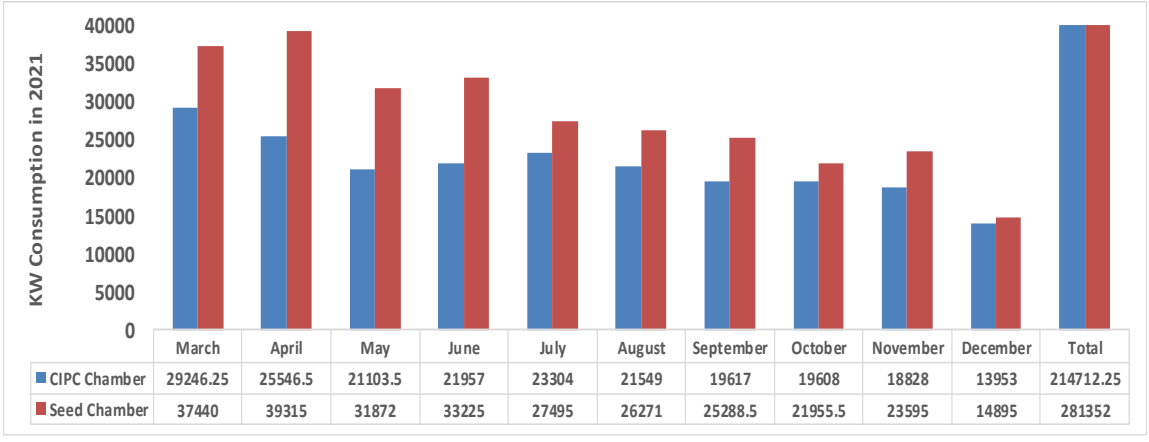
(a) CIPC chamber and Seed Chamber frying difference in BARI Alu- 28 (Lady Rosetta)

(b) CIPC chamber and Seed Chamber frying difference in BARI Alu- 29 (Courage)

Figure 12. Frying color of difference in different storage system

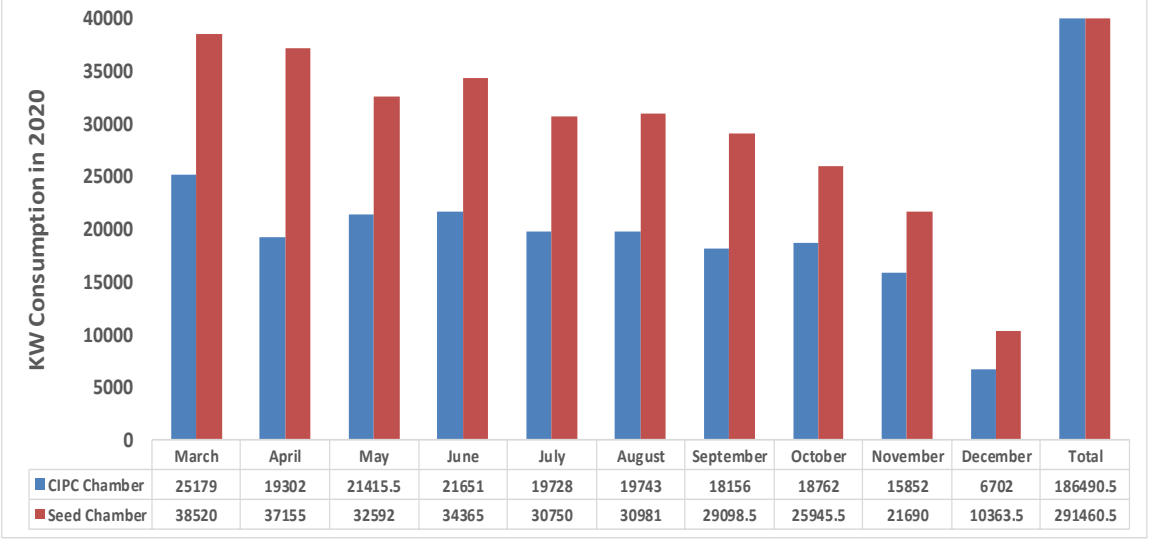
To assess the electricity consumption of CIPC and Normal cold storing systems data were recorded for 2020 and 2021 storage seasons and summarized that in 2020 total Electricity consumption was 4,77,951.00 KW among this CIPC Chamber consumed 39% and Seed Chamber Consumed 61%. In 2021 total Electricity consumption was 496064 KW among this CIPC Chamber consumed 43% and Seed Chamber Consumed 57%. Result can be summarized that around 17-20% electricity reduced by using this technology (Fig. 13&14 and details data sheet presented in Annexture-1.). Results reveled that as CIPC chamber required high temperature and need not run the cooling system as needed in normal seed chamber meanwhile the compressor is using less than usual. Mostly compressor is the vital electricity consumer of a cold storage unit. In 2021 total electricity cost was 41,32,414 among CIPC Chamber were 18,10,114 and Normal Chamber Cost was 23,22,300. Another key factor is peak and off peak hour as maintained by Rural Electrification Board (REB) in off peak and peak hour rate per KW is Tk 7.70 and Tk 30.00 respectively. As compressor is running

very minimum if any cold storage chamber can maintain the temperature in off peak period then electricity cost will be less.



	March	April	May	June	July	August	September	October	November	December	Total
CIPC Chamber	29246.25	25546.5	21103.5	21957	23304	21549	19617	19608	18828	13953	214712.25
Seed Chamber	37440	39315	31872	33225	27495	26271	25288.5	21955.5	23595	14895	281352

Figure 13. Comparison between electricity consumption in CIPC chamber and normal cold storage chamber in 2020



	March	April	May	June	July	August	September	October	November	December	Total
CIPC Chamber	25179	19302	21415.5	21651	19728	19743	18156	18762	15852	6702	186490.5
Seed Chamber	38520	37155	32592	34365	30750	30981	29098.5	25945.5	21690	10363.5	291460.5

Figure 14. Comparison between electricity consumption in CIPC chamber and normal cold storage chamber in 2021

Component-4 (Quasem Food Products Limited):

Processing quality of chips and French fry depends on specific gravity, dry matter (%), reducing sugar, flash color and frying color of chips. Potato varieties with high dry matter, low reducing sugar content, good flesh color and creamish to light brown frying color was considered as good processing quality. Specific gravity is directly correlated with that of dry matter content. Above 20% dry matter is required for French fry and chips. In that case, BARI Alu- 12 (Dheera), BARI Alu-35, BARI Alu-53 (LB-6), BARI Alu-68 (Atlantic) had more than 22%, BARI Alu-46, BARI Alu-61 (Volumia) had more than 21% and other 14 variety had more than 20% dry matter content. BARI Alu-47, BARI Alu-54 (Musica), BARI Alu-58 (Elmundo), BARI Alu-84 (Memphis), BARI Alu-85 (7 four 7) and Jarjina had higher amount of reducing sugar. The amount of reducing sugars

in the potato is responsible for the color of the fried products such as chips and French fry. Maximum reducing sugar for French fries 500 mg/dL and for chips 200 mg/dL. All variety showed creamish flesh color.

In case of chips qualities of dirrerent potato varieties BARI Alu-34 (Laura), BARI Alu-54 (Musica), BARI Alu-58 (Elmundo), BARI Alu-73 (CIP-127), BARI Alu-83 (Cimega), BARI Alu-84 (Memphis) and Cumbika were quite unfit for chips preparation due to very high deep brown color affection. BARI Alu-12 (Dheera), BARI Alu-21 (Provento), BARI Alu-40, BARI Alu-47, BARI Alu-49, BARI Alu-57, BARI Alu-60 (Vivaldi), BARI Alu-64 (Folva), BARI Alu-72 (CIP-139), BARI Alu-81 (CIP-10), BARI Alu-82 (11.68), BARI Alu-86 (12.13), BARI Alu-87 (CIP-225), BARI Alu-89 (Fortus), Jarjina and Sun Red were of medium quality. Others have good chips quality. Very good ones were BARI Alu-28 (Lady Rosetta), BARI Alu-29 (Courage), BARI Alu-71 (Dolly), BARI Alu-59 (Metro), BARI Alu-31 (Sagitta), BARI Alu-66 (Pamela), BARI Alu-77 (Sarpomira), BARI Alu-68 (Atlantic), Innovator and Al. Russet (Table 161 and 162).

Table 161. Processing qualities of different potato varieties

Variety	Specific gravity (SG)	Dry matter (DM) (%)	Reducing sugar (RS) (mg/dL)	Flesh Color
BARI Alu-7 (Diamant)	1.078	19.89	82.00	Creamish
BARI Alu-8 (Cardinal)	1.077	19.60	119.27	Creamish
BARI Alu-12 (Dheera)	1.089	22.48	37.20	Creamish
BARI Alu-13 (Granola)	1.084	21.08	77.40	Creamish
BARI Alu-21 (Provento)	1.073	19.17	169.67	Creamish
BARI Alu-25 (Asterix)	1.074	18.18	37.21	Creamish
BARI Alu-27 (Espirit)	1.078	19.80	128.87	Creamish
BARI Alu-28 (L. Rosetta)	1.074	18.98	17.40	Creamish
BARI Alu-29 (Courage)	1.081	20.26	29.33	Creamish
BARI Alu-31 (Sagitta)	1.075	19.20	50.97	Creamish
BARI Alu-32 (Quincy)	1.066	17.09	76.80	Creamish
BARI Alu-34 (Laura)	1.069	17.64	105.00	Creamish
BARI Alu-35	1.090	22.30	106.00	Creamish
BARI Alu-36	1.077	19.50	134.00	Creamish
BARI Alu-37	1.076	19.40	60.94	Creamish
BARI Alu-40	1.078	19.80	148.80	Creamish
BARI Alu-41	1.081	20.42	55.80	Creamish
BARI Alu-44 (Elgar)	1.070	18.10	60.40	Creamish
BARI Alu-46	1.084	21.08	105.07	Creamish
BARI Alu-47	1.083	20.86	202.20	Creamish
BARI Alu-48	1.076	19.40	129.60	Creamish
BARI Alu-49	1.078	19.80	128.40	Creamish
BARI Alu-50 (7.86)	1.077	19.60	125.10	Creamish
BARI Alu-51 (Bellarosa)	1.078	19.80	74.20	Creamish
BARI Alu-52 (Labadia)	1.071	18.32	99.53	Creamish
BARI Alu-53 (LB-6)	1.087	22.07	90.90	Creamish
BARI Alu-54 (Musica)	1.075	19.05	282.27	Creamish
BARI Alu-56	1.077	20.04	81.53	Creamish
BARI Alu-57	1.083	20.86	89.93	Creamish
BARI Alu-58 (Elmundo)	1.072	18.54	269.00	Creamish
BARI Alu-59 (Metro)	1.080	20.00	43.80	Creamish
BARI Alu-60 (Vivaldi)	1.079	20.00	82.20	Creamish
BARI Alu-61 (Volumia)	1.088	21.90	107.40	Creamish

Variety	Specific gravity (SG)	Dry matter (DM) (%)	Reducing sugar (RS) (mg/dL)	Flesh Color
BARI Alu-62 (9.112)	1.075	19.25	28.00	Creamish
BARI Alu-63 (9.125)	1.070	18.10	90.60	Creamish
BARI Alu-64 (Folva)	1.077	19.60	105.00	Creamish
BARI Alu-66 (Pamela)	1.075	19.25	46.80	Creamish
BARI Alu-68 (Atlantic)	1.086	22.00	62.50	Creamish
BARI Alu-71 (Dolly)	1.073	18.76	26.10	Creamish
BARI Alu-72 (CIP-139)	1.075	19.05	139.40	Creamish
BARI Alu-73 (CIP-127)	1.074	18.85	132.00	Creamish
BARI Alu-77 (Sarpomira)	1.073	18.76	35.40	Creamish
BARI Alu-78 (CIP-112)	1.074	19.48	62.20	Creamish
BARI Alu-79 (CIP-126)	1.078	19.80	51.00	Creamish
BARI Alu-81 (CIP-10)	1.082	20.64	166.50	Creamish
BARI Alu-82 (11.68)	1.077	19.49	177.33	Creamish
BARI Alu-83 (Cimega)	1.064	16.50	191.20	Creamish
BARI Alu-84 (Memphis)	1.080	20.00	285.47	Creamish
BARI Alu-85 (7 four 7)	1.061	15.22	418.80	Creamish
BARI Alu-86 (12.13)	1.080	20.00	196.13	Creamish
BARI Alu-87 (CIP-225)	1.077	19.60	117.53	Creamish
BARI Alu-88 (CIP-239)	1.082	20.54	113.53	Creamish
BARI Alu-89 (Fortus)	1.073	18.76	194.80	Creamish
BARI Alu-90 (Alouette)	1.071	18.32	43.80	Creamish
BARI Alu-91 (Carolus)	1.070	18.10	25.20	Creamish
BARI Alu-92	1.080	20.42	183.50	Creamish
Labela	1.062	16.39	36.47	Creamish
Jarjina	1.083	20.86	255.87	Creamish
Cumbika	1.079	20.00	177.47	Creamish
Sun Red	1.059	15.38	183.40	Creamish
Innovator	1.078	19.80	55.80	Creamish
Al. Russet	1.077	19.60	115.20	Creamish

Table 162. Chips qualities of different potato variety

Variety	Lab fry test		
	Creamish	Light Brown	Deep Brown
BARI Alu-7 (Diamant)	33	14	53
BARI Alu-8 (Cardinal)	35	27	38
BARI Alu-12 (Dheera)	33	05	62
BARI Alu-13 (Granola)	38	27	35
BARI Alu-21 (Provento)	03	44	53
BARI Alu-25 (Asterix)	65	19	16
BARI Alu-27 (Espirit)	67	0	33
BARI Alu-28 (L. Rosetta)	98	02	0
BARI Alu-29 (Courage)	83	17	0
BARI Alu-31 (Sagitta)	33	50	17
BARI Alu-32 (Quincy)	36	22	42
BARI Alu-34 (Laura)	0	22	78
BARI Alu-35	44	23	33
BARI Alu-36	37	08	55
BARI Alu-37	41	24	35
BARI Alu-40	12	20	68

