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Original Research Article

Yield performance and growth variability of elephant foot yam (*Amorphophallus paeoniifolius* L.) genotypes under coastal saline conditions of Bangladesh

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ABSTRACT

A field experiments was conducted at a field in Kharnia, Dumuria upazilla of Khulna district in Bangladesh to evaluate elephant foot yam (*Amorphophallus paeoniifolius* L.) genotypes on the basis of their growth and yield characteristics. Ten elephant foot yam genotypes *viz.* Kolkata, BAU-1, Satkhira Bagha, Jashore Local, Chuadanga, Madrasi, Bandarban Ruma, Satkhira Local, Sahebi Lomba and BAU-2 was taken in a randomized block design with three replications. Data were recorded on different growth parameters and yield. The growth and yield components of elephant foot yam varied significantly ($p<0.05$) among the varieties except number of plants per plot. Results revealed that less time was required for sprouting (23.00 day) in Bandarban Ruma genotype of elephant foot yam. The highest number of sprouting (16.00) was found in BAU-2. The highest plant height (158.33 cm) was recorded in Madrasi genotype. The maximum number of leaf was recorded (49.66) in Jashore Local genotype. The maximum corm length was observed in Sahebi Lomba (22.40 cm) and corm breadth in Madrasi (24.33 cm) genotypes. The highest corm yield was recorded from Madrasi (40.13 ton/ha). The maximum number of cormels were found in Bandarban Ruma (10.33) and cormel yield was also found the highest in Bandarban Ruma (2.66 ton/ha) genotypes of elephant foot yam. Therefore, it could be concluded that among different genotypes, Madrasi genotype produced highest yield and Madrasi genotype of elephant foot yam may be selected for commercial cultivation in Khulna region of Bangladesh.

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INTRODUCTION

Elephant foot yam (*Amorphophallus paeoniifolius* L.), commonly known as 'Olkachu' in Bangladesh, is a perennial herbaceous tuber crop belonging to the family Araceae. It is a diploid species with chromosome numbers of 2n = 2× = 26 or 28 (Nedunchezhiyan *et al.*, 2017; Abraham *et al.*, 2021). The crop adapts well to various soil types but performs best in well-drained sandy loam to sandy clay loam soils with near-neutral pH (Mukherjee *et al.*, 2020). It is a rich source of carbohydrates, starch, proteins, dietary fiber, and essential minerals (Nedunchezhiyan *et al.*, 2002; Kamalkumaran *et al.*, 2020), making it an important food crop. In addition to its use as a fresh vegetable in Indian, Chinese, and Japanese cuisines, it is used for value-added products such as pickles, dried cubes, chips, flour, and thickening agents (Bansode *et al.*, 2019). The crop also possesses significant therapeutic properties, including gastro protective, antioxidative, antidiarrheal, and anti-inflammatory activities (Kamalkumaran *et al.*, 2020). According to the Bangladesh Bureau of Statistics (BBS, 2025), elephant foot yam production in Bangladesh reached 16,203 metric tons from 2,199 acres during 2023–24, with an average yield of 35–45 t ha^{-1}. This productivity is much lower than the 50–80 t ha^{-1} commonly achieved in India. Originating in Southeast Asia, the crop has wide distribution across tropical and subtropical regions. India is the leading producer and major research hub for this crop in South Asia. Numerous studies have been conducted on character association for yield (Zala *et al.*, 2021), nutrient management (Laxminarayana, 2021), genetic transformation (Abraham *et al.*, 2021), genetic diversity using morphological and ISSR markers (Kandekar *et al.*, 2021), and starch properties, phytochemical profiling, and anti-hyperglycemic effects (Rahman & Hajong, 2022; Utomo & Ginting, 2021).

