



Research article

Evaluation of potato varieties in the south-western coastal region of Bangladesh

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ABSTRACT

A field experiment was accomplished at the Khulna University Germplasm Centre of Bangladesh from November 2020 to March 2021 to evaluate the growth and yield performances of ten selected potato varieties for Khulna region following a Randomized Complete Block Design with three replications. BARI Alu-63 required the minimum time (12.67 days) for emergence and the highest percent of emergence (82.5%) was obtained in BARI Alu-37. BARI Alu-36 produced the tallest plant (98.17 cm) which was statistically similar to BARI Alu-40 (97.72 cm) and BARI Alu-37 (96.33 cm). BARI Alu-37 also had the biggest leaf. The highest number of tubers per plot (777), tuber shape index (1.49), dry matter content (25.99%) and specific gravity (1.32) were recorded in BARI Alu-47, BARI Alu-37, BARI Alu-48 and BARI Alu-47, respectively. BARI alu-37 also produced the highest weight of grade I potato. Disease incidence was the highest in the plot of BARI Alu-48 (91.28%) and lowest in BARI Alu-48 (23.81%). BARI Alu-40 resulted in the highest tuber yield (17.11 t h⁻¹). Overall, BARI Alu-40 or BARI Alu-37 can be selected for cultivation in Khulna region. However, more experiments should be conducted before making a final recommendation.

Introduction

Potato (*Solanum tuberosum L.*) — the chief tuber crops in the world — is a starchy, tuberous-herbaceous annual of the genus *Solanum* under Solanaceae or Nightshade family and also popularly called the king of vegetable (Mekashaw et al., 2020). Potato grows >125 countries in world covering diverse geography and ecology and is consumed by > 1 million people daily (Lutaladio et al., 2009). Hundreds of millions of people from developing countries survive on potato which, as the 4th largest crop of the world, supplies about 2% of dietary energy worldwide (Thapa and Thapa, 2019). It produces underground stems (stolons) which turns into a tuber upon swelling (Namugga, 2017).

Potato — a very good crop for ensuring food security in Bangladesh — produces higher protein and energy compared to the major food crops (Chowdhury and Chowdhury, 2015). It is a fat-free, rich in minerals e.g., potassium, phosphorus, iron, magnesium and vitamins (B₁, B₃, B₆, C), antioxidants and dietary fiber (Hafiz, 2015). A 150 g potato may provide 50% of daily required vitamin C of an adult. Potato is very important crop for food security and cash earnings as they are easy to cultivate and produce more food and nutrient from a specific area and unit time (Lutaladio et al., 2009). Potato

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ranks 3rd most important crop just after rice and wheat in Bangladesh and is used directly as vegetable and indirectly as ingredients of many processed foods (Azad et al., 2017). Moreover, the government of Bangladesh encourages to consume potato instead of rice (Chowdhury and Chowdhury, 2015). Although, the existing conditions for potato cultivation in Bangladesh are good, farmers usually do not prefer to grow more potatoes because of low, unstable, and fluctuating market prices. Bangladesh exports a negligible amount of potato but imports plenty of seed potatoes (BBS, 2018). Moreover, the average potato yield in Bangladesh is much lower than other potato growers (Netherlands, UK, France, USA and Germany) in the world. Though, yield of potato in Bangladesh is 21.86 t ha⁻¹ BBS, 2021), it is 48.00 t ha⁻¹ in UK indicating very low production (Azad et al., 2017). Therefore, there is a very good scope of increasing potato production through introducing and adopting improved varieties and cultivation technologies (Siddique et al., 2015).