Variety	Lab fry test		
	Creamish	Light Brown	Deep Brown
BARI Alu-41	37	49	14
BARI Alu-44 (Elgar)	57	10	33
BARI Alu-46	37	15	48
BARI Alu-47	33	0	67
BARI Alu-48	36	26	38
BARI Alu-49	02	26	72
BARI Alu-50 (7.86)	34	13	53
BARI Alu-51 (Bellarosa)	34	32	34
BARI Alu-52 (Labadia)	18	46	36
BARI Alu-53 (LB-6)	39	23	38
BARI Alu-54 (Musica)	0	0	100
BARI Alu-56	41	21	38
BARI Alu-57	13	25	62
BARI Alu-58 (Elmundo)	0	05	95
BARI Alu-59 (Metro)	67	31	02
BARI Alu-60 (Vivaldi)	33	05	62
BARI Alu-61 (Volumia)	25	13	62
BARI Alu-62 (9.112)	60	07	33
BARI Alu-63 (9.125)	54	13	33
BARI Alu-64 (Folva)	32	05	63
BARI Alu-66 (Pamela)	59	28	13
BARI Alu-68 (Atlantic)	63	07	30
BARI Alu-71 (Dolly)	72	28	0
BARI Alu-72 (CIP-139)	34	03	63
BARI Alu-73 (CIP-127)	0	24	76
BARI Alu-77 (Sarpomira)	62	20	18
BARI Alu-78 (CIP-112)	60	07	33
BARI Alu-79 (CIP-126)	45	38	17
BARI Alu-81 (CIP-10)	33	0	67
BARI Alu-82 (11.68)	33	01	66
BARI Alu-83 (Cimega)	0	20	80
BARI Alu-84 (Memphis)	0	12	88
BARI Alu-85 (7 four 7)	0	0	100
BARI Alu-86 (12.13)	33	0	67
BARI Alu-87 (CIP-225)	33	0	67
BARI Alu-88 (CIP-239)	23	18	59
BARI Alu-89 (Fortus)	32	08	60
BARI Alu-90 (Alouette)	32	58	10
BARI Alu-91 (Carolus)	66	21	13
BARI Alu-92	05	40	55
Labela	56	30	14
Jarjina	17	16	67
Cumbika	0	24	76
Sun Red	33	0	67
Innovator	68	16	16
Al. Russet	67	0	33

(a) BARI Alu- 28 (Lady Rosetta)

(b) BARI Alu- 29 (Courage)

(c) BARI Alu- 54 (Musica)

(d) BARI Alu- 85 (7 four 7)

Figure 15. Chips color of different potato variety

Table 163 and 164 showing the effect of CIPCon the processing qualities of potato tubers of 1st season and Table-124 and Table-125 showing 2nd season data. To check the processing qualities of different potato varieties with time at a commercial scale, two popular industrial variety viz. BARI Alu- 28 (Lady Rosseta) and BARI Alu- 29 (Courage) was used in this experiment. The concentration of reducing sugars in potatoes was not at all static. Reducing sugars increase during storage, depending on the storage temperature with time. The amount of reducing sugars in the potato is responsible for the color of the fried products such as chips and French fry. Maximum reducing sugar for French fries 500 mg/dL and for chips 200 mg/dL.

In Table 165, specific gravity and dry matter slightly changed with storage period but reducing sugar was higher with time. In seed chamber and normal storage condition reducing temperature higher because of the low temperature (2^0C-4^0C). So these types of storage condition are incompatible for potato processing. On the other hand, CIPC was able to lower the reducing sugar upto six months. This was because of the higher temperature (10^0C-12^0C).

In Table 165, CIPC stored tubers showed lower in deep colored scored compared to the seed chamber or normal chamber. Generally, reducing sugar content increased with storage time in all the varieties, but CIPC stored tubers had little changes in the reducing sugar content.

Table 166 showed that CIPC treatment, reducing sugar content was much lower than other treatments. CIPC treated potato maintained good processing quality for chips and French fry with increasing time. When tubers were stored, all the potatoes reduced in the specific gravity and dry matter content but reducing sugar content increased with time. CIPC storage and seed chamber storage condition were similar in specific gravity and dry matter content data. Reducing sugar content was very high compared to CIPC treated cold storage and outside shade storage.

(a) BARI Alu- 28 (Lady Rosetta) in Non-CIPC treated chamber

(b) BARI Alu- 28 (Lady Rosetta) in CIPC treated chamber

(c) BARI Alu- 29 (Courage) in Non-CIPC treated chamber

(d) BARI Alu- 29 (Courage) in CIPC treated chamber

Figure 16: Effect of CIPC and Non-CIPC treated chamber on chips color

Table 163. Data showing the effect of CIPC on the processing qualities of potato tubers (1st season)

Date	Chamber	Sp. Gravity		Dry Matter Content (%)		Reducing Sugar (Glucose) (mg/dl)	
		BARI Alu-28 (Lady Rosetta)	BARI Alu-29 (Courage)	BARI Alu-28 (Lady Rosetta)	BARI Alu-29 (Courage)	BARI Alu-28 (Lady Rosetta)	BARI Alu-29 (Courage)
20.06.2020	CIPC	1.078	1.085	19.80	21.30	147.60	140.40
	Normal	1.084	1.080	21.08	20.20	High	High
	Seed Chamber	1.083	1.084	20.86	21.08	151.20	264.60
04.07.2020	CIPC	1.081	1.088	20.42	21.90	201.60	158.40
	Normal	1.086	1.083	21.50	20.86	High	High
	Room Temp.	1.074	1.087	18.98	21.70	57.60	153.00
19.07.2020	CIPC	1.080	1.081	20.20	20.42	190.80	165.60
	Non CIPC	1.084	1.081	21.08	20.42	High	High
	Room Temp.	1.070	1.073	18.32	18.54	111.60	75.60
08.08.2020	CIPC	1.084	1.085	21.08	21.30	66.60	149.40
	Non CIPC	1.083	1.082	20.86	20.64	High	High
26.08.2020	CIPC	1.082	1.080	20.64	20.20	414.00	216.00
	Non CIPC	1.085	1.085	21.30	21.30	High	High
15.09.2020	CIPC	1.075	1.083	19.20	20.86	75.60	95.40
	Non CIPC	1.077	1.080	19.60	20.20	High	High
05.10.2020	CIPC	1.082	1.083	20.64	20.86	39.60	109.80
	Non CIPC	1.080	1.085	20.20	21.30	High	523.80
21.10.2020	CIPC	1.082	1.083	20.64	20.86	207.00	127.80
	Non CIPC	1.084	1.080	21.08	20.20	High	High
09.11.2020	CIPC	1.082	1.080	20.64	20.20	212.40	154.80
	Non CIPC	1.087	1.076	21.70	19.40	High	High
16.11.2020	CIPC	1.082	1.078	20.64	19.80	181.80	106.20
	Non CIPC	1.088	1.083	21.90	20.86	565.20	High
30.11.2020	CIPC	1.080	1.078	20.20	19.80	183.60	156.60
	Seed	1.084	1.080	21.08	20.20	421.20	High
20.12.2020	CIPC	1.080	1.081	20.20	20.42	185.40	140.40
	Seed	-	1.080	-	20.20	-	248.40

Table 164. Data showing date effect of CIPC on the Chips qualities of potato tubers (1st season)

Date	Chamber	BARI Alu-28 (Lady Rosetta)			BARI Alu-29 (Courage)		
		Creamish (%)	Light Brown (%)	Deep Brown (%)	Creamish (%)	Light Brown (%)	Deep Brown (%)
20.06.2020	CIPC	24	67	09	50	41	09
	Normal	0	0	100	0	0	100
	Seed Chamber	0	05	95	0	0	100
04.07.2020	CIPC	20	70	10	40	17	43
	Normal	0	0	100	0	0	100
	Seed Chamber	13	85	02	0	11	89
19.07.2020	CIPC	15	50	35	30	10	60
	Normal	0	0	100	0	0	100
	Seed Chamber	0	60	40	18	68	14
08.08.2020	CIPC	30	25	45	15	20	65
	Normal	0	0	100	0	0	100
26.08.2020	CIPC	0	60	40	20	0	80
	Non CIPC	0	0	100	0	0	100
15.09.2020	CIPC	06	61	33	0	68	32
	Non CIPC	0	0	100	0	0	100
05.10.2020	CIPC	16	74	10	0	13	87
	Non CIPC	0	0	100	0	0	100
21.10.2020	CIPC	0	20	80	10	14	76
	Non CIPC	0	0	100	0	0	100
09.11.2020	CIPC	0	0	100	0	0	100
	Non CIPC	0	0	100	0	0	100
16.11.2020	CIPC	0	10	90	0	8	92
	Non CIPC	0	0	100	0	0	100
30.11.2020	CIPC	0	0	100	0	0	100
	Seed	0	0	100	0	0	100
20.12.2020	CIPC	0	0	100	0	0	100
	Seed	-	-	-	0	0	100

Table 165.Data showing date wise effect of CIPC on the processing qualities of potato tubers (2nd season)

Date	Chamber	Sp. Gravity (%)		Dry Matter Content (%)		Reducing Sugar (Glucose) (mg/dl)	
		BARI Alu-28 (Lady Rosetta)	BARI Alu-29 (Courage)	BARI Alu-28 (Lady Rosetta)	BARI Alu-29 (Courage)	BARI Alu-28 (Lady Rosetta)	BARI Alu-29 (Courage)
07.05.2021	CIPC	1.090	1.090	22.30	22.64	23.40	57.60
	Seed	1.087	1.085	21.70	21.30	320.40	203.40
	Outside Shade	1.085	1.088	21.30	21.90	18.00	68.40
22.05.2021	CIPC	1.085	1.076	22.30	21.40	21.60	57.00
	Seed	1.089	1.085	22.10	21.30	22.00	420
	Outside Shade	1.087	1.089	21.70	22.10	68.40	19.80
03.07.2021	CIPC	1.087	1.083	21.80	20.86	111.20	156.60
	Seed	1.085	1.080	21.30	20.20	25.20	226.80
	Outside Shade	1.083	1.087	20.86	21.70	16.20	41.40
28.07.2021	CIPC	1.084	1.084	21.08	21.10	147.60	120.60
	Seed	1.082	1.087	20.64	21.70	496.80	547.20
	Outside Shade	1.084	1.086	21.08	21.50	34.20	27.00
12.08.2021	CIPC	1.085	1.084	21.64	21.08	88.20	71.00
	Seed	1.080	1.085	20.20	21.30	High	High
	Outside Shade	1.084	1.082	21.08	20.64	16.20	14.40
12.09.2021	CIPC	1.081	1.084	20.42	21.08	25.20	88.20
	Seed	1.079	1.075	20.00	19.20	550.00	High
28.09.2021	CIPC	1.089	1.084	21.90	21.08	135.00	130.00
	Seed	1.081	1.079	20.42	20.00	High	174.60
31.10.2021	CIPC	1.084	1.086	21.08	21.50	70.20	61.20
	Seed	1.081	1.083	20.42	20.86	221.40	374.40
12.12.2021	CIPC	1.083	1.085	20.86	21.30	221.40	189.00
	Seed	1.081	1.082	20.42	20.70	379.80	439.20
21.12.2021	CIPC	1.080	1.089	20.20	22.10	151.20	124.20
	Seed	1.084	1.087	21.08	21.70	154.80	212.40

Table 166.Data showing date effect of CIPC on the processing (Chips) qualities of potato tubers (2nd season)

Date	Chamber	BARI Alu-28 (Lady Rosetta)			BARI Alu-29 (Courage)		
		Creamish (%)	Light Brown (%)	Deep Brown (%)	Creamish (%)	Light Brown (%)	Deep Brown (%)
07.05.2021	CIPC	95	5	0	35	41	24
	Seed	0	0	100	0	0	100
	Outside Shade	100	0	0	0	65	35
22.05.2021	CIPC	88	12	0	40	18	42
	Seed	0	0	100	0	0	100
	Outside Shade	0	66	34	92	8	0
03.07.2021	CIPC	90	0	10	60	20	20
	Seed	0	80	20	0	0	100
	Outside Shade	95	5	0	10	73	18
28.07.2021	CIPC	50	20	30	50	10	40
	Seed	0	0	100	0	0	100
	Outside Shade	84	16	0	94	6	0
12.08.2021	CIPC	20	27	53	30	30	40
	Seed	0	0	100	0	0	100
	Outside Shade	95	5	0	94	6	0
12.09.2021	CIPC	29	71	0	30	42	38
	Seed	0	0	100	0	0	100
28.09.2021	CIPC	10	42	48	10	10	80
	Seed	0	0	100	0	0	100
31.10.2021	CIPC	30	32	38	5	15	80
	Seed	0	0	100	0	0	100
12.12.2021	CIPC	20	20	60	10	50	40
	Seed	0	0	100	0	0	100
21.12.2021	CIPC	0	0	100	0	0	100
	Seed	0	0	100	0	0	100

Figure 17. Pictorial view of project activities

12. Research highlight (title of the sub-project, background, objectives, methodology, key findings, and key words):

Title of the sub-project: Development of Production Package for Export and Processing Potatoes to Sustain Productivity and Food Security in Bangladesh

Background: Potato is an important food as well as a cash crop of Bangladesh. Its acreage, yield and production have been increasing since the beginning of cultivation in 1950s. In recent years it has become a vital crop of the country, and for the last few years, Bangladesh has been the 7th largest potato producer in the world. This big production sometimes becomes a huge problem in the country due to glut in the market. Bangladeshi people are unable to utilize this valuable food in full. Every year over three million tons of potato remains unutilized or being under-utilized. So farmers are losing their interest in potato cultivation, but Bangladesh has the ability to produce more potatoes, and potato is the highest food producing crop in terms of unit area or time. So, potato is the most vital crop in Bangladesh. In order to face this problem, the means and ways of best utilization of potato must be found out. Consumption of potato as a staple or part of a staple food, export of larger sized tubers to neighboring countries, and use of high dry matter containing tubers in the processing industries are some important options to remove this excess potato problem. But Bangladeshi produced tubers are small, deshaped and low in dry matter content. So, unfit for export and processing. In order to improve the tuber qualities, the project was designed to develop new varieties, to select suitable ones among the earlier released varieties, identification of suitable location, and to standardize improved agro-techniques relating to high quality tuber production suitable for export and processing.

Objectives: The major objective of the project was to select potato varieties for export and processing purposes through breeding, introduction and selection, and to improve the tuber qualities through improved agro-practices.

Methodology:
The project was designed to conduct some studies to identify suitable varieties, suitabe location, improved agro-techniques relating to expotable and processing quality tuber production. The study was conducted at the TCRC research stations, namely Joydebpur, Bogura, Munshigonj, Jashore and Debigonj, and other BARI research stations, namely Rangpur, Burirhat, Thakurgonj, Faridpur, Madaripur, Barisal and Patuakhali including some OFRD research sites where ever necessary. Standard experimental procedures including appropriate designs, lay out and treatments were followed according to TCRC's recommendations (Kundu et al, 2013; Rashid et al, 1987). At the end of each season the results were analyzed and critically reviewed, and necessary amendments/ modifications were made as per comments/suggestions of the experts. Suitable locations were identified through multi-location trials, PVS trials and on-farm demonstration trials. In search of exportable and processing qualities, 91 released varieties and advanced crossed materials were evaluated at ten locations throughout the country. Tuber size, shape and dry matter content were measured at the TCRC labs at Joydebpur and Debigonj. New materials were developed through hybridization among desirable varieties at Joydebpur and Debigonj.