In the face of increasing population pressure and depletion of natural resources, diversification of cropping systems with high-value, resilient crops like elephant foot yam has become essential for food and nutritional security (Suja *et al.*, 2012). The crop holds substantial export potential as it is not yet widely cultivated commercially in many countries (Misra *et al.*, 2016). It offers excellent scope as a cash crop in tropical and subtropical regions due to its high yield potential, popularity as a vegetable, good keeping quality, culinary versatility, and medicinal value (Chattopadhyay & Nath, 2007). Often referred to as the "King of tuber crops" because of its high profitability (Suja *et al.*, 2012), elephant foot yam forms an integral part of daily diets in many Asian countries. Elephant foot yam produces significantly larger tubers compared to other yam species. Key yield attributes include tuber size and weight, number of tubers per plant, and quality parameters such as shape uniformity, texture, and palatability (Jaganathan *et al.*, 2021; Singh *et al.*, 2016). Although considerable research has been carried out globally, very limited studies have been conducted on its growth and yield performance under Bangladeshi conditions, particularly in the Khulna region of southern Bangladesh. Therefore, the present study was undertaken to evaluate the comparative performance of different elephant foot yam genotypes for growth and yield attributes in southern Bangladesh.

MATERIALS AND METHODS

Experimental site and soil

The experiment was conducted at a leased farmer's field in Kharnia Union, Dumuria Upazila, Khulna, Bangladesh, located in Agroecological Zone (AEZ-13). The site is situated at 22°49' N latitude and 89°21' E longitude with an altitude of approximately 1 m above sea level. The soil is clay loam in texture with low organic matter (1.12%), moderately slow permeability, and deficient in nitrogen, potassium, and sulphur. The soil pH ranged from 6.5 to 8.5, indicating slightly saline conditions.

Experimental design and plant material

The study was laid out in a Randomized Complete Block Design (RCBD) with three replications. Ten locally available elephant foot yam genotypes were evaluated: BAU-1, BAU-2, Satkhira (Bagha), Kolkata, Jashore (Local), Chuadanga, Madrasi, Bandarban Ruma, Satkhira (Local), and Sahebi (Lomba). Healthy corms weighing 300–400 g were collected from different districts of Bangladesh and used as planting material.

Land preparation and crop management

The land was prepared 15 days before planting by ploughing with a power tiller followed by laddering. Plot size was 4 m × 4 m. Recommended fertilizers were applied during final land preparation at the rate of: well-decomposed cow dung 5 t ha^{-1}, TSP 150 kg ha^{-1}, MoP 200 kg ha^{-1}, Gypsum 70 kg ha^{-1}, and Boron 10 kg ha^{-1}. Corms were treated with Autostin (3 g L^{-1}) and Nitro 505 EC (2 mL L^{-1}) before planting. Planting was done on 10 March 2024 at a spacing of 1 m × 1 m. Weeding was performed six times during the growing season. Soil mulching was done to conserve moisture and improve aeration. The field was irrigated four times at regular intervals to maintain adequate soil moisture.

Data collection

Five competitive plants were randomly selected from each plot for data recording, excluding border rows and extreme plants. Observations were recorded on the following parameters: days to sprouting, number of sprouts per plot, number of plants per plot, plant height (cm), number of leaves per plant, corm length (cm), corm breadth (cm), corm weight per plant (kg), corm yield (t ha^{-1}), number of cormels per plant, cormel length (cm), cormel breadth (cm), cormel weight per plant (kg), and cormel yield (t ha^{-1}).

Statistical analysis

Collected data were statistically analyzed using R software (version 3.5.1). Treatment means were separated using Least Significant Difference (LSD) test at 5% level of significance.

RESULTS AND DISCUSSION

Growth attributes of elephant foot yam varieties

Days to first sprouting

Significant variation was observed among the elephant foot yam genotypes in days to first sprouting (Table 1). Bandarban Ruma required the shortest time for first sprouting (23.00 days), followed by Madrasi (24.33 days) and BAU-2 (24.66 days), whereas Kolkata, Satkhira Bagha, and Jashore Local required the longest time (26.33 days). The variation in sprouting behavior among genotypes might be attributed to genetic differences and environmental influences. Similar findings were reported by Santosa *et al.* (2006).

Days to complete sprouting

Days to complete sprouting varied significantly among the genotypes (Table 1). Jashore Local required the longest time for complete sprouting (37.66 days), followed by Satkhira Local and Sahebi Lomba (35.33 days), whereas Bandarban Ruma completed sprouting in the shortest time (32.00 days), closely followed by Madrasi (32.33 days). Similar varietal differences in sprouting characteristics were also reported by Das *et al.* (1997).