Khulna—the southwest coastal region of Bangladesh — is experiencing various stresses like salinity intrusion, poor drainage, flood, water stagnation and atypical rainfall pattern (Kabir and Golder, 2017). These stressed conditions are less favorable for potato cultivation. The varieties of potato cultivated in Bangladesh are mostly

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indigenous and high yielding improved varieties. At present, 85% of the total land of potato cultivation is under improved varieties of potato and 15% is under cultivation of local varieties. The average yield of local cultivar is 11.8 t ha⁻¹; whereas, high yielding variety produces 25.98 t ha⁻¹ (BBS, 2021). About 100 improved varieties of potatoes have been developed by the Bangladesh Agriculture Research Institute (BARI), however, their performances were not evaluated at climate-stressed Khulna zone. Identifying suitable potato varieties for Khulna region also help to contribute to the food security as well as towards sustainable development goals (SDGs) in Bangladesh. Based on above facts, this study was conducted to evaluate the performance of ten potato varieties to identify suitable variety(ies) for Khulna region.

Materials and Methods

Experiment set up

The study was accomplished at the Germplasm Center of Khulna University, Bangladesh under Agroecological Zone (AEZ) 13 at 22°50' North latitudes and 89°33' East longitudes at an altitude of 8 meters above the sea level (UNDP, 1988). The clay loam soil contains low organic matter (1.12%) along with low N (nitrogen), K (potassium), and S (Sulphur) with a pH ranging 6.5-8.5 (Saha et al., 2019). Land preparation (15 days before planting) includes ploughing the land with power tiller followed by laddering. All the debris (plant parts, inert materials, visible insect pests) were removed, the recommended dose of cow dung was incorporated to the soil and the field was divided into blocks and unit plots. There was a total of 30 plots and each plot measures 3.6 m by 2.0 m with 0.5 m plot-plot and 1.5 m block-block distances. The treatment consists of ten potato varieties viz. BARI Alu-36, BARI Alu-37, BARI Alu-40, BARI Alu-41, BARI Alu-47, BARI Alu-48, BARI Alu-49, BARI Alu-56, BARI Alu-62, and BARI Alu-63 which were developed by the Bangladesh Agricultural Research Institute (BARI) and provided by the On-Farm Research Division, BARI, Khulna. Medium sized whole potato ('Alu' in Bengali) tubers weighing 40-50 g was planted on 2nd December, 2020 maintaining a distance of 60 cm between rows and 20 cm between plants.

Fertilizers application, intercultural operations and harvesting

Recommended dose of fertilizers (urea @ 350 kg ha⁻¹, TSP @ 220 kg ha⁻¹, MoP @ 250 kg ha⁻¹, gypsum @ 120 kg ha⁻¹, ZnSO₄ @ 10 kg ha⁻¹, and cow dung @ 10 t ha⁻¹) were applied and among them, cow dung was applied during land preparation (15 days before planting). The full dose of TSP, MoP, gypsum, ZnSO₄ and half dose of urea were applied on the day of planting. The rest half urea was applied after thirty days of planting. Weeding and mulching were done as per requirement to keep the plants free from weeds and to conserve soil moisture. Light irrigation was given just after sowing for better germination. Full irrigation was applied at 25 days after emergence (DAE) (tuber initiation stage) and 40 DAE (tuber development stage). As a part of earthing up, potato shoots were mounded around with soil at 30 and 60 days after planting. To control foliar diseases, Dithane M-45 was sprayed @ 2g L⁻¹ at 10 days interval during the foggy weather. As there were n Haulm pulling — the

removal of above ground plant parts — was done 10 days before harvesting. After haulm pulling, the tubers were kept for 10 days below ground to tighten the tuber skin. Harvesting was done carefully avoiding injury on 14th April 2021 with the help of a spade. Diseased, injured and green tubers were sort out carefully, to keep the other healthy tubers free from infestation. The healthy tubers were graded into three different grades (grade I, grade II, and grade III) based on their weights: grade I ≥ 75g, grade II 40-75g, and grade III < 40g (Banerjee et al., 2016).

Data collection

Data on growth and yield attributes, and decay were obtained during the study period and at harvest. The period between first and last date of emergence was recorded to identify the days required for completion of emergence for each variety. The number of stems per plant was recorded at 10 days interval from day of emergence to completion. To determine plant height, six randomly selected plants from each plot were measured from the base of plant at soil level to the plant tip. Number of leaves were counted from randomly selected six plants per plot. To measure the length and breadth of leaf, the largest leaf of a plant has been identified and measured for six randomly selected plants per plot on 9th February 2021.