Standardization of agro-practices like seed size, spacing, fertilizer, manure and irrigation for quality tuber production were done at the Agronomy Division, SAU, Dhaka, and in some BARI research stations. Development of storage techniques for cost reduction using CIPC was done by Giant Agro at the Himadri Cold Storage in Thakurgaon (Ahmed et al, 2012). Processing quality of the varieties

was estimated by Quasem Food Products Limited, Konabari, Gazipur. Post-harvest quality of the released varieties was studied at the respective locations (Akter et al, 2012).

Key Findings:

1. An amount of 1255 g hybrid potato seed (TPS) was obtained.
2. An amount of 1705 kg seedling tubers was selected out of 1200 hybrid combinations.
3. Four hybrid varieties were released and 5 more are ready for release from crossed materials.
4. Five exotic varieties were released and ten more are in the pipeline.
5. Varieties Innovator, Alberstone Russet and cross 13.7 are most suitable for fry preparation. Nine more are partially suitable.
6. Courage, Lady Rosetta, Dolly, Destiny, Alcander and *Crisp for All*are best varieties selected for chips production. Varieties Atlantic, Atlas and cross 13.10 are partially suitable for this purpose.
7. Among the released varieties, 12 were selected for French fries, 8 for Chips, 16 for export and other 13 for flakes or powder production.
8. Among the locations, Thakurgao, Rangpur and Bogura are good places for export potato production; Central region (Faridpur, Sariatpur and Munshigonj) and Jashore are good for French fry and Chips production.
9. November 1 to 30 is the best time of sowing of seeds for processing or export potato production.
10. Larger seeds (±35mm) are most suitable for export quality tuber production.
11. For export and processing quality tuber production, 65 cm row to row and 20 cm plant to plant spacings were found best.
12. With the application of CIPC, potato tubers could be stored for long time in the cold storage at 10-12^{0}C instead of 2-3^{0}C.
13. Application of Urea Super Granule (USG) + Biochar (8 t/ha), and vermi-compost (8-12 t/ha) helped in plant growth and development as well as exportable tuber production, but it might not be economic due to high cost involvement.
14. Application of K_2SO_4 instead of KCl gave better results for production of export quality potatoes.

Key words: CIPC**,** French fries, Chips, Flakes, Potato variety development, Hybridization, Clonal selection**.**

B. Implementation Status

1. Procurement (component wise):

Component-1 (BARI):

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment	24	693000.00	24	693000.00	-
(b) Lab &field equipment	1092	1677702.00	1092	1677702.00	-
(c) Other capital items	2	175000.00	2	175000.00	-

Component-2 (SAU):

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment	-	-	-	-	-
(b) Lab &field equipment	45	1195536.00	45	1189700.00	-
(c) Other capital items	-	-	-	-	-

Component-3 (GAPL): No capital item procurement
Component-4 (QFPL): No capital item procurement

2. Establishment/renovation facilities: Not Applicable

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	
-	-	-	-	-	-

3. Training/study tour/ seminar/workshop/conference organized:

Component-1 (BARI):

Description	Number of participant			Duration (Days)	Remarks
	Male	Female	Total		
(a) Training					-
i) Officers training	25	5	30	3 days	
ii) SA, LA, FA and others training	33	2	35	3 days	
ii) Farmer, SA, LA, FA and others Training	146	4	150	1 day	
(b) Workshop	72	13	85	1 day	-
(c) Others (if any)	-	-	-	-	-

Component-2 (SAU):

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training	22	1	23	1 days (28/11/2020)	1st Seminar
(b) Workshop	-	-	-	-	-
(c) Others (if any)	-	-	-	-	-

Component-3 (GAPL):

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training	-	-	-	-	-
(b) Workshop	33	0	33	2 days	-
(c) Others (if any)	-	-	-	-	-

Component-4 (QFPL):

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training	55	1	56	2 days	-
(b) Workshop	8	0	8	1 day	-
(c) Others (if any)	-	-	-	-	-

C. Financial and Physical Progress (combined & component wise)

Combined: Fig in Tk

Items of expenditure/ activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	8491961	7939162.8	7350986	0	100%	
b. Field research/lab expenses and supplies	12636562	11852541.33	12954983	0	100%	
c. Operating expenses	3776505	3498167.274	3624595	0	100%	
d. Vehicle hire and fuel, oil & maintenance	2431800	2260662.488	1954988	0	100%	
e. Training/workshop/ seminar etc.	1600560	1495543.8	1337060	0	100%	
f. Publications and printing	540000	501105.1109	327165	0	100%	
g. Miscellaneous	1160900	1080289.2	1081993	0	100%	
h. Capital expenses	3345702	3347400	3343102	0	100%	
Total	**33983990**	**31974872**	**31974872**	**0**	**100%**	

Component-1 (BARI): Fig in Tk

Items of expenditure/ activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	7106309	6553511	5965334	0	100%	
b. Field research/lab expenses and supplies	9627906	8878953	9981395	0	100%	
c. Operating expenses	3293500	3037299	3163727	0	100%	
d. Vehicle hire and fuel, oil & maintenance	2200000	2028862	1723188	0	100%	
e. Training/workshop/ seminar etc.	1350000	1244984	1086500	0	100%	
f. Publications and printing	500000	461105	287165	0	100%	
g. Miscellaneous	900000	829989	831693	0	100%	
h. Capital expenses	2545702	2550000	2545702	0	100%	
Total	**27523417**	**25584704**	**25584704**	**0**	**100%**	

Component-2 (SAU): Fig in Tk

Items of expenditure/ activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	679164	679164	679164	0	100%	
b. Field research/lab expenses and supplies	1514809	1488846	1488846	0	100%	
c. Operating expenses	150000	145505	145505	0	100%	
d. Vehicle hire and fuel, oil & maintenance	60000	60000	60000	0	100%	
e. Training/workshop/ seminar etc.	70000	70000	70000	0	100%	
f. Publications and printing	40000	40000	40000	0	100%	
g. Miscellaneous	150000	139400	139400	0	100%	
h. Capital expenses	800000	797400	797400	0	100%	
Total	**3463973**	**3420315**	**3420315**	**0**	**100%**	

Component-3 (GAPL): Fig in Tk

Items of expenditure/ activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	353244	353244	353244	0	100%	
b. Field research/lab expenses and supplies	767849	767849	767849	0	100%	
c. Operating expenses	207947	207444	207444	0	100%	
d. Vehicle hire and fuel, oil & maintenance	169800	169800	169800	0	100%	
e. Training/workshop/ seminar etc.	127560	127560	127560	0	100%	
f. Publications and printing	0	0	0	0	-	
g. Miscellaneous	106900	106900	106900	0	100%	
h. Capital expenses	0	0	0	0	-	
Total	**1733300**	**1732797**	**1732797**	0	100%	

Component-4 (QFPL):Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	353244	353244	353244	0	100%	
b. Field research/lab expenses and supplies	725998	716893	716893	0	100%	
c. Operating expenses	125058	107919	107919	0	100%	
d. Vehicle hire and fuel, oil & maintenance	2000	2000	2000	0	100%	
e. Training/workshop/ seminar etc.	53000	53000	53000	0	100%	
f. Publications and printing	0	0	0	0	-	
g. Miscellaneous	4000	4000	4000	0	100%	
h. Capital expenses	0	0	0	0	-	
Total	**1263300**	**1237056**	**1237056**	**0**	**100%**	

D. Achievement of Sub-project by Objectives (Tangible form): Technology generated/developed
Component-1 (BARI):

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)
a) Development of processing and export quality potato varieties through in-country hybridization and selection	1. Hybridization was done at Joydebpur and Debigonj under extended photoperiod following brick planting method. 2. Seeds were sown in soil under net house after treating with 1500 ppm GA_3. Seedlings were transplanted in the beds under net, and kept upto maturity. At harvest, one tuber per plant was collected. 3. Clonal selection was done in subsequent clonal selection until RYT (F_1C_0; F_1C_1; F_1C_2; F_1C_3; F_1C_4; PYT; SYT; AYT; RYT and PVS).	1. During the project period 1255g hybrid seeds were produced in 3156 combinations. 2. In total, 1705 kg hybrids seedling tubers were selected based on desired characters. 3. Four hybrid clones were released as commercial varieties. 4. Twenty-two advanced hybrid clones were in advanced generations.	1.Four hybrid clones 13.7, 13.17, 14.10, 14.11 have been released as Bangladeshi varieties namely BARI Alu-92, BARI Alu-93, BARI Alu-95 and BARI Alu-96. The first one was good for French fry, other three were suitable for Chips.
b) Introduction and selection of exotic varieties for export and processing purposes.	1. Twenty-three exotic varieties were introduced from different countries through several seed companies. 2. Introduced varieties were tested for subsequent four generations at multi-location in replicated yield trials. The best ones were released.	1.Five exotic varieties were released by NSB for commercial cultivation in Bangladesh. 2.Further introduction and evaluation for variety selection would be continued. ,	2.Five exotic varieties, namely Sun red, Alverstone Russet, Arizona, HZD 1249 and Ottawa have been released as BARI Alu-94, BARI Alu-97, BARI Alu-98, BARI Alu-99 and BARI Alu-100. The first two were suitable for French fries, and the rest trees are good for export.
c) Identification of suitable locations for the production of export and	1. All available released varieties and some advanced lines were evaluated for tuber qualities and tested for	1. Among the released varieties, 22 were selected for French fries, 9 for Chips, 24 for export and another 12 for flakes or powder.	1. Potato producers would be able to choose desirable varieties for

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)
processing quality potatoes.	chips and French fry qualities at 8-10 locations. 2. After harvesting all the varieties were stored under natural condition to observe the rottageand sprouting behaviour. 3. Collected samples of all varieties were tested for tuber size, tuber dry matter, reducing sugar, crispiness, Frenc fry and chips qualities.	2. Thakurgao, Rangpur, Munshigonj, Sariatpur, Faridpur, Rajshahi were identified as suitable for Export potato production. 3. Rangpur, Thakurgaon, Bogura Jashore, Faridpur, Sariatpur were identified as suitable for Processing potato production	specific purpose. 2. Processors and Exporters would be benefited by using this technology.
d) Standardization of agro-techniques for the production of export and processing quality potatoes under Bangladesh condition	1.Selected varieties were tested at 3-5 locations applying different seed size, spacing, fertilizer, manure, planting time and irrigation.	1. Date of planting: Nov 10 – 20 best for Northern region, and Nov 20 was best for Central regions. 2. Seed size and spacing: larger seed and wider spacing is better. 65 x 20 cm spacing seemed to be the best. 3. Biochar x Vermicompost: 2 t/ha of each seemed best for potato. 4. Ferti x Irrigatn: FRG 2018 (3 splits of N, SOP and Mg) along with two irrigations found best for processing and export.	1. By using this technology desired good quality potato tubers would be produced, which would be helpful for potato processors and exporters.

Component-2 (SAU):

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)
To study the effect of various sources of potassium and vermicompost level on yield and processing quality of potato.	The potato variety BARI Alu-25 (Asterix) was used as test crop. The experiment consisted of two factors: Factor A: 3 sources of Potassium as-K_1: KCl, K_2: KNO_3, K_3: K_2SO_4; Factor B: 4 levels of vermicompost as-Vm_0: 0 t ha^{-1}, Vm_1: 4 t ha^{-1}, Vm_2: 8 t $ha^{-1}$and Vm_3: 12 t ha^{-1}. The two factors experiment was laid out in a split-plot design with three replications.	K_2SO_4 or KCl as a source of potassium and 8 vermicompost tha^{-1} was found to be better in respect of yield and processing grade (French fries, Chips, Dehydrates and Canned) tubers	KCl and vermicompost application was found most promising agronomic inputs for improving the processing export qualities of potatoes.
To evaluate the effect of nitrogen form and biochar level and their interaction on growth, yield and processing quality of potato production	The potato variety BARI Alu-29 (Courage) was used as test crop. The experiment consisted of two factors. Factor A: Nitrogen form (2): 1. Prilled Urea (Up), 2. Urea Super Granule (U_S), and Factor B: Biochar level (6): 1. B_0- Control, 2. B_1- 2 t ha^{-1}, 3. B_2- 4 t ha^{-1}, 4. B_3- 6 t ha^{-1}, 5. B_4-8 t ha^{-1}, and 6. B_5-10 t ha^{-1}. The experiment was laid out in a split-plot design with three replications.	The application of Urea Super Granule (350 kg ha^{-1}) + Biochar (8 t ha^{-1}) was found to be most economic maintaining optimum yield (37.981 t ha-^{1}), maximum dry matter content (21.80 %), polyphenol (87.523), starch (15.900 %) and antioxidant activity (509.23 µg 100 g^{-1} FW).	Urea super granule and biochar was found most environmental friendly inputs for studied qualities of potato.
To examine effects of dose of phosphorus and source of potassium on quality of potato.	The potato variety BARI Alu-29 (Courage) was used as test crop. The experiment consisted the factors: phosphorus dose (4); P_1 = 42.55 kg ha^{-1} P; P_2 = 81 kg ha^{-1} P, P_3 = 51.06 kg ha^{-1} P and P_4 = 55.32 kg ha^{-1} P, and potassium sources (3); K_1=KCl (130 kg ha^{-1} K), K_2 = KH_2PO_4 (130 kg ha^{-1} K) and K_3 = K_2SO_4 (130 kg ha^{-1} K).	The highest dry matter (22.85%), starch (17.936%), antioxidant (630.12 Trolox µMol/100 g FW), polyphenol (92.994 GA mg/100 g FW) and the lowest reducing sugar (0.1713 mg g^{-1} FW) and non-reducing sugar (0.3290 mg g^{-1} FW) were from 200 kg ha^{-1} TSP and K_2SO_4 as sources of potassium to produce potato.	200 kg ha^{-1} TSP and K_2SO_4 was found most influential for potato processing and export traits but, KCl may be used as conventional inputs as source of potassium.