Number of sprouts plot^{-1}

The number of sprouts plot^{-1} did not differ significantly among the genotypes (Table 1). However, numerically the highest number of sprouts was recorded in BAU-2 (16.00), followed by Jashore Local (15.33), whereas Bandarban Ruma produced the lowest number of sprouts (13.66). The remaining genotypes showed statistically similar results for sprout number.

Plant height (cm)

Significant variation in plant height was observed among the genotypes at different growth stages (Figure 1). Madrasi consistently produced the tallest plants from 30 to 110 DAS, reaching the maximum height at 110 DAS (158.33 cm), followed by Bandarban Ruma (140.67 cm) and BAU-2 (137.00 cm). In contrast, Kolkata showed the shortest plant height throughout the growth period, recording 103.00 cm at 110 DAS. The differences in plant height among the genotypes might be attributed to their genetic variability and growth potential. Similar results were also reported by Rahman & Hajong (2022), Hossain *et al.* (2014) and Mukherjee *et al.* (2020).

Table 1. Effect of genotypes on sprouting behavior and number of sprouts plot^{-1} of elephant foot yam.

Genotypes	Days to 1st sprouting	Days to sprout complete	Number of sprouts's per plot
Kolkata	26.33a	34.33bcd	14.00
BAU-1	25.33abc	35.00abc	14.33
Satkhira Bagha	26.33a	34.33bcd	15.00
Jashore Local	26.33a	37.66a	15.33
Chuadanga	25.66ab	33.00bcd	14.66
Madrasi	24.33c	32.33cd	14.33
Bandarban Ruma	23.00d	32.00d	13.66
Satkhira Local	25.33abc	35.33ab	14.66
Sahebi Lomba	25.66ab	35.33ab	15.00
BAU-2	24.66bc	32.66bcd	16.00
Level of significant	**	*	NS
CV	2.92	4.70	7.79

Note: In a column figure having similar letters do not differ significantly whereas figure having dissimilar letter differ significantly as per DMRT. Data are means of three replications. In a column **= significant at p≤0.01 and *= significant at p≤0.05. NS= Non-significant and CV=Co-efficient of variation.

Number of leaves plant^{-1}

Significant variation in the number of leaves plant^{-1} was observed among the elephant foot yam genotypes at different growth stages (Table 2). Jashore Local consistently produced the highest number of leaves from 50 to 110 DAS, reaching the maximum value at 110 DAS (49.66), followed by BAU-1. In contrast, Madrasi and Bandarban Ruma produced comparatively fewer leaves throughout the growth period. The variation in leaf number among the genotypes might be associated with genetic variability and growth behavior. Similar results were also reported by Singh & Singh (2019), Das *et al.* (1997), and Santosa *et al.* (2006).

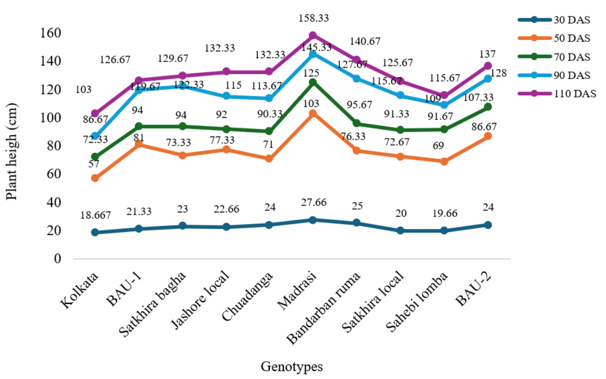

Figure 1. *Plant height of different genotypes at different days after sowing (DAS).*

Table 2. Number of leaves plant^{-1} of elephant foot yam genotypes at different days after sowing (DAS).