Attributes of harvested tubers (number, weight, length, breadth, shape index, color, skin type, number and depth of eyes) were measured at harvest. The shape index was calculated as, shape index = length of tuber/ breadth of tuber. Six fresh tubers immediately after harvest from each plot were weighed, sliced, and oven dried (80 °C) for 72 hours and weighed again to calculate dry matter content as: dry matter (%) = (dry weight/fresh weight) × 100. Specific gravity [specific gravity = (weight in air)/(weight in air – weight in water)]; disease incidence (%) [disease incidence = (number of infected plants × 100) / (number of total plant)]; proportion (%) of infected tubers [infected tubers (no.) = (number of infected tuber plot⁻¹/ total number of tubers plot⁻¹) × 100]; and weight of infected tuber (%) [infected tubers (weight) = (weight of infected tuber per plot/weight of total tuber per plot) × 100] were also calculated (Sinha et al., 1992).

Data analysis

The data on growth and yield attributes were statistically analysed with one-way ANOVA using Statistix-10 software and the treatment means were separated by Duncan's New Multiple Range Test (DMRT) at α = 5%.

Results

Growth attributes of potato varieties

Emergence time for potato varieties varied significantly (Table 1). BARI Alu-41 required the shortest time (8.00 days) for sprouting preceded by BARI Alu-40 (11.33 days) and BARI Alu-47 (12.33 days); on the other hand, BARI Alu-37 required the longest time (17 days) for the completion of emergence followed by BARI Alu-48 (16.33 days) and BARI Alu-56 (16.33 days). The highest percent of emergence (82.50%) was recorded from BARI Alu-37 and the lowest from BARI Alu-40 (71.34%). The number of stems per plant did not differ among the varieties. However, numerically the higher number of stems plant⁻¹ was observed in BARI Alu-37 (5.87) and

lower from BARI Alu-40 (3.17). Plant height differed significantly among the varieties. The tallest plant was recorded in BARI Alu-36 (98.17cm) which was

Table 1: Varietal effect of potato on sprouting, plant number and plant height

Variety	Time of emergence (days)	Emergence (%)	Number of stems plant ⁻¹	Height of plant (cm)
BARI Alu-36	12.67 c	75.83 a-d	4.67	98.17 a
BARI Alu-37	17.00 a	82.50 a	5.87	96.33 a
BARI Alu-40	11.33 cd	71.34 d	3.17	97.72 a
BARI Alu-41	8.00 d	76.67 a-d	5.77	80.83 ab
BARI Alu-47	12.33 c	78.33 abc	4.41	60.39 b
BARI Alu-48	16.33 ab	77.50 a-d	3.60	65.78 b
BARI Alu-49	13.67 abc	79.73 ab	4.68	80.11 ab
BARI Alu-56	16.33 ab	76.94 bcd	3.56	62.83 b
BARI Alu-62	13.00 bc	71.94 cd	3.36	58.84 b
BARI Alu-63	12.67 c	75.56 bcd	3.30	74.69 ab
<i>p</i> value	0.0014	0.0335	0.2965	0.0078

Means followed by common letter(s) in a column do not differ significantly at 5% level by DMRT.

Table 2: Characteristics of leaves of different potato varieties

Variety	No. of leaves plant ⁻¹	Length of leaves (cm)	Breadth of leaves (cm)
BARI Alu-36	17.72	23.06 ab	8.44 cde
BARI Alu-37	21.11	25.50 a	11.91 a
BARI Alu-40	17.89	21.64 bc	10.67 ab
BARI Alu-41	15.28	21.11 bcd	9.19 bc
BARI Alu-47	14.67	17.61 de	8.19 cde
BARI Alu-48	14.50	18.17 cde	7.17 de
BARI Alu-49	15.28	17.36 e	6.83 e
BARI Alu-56	14.56	18.72 cde	9.18 bc
BARI Alu-62	14.55	19.95 bcde	9.05 bcd
BARI Alu-63	10.22	17.58 e	7.58 cde
<i>p</i> value	0.1174	0.0013	0.0009

Means followed by common letter(s) in a column do not differ significantly at 5% level by DMRT.

statistically similar to BARI Alu-40 (97.73 cm) and BARI Alu-37 (96.33cm) and the shortest one was BARI Alu-62 (58.84 cm) (Table 1).