Component-3 (GAPL):

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)
a) To find out the possibility of using CIPC in the cold storage in order to reduce electricity consumption.	CIPC was fumigated in the chamber filled with potato tubers. Temp. was maintained at 10-12^{0}C. Tuber quality was compared with that of tubers stored at 2-3^{0}C.	Electricity can be reduced up to 45% compare the normal cold storage system	Tubers stored with CIPC would reduce the storage cost. Cold stored would be supplied to the processing industries for longer time.
b) To find out the best method and duration of storage for quality processed products.	Potatoes were kept three different storage systems viz. conventional systems, normal cold storage, improved storage system (CIPC)	Improved storage system (CIPC) was found better to keep Industry and export usable potatoes	Industry and export customers were becoming benefitted by using this technology.
c) To find out the possibility of using cold-stored potatoes for export and processing.	Testing of potato varieties under 3- storage conditions for six months and data recorded at every 15 days interval on processing qualities.	CIPC stored potatoes were equally good as normal stored ones (stored at 2-3^{0}C).	Long time supply of raw materials to processing industries.

Component-4 (QFPL):

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)
a) To find out the processing qualities of different potato varieties at a commercial scale.	All available varieties were tested in the laboratories for processing qualities like dry matter, reducing sugar, crispiness and taste.	Identified 22 varieties suitable for French fry, 9 for chips and 10 for starch/flex.	Industry and export customers will be benefitted by using this technology.
b) To find out the consumer preferences of the processed products of different potato varieties.	Qualities of the processed products were tested in the labs color, crispiness, firmness and taste.	Qualities of the chips, French fries, flakes and starch were known for each variety.	Processors would be able to make their own choice in selecting specific processing varieties.
c) To find out the commercial values of the processed products of different potato varieties.	Chips, French fries, flakes and starch qualities were tested in the laboratory.	Qualities of the chips, French fries, flakes and starch were known for each variety.	The user would be able to select desirable varieties.

E: Information/Knowledge generated/Policy generated

Component-1 (BARI):

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
a) Development of breeding lines/varieties through hybridization suitable for export and processing.	Desirable potato verities were crossed under 16 hours' photo received following brick planting method for tuber pruning. This method helped in flower induction and berry retention.	Under normal climates condition potato plants do not flower following this technologies anybody can conduct hybridization program for potato improvement.	Researcher could learn how to conduct hybridization and use hybrid seed and clones for verities development.
b) Introduction and selection of exotic varieties for export and processing purposes.	Over 100 verities were planted screening at 8-11 locations (same verities 2-3 years) in replicated yield trial for export and processing qualities.	Selected verities would be used by private sectors for export and industrial uses.	After necessary steps high amount of foreign exchange might be earned though export fresh potatoes and preparation of processed products.
c) To find out the suitable locations for the production of export and processing quality potatoes.	Imported verities and advanced breeding lines were tested in different agro-ecological regions for export and processing quality tubers.	Specific verities would be planted in specific locations where desirable quality tuber can be produced.	Only best locations wouldbe used for specific purposes potato production which would be enhance export and processing.
d) To standardize suitable agro-techniques for the production of export and processing quality potatoes under Bangladesh condition	Trials were conducted at3-5 locations for seed size, spacing, fertilizer level, planting time and irrigation with some good verities so that good returnee can be obtained with minimum losses.	Very Specific Agro-techniques would be used for good quality potato production suitable for export or processing.	Desired good quality potato tuber would be produced which will increase the export and processing, simultaneously solved the excess produced potato each and every year.

Component-2 (SAU):

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
a) To know the response of potassium source and vermicompost on the qualities of potatoes.	The potato variety BARI Alu-25 (Asterix) was used as test crop. The experiment consisted of two factors: Factor A: 3 sources of Potassium (KCl, KNO_3 and K_2SO_4); Factor B: 4levels of vermicompost (0, 4, 8 and 12 t ha^{-1}. Design: Split-plot design with three replications.	KCl as a source of potassium and 8 ton vermicompost ha^{-1} was exhibited best for processing qualities of potato.	KCl and vermicompost application increased the tuber bulking and improved processing traits.
b) To find out the effect of nitrogen form and biochar level on the yield and processing quality of potato.	The potato variety BARI Alu-29 (Courage) was used as test crop. The experiment consisted of two factors. Factor A: Nitrogen form (Prilled Urea and Urea Super Granule) and Factor B: Biochar level (Control, 2, 4, 6, 8, 10 t ha^{-1}). Design: Split-plot design with three replications.	The application of Urea Super Granule and Biochar (8 t ha^{-1}) was found to be most economic for improving yield and processing qualities of potato.	Urea super granule and biochar was found most beneficial inputs for maintaining soil and environment stewardship.
c) To evaluate the phosphorus doses with different source of potassium on the processing quality of potato.	The potato variety BARI Alu-29 (Courage) was used as test crop. The experiment consisted of two factors: 4 phosphorus dose (42.55, 81, 51.06, and 55.32 kg ha^{-1}) and 3 potassium sources (KCl, KH_2PO_4 and K_2SO_4).	Application of TSP @200 kg ha^{-1} and K_2SO_4 exhibited the highest dry matter, starch, antioxidant, polyphenol and the lowest reducing sugar and non-reducing sugar.	Phosphorus from TSP @200 kg ha^{-1} and KCl could be be used as source of potassium for improving potato processing qualities as found from K_2SO_4.

Component-3 (GAPL):

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
a) To find out the possibility of using CIPC in the cold storage in order to reduce electricity consumption.	CIPC was fumigated in the chamber filled with potato tubers. Temp. was maintained at 10-12^{0}C. Tuber quality was compared with that of tubers stored at 2-3^{0}C.	Electricity could be reduced up to 45% compare the normal cold storage system	Tubers stored with CIPC would reduce the storage cost. Cold stored would be supplied to the processing industries for longer time.
b) To find out the best method and duration of storage for quality processed products.	Potatoes were kept three different storage systems viz. conventional systems, normal cold storage, improved storage system (CIPC)	Improved storage system (CIPC) was found better to keep Industry and export usable potatoes	Industry and export customers were becoming benefitted by using this technology.
c) To find out the possibility of using cold-stored potatoes for export and processing.	Testing of potato varieties under 3- storage conditions for six months and data recorded at every 15 days interval on processing qualities.	CIPC stored potatoes were equally good as normal stored ones (stored at 2-3^{0}C).	Long time supply of raw materials to processing industries.

Component-4 (QFPL):

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome(short term effect of the research)
a) To find out the processing qualities of different potato varieties at a commercial scale.	All available varieties were tested in the laboratories for processing qualities like dry matter, reducing sugar, crispiness and taste.	Identified 22 varieties suitable for French fry, 9 for chips and 10 for starch/flex.	Industry and export customers would be benefitted by using this technology.
b) To find out the consumer preferences of the processed products of different potato varieties.	Qualities of the processed products were tested in the labs color, crispiness, firmness and taste.	Qualities of the chips, French fries, flakes and starch were known for each variety.	Processors would be able to make their own choice in selecting specific processing varieties.
c) To find out the commercial values of the processed products of different potato varieties.	Chips, French fries, flakes and starch qualities were tested in the laboratory.	Qualities of the chips, French fries, flakes and starch were known for each variety.	The user would be able to select desirable varieties.

F. Materials Development/Publication made under the Sub-project

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/ leaflet/ flyer etc.	**9**	**-**	1. রপ্তানী উপযোগী আলুর উৎপাদন কলাকৌশল 2. প্রক্রিয়াজাতকরন উপযোগী আলুর উৎপাদন কলাকৌশল 3. BARI Alu-93: An Excellent Variety for Export and Table Potato 4. BARI Alu-94 (Sun Red): A Promising Variety for Food Security in Bangladesh 5. BARI Alu-95: A High Yielding Potato Variety for Export 6. BARI Alu-96: A Promising Variety for Export and Table Potato 7. BARI Alu-97 (Alverstone Russet): A Promising Variety for Export and Processing 8. BARI Alu-98 (Arizona): A High Yielding Potato Variety for Export 9. Development of Production Package for Export and Processing Potatoes to Sustain Productivity and Food Security in Bangladesh
Journal publication	**6**	**4**	**Published:** 1. Md Mazadul Islam, Md Nasir Uddin, Sauda Naznin, Md. Nurul Amin, Md. Raziul Hassan Mondol, Afroz Naznin, Md. Zannatul Ferdous, Md. Salim, Md. Rezaul Karim and Bimal Chandra Kundu. 2022. Screening for Export Potential Potato Varieties in Bangladesh International Journal of Plant & Soil Science 34(20), 623-634. 2. Bimal Chandra Kundu, Sauda Naznin, Md. Abu Kawochar, Md. Mazadul Islam, Abdullah Al Mahmud, Md Nurul Amin, Md. Nasir Uddin, K.M. Delowar Hossain. 2022.Selection of Processing Potato Varieties Through Multi-Location Trials Malaysian Journal of Sustainable Agriculture 6(2), 72-78. 3. Tuhin Suvra Roy, Naiem Imtiaz, Rajesh Chakraborty, Bimal Chandra Kundu, Eti Chakraborty. 2022. Applying biochar and different form of nitrogen: be a good agricultural practice for better yield and processing quality of potato Journal of Horticulture and Postharvest Research 5(2), 187-196.

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
			4. M.N. Amin, M.M. Rahman, S. Naznin, M.K. Alam, M.M.H. Tipu, M.Z.H. Prodhan, M.M. Islam, B.C. Kundu. 2021. Tuber Yield and Stability Assessment of Potato Genotypes in Bangladesh Indian Journal of Agricultural Research 55(5), 609-613. 5. A. Badrunnesa, T. S. Roy, R. Chakraborty, S. C. Sarker, B. C. Kundu and M. Malek. 2021. Yield and Grading of Potato Tuber for Processing Purpose as Affected by Vermicompost and Potassium Sources Journal of Agriculture, Food and Environment 2(2), 57-61. 6. Jannatul Ferdous, Tuhin Suvra Roy, Rajesh Chakraborty, Maruf Mostofa, Bimal Chandra Kundu and Hossain K. M. Delowar . 2019. Vitamin C, Antioxidant and Polyphenol Activity of Some Selected Potato Varieties as Influenced by VermicompostJournal of Experimental Agriculture International 33(1), 1-9. **Under preparation:** 1. Phosphorus dose and Potassuim source on the Export and Processing quality of Potato. 2. Innovator and Alberstone Russet Two Most Suitable French Fry Potato Varieties for Bangladesh 3. Alcander a New Chips Making Potato Variety for Bangladesh 4. Dolly, Atlantic, Crisp 4 All and Destiny Identified as Chips Quality Potato Producing Varieties Under Bangladesh Condition 5. Screening of Potato Varieties Against Late Blight Under Bangladesh Condition.
Video clip/TV Program	-	-	-
News Paper/ Popular Article	-	-	-
Other publications	-	-	-

G. Description of generated Technology/Knowledge/Policy

i. Technology Factsheet (title of the technology, introduction, description, suitable location/ ecosystem, benefits, name and contact address of author)

1. Title of the technology: BARI Alu-93: An Excellent Variety for Export and Table Potato

Introduction

After wheat, maize and rice, potato is the world's 4th most important non-cereal food crop. It's playing a vital role to safeguard food security because of its growing demand and nutritional value. Considering the high yield potential, it can be a good substitute for cereal crops with a high harvesting index above 75%. According to FAO, Bangladesh ranks 7th position in potato production among the potato-producing countries of the world and is considered as 2nd most important food crop in the country. The country's average yield of potatoes is 20.61t/ha. However, this yield of potatoes is still low compared to other potato-growing countries. To ensure the country's food and nutritional security, the per unit area of potato production should be 41.50 t/ha by the year 2030. During the harvesting time, the price of potatoes goes down due to a glut of potatoes in the market and farmers experience financial loss, which influences low investment. The only way to overcome this situation is to increase the export and processing of potatoes. Therefore, to enhance the export and processing of potatoes, it is necessary to improve the tuber quality through suitable varieties and improved management practices which could ultimately increase total area and production and also increase quantity of export and processing potato in the country and helps to reduce the existing gap between production and surplus wasted and increase farmer's income.

Description of the Technology

- Tuber is Oval to long oval shape and large size tuber with medium eye depth and skin color red with cream flesh color.
- Tuber Yield 41.81(27.68-49.26) t/ha at farm level and 36.12 (30.86-42.62) t/ha at farmers field.
- Crop duration 80-85 days.
- Dry matter 19.69% (17.37-21.67%).
- Dormancy 80-90 days.
- Suitable for export and table potato.

Benefit of the Technology

High yielder, better taste, large size tuber (66.81%>40mm diameter) and higher dormancy (80-90 days) suitable for export and table purpose.

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2. Title of the technology: BARI Alu-94 (Sun Red): A Promising Variety for Food Security in Bangladesh

Introduction

After wheat, maize and rice, potato is the world's 4th most important non-cereal food crop. It's playing a vital role to safeguard food security because of its growing demand and nutritional value. Considering the high yield potential, it can be a good substitute for cereal crops with a high harvesting index above 75%. According to FAO, Bangladesh ranks 7th position in potato production among the potato-producing countries of the world and is considered as 2nd most important food crop in the country. The country's average yield of potatoes is 20.61t/ha. However, this yield of potatoes is still low compared to other potato-growing countries. To ensure the country's food and nutritional security, the per unit area of potato production should be 41.50 t/ha by the year 2030. During the harvesting time, the price of potatoes goes down due to a glut of potatoes in the market and farmers experience financial loss, which influences low potato quality. The only way to overcome this situation is to increase the quality of potatoes. Therefore, to enhance the quality of potatoes, it is necessary to improve varieties and management practices which could ultimately increase total area and production potato in the country and helps to reduce the existing gap between production and surplus wasted and increase farmer's income.

Description of the Technology

- Tuber is Oval, short oval shape and medium size tuber with medium eye depth and skin color deep red with cream flesh color.
- Tuber yield 39.54 (31.39-52.42) t/ha at farm level.
- Tuber yield at farmers field 34.50 (30.46-38.97) t/ha.
- Crop duration 80-85 days.
- Dry matter content 17.86 (14.93-19.91) %.
- Dormancy 45-50 days.

Benefit of the Technology

High yielder, large size tuber (67.13%>40mm diameter) and low disease and insect infestation, suitable for table purpose.