Variety	No. of leaves plant^{-1}			
	50DAS	70DAS	90DAS	110DAS
Kolkata	26.66b	33.66de	39.33bc	38.33b
BAU-1	39.00a	42.66ab	39.66bc	39.66b
Satkhira bagha	32.00ab	35.00cde	37.00cd	38.00b
Jashore local	39.66a	44.66a	47.00a	49.66a
Chuadanga	33.00ab	35.00cde	37.33cd	38.33b
Madrasi	28.33b	29.33e	31.00e	31.33d
Bandarban ruma	27.33b	32.00de	33.66de	32.33cd
Satkhira local	37.00a	38.00bcd	38.66bc	37.33bc
Sahebi lomba	33.00ab	40.33abc	44.33ab	39.66b
BAU-2	38.33a	41.33ab	41.33bc	38.00b
Level of significance	*	**	**	**
CV	14.21	9.49	7.34	7.83

Note: In a column figure having similar letters do not differ significantly whereas figure having dissimilar letter differ significantly as per DMRT. Data are means of three replications. In a column **= significant at p≤0.01 and *= significant at p≤0.05. CV=Co-efficient of variation.

Yield attributes of elephant foot yam varieties

Length and breadth of corms

Corm length differed significantly among varieties (Table 3). The longest corms were observed in Sahebi lomba (22.40 cm) and Madrasi (21.40 cm), followed by Satkhira local (18.40 cm). Intermediate values were recorded in Satkhira bagha (14.46 cm), Chuadanga (14.40 cm), Jessore local (14.20 cm), Bandarban ruma (13.93 cm), BAU-2 (13.60 cm), BAU-1 (13.13 cm), while Kolkata showed the shortest corms (10.66 cm). Similar trends were previously reported by Das *et al.* (1997) and Hossain *et al.* (2014), where corm length ranged from about 11–14 cm across genotypes. Ravi *et al.* (2011) also reported comparable variation, suggesting that genotypic differences and favorable growth conditions may enhance corm development through reduced competition and improved assimilate allocation. The breadth of corm varied significantly among the tested varieties (Table 3). The widest corm was recorded in Madrasi (24.33 cm), followed by Chuadanga (19.66 cm) and Satkhira bagha (19.60 cm), while the narrowest was observed in Kolkata (13.00 cm) and Sahebi lomba (13.33 cm). Planting material size significantly influenced corm diameter. Similar variation was reported by Hossain *et al.* (2014), where corm breadth ranged from 14.62–16.03 cm in elephant foot yam genotypes. Comparable significant effects were also observed by Das *et al.* (1997) and Nath *et al.* (2007), who reported a wider range of 17.2–28.02 cm. Large seed corms likely enhanced corm diameter due to greater assimilate accumulation (Laxminarayana, 2021). Wider spacing also improves airflow and light penetration, promoting corm development (Hathan, 2016; Singh *et al.*, 2016).

Corm weight (kg plant^{-1})

The weight of corm per plant showed highly significant variation among varieties (Table 3). The highest corm weight was recorded in Madrasi (4.01 kg), followed by Satkhira local (2.41 kg) and Satkhira bagha (2.40 kg). Jashore local (2.30 kg), Bandarban ruma (2.30 kg), BAU-2 (2.39 kg), BAU-1 (2.23 kg), and Chuadanga (2.18 kg) showed intermediate values. The lowest corm weight was observed in Kolkata (1.08 kg), followed by Sahebi lomba (1.93 kg). Comparable trends were reported by Singh *et al.* (2016), who observed corm yield ranging from 1.05–2.26 kg across elephant foot yam genotypes. Similar findings were also reported by Hossain *et al.* (2014). Enhanced corm weight with larger planting materials was reported by Kumar *et al.* (2023) and Sahoo *et al.* (2015) attributed higher corm yield to wider spacing due to reduced inter-plant competition for light, nutrients, and water.