Though, leaf number per plants ranged 10.22 - 21.11, it did not show significant differences among the varieties (Table 2). The length of leaves was different. The longest leaf was found in BARI Alu-37 (25.50 cm) followed by BARI Alu-36 (23.06 cm), BARI Alu-40 (21.64 cm), and the shortest leaf was found in BARI Alu-49 (17.36 cm). Leaf breadth of potato varieties differed statistically. Widest leaf was found in BARI Alu-37 (11.91 cm) followed by BARI Alu-40 (10.67 cm), BARI Alu-41 (9.19 cm), and the narrowest leaf was found in BARI Alu-49 (6.83 cm) preceded by BARI Alu-48 (7.17 cm) and BARI Alu-63 (7.58 cm) (Table 2).

Yield attributes of potato

Tuber number in a plot varied statistically for potato varieties (Table 3). BARI Alu-47 yielded the highest

number of tubers (777) followed by BARI Alu-37 (556.33) and BARI Alu-49 (443.33) and the least number of tubers was counted in BARI Alu-62 (290.67) (Table 3). Proportion of potato tubers also varied significantly for all three grades (grade I, grade II, and grade III). BARI Alu-63 resulted in the highest proportion (11.15%) of grade I potato tubers followed by BARI Alu-40 (7.95%), and BARI Alu-62 (7.25%), and the lowest proportion was counted in BARI Alu-47 (0.15%). In case of grade II, BARI Alu-40 shared the highest ratio (40.77%) and the lowest was found in BARI Alu-47 (11.86%). For grade III, BARI Alu-40 shared the lowest proportion (51.28%) and the highest was recorded from BARI Alu-47 (87.99%) followed by BARI Alu-56 (79.75%) and BARI Alu-40 (51.28%) (Table 3).

The yield of tubers including tuber weight per plot and graded tuber weights were different (Table 4). The maximum tuber yield was resulted in BARI Alu-40 (17.11 t ha⁻¹) followed by BARI Alu-37 (16.41 t ha⁻¹)

and BARI Alu-36 (16.20 t ha⁻¹) and the minimum from BARI Alu-48 (10.33 t ha⁻¹). The tuber yield is the reflection of tuber weight per plot and therefore, very similar results are obtained. Weights of tubers varied for

grade I, grade II, and grade III too. Under grade I category, BARI Alu-37 (29.11%) showed the best performances followed by BARI Alu-62 (19.72%), BARI Alu-40 (19.50%) and the lowest proportion was

Table 3: Variation in tuber number of different potato varieties

Variety	Number of tubers pot ⁻¹			
	Total	Grade I (%)	Grade II (%)	Grade III (%)
BARI Alu-36	414.67 cd	5.37 bcd	32.96 ab	61.67 bcd
BARI Alu-37	556.33 b	1.65 de	25.67 abc	72.68 abc
BARI Alu-40	349.33 cd	7.95 ab	40.77 a	51.28 d
BARI Alu-41	331.67 cd	1.48 de	22.44 bc	76.09 abc
BARI Alu-47	777.00 a	0.15 e	11.86 c	87.99 a
BARI Alu-48	321.00 cd	2.94 cde	19.22 bc	77.84 ab
BARI Alu-49	443.33 bc	1.63 de	20.53 bc	77.84 ab
BARI Alu-56	332.33 cd	1.67 de	18.57 bc	79.75 a
BARI Alu-62	290.67 d	7.25 abc	31.22 ab	61.53 cd
BARI Alu-63	336.67 cd	11.15 a	26.26 abc	62.59 bcd
<i>p</i> value	0.0000	0.0006	0.0432	0.0049

Means followed by common letter(s) in a column do not differ significantly at 5% level by DMRT.