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3. Title of the technology: BARI Alu-95: A High Yielding Potato Variety for Export

Introduction

After wheat, maize and rice, potato is the world's 4th most important non-cereal food crop. It's playing a vital role to safeguard food security because of its growing demand and nutritional value. Considering the high yield potential, it can be a good substitute for cereal crops with a high harvesting index above 75%. According to FAO, Bangladesh ranks 7th position in potato production among the potato-producing countries of the world and is considered as 2nd most important food crop in the country. The country's average yield of potatoes is 20.61t/ha. However, this yield of potatoes is still low compared to other potato-growing countries. To ensure the country's food and nutritional security, the per unit area of potato production should be 41.50 t/ha by the year 2030. During the harvesting time, the price of potatoes goes down due to a glut of potatoes in the market and farmers experience financial loss, which influences low investment. The only way to overcome this situation is to increase the export of potatoes. Therefore, to enhance the export of potatoes, it is necessary to improve the tuber quality through suitable varieties and improved management practices which could ultimately increase total area and production and also increase quantity of export potato in the country and helps to reduce the existing gap between production and surplus wasted and increase farmer's income.

Description of the Technology

- Tuber is oval to short oval shape, medium sized tuber with smooth red color skin. Shallow red color eyes which are evenly distributed throughout the tuber. Uniformity of tuber is medium and color of flesh is light yellow.
- Tuber yield 40.19 (32.55-47.17) t/ha at farm level and 42.16 (32.52-51.67) t/ha at farmers field.
- Crop duration 80-85 days.
- Dry matter 20.20% (18.47-21.33%).
- Dormancy 85-90 days.

Benefit of the Technology

High yielder, large in size tuber (79.25%>40mm diameter) and higher dormancy (85-90 days) which is suitable for export and table purpose.

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4. **Title of the technology: BARI Alu-96: A Promising Variety for Export and Table Potato**

Introduction

After wheat, maize and rice, potato is the world's 4th most important non-cereal food crop. It's playing a vital role to safeguard food security because of its growing demand and nutritional value. Considering the high yield potential, it can be a good substitute for cereal crops with a high harvesting index above 75%. According to FAO, Bangladesh ranks 7th position in potato production among the potato-producing countries of the world and is considered as 2nd most important food crop in the country. The country's average yield of potatoes is 20.61t/ha. However, this yield of potatoes is still low compared to other potato-growing countries. To ensure the country's food and nutritional security, the per unit area of potato production should be 41.50 t/ha by the year 2030. During the harvesting time, the price of potatoes goes down due to a glut of potatoes in the market and farmers experience financial loss, which influences low investment. The only way to overcome this situation is to increase the export and processing of potatoes. Therefore, to enhance the export and processing of potatoes, it is necessary to improve the tuber quality through suitable varieties and improved management practices which could ultimately increase total area and production and also increase quantity of export and processing potato in the country and helps to reduce the existing gap between production and surplus wasted and increase farmer's income.

Description of the Technology

- Tuber - oval to long oval shape, medium to large sized tuber with smooth yellow color skin. Shallow yellow color eyes which are evenly distributed throughout the tuber. Uniformity of tuber is medium and color of flesh is light yellow.
- Tuber Yield 45.86 (31.27-54.31) t/ha at farm level and 48.42 (34.72-60.08) t/ha at farmers field
- Crop duration 80-85 days.
- Dry matter 19.38% (17.33-20.98%).
- Dormancy 65-70 days.

Benefit of the Technology

High yielder, large in size tuber (65.66%>40mm diameter) and higher dormancy (65-70 days) which is suitable for export and table purpose.

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5. BARI Alu-97 (Alverstone Russet): A Promising Variety for Export and Processing

Introduction

After wheat, maize and rice, potato is the world's 4th most important non-cereal food crop. It's playing a vital role to safeguard food security because of its growing demand and nutritional value. Considering the high yield potential, it can be a good substitute for cereal crops with a high harvesting index above 75%. According to FAO, Bangladesh ranks 7th position in potato production among the potato-producing countries of the world and is considered as 2nd most important food crop in the country. The country's average yield of potatoes is 20.61t/ha. However, this yield of potatoes is still low compared to other potato-growing countries. To ensure the country's food and nutritional security, the per unit area of potato production should be 41.50 t/ha by the year 2030. During the harvesting time, the price of potatoes goes down due to a glut of potatoes in the market and farmers experience financial loss, which influences low investment. The only way to overcome this situation is to increase the export and processing of potatoes. Therefore, to enhance the export and processing of potatoes, it is necessary to improve the tuber quality through suitable varieties and improved management practices which could ultimately increase total area and production and also increase quantity of export and processing potato in the country and helps to reduce the existing gap between production and surplus wasted and increase farmer's income.

Description of the Technology

- Tuber is oval shape, medium sized tuber with smooth yellow color skin. Medium yellow color eyes which are evenly distributed throughout the tuber. Uniformity of tuber is medium and color of flesh is light yellow.
- Tuber yield 45.58 (30.01-57.25) t/ha at farm level and 38.13 (24.89-45.09) t/ha at farmers field.
- Crop duration 80-85 days.
- Dry matter content 20.93 (17.77-24.33)%.
- Dormancy 100-105 days.
- Better organoleptic taste performance regarding taste, appearance and texture of boiled potato.
- Very suitable for export and processing (French Fry).

Benefit of the Technology

High yielder, better taste, and large in size tuber (74.58%>40mm diameter) and higher dormancy (100-105 days) and high dry matter, suitable for export and processing (French Fry).

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6. BARI Alu-98 (Arizona): A High Yielding Potato Variety for Export

Introduction

After wheat, maize and rice, potato is the world's 4th most important non-cereal food crop. It's playing a vital role to safeguard food security because of its growing demand and nutritional value. Considering the high yield potential, it can be a good substitute for cereal crops with a high harvesting index above 75%. According to FAO, Bangladesh ranks 7th position in potato production among the potato-producing countries of the world and is considered as 2nd most important food crop in the country. The country's average yield of potatoes is 20.61t/ha. However, this yield of potatoes is still low compared to other potato-growing countries. To ensure the country's food and nutritional security, the per unit area of potato production should be 41.50 t/ha by the year 2030. During the harvesting time, the price of potatoes goes down due to a glut of potatoes in the market and farmers experience financial loss, which influences low investment. The only way to overcome this situation is to increase the export of potatoes. Therefore, to enhance the export of potatoes, it is necessary to improve the tuber quality through suitable varieties and improved management practices which could ultimately increase total area and production and also increase quantity of export potato in the country and helps to reduce the existing gap between production and surplus wasted and increase farmer's income.

Description of the Technology

- Tuber is oval to long oval shape, medium sized tuber with smooth yellow color skin. Shallow yellow color eyes which are evenly distributed throughout the tuber. Uniformity of tuber is medium and color of flesh is cream.
- Tuber Yield 46.40 (27.19-55.63) t/ha at farm level and 38.53 (26.81-54.03) t/ha at farmers field.
- Crop duration 80-85 days.
- Dry matter 17.82% (14.40-21.00%).
- Dormancy 85-90 days.
- Best organoleptic taste performance regarding taste, appearance and texture of boiled potato.

Benefit of the Technology

High yielder, medium in size (81.03%>40mm diameter), higher dormancy and suitable for export.

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7. Research Title (In English): Development of Production Package for Export and Processing Potatoes to Sustain Productivity and Food Security in Bangladesh

গবেষণা শিরোনাম (বাংলায়): রপ্তানি ও প্রক্রিয়াজাতকরণ উপযোগী আলু উৎপাদন প্যাকেজের উন্নয়নের দ্বারা বাংলাদেশের উৎপাদনশীলতা ও খাদ্য নিরাপত্তা বজায় রাখা।

গবেষণার গুরুত্বঃ

আলু বাংলাদেশের একটি গুরুত্বপূর্ণ অর্থকরী ফসল। সাধারণত ধান ও গমের পরেই আলুর অবস্থান। বাংলাদেশ একটি কৃষিপ্রধান দেশ যেখানে বিভিন্ন কৃষিজাত পণ্য উৎপাদনের জন্য চমৎকার জমি রয়েছে। দিন দিন বিভিন্ন কৃষিজাত পণ্যের মধ্যে আলু মানুষের হৃদয়ে স্থান করে নিচ্ছে। সমগ্র বিশ্বে অনেক খাদ্য সামগ্রী উৎপাদনের জন্য আলুর উজ্জ্বল এবং বহুমুখী ব্যবহার রয়েছে। বিশেষ করে আলুর কন্দ থেকে বিভিন্ন প্রক্রিয়াজাতকরণ সামগ্রী তৈরি করা হচ্ছে। বাংলাদেশের মাটিও আলু উৎপাদনের জন্য একটি বিস্ময়কর ভিত্তি প্রদর্শন করছে যেমনটি বিভিন্ন প্রধান আলু উৎপাদনকারী দেশে পাওয়া যায় কিন্তু জলবায়ু পরিবর্তনের কারণে মাটি ও পরিবেশ আমাদের দেশে আলু উৎপাদনে স্থিতিশীল হতে পারছে না। যান্ত্রিকীকরণের পাশাপাশি বাংলাদেশের মাটি তার পুষ্টি উপাদানগুলো হারাচ্ছে এবং ভারসাম্যহীনতায় পৌঁছে যাচ্ছে। সাম্প্রতিক বছরগুলোতে, বাংলাদেশ প্রচুর পরিমাণে আলু উৎপাদন করেছে এবং স্থানীয় চাহিদা পূরণ করেছে কিন্তু বর্তমানে উপস্থিত গুণগত মান বিদেশে রপ্তানি করতে অনুমতি দিচ্ছে না, যা আমাদের স্থানীয় চাহিদার তুলনায় অনেক বেশি। তাই প্রতি বছর আমরা প্রচুর পরিমাণে উদ্বৃত্ত (প্রায় ৩৫ লাখ টন) আলু পাচ্ছি যা প্রক্রিয়াজাত করে রপ্তানি করা যায় এবং রপ্তানীমুখী শিল্পকারখানা গড়ে তোলা যায়। তবে, আশার কথা এই যে, টিসিআরসি, বিএআরআই প্রক্রিয়াকরণ এবং রপ্তানির প্রস্তাবের জন্য কয়েকটি আলুর জাত উদ্ভাবন করেছে কিন্তু কৃষক পর্যায়ে উৎপাদিত আলু দিয়ে বাস্তব পরিস্থিতিতে আন্তর্জাতিক বাজার ধরা সম্ভব হচ্ছেনা। এই দৃষ্টিকোণ থেকে, বাংলাদেশের প্রেক্ষাপটে প্রক্রিয়াজাত রপ্তানি মানের আলু উৎপাদনের জন্য এই উপ-প্রকল্পের অধীনে গবেষণা কার্যক্রম পরিচালনার মাধ্যমে একটি উৎপাদন প্যাকেজ প্রস্তাব করা হয়েছে যার মাধ্যমে ভবিষ্যতের চাষীরা উন্নতমানের রপ্তানীযোগ্য আলু উৎপাদন করত সক্ষম হবে এবং বাংলাদেশ একদিন বিশ্ববাজারে গুরুত্বপূর্ণ স্থান পাবে।

উপকরণ ও পদ্ধতিসমুহ

গবেষণার ধরণঃ মাঠ গবেষণা

এলাকাঃ গবেষণা মাঠ, শেরেবাংলা কৃষি বিশ্ববিদ্যালয়, ঢাকা-১২০৭।

সারঃ টিসিআরসি, বারি, গাজীপুর কর্তৃক সুপারিশকৃত সার ব্যবস্থাপনার উপর ভিত্তি করে গবেষণা কার্যক্রমটি পরিচালনা করা হয়েছে। জমিতে ব্যাবহারের সময় সুপারিশকৃত সারের পরিমাণ থেকে কম বেশি করে আলুর ফলন ও গুণগতমান যাচাই করা হয়েছে। আলুর রপ্তানি ও প্রক্রিয়াজাতকরণ বৈশিষ্ট্যের উন্নতির জন্য নিম্নোলিখিত সারসমূহ ব্যাবহার করা যেতে পারেঃ

ইউরিয়াঃ ৩৫০ কেজি/হেক্টর, যেখানে দানাদার ইউরিয়া সারের বদলে গুটি ইউরিয়া ব্যাবহার যেতে পারে।

টিএসপিঃ ২০০ কেজি/হেক্টর।

এমওপিঃ ২৮৮.৬ কেজি/হেক্টর পটাশিয়াম সালফেট (K_2SO_4)

জিপসামঃ ১১০ কেজি/হেক্টর

জিংক সালফেটঃ ৯ কেজি/হেক্টর

বোরনঃ ৭ কেজি/হেক্টর

ভার্মিকম্পোস্টঃ ৫-৮ টন/হেক্টর; আলুর রপ্তানি ও প্রক্রিয়াজাতকরণ মান নিয়ন্ত্রণের জন্য গোবরের বদলে ভার্মিকম্পোস্ট ব্যাবহার করা যেতে পারে। আর যদি আমরা মাটির জৈব কার্বনের পরিমাণ বাড়ানোর মাধ্যমে পরিবেশের দূষণরোধ করতে চাই সেক্ষেত্রে বায়োচার ব্যবহার করা অতীব জরুরী।

ফসলঃ আলু

ফলাফল

শেরেবাংলা কৃষি বিশ্ববিদ্যালয় অন্তর্গত কৃষিতত্ত্ব বিভাগের অধীনে ১০ ডিসেম্বর, ২০১৮ থেকে ১৫ ফেব্রুয়ারী, ২০২২ পর্যন্ড় গবেষণা কার্যক্রমটি পরিচালিত হয়। মাঠের গবেষণা শুরুর পূর্বে দেশের বিভিন্ন জায়গা থেকে আলুর কন্দ সংগ্রহ করা হয়। টানা ৩ বছর গবেষণা করে আলুর রপ্তানি ও প্রক্রিয়াজাতকরণ মান নিয়ন্ত্রণের জন্য বিভিন্ন খাদ্য উপাদান ও উৎপাদককে খুঁজে পাওয়া

যায়। এর মাঝে আলুর ফলন, % শুষ্ক পদার্থ (ড্রাই মেটার), আপেক্ষিক গুরুত্ব (স্পেসিফিক গ্রেভিটি), মোট দ্রবণীয় কঠিন (টিএসএস-ব্রিক্স), চিপস পটেটো, কেনড পটেটো, ফ্লেক্স পটেটো, ফ্রেঞ্চফ্রাই পটেটো, স্টার্চ, এন্টিঅক্সিডেন্ট, পলিফেনল-এর উপরে নাইট্রোজেন, ফসফরাস, পটাশিয়াম, ভার্মিকম্পোস্ট এবং বায়োচারের ব্যাবহার খুব ভালো ফলাফল দিয়েছে। যেখানে, পটাসিয়ামের উৎস হিসেবে পটাশিয়াম সালফেট (K_2SO_4) এবং ৮ টন/হেক্টর ভার্মিকম্পোস্ট চমৎকার কর্মক্ষমতা দেখিযয়েছে; ইউরিয়া সুপার গ্রানুল (ইউএসজি) + বায়োচার (৮ টন/হেক্টর) সবচেয়ে ভাল সমন্বয় হিসাবে দেখা গেছে এবং ২০০ কেজি/হেক্টর টিএসপি ফসফরাসের ডোজ হিসেবে খুব ভাল ফলাফল দিয়েছে।