Table 4: Tuber yield and weights of different potato varieties

Variety	Total yield (t ha ⁻¹)	Tuber weights			
		Weight of tuber (kg) plot ⁻¹	Weight of tuber in grade I (%)	Weight of tuber in grade II (%)	Weight of tuber in grade III (%)
BARI Alu-36	16.20 ab	11.34 ab	15.00 bc	50.58 ab	34.42 cd
BARI Alu-37	16.41 a	11.49 a	29.11 a	33.75 bcd	37.14 cd
BARI Alu-40	17.11 a	11.97 a	19.50 b	55.58 a	24.97 d
BARI Alu-41	12.88 ab	9.02 ab	3.05 d	27.91 d	69.04 a
BARI Alu-47	15.26 ab	10.68 ab	0.97 d	28.84 cd	70.19 a
BARI Alu-48	10.33 b	7.23 b	6.32 cd	33.97 bcd	59.71 ab
BARI Alu-49	12.65 ab	8.86 ab	5.59 d	37.22 a-d	57.19 ab
BARI Alu-56	10.68 b	7.47 b	7.50 cd	29.42 cd	63.08 ab
BARI Alu-62	12.76 ab	8.93 ab	19.72 b	40.89 a-d	39.39 cd
BARI Alu-63	15.65 ab	10.96 ab	6.90 cd	46.67 abc	46.43 bc
<i>p</i> value	0.0279	0.0279	0.0001	0.0549	0.0002

Means followed by common letter(s) in a column do not differ significantly at 5% level by DMRT.

found in BARI Alu-47 (0.97%). The maximum proportion for grade II tuber weight was found in BARI Alu-40 (55.58%) and the minimum (27.91%) in BARI Alu-41. BARI Alu-40 resulted in the lowest proportion of weight (24.97%) at grade III (Table 4).

Tuber attributes

Yellow appeared as the predominant tuber color (BARI Alu-37, BARI Alu-47, BARI Alu-48, BARI Alu-49, BARI Alu-62) followed by red (BARI Alu-36, BARI Alu-41, BARI Alu-56, BARI Alu-63) and only BARI Alu-40 produced cream color tuber (Table 5). Among ten potato genotypes, six had smooth skin (BARI Alu-37, BARI Alu-40, BARI Alu-41, BARI Alu-47, BARI Alu-49 and BARI Alu-62) and the rest four had uneven skin. The tuber shapes were oval (BARI Alu-36, BARI Alu-37, BARI Alu-40, Alu-62), round (BARI Alu-41,

BARI Alu-56, and BARI Alu-63), flattened round (BARI Alu-48, BARI Alu-49), and flattened oval (BARI Alu-47). Tuber shape index, dry matter content, and specific gravity differed significantly among the varieties. Though number of eyes per tuber varied statistically, eye depth did not show any differences (Table 6). The highest tuber shape index was found in BARI Alu-37 (1.49) followed by BARI Alu-62 (1.28) and BARI Alu-36 (1.25) and the lowest was found in BARI Alu-49 (1.02).

The maximum dry matter content was estimated in BARI Alu-48 (25.99) and the minimum in BARI Alu-36 (17.24). Specific gravity was recorded the highest in BARI Alu-47 (1.32) followed by BARI Alu-62 (1.19), BARI Alu-48 (1.16) and BARI Alu-63 (1.16) and the lowest in BARI Alu-49 (1.12). The highest number of eyes was recorded in BARI Alu-56 (9.47) followed by

BARI Alu-37 (8.89) and BARI Alu-36 (7.83) and the lowest in BARI Alu-49 (5.67).