উপসংহার

রপ্তানি ও প্রক্রিয়াজাতকরণ মানের আলু উৎপাদনের জন্য ভার্মিকম্পোস্ট/বায়োচার ব্যাবহার পরিবেশবান্ধব একটি কৌশল এবং যেখানে ভবিষ্যতে আলু উৎপাদনকারীরা রাসায়নিক সারের পরিমাণ কমিয়ে জৈব উৎস হিসাবে ব্যবহার করতে পারবে। বর্তমান গবেষণায় দেখা গেছে যে, ভার্মিকম্পোস্ট/বায়োচার এর পরিমাণ বাড়ানোর সাথে সাথে আলুর রপ্তানি ও প্রক্রিয়াজাতকরণ মানের উন্নয়ন হয়েছে। ভার্মিকম্পোস্ট/বায়োচার দুটোই বেশ ব্যয়বহুল হওয়ায় এর ব্যবহারের মাত্রা কমিয়ে কৃষকের জন্য স্বল্প খরচের উৎপাদন কৌশল উদ্ভাবনের জন্য ভবিষ্যতে আরও গবেষণা গবেষণার প্রয়োজন রয়েছে।

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Mobile: 01710515090

ii. Effectiveness in policy support (if applicable)

H. Technology/Knowledge generation/Policy Support (as applied)

i. Immediate impact ongenerated technology (commodity & non-commodity)

Export and processing potato production will be increased by the utilization of recently developmed or selected export and processing potato varieties. Desired quality tuber will be produced by using of developed agro-techniques. Location specific potato production will be helpful for farmers, exporters and processing industries as well as government for proper planning. CIPC treatment helps to maintain good processing quality for chips and French fry. By keeping in CIPC treated cold storage, post-harvest loss and electricity cost will be reduced and farmers will get good selling prices due to good processing quality.

ii. Generation of new knowledge that help in developing more technology in future

a) Hybridization techniques will be used in future for desired variety development.
b) More location may be selected for conducting the same type of multi-location trial for export and processing.
c) More variety will be tested using CIPC Technology.

iii. Technology transferred that help increased agricultural productivity and farmers' income

Developed or selected export and processing potato as well as agro-techniques will help to produce more export and processing potato. CIPC treatemnt helps to maintain good processing quality of potato. Above mention technology can helps to increas export and processing potato which will help to increase export and processing and producers get good selling price, which helps to sustainable potato production as well as uplifting the socio-economic status of potato related person.

iv. Policy support:

Specific location should be identified for processing and export potato production. Government should give more empasise on CIPC modified cold storage establishment.

I. Information regarding Desk and Field Monitoring

i. Desk Monitoring [description & output of consultation meeting, monitoring workshops/ seminars etc.)

ii. Field Monitoring (date& no. of visit, name and addresses of team visit and output)

Component-1 (BARI):

Date & location	Address of team visit	Output
18.01.2020 Bogura	1. Dr. M.N. Ali Sardar, Monitoring Specialist, PIU-BARC, NATP-2 2. Md. Abdur Rahman, Monitoring Associate, PIU-BARC, NATP-2 3. Dipak Kumar, Monitoring Associate, PIU-BARC, NATP-2	
20.01.2020 Rangpur	1. Dr. M.N. Ali Sardar, Monitoring Specialist, PIU-BARC, NATP-2 2. Md. Abdur Rahman, Monitoring Associate, PIU-BARC, NATP-2 1. Dipak Kumar, Monitoring Associate, PIU-BARC, NATP-2	
22.01.2020 Debigonj	1. Dr. M.N. Ali Sardar, Monitoring Specialist, PIU-BARC, NATP-2 2. Md. Abdur Rahman, Monitoring Associate, PIU-BARC, NATP-2 3. Dipak Kumar, Monitoring Associate, PIU-BARC, NATP-2	
02.03.2021 Gazipur	1. Dr. Md. Abdur Razzaque, Sector Coordinator-Extension, PMU, NATP-2 2. Md. Harun-ou-Rashid, Training & Communication Specialist, PMU,	

Date & location	Address of team visit	Output
	NATP-2 3. Dr. Md. Mahbub Alam, Producer Organization Mobilization Specialist, PMU, NATP-2 4. Dr. Shantana Halder, Monitoring & Evaluation Specialist, PMU, NATP-2 5. Dr. G.P. Das, Research-Extension Linkage Specialist, PMU, NATP-2	
10.06.2021 Gazipur	1. Dr. Md. Harunur Rashid, Director, PIU-BARC, NATP-2 2. Mohammad Shahidul Islam, Procurement Specialist, PIU-BARC, NATP-2 3. Dr. Mohammad Abdullah Al Faroque, Assistant Manager (Administration) PIU-BARC, NATP-2 4. Md Ashequar Rahman, Assistant Manager (Accountants), PIU-BARC, NATP-2	
31.12.2021 Debigonj	1. Munsi Mamunur Rahman, Documentation Associate, PIU-BARC, NATP-2 2. Md. Abdur Rahman, Monitoring Associate, PIU-BARC, NATP-2	
01.01.2022 Bogura	3. Munsi Mamunur Rahman, Documentation Associate, PIU-BARC, NATP-2 4. Md. Abdur Rahman, Monitoring Associate, PIU-BARC, NATP-2	
21.02.2022 Faridpur	1. Dr. Md. Harunur Rashid, Director, PIU-BARC, NATP-2 2. Mohammad Shahidul Islam, Procurement Specialist, PIU-BARC, NATP-2 3. Dr. Mohammad Abdullah Al Faroque, Assistant Manager (Administration) PIU-BARC, NATP-2 4. Md Ashequar Rahman, Assistant Manager (Accountants), PIU-BARC, NATP-2 5. Munsi Mamunur Rahman, Documentation Associate, PIU-BARC, NATP-2	

Component-2 (SAU):

Date & location	Address of team visit	Output
18.01.2021 Dhaka	1. Dr. Md. Harunur Rashid, Director, PIU-BARC, NATP-2 2. Mr. Mohammad Assaduzzaman, Manager (Financial Management) 3. Mr. Mohammad Shahidul Islam, Procurement Specialist **4.** Dr.Mohammad Abdullah Al Faroque, Assistant Manager (Administration)	1. Need special emphasis to complete the rest of task using alternate plan overcoming the losses due to COVID-19 pandemic situation 2. Should ensure the stock entry of procured goods items 3. Should preserve the bills and finance related documents properly 4. In case of procurement of goods should complete in time 5. Using the checklist of Indicative Fraud & Corruption for RFQ method 6. Should preserved the procurement related documents properly

Component-3 (GAPL):

Date & location	Address of team visit	Output
11.11.2021 Thakurgaon	1. Dr. Harunur Rashid, Director, PIU-BARC, NATP-2 2. Mohammad Shahidul Islam, Procurement Specialist, PIU-BARC, NATP-2 3. Dr. Mohammad Abdullah Al Faroque, Assistant Manager (Administration), PIU-BARC, NATP-2 4. Md. Ashequar Rahman, Assistant Manager (Accounts), PIU-BARC, NATP-2	

Component-4 (QFPL):

Date & location	Address of team visit	Output
10.06.2021 Gazipur	1. Dr. Harunur Rashid, Director, PIU-BARC, NATP-2 2. Mohammad Shahidul Islam, Procurement Specialist, PIU-BARC, NATP-2 3. Dr. Mohammad Abdullah Al Faroque, Assistant Manager (Administration), PIU-BARC, NATP-2 4. Md. Ashequar Rahman, Assistant Manager (Accounts), PIU-BARC, NATP-2	

iii. Weather data, flood/salinity/drought level (if applicable) and natural calamities:

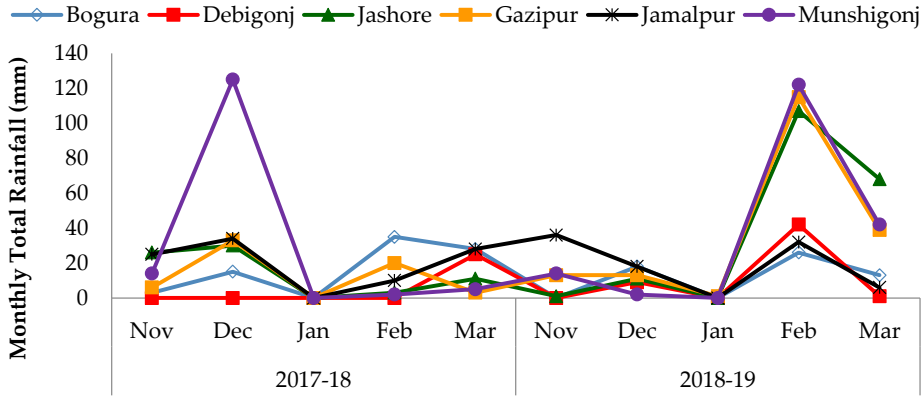

Figure 18: Monthly mean rainfall (mm) of the experimental sites during the potato growing season (2017-2018 and 2018–2019 crop season).

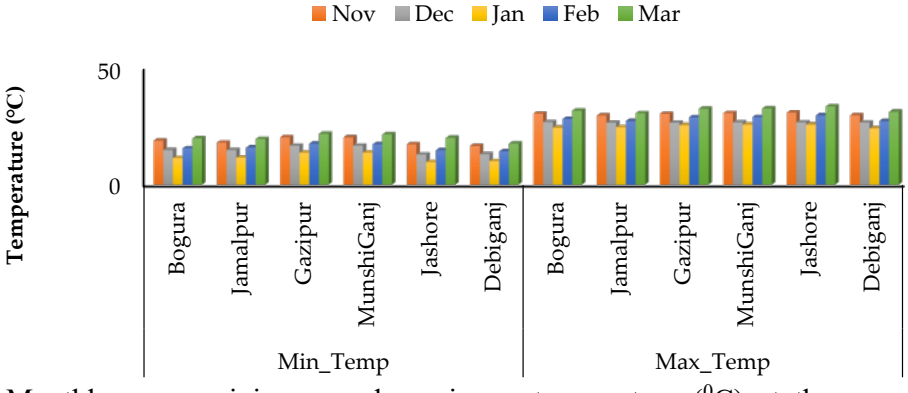

Figure 19: Monthly mean minimum and maximum temperature (^{0}C) at the experimental sites during the potato growing season (average of 2017-2018 and 2018–2019 crop season).

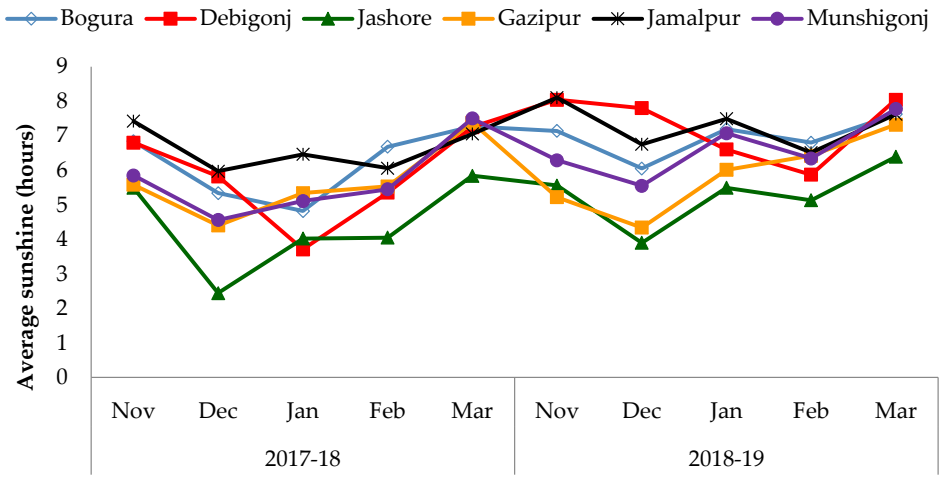

Figure 20: Monthly mean sunshine (hours) at the experimental sites during the potato growing season (2017-2018 and 2018–2019 crop season).

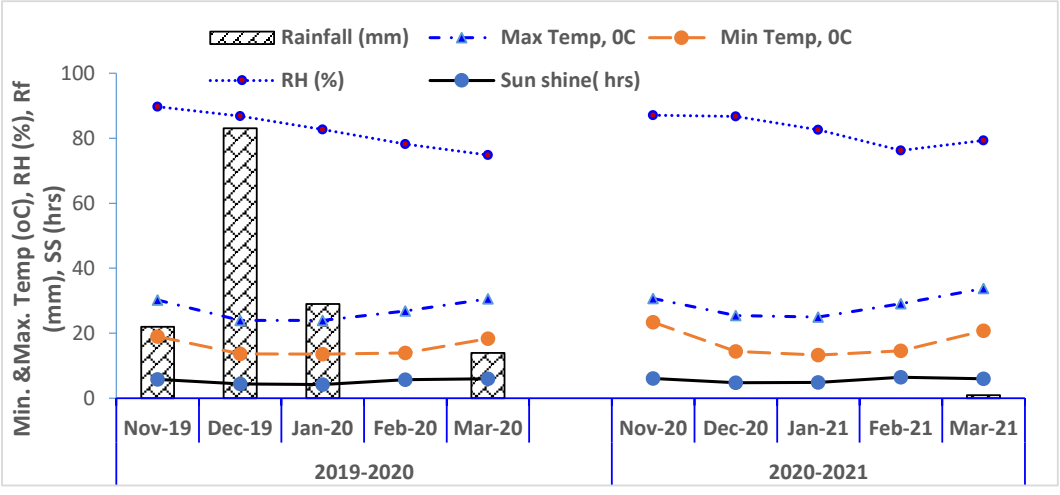

Figure 21. Maximum and minimum mean monthly temperature, relative humidity (RH, %), monthly rainfall (Rf, mm) and sunshine (SS, hour) in 2019-20 and 2020–21.

J. Sub-project Auditing (covers all types of audit performed)

Component-1 (BARI):

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
Financial (FAPAD)	No issues	11,68,583	Good	1st Audit (2018-2019)
Financial (FAPAD)	No issues	69,56,051	Good	2nd Audit (2019-2020)
Financial (FAPAD)	No issues	77,13,314	Good	3rd Audit (2020-2021)

Component-2 (SAU):

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
Financial (FAPAD)	No issues	1,90,779	Good	1st Audit (2018-2019)
Financial (FAPAD)	No issues	17,59,052	Good	2nd Audit (2019-2020)
Financial (FAPAD)	No issues	8,71,972	Good	3rd Audit (2020-2021)

Component-3 (GAPL):

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
Financial (FAPAD)	No issues	55,513	Good	1st Audit (2018-2019)
Financial (FAPAD)	No issues	1,33,415	Good	2nd Audit (2019-2020)
Financial (FAPAD)	No issues	8,60,276	Good	3rd Audit (2020-2021)

Component-4 (QFPL):

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
Financial (FAPAD)	No issues	1,11,682.50	Good	1st Audit
Financial (FAPAD)	No issues	6,43,390.00	Good	2nd Audit

K. Lessons Learned:

i. Multi location trial is efficient to identify the suitable variety(s) and location for potato production for specific purpose, such as export and processing.
ii. Required Quality of potato can be improved through different management practices (such as fertilizer, irrigation, planting spacing, earthing up method etc.)
iii. CIPC treatment helps to maintain good processing quality for chips, French fry and other product.
iv. Modified storage reduces the electricity consumption as well as reduces the cost of storage.

L. Challenges (if any):

i. During the implementation of this sub project we have faced many problems due to lockdown for COVID-19 issue.
ii. Sudden and uncertain rainfall during planting and harvesting time was noticedas a problem for experimentation as well as future potato cultivation due to climate change.

M. Suggestions for Future Planning (if any):

i. Big project with more stakeholders required for improvement of potato export and processing sector of Bangladesh.
ii. Sufficient and timely fund release is required for smoothly running the work.
iii. Required research facility and Infrastructures development is essential for doing this type of work properly.

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Signature of the Coordinator
Date …….
Seal

Counter signature of the Head of the organization/authorized representative
Date ……..
Seal

Annexture

Electricity Bill Of March 2020 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69taka= xi
1	Bolwer Fan	28	8	224	6720	51744	4	112	3360	35918.4
	FA & CO2	5.2	2	10.4	312	2402.4	2	10.4	312	3335.28
	Humidfier	7.5	2	15	450	3465		0	0	0
	Compressor	36	8	288	8640	66528	3	108	3240	34635.6
	Condenser	5	8	40	1200	9240	3	15	450	4810.5
	Vassel Pump	1.5	8	12	360	2772	3	4.5	135	1443.15
Peak-Off Peak Wise Khw & Bill Of March (CIPC Chamber)					17682	136151.4			7497	80142.93
Total Kwh & Bill Of March (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)= a			Total Bill BDT (Peak+Off-Peak) (vii+xi) =c			
				25179			216294.33			

Electricity Bill Of March 2020 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	18	342	10260	79002	4.00	76	2280	24373
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	18	648	19440	149688	3	108	3240	34636
	Condenser	5	13	65	1950	15015	3	15	450	4811
	Vassel Pump	1.5	11	16.5	495	3811.5	3	4.5	135	1443
Peak-Off Peak Wise Khw & Bill Of March (Normal Cold					32415	249595.5			6105	65262.45
Total Kwh & Bill March (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x) = b			Total Bill (Peak+Off-Peak) (vii+xi)=d			
				38520			314857.95			
Total Kwh & Bill Of March (CIPC Chamber & Normal Cold Chamber)				Total kwh (a+b)			Total Bill BDT (c+d)			
				63699			531152.28			

Electricity Bill Of April 2020 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	8	224	6720	51744	3.00	84	2520	26938.8
	FA & CO2	5.2	2	10.4	312	2402.4	0	0	0	0
	Humidifier	7.5	2	15	450	3465	1	7.5	225	2405.25
	Compressor	36	7.00	252	7560	58212	0.00	0	0	0
	Condenser	5	7	35	1050	8085	1	5	150	1603.5
	Vassel Pump	1.5	5	7.5	225	1732.5	2	3	90	962.1
Peak-Off Peak Wise Khw & Bill Of April (CIPC Chamber)					16317	125640.9			2985	31909.65
Total Kwh & Bill Of April (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)= c			
				19302			157550.55			

Electricity Bill Of April 2020 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	17	323	9690	74613	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079		0	0	0
	Compressor	36	15	540	16200	124740	5	180	5400	57726
	Condenser	5	12	60	1800	13860	5.30	26.5	795	8498.55
	Vassel Pump	1.5	12	18	540	4158	4	6	180	1924.2
Peak-Off Peak Wise Khw & Bill Of April (Normal Cold					28500	219450			8655	92521.95
Total Kwh & Bill Of April (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x) =b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				37155			311971.95			
Total Kwh & Bill Of April (CIPC Chamber & Normal Cold Chamber)				Total Kwh (a+b)			Total Bill BDT (c+d)			
				56457			469522.5			

Electricity Bill Of May 2020 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	10	280	8400	64680	4	112	3360	35918.4
	FA & CO2	5.2	2	10.4	312	2402.4		0	0	0
	Humidfier	7.5	2	15	450	3465		0	0	0
	Compressor	36	5.50	198	5940	45738	1.50	54	1620	17317.8
	Condenser	5	5	25	750	5775	2	10	300	3207
	Vassel Pump	1.5	5	7.5	225	1732.5	1.30	1.95	58.5	625.365
Peak-Off Peak Wise Khw & Bill Of May (CIPC Chamber)					16077	123792.9			5338.5	57068.565
Total Kwh & Bill Of May (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				21415.5			180861.465			

Electricity Bill Of May 2020 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	17	323	9690	74613	4.00	76	2280	24373
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	14.00	504	15120	116424	2.40	86.4	2592	27708
	Condenser	5	11.00	55	1650	12705	3	15	450	4811
	Vassel Pump	1.5	10.00	15	450	3465	2	3	90	962
Peak-Off Peak Wise Khw & Bill Of May (Normal Cold					27180	209286			5412	57854
Total Kwh & Bill Of May (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				32592			267140.28			
Total Kwh & Bill Of May (CIPC Chamber& Normal Cold Chamber)				Total kwh (a+b)			Total Bill BDT (c+d)			
				54007.5			448001.745			

Electricity Bill Of June 2020 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	10	280	8400	64680	4.00	112	3360	35918.4
	FA & CO2	5.2	2	10.4	312	2402.4	2	10.4	312	3335.28
	Humidifier	7.5	2	15	450	3465	4	30	900	9621
	Compressor	36	5.00	180	5400	41580	1.15	41.4	1242	13276.98
	Condenser	5	5	25	750	5775	2	10	300	3207
	Vassel Pump	1.5	3	4.5	135	1039.5	2	3	90	962.1
Peak-Off Peak Wise Khw & Bill Of June (CIPC Chamber)					15447	118941.9			6204	66320.76
Total Kwh & Bill Of June (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				21651			185262.66			

Electricity Bill Of June 2020 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	17	323	9690	74613	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	14	504	15120	116424	4	144	4320	46180.8
	Condenser	5	9	45	1350	10395	5.30	26.5	795	8498.55
	Vassel Pump	1.5	8	12	360	2772	4	6	180	1924.2
Peak-Off Peak Wise Khw & Bill Of June (Normal Cold					26790	206283			7575	80976.75
Total Kwh & Bill Of June (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				34365			287259.75			
Total Kwh & Bill Of June (CIPC Chamber& Normal Cold Chamber)				Total kwh (a+b)			Total Bill BDT (c+d)			
				56016			472522.41			

Electricity Bill Of July 2020 (Normal Cold Chamber)										
Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	17	323	9690	74613	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	13	468	14040	108108	2	72	2160	23090.4
	Condenser	5	10	50	1500	11550	2.10	10.5	315	3367.35
	Vassel Pump	1.5	9	13.5	405	3118.5	2	3	90	962.1
Peak-Off Peak Wise Khw & Bill Of July (Normal					25905	199468.5			4845	51793.05
Total Kwh & Bill Of July (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				30750			251261.55			
Total Kwh & Bill Of July (CIPC Chamber& Normal Cold Chamber)				Total kwh (a+b)			Total Bill BDT (c+d)			
				50478			419375.94			

Electricity Bill Of August 2020 (CIPC Chamber)										
Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	8	224	6720	51744	4.00	112	3360	35918.4
	FA & CO2	5.2	2	10.4	312	2402.4	2	10.4	312	3335.28
	Humidifier	7.5	2	15	450			0	0	0
	Compressor	36	5.50	198	5940	45738	1.30	46.8	1404	15008.76
	Condenser	5	5	25	750	5775	1.50	7.5	225	2405.25
	Vassel Pump	1.5	5	7.5	225	1732.5	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of August (CIPC					14397	110856.9			5346	57148.74
Total Kwh & Bill Of August (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				19743			168005.64			

Electricity Bill Of August 2020 (Normal Cold Chamber)										
Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	14	266	7980	61446	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	14	504	15120	116424	2.20	79.2	2376	25399.44
	Condenser	5	13.2	66	1980	15246	2.30	11.5	345	3688.05
	Vassel Pump	1.5	12	18	540	4158	2	3	90	962.1
Peak-Off Peak Wise Khw & Bill Of August(Normal					25890	199353			5091	54422.79
Total Kwh & Bill Of August (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				30981			253775.79			
Total Kwh & Bill Of August (CIPC Chamber & Normal Cold Chamber)				Total kwh (a+b)			Total Bill BDT (c+d)			
				50724			421781.43			

Electricity Bill Of September 2020 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	8	224	6720	51744	3.00	84	2520	26938.8
	FA & CO2	5.2	2	10.4	312	2402.4	2	10.4	312	3335.28
	Humidifier	7.5	2	15	450			0	0	0
	Compressor	36	5.00	180	5400	41580	1.15	41.4	1242	13276.98
	Condenser	5	5	25	750	5775	1.20	6	180	1924.2
	Vassel Pump	1.5	5	7.5	225	1732.5	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of Septembert (CIPC					13857	106698.9			4299	45956.31
Total Kwh & Bill Of September (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				18156			152655.21			

Electricity Bill Of September 2020 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	14	266	7980	61446	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	13	468	14040	108108	2.00	72	2160	23090.4
	Condenser	5	10.30	51.5	1545	11896.5	2.10	10.5	315	3367.35
	Vassel Pump	1.5	10	15	450	3465	1.30	1.95	58.5	625.365
Peak-Off Peak Wise Khw & Bill Of September (Normal					24285	186994.5			4813.5	51456.315
Total Kwh & Bill Of September (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				29098.5			238450.815			
Total Kwh & Bill Of September (CIPC Chamber & Normal Cold Chamber)				Total kwh (a+b)			Total Bill BDT (c+d)			
				47254.5			391106.025			

Electricity Bill Of October 2020 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	8	224	6720	51744	3.00	84	2520	26938.8
	FA & CO2	5.2	2	10.4	312	2402.4	2	10.4	312	3335.28
	Humidifier	7.5	2	15	450			0	0	0
	Compressor	36	5.50	198	5940	45738	1.10	39.6	1188	12699.72
	Condenser	5	6.4	32	960	7392	1.20	6	180	1924.2
	Vassel Pump	1.5	3	4.5	135	1039.5	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of October (CIPC					14517	111780.9			4245	45379.05
Total Kwh & Bill Of October (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				18762			157159.95			

Electricity Bill Of October 2020 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	14	266	7980	61446	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	11.00	396	11880	91476	1.40	50.4	1512	16163.28
	Condenser	5	9.00	45	1350	10395	1.40	7	210	2244.9
	Vassel Pump	1.5	9	13.5	405	3118.5	1.3	1.95	58.5	625.365
Peak-Off Peak Wise Khw & Bill Of October (Normal Cold					21885	168514.5			4060.5	43406.745
Total Kwh & Bill Of October (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				25945.5			211921.245			
Total Kwh & Bill Of October (CIPC Chamber & Normal Cold Chamber)				Total kwh (a+b)			Total Bill BDT (c+d)			
				44707.5			369081.195			

Electricity Bill Of November 2020 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	8	224	6720	51744	3.00	84	2520	26938.8
	FA & CO2	5.2	2	10.4	312	2402.4	2	10.4	312	3335.28
	Humidifier	7.5	2	15	450			0	0	0
	Compressor	36	3.35	120.6	3618	27858.6	1.00	36	1080	11545.2
	Condenser	5	3.4	17	510	3927	1.00	5	150	1603.5
	Vassel Pump	1.5	3	4.5	135	1039.5	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of November (CIPC					11745	90436.5			4107	43903.83
Total Kwh & Bill Of November (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				15852			134340.33			

Electricity Bill Of November 2020 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	18	342	10260	79002	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079		0	0	0
	Compressor	36	6.00	216	6480	49896	1.00	36	1080	11545.2
	Condenser	5	6.00	30	900	6930	1.00	5	150	1603.5
	Vassel Pump	1.5	5	7.5	225	1732.5	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of November (Normal					18135	139639.5			3555	38002.95
Total Kwh & Bill Of November (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				21690			177642.45			
Total Kwh & Bill Of November (CIPC Chamber & Normal Cold Chamber)				Total kwh (a+b)			Total Bill BDT (c+d)			
				37542			311982.78			

Electricity Bill Of December 2020 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	4	112	3360	25872	1.00	28	840	8979.6
	FA & CO2	5.2	1	5.2	156	1201.2	1	5.2	156	1667.64
	Humidifier	7.5	1	7.5	225			0	0	0
	Compressor	36	1.55	55.8	1674	12889.8	0.00	0	0	0
	Condenser	5	1.55	7.75	232.5	1790.25	0.00	0	0	0
	Vassel Pump	1.5	1.30	1.95	58.5	450.45	0	0	0	0
Peak-Off Peak Wise Khw & Bill Of December (CIPC					5706	43936.2			996	10647.24
Total Kwh & Bill Of December (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				6702			54583.44			

Electricity Bill Of December 2020 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	3	57	1710	13167	0	0	0	0
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	5.5	198	5940	45738	2	72	2160	23090.4
	Condenser	5	1.5	7.5	225	1732.5	0	0	0	0
	Vassel Pump	1.5	1.3	1.95	58.5	450.45	0	0	0	0
Peak-Off Peak Wise Khw & Bill Of November (Normal					8203.5	63166.95			2160	23090.4
Total Kwh & Bill Of December (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				10363.5			86257.35			
Total Kwh & Bill Of December (CIPC Chamber & Normal Cold Chamber)				Total kwh (a+b)			Total Bill BDT (c+d)			
				17065.5			140840.79			