Decay of tubers

The disease incidence, number (%) and weight (%) of infected tubers showed differences statistically (Table 7). Minimum disease infestation was observed in case of BARI Alu-40 (23.81%) which was statistically similar to

Table 5: Variation in different external quality parameters of tuber of different potato varieties

Variety	Color of Tubers	Skin type of Tubers	Tuber shape
BARI Alu-36	Red	Uneven	Oval
BARI Alu-37	Yellow	Smooth	Oval
BARI Alu-40	Creamy	Smooth	Oval
BARI Alu-41	Red	Smooth	Round
BARI Alu-47	Yellow	Smooth	Flatted oval
BARI Alu-48	Yellow	Uneven	Flatted round
BARI Alu-49	Yellow	Smooth	Flatted round
BARI Alu-56	Red	Uneven	Round
BARI Alu-62	Yellow	Smooth	Oval
BARI Alu-63	Red	Uneven	Round

Table 6: Variation in quality attributes of potato tubers

Variety	Tuber Index	Shape	Dry matter content of Tubers (%)	Specific Gravity of Tubers	No. of tuber ⁻¹	eyes	Depth of eyes (mm)
BARI Alu-36	1.25 b		17.24 e	1.15 b	7.83 bc		2.00
BARI Alu-37	1.49 a		18.01 e	1.15 b	8.89 ab		2.50
BARI Alu-40	1.22 b		21.65 cd	1.14 b	5.89 de		2.17
BARI Alu-41	1.09 c		21.43 d	1.14 b	7.06 cd		2.33
BARI Alu-47	1.24 b		24.46 ab	1.32 a	7.14 cd		1.50
BARI Alu-48	1.03 c		25.99 a	1.16 b	6.61 cde		2.83
BARI Alu-49	1.02 c		23.31 bc	1.12 b	5.67 e		2.33
BARI Alu-56	1.08 c		21.11 d	1.16 b	9.47 a		2.83
BARI Alu-62	1.28 b		23.30 bc	1.19 b	7.50 c		1.83
BARI Alu-63	1.08 c		18.83 e	1.16 b	7.50 c		4.00
<i>p</i> value	0.00		0.00	0.0029	0.0002		0.2163

Means followed by common letter(s) in a column do not differ significantly at 5% level by DMRT.

Table 7: Decay attributes of potato tubers as affected by varieties

Variety	Disease Incidence (%)	No. of infected tubers (%)	Weight of infected tubers (%)
BARI Alu-36	58.89 abc	4.73 b	3.85 b
BARI Alu-37	88.23 a	9.48 b	7.85 b
BARI Alu-40	23.81 c	3.26 b	2.40 b
BARI Alu-41	91.14 a	6.62 b	6.18 b
BARI Alu-47	53.01 abc	1.68 b	2.58 b
BARI Alu-48	91.28 a	3.90 b	4.55 b
BARI Alu-49	24.49 c	2.88 b	4.31 b
BARI Alu-56	81.87 ab	2.70 b	2.46 b
BARI Alu-62	32.87 c	3.95 b	6.23 b
BARI Alu-63	46.14 bc	43.74 a	23.20 a
<i>p</i> value	0.005	0.0000	0.0001

Means followed by common letter(s) in a column do not differ significantly at 5% level by DMRT.

BARI Alu-49 (24.49%) and BARI Alu-62 (32.87%) and the maximum infected tubers were found in BARI Alu-48 (91.28%). Maximum infected tuber was found in BARI Alu-63 (43.74%) and the minimum in BARI Alu-47 (1.68%). The highest proportion of infected tuber weight was found in BARI Alu-63 (23.20%) and the lowest from BARI Alu-40 (2.40%).

Discussion

Growth attributes of potato varieties

Potato growth attributes varied widely in this study. Variation in sprouting time are due to genetical background and for environmental factors (Mani et al., 2015; Belay et al. 2022) and differences in number of sprouts are due to tuber size, varietal differences, apical dominance, and GA level (Belay et al., 2022; Hampson, 1991; Mishra et al., 2019; Otrushy and Struik, 2010). Similar to present study, no statistical variation in number of plants per plot was found by Eaton et al. (2017). However, Islam et al. (2017) reported variations in plant number which is due to differences in varieties, seed physiology, health status, weather and soil conditions (Haverkort, 2018). Variations in plant height are also found by the other authors (Ahmad et al., 2005; Eaton et al., 2017; Giri et al., 2023; Hossain, 1981; Jafar et al., 2020; Thapa et al., 2022). Plant height of potato relies on genetic makeup, growing environment and crop management practices (Rahman et al, 2021). As the growing condition and crop production practices were similar in the current study, differences in plant height can be explained with the inherent varietal differences. The genetic makeup of BARI Alu-36, BARI Alu-40 and BARI Alu-37 may have favored more uptake of water and nutrients from the soil resulting in better photosynthesis leading to vigorous taller plants.

Leaf number varied among potato genotypes due to different genetic background along with availability of soil moisture and nitrogen and their interactions (Ahmad et al., 2005; Fender et al., 2011; Mishra et al., 2019; Tessema et al., 2020). The variations in potato leaf length can be interpreted through the differences in hereditary attributes, environment and planting material qualities (Mishra et al., 2019) and variations leaf breadth are due to varietal differences (Mishra et al., 2019).

Yield attributes of potato

Potato tuber number in a plot are the results of available stem number, total stolon number and the number of stolons producing tubers (Gebreselassie et al., 2016; Subarta and Upadhyya, 1997) and it differed due to heredity and environment (Ahmad et al., 2005; Khan et al., 2019). In fact, genetical background of plant along with the existing environment determine the processes of stolon development and tuberization. Moreover, number of tubers per hill is mostly varietal attributes and depends on environment and production practices (Islam et al., 2017). The potato genotypes varied in production ability because of variations in genotypes, environment, and their interactions. As the potatoes were grown in the same field in this study, the yield differences are mainly due to varietal attributes (Asmamawu, 2007; Elfresh et al., 2011; Gebreselassie et al., 2016; Giri et al., 2023; Thapa et al., 2022). The higher yields of BARI Alu-40 and BARI Alu-37 are probably due to higher number of leaves that helping in photosynthesis and thus yield

attributes (Alam et al., 2020; Islam et al., 2017). Among the produced potatoes, the differences tuber grades are mainly due to hereditary characteristics (Eaton et al., 2017).

Tuber characteristics

Differences of tuber colors are also reported in other studies which depends on number of genetic factors (Akhter et al., 1994; Alam et al., 2003; Khan et al., 2019; Rahman et al., 2021). The difference in skin type among the varieties might be linked to heredity attributes (Rahman et al., 2017). However, another study reported all genotypes with smooth skin (Arifa et al., 2018). Varietal effect on the shape of tuber is also reported (Khan et al., 2019; Rahman et al., 2021; Shrestha et al., 2020). Difference in tuber shape index are also claimed which depends on genotypes as the length and width of the potato tubers depends on their genetic constitution (Akhter et al., 1994; Alam et al., 2003; Bubeníková and Simeonovová, 2011; Rahman et al. 2021).

In the present study, the dry matter content varies between 17.24% and 25.99% whereas, another study reported that the dry matter content of potato tuber can vary from 14.67% to 23.73% (Rahman et al., 2021). These variations might be due to differences in genetic makeup and growing environment along with their interactions (Abebe et al. 2012; Arslanović-Lukač et al. 2021; Mondal and Hosain, 2006; Tessema et al., 2020). Differences in specific gravity are attributed by the diameter and mass of potatoes linked with genetical and environmental factors (Abbas et al., 2011; Rahman et al., 2017; Tai and Coleman, 1999; Tessema et al., 2020). Varietal differences in case of number of eyes of tubers are reported which might be due to genotypic differences (Khan et al., 2019; Rahman et al., 2017). Though no differences in depth of eyes were reported in the present study, other studies found varietal effect on depth of eyes (Rahman et al., 2017; Shrestha et al. 2020).

Decay of tubers

Decay in tubers including diseases incidence and number and weight percentages of tubers differed in this study. Differences in disease incidence among the potato varieties are mainly due to genetic makeup (Bittara et al., 2016; Eaton et al., 2017; Jafar et al., 2020) and the less infected tubers are late blight resistant varieties. On the other hand, the susceptible varieties get more disease infestation in Bangladesh condition (Jafar et al., 2020).