Electricity Bill Of March 2021(CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69taka= xi
1	Bolwer Fan	28	10	280	8400	64680	4	112	3360	35918.4
	HE Unit	7	9	63	1890	14553	3	21	630	6734.7
	Humidfier	7.5	2	15	450	3465	2.05	15.375	461.25	4930.7625
	Compressor	36	10	360	10800	83160	1	36	1080	11545.2
	Condenser	5	10.00	50	1500	11550	1.20	6	180	1924.2
	Vassel Pump	1.5	10.00	15	450	3465	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of March (CIPC Chamber)					23490	180873			5756.25	61534.3125
Total Kwh & Bill Of March (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)= a			Total Bill BDT (Peak+Off-Peak) (vii+xi) =c			
				29246.25			242407.3125			

Electricity Bill Of March 2021 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	18	342	10260	79002	4.00	76	2280	24373
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	17.00	612	18360	141372	3	108	3240	34636
	Condenser	5	13	65	1950	15015	3	15	450	4811
	Vassel Pump	1.5	11	16.5	495	3811.5	3	4.5	135	1443
Peak-Off Peak Wise Khw & Bill Of March (Normal Cold					31335	241279.5			6105	65262.45
Total Kwh & Bill March (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x) = b			Total Bill (Peak+Off-Peak) (vii+xi)=d			
				37440			306541.95			
Total Kwh & Bill Of March (CIPC Chamber & 2)				Total kwh (a+b)			Total Bill BDT (c+d)			
				66686.25			548949.2625			

Electricity Bill Of April 2021 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	10	280	8400	64680	4.00	112	3360	35918.4
	HE Unit	7	7	49	1470	11319	3	21	630	6734.7
	Humidifier	7.5	1	7.5	225	1732.5	4	30	900	9621
	Compressor	36	5.00	180	5400	41580	3.30	118.8	3564	38099.16
	Condenser	5	5	25	750	5775	4	20	600	6414
	Vassel Pump	1.5	3	4.5	135	1039.5	2.5	3.75	112.5	1202.625
Peak-Off Peak Wise Khw & Bill Of March (CIPC Chamber)					16380	126126			9166.5	97989.885
Total Kwh & Bill Of April (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)= c			
				25546.5			224115.885			

Electricity Bill Of April 2021 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	17	323	9690	74613	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079	3	13.5	405	4329.45
	Compressor	36	17	612	18360	141372	5	180	5400	57726
	Condenser	5	9	45	1350	10395	5.30	26.5	795	8498.55
	Vassel Pump	1.5	13	19.5	585	4504.5	4	6	180	1924.2
Peak-Off Peak Wise Khw & Bill Of March (Normal Cold					30255	232963.5			9060	96851.4
Total Kwh & Bill Of April (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x) =b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				39315			329814.9			
Total Kwh & Bill Of April (CIPC Chamber&2)				Total Kwh (a+b)			Total Bill BDT (c+d)			
				64861.5			553930.785			

Electricity Bill Of May 2021 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	8	224	6720	51744	4	112	3360	35918.4
	HE Unit	7	9	63	1890	14553	3	21	630	6734.7
	Humidfier	7.5	0	0	0	0		0	0	0
	Compressor	36	5.00	180	5400	41580	1.50	54	1620	17317.8
	Condenser	5	6	30	900	6930	2	10	300	3207
	Vassel Pump	1.5	5	7.5	225	1732.5	1.30	1.95	58.5	625.365
Peak-Off Peak Wise Khw & Bill Of May (CIPC Chamber)					15135	116539.5			5968.5	63803.265
Total Kwh & Bill Of May (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				21103.5			180342.765			

Electricity Bill Of May 2021 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	16	304	9120	70224	4.00	76	2280	24373
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	14.00	504	15120	116424	2.40	86.4	2592	27708
	Condenser	5	10.00	50	1500	11550	3	15	450	4811
	Vassel Pump	1.5	10.00	15	450	3465	2	3	90	962
Peak-Off Peak Wise Khw & Bill Of May (Normal Cold					26460	203742			5412	57854
Total Kwh & Bill Of May (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				31872			261596.28			
Total Kwh & Bill Of May (CIPC Chamber&2)				Total kwh (a+b)			Total Bill BDT (c+d)			
				52975.5			441939.045			

Electricity Bill Of June 2021 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	8	224	6720	51744	4.00	112	3360	35918.4
	HE Unit	7	9	63	1890	14553	3	21	630	6734.7
	Humidifier	7.5	0	0	0	0	4	30	900	9621
	Compressor	36	5.50	198	5940	45738	1.15	41.4	1242	13276.98
	Condenser	5	5	25	750	5775	2	10	300	3207
	Vassel Pump	1.5	3	4.5	135	1039.5	2	3	90	962.1
Peak-Off Peak Wise Khw & Bill Of June (CIPC Chamber)					15435	118849.5			6522	69720.18
Total Kwh & Bill Of June (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				21957			188569.68			

Electricity Bill Of June 2021 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	15	285	8550	65835	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	13	468	14040	108108	5	180	5400	57726
	Condenser	5	9	45	1350	10395	5.30	26.5	795	8498.55
	Vassel Pump	1.5	8	12	360	2772	4	6	180	1924.2
Peak-Off Peak Wise Khw & Bill Of June (Normal Cold					24570	189189			8655	92521.95
Total Kwh & Bill Of June (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				33225			281710.95			
Total Kwh & Bill Of June (CIPC Chamber& 2)				Total kwh (a+b)			Total Bill BDT (c+d)			
				55182			470280.63			

Electricity Bill Of July 2021 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	10	280	8400	64680	4.00	112	3360	35918.4
	HE Unit	7	9	63	1890	14553	3	21	630	6734.7
	Humidifier	7.5	2	15	450			0	0	0
	Compressor	36	5.50	198	5940	45738	1.30	46.8	1404	15008.76
	Condenser	5	5	25	750	5775	2	10	300	3207
	Vassel Pump	1.5	3	4.5	135	1039.5	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of July (CIPC Chamber)					17565	135250.5			5739	61349.91
Total Kwh & Bill Of July (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				23304			196600.41			

Electricity Bill Of July 2021 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	15	285	8550	65835	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	11	396	11880	91476	2	72	2160	23090.4
	Condenser	5	10	50	1500	11550	2.10	10.5	315	3367.35
	Vassel Pump	1.5	10	15	450	3465	2	3	90	962.1
Peak-Off Peak Wise Khw & Bill Of July (Normal Cold					22650	174405			4845	51793.05
Total Kwh & Bill Of July (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				27495			226198.05			
Total Kwh & Bill Of July (CIPC Chamber&2)				Total kwh (a+b)			Total Bill BDT (c+d)			
				50799			422798.46			

Electricity Bill Of August 2021 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	8	224	6720	51744	4.00	112	3360	35918.4
	HE Unit	7	9	63	1890	14553	3	21	630	6734.7
	Humidifier	7.5	2	15	450			0	0	0
	Compressor	36	5.50	198	5940	45738	1.30	46.8	1404	15008.76
	Condenser	5	5	25	750	5775	1.50	7.5	225	2405.25
	Vassel Pump	1.5	3	4.5	135	1039.5	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of August (CIPC Chamber)					15885	122314.5			5664	60548.16
Total Kwh & Bill Of August (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				21549			182862.66			

Electricity Bill Of August 2021 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	13	247	7410	57057	4	76	2280	24373.2
	FA & CO2	4.5	4	18	540	4158	0	0	0	0
	Compressor	36	10	360	10800	83160	2.20	79.2	2376	25399.44
	Condenser	5	13.2	66	1980	15246	2.30	11.5	345	3688.05
	Vassel Pump	1.5	10	15	450	3465	2	3	90	962.1
Peak-Off Peak Wise Khw & Bill Of August(Normal Cold					21180	163086			5091	54422.79
Total Kwh & Bill Of August (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				26271			217508.79			
Total Kwh & Bill Of August (CIPC Chamber&2)				Total kwh (a+b)			Total Bill BDT (c+d)			
				47820			400371.45			

Electricity Bill Of September 2021 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	8	224	6720	51744	3.00	84	2520	26938.8
	HE Unit	7	9	63	1890	14553	2	14	420	4489.8
	Humidifier	7.5	1	7.5	225			0	0	0
	Compressor	36	5.00	180	5400	41580	1.15	41.4	1242	13276.98
	Condenser	5	5	25	750	5775	1.20	6	180	1924.2
	Vassel Pump	1.5	5	7.5	225	1732.5	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of Septembert (CIPC					15210	117117			4407	47110.83
Total Kwh & Bill Of September (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				19617			164227.83			

Electricity Bill Of September 2021 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	13	247	7410	57057	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	10	360	10800	83160	2.00	72	2160	23090.4
	Condenser	5	10.30	51.5	1545	11896.5	2.10	10.5	315	3367.35
	Vassel Pump	1.5	10	15	450	3465	1.30	1.95	58.5	625.365
Peak-Off Peak Wise Khw & Bill Of September (Normal					20475	157657.5			4813.5	51456.315
Total Kwh & Bill Of September (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				25288.5			209113.815			
Total Kwh & Bill Of September (CIPC Chamber&2)				Total kwh (a+b)			Total Bill BDT (c+d)			
				44905.5			373341.645			

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Electricity Bill Of October 2021 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	9	252	7560	58212	3.00	84	2520	26938.8
	HE Unit	7	6	42	1260	9702	2	14	420	4489.8
	Humidifier	7.5	2	15	450	3465		0	0	0
	Compressor	36	5.00	180	5400	41580	1.10	39.6	1188	12699.72
	Condenser	5	3	15	450	3465	1.20	6	180	1924.2
	Vassel Pump	1.5	3	4.5	135	1039.5	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of October (CIPC					15255	117463.5			4353	46533.57
Total Kwh & Bill Of October (CIPC Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=a			Total Bill BDT (Peak+Off-Peak) (vii+xi)=c			
				19608			163997.07			

Electricity Bill Of October 2021 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	9	171	5130	39501	4	76	2280	24373.2
	FA & CO2	4.5	2	9	270	2079	0	0	0	0
	Compressor	36	10.00	360	10800	83160	1.40	50.4	1512	16163.28
	Condenser	5	8.30	41.5	1245	9586.5	1.40	7	210	2244.9
	Vassel Pump	1.5	10	15	450	3465	1.3	1.95	58.5	625.365
Peak-Off Peak Wise Khw & Bill Of October (Normal Cold					17895	137791.5			4060.5	43406.745
Total Kwh & Bill Of October (Normal Cold Chamber)				Total kwh (Peak+Off-Peak) (vi+x)=b			Total Bill BDT (Peak+Off-Peak) (vii+xi)=d			
				21955.5			181198.245			
Total Kwh & Bill Of October (CIPC Chamber&2)				Total kwh (a+b)			Total Bill BDT (c+d)			
				41563.5			345195.315			

Electricity Bill Of November 2021 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	9	252	7560	58212	3.00	84	2520	26938.8
	HE Unit	7	8	56	1680	12936	3	21	630	6734.7
	Humidifier	7.5	2	15	450	3465	2	15	450	4810.5
	Compressor	36	3.35	120.6	3618	27858.6	1.00	36	1080	11545.2
	Condenser	5	3.4	17	510	3927	1.00	5	150	1603.5
	Vassel Pump	1.5	3	4.5	135	1039.5	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of November					**13953**	107438.1			**4875**	**52113.75**
Total Kwh & Bill Of November (CIPC Chamber)				**Total kwh (Peak+Off-Peak) (vi+x)=a**			**Total Bill BDT (Peak+Off-Peak) (vii+xi)=c**			
				18828			**159551.85**			

Electricity Bill Of November 2021 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	9	171	5130	39501	4	76	2280	24373.2
	FA & CO2	6	9	54	1620	12474	3	18	540	5772.6
	Compressor	36	10.00	360	10800	83160	1.00	36	1080	11545.2
	Condenser	5	10.00	50	1500	11550	1.00	5	150	1603.5
	Vassel Pump	1.5	10	15	450	3465	1	1.5	45	481.05
Peak-Off Peak Wise Khw & Bill Of November					**19500**	**150150**			**4095**	**43775.55**
Total Kwh & Bill Of November (Normal Cold Chamber)				**Total kwh (Peak+Off-Peak) (vi+x)=b**			**Total Bill BDT (Peak+Off-Peak) (vii+xi)=d**			
				23595			**193925.55**			
Total Kwh & Bill Of November (CIPC Chamber&2)				**Total kwh (a+b)**			**Total Bill BDT (c+d)**			
				42423			**353477.4**			

Electricity Bill Of December 2021 (CIPC Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
1	Bolwer Fan	28	9	252	7560	58212	0.00	0	0	0
	HE Unit	7	8	56	1680	12936	0.00	0	0	0
	Humidifier	7.5	2	15	450	3465	0.00	0	0	0
	Compressor	36	3.35	120.6	3618	27858.6	0.00	0	0	0
	Condenser	5	3.4	17	510	3927	0.00	0	0	0
	Vassel Pump	1.5	3	4.5	135	1039.5	0.00	0	0	0
Peak-Off Peak Wise Khw & Bill Of December					**13953**	**107438.1**			**0**	**0**
Total Kwh & Bill Of December (CIPC Chamber)				**Total kwh (Peak+Off-Peak) (vi+x)=a**			**Total Bill BDT (Peak+Off-Peak) (vii+xi)=c**			
				13953			**107438.1**			

Electricity Bill Of December 2021 (Normal Cold Chamber)

Chamber No	Load Name	Load KW	Off Peak Hour 11pm-5pm	Total Kwh(Daily)	Total Kwh (Monthly)	Total Bill (Monthly)	Peak Hour 5pm-11pm	Total Kw(Daily)	Total Kwh (Monthly)	Total Bill (Monthly
i	ii	iii	iv	iii x iv = v	v x 30 = vi	vi x7.70Taka= vii	viii	iii x viii= ix	ix x 30 = x	x x 10.69 taka= xi
2	Bolwer Fan	19	12	228	6840	52668	0	0	0	0
	FA & CO2	4.5	3	13.5	405	3118.5	0	0	0	0
	Compressor	36	6.00	216	6480	49896	0	0	0	0
	Condenser	5	6.00	30	900	6930	0	0	0	0
	Vassel Pump	1.5	6	9	270	2079	0	0	0	0
Peak-Off Peak Wise Khw & Bill Of November					**14895**	**114691.5**			**0**	**0**
Total Kwh & Bill Of December (Normal Cold Chamber)				**Total kwh (Peak+Off-Peak) (vi+x)=b**			**Total Bill BDT (Peak+Off-Peak) (vii+xi)=d**			
				14895			**114691.5**			
Total Kwh & Bill Of December (CIPC Chamber&2)				**Total kwh (a+b)**			**Total Bill BDT (c+d)**			
				28848			**222129.6**			

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