Conclusion

After performance evaluation of the ten selected potato varieties, no single variety was found to be superior regarding most of the growth and yield attributes. However, BARI Alu-40 resulted the highest yield and maximum premium quality (grade I and grade II) tuber yield along with low disease incidence. The growth and yield performances of BARI Alu-37 was close to BARI Alu-40. Therefore, BARI Alu-40 and BARI Alu-37 may be selected for obtaining better yield in coastal Khulna. However, further research is required with other potato varieties where the present study could serve as a reference to select the most suitable potato variety for the region.

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Competing Interest

The authors report that there are no competing interests to declare.

Credit Author Statement

Hira Moni: Methodology, setting up of experiment, data collection, data analysis, Writing – preliminary manuscript Md. Abdul Mannan: Supervision, conceptualization, analysis fund acquisition; Md. Yamin Kabir: Co-supervision, Writing – original draft, review & editing.

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Appendices

Appendix I. Analysis of variance for the Varietal effect of potato on sprouting, plant number, plant height and leaf characteristics

Source of variance	Degrees of freedom	Mean Sum of Square (MS)						
		Time of sprouting (days)	No. of sprout plot ¹	Number of plants plot ¹	Height of plant (cm)	No. of Leaves plant ⁻¹	Length of leaves (cm)	Breadth of leaves (cm)
Replication	2	5.43	43.43	9043.39	589.19	30.55	43.08	2.76
Factor (Variety)	A 9	22.00	47.51	4850.78	736.77	24.49	22.33	7.35
Error	18	4.21	22.69	3693.09	194.44	12.87	4.18	1.29
P value		0.0014	0.0335	0.2965	0.0078	0.1174	0.0013	0.0009
F value		5.22	5.35	1.31	3.79	1.90	5.34	5.66

Appendix II. Analysis of variance of Number of Tuber Plot⁻¹ and yield of tuber (t h⁻¹) of ten potato varieties

Source of variance	Degrees of freedom	Mean Sum of Square (MS)							
		Number of Tuber Plot ⁻¹				yield of tuber (t h ⁻¹)			
		Total	G1 (%)	G2 (%)	G3 (%)	Total yield (t ha ⁻¹)	weight of tuber in grade1 (%)	weight of tuber in grade 2 (%)	weight of tuber in grade 3 (%)
Replication	2	13158.7	49.68	1124.2	1610.8	11.53	276.84	1090.75	2196.96
Factor (Variety)	A 9	67910.5	39.26	208.90	374.51	8.77	244.64	280.90	748.95
Error	18	6686.1	6.50	81.80	90.12	6.48	29.14	118.41	99.99
P value		0.0000	0.001	0.0432	0.0049	0.027	0.0001	0.0549	0.0002
F value		10.16	6.04	2.55	4.16	3.35	8.40	2.37	7.49

Appendix III. Analysis of variance for tuber shape index, no. of eyes tuber⁻¹, depth of eyes (mm), dry matter contents of tubers, specific gravity of tubers, disease incidence (%), no. and weight (%) of infested tubers of ten potato varieties

Source of variance	Degrees of freedom	Mean Sum of Square (MS)							
		Tuber Shape index	No. of Eyes tuber ⁻¹	Depth of Eyes (mm)	Dry matter content of tubers	Specific gravity of tubers	Disease Incidence (%)	No. of Infested Tubers (%)	Weight of Infested Tubers (%)
Replication	2	0.01	1.62	0.76	0.0858	2.252	1465.24	19.13	11.35
Factor (Variety)	A 9	0.06	4.26	1.43	24.3440	9.302	2255.09	480.51	114.88
Error	18	0.004	0.59	0.94	6.9523	2.021	544.20	33.04	14.56
P value		0.0000	0.0002	0.2163	0.0000	0.0029	0.005	0.0000	0.0001
F value		14.55	7.14	1.52	25.56	4.60	4.14	14.55	7.89