Corm yield of different genotypes (t ha^{-1})

Corm yield varied significantly among the genotypes (Table 3). The highest yield was recorded in Madrasi (40.13 t ha^{-1}), followed by Satkhira Bagha (24.13 t ha^{-1}). Intermediate yields were observed in Jashore Local (23.00 t ha^{-1}) and Bandarban Ruma (23.00 t ha^{-1}), while Sahebi Lomba produced 19.33 t ha^{-1}. The lowest yield was found in Kolkata (10.83 t ha^{-1}). These variations are attributed to genetic potential and genotype × environment interaction (Salam *et al.*, 2016). Similar yield ranges in *Amorphophallus* have been reported between 19.23–25.92 t ha^{-1} (Nath *et al.*, 2007) and 20.14–31.44 t ha^{-1} (Salam *et al.*, 2016), supporting the present findings.

Number of cormels plant^{-1}

Significant variation was observed among varieties for number of cormels per plant (Table 4). Bandarban Ruma produced the highest number (10.33), followed by Kolkata (5.33), while the lowest values (3.33) were recorded in BAU-2, Madrasi, and Satkhira Bagha. Sahebi Lomba (3.66) and BAU-1 (3.66) were statistically similar. The variation is consistent with Sankaran *et al.* (2011), who reported 5–15 cormels plant^{-1} depending on management and environment. Improved spacing and crop management enhance cormel formation through better growth conditions (Chakraborty *et al.*, 2015; Singh *et al.*, 2016).

Length and breadth of cormel (cm)

Cormel length differed significantly among genotypes (Table 4). The highest length (5.40 cm) was recorded in Bandarban Ruma and Kolkata, while the lowest (4.13 cm) was in Madrasi. Wider spacing and better resource availability promote longer cormels, as also reported by Singh *et al.* (2016) and Prathap *et al.* (2017), due to reduced competition and higher nutrient allocation. Significant variation was observed in cormel breadth (Table 4). The widest cormels (3.33 cm) were found in Kolkata, Bandarban Ruma, and Satkhira Local, while the narrowest (2.66 cm) occurred in Sahebi Lomba. Wider spacing enhances cormel development by reducing inter-plant competition (Singh & Singh, 2019; Meena *et al.*, 2017).

Weight and yield of cormels plant^{-1}

Cormel weight differed significantly among varieties (Table 4). Bandarban Ruma recorded the highest weight (0.26 kg plant^{-1}), followed by Jashore Local (0.18 kg), while Madrasi showed the lowest (0.10 kg). Larger seed corms and wider spacing significantly increased cormel weight, consistent with Sankaran *et al.* (2011), Singh & Singh (2019) and Jaganathan *et al.* (2021), due to higher assimilate availability and reduced competition. Similarly, cormel yield varied significantly among varieties (Table 4). The highest yield was obtained from Bandarban Ruma (2.66 t ha^{-1}), followed by Jashore Local (1.87 t ha^{-1}), while the lowest was in Madrasi (1.04 t ha^{-1}). Yield differences were associated with corm size and plant population effects, as also reported by Singh *et al.* (2016), and Salam *et al.* (2016). Higher plant density increases yield per unit area despite reduced individual plant performance.

Table 3. Varietal effect on corm length, breadth and weight of elephant foot yam genotypes.

Variety	Corm length (cm)	Corm breadth (cm)	Corm weight plant^{-1} (kg)	Corm yield (t ha^{-1})
Kolkata	10.66d	13.00c	1.08d	10.83g
BAU-1	13.13c	18.16bc	2.23bc	22.33d
Satkhira bagha	14.46c	19.60b	2.40b	24.00b
Jashore local	14.20c	19.40b	2.30b	23.00c
Chuadanga	14.40c	19.66b	2.18bc	21.80e
Madrasi	21.40a	24.33a	4.01a	40.13a
Bandarban ruma	13.93c	16.80cd	2.30b	23.00c
Satkhira local	18.40b	15.26d	2.41b	24.13b
Sahebi lomba	22.40a	13.33c	1.93c	19.33f
BAU-2	13.60d	17.66c	2.39b	23.93c
Level of significance	**	**	**	**
CV	5.85	5.69	8.43	10.21

Note: In a column figure having similar letters do not differ significantly whereas figure having dissimilar letter differ significantly as per DMRT. Data are means of three replications. In a column **= significant at $p \leq 0.01$ and CV=Co-efficient of variation.

Table 4. Varietal effect on cormels number, length, breadth, weight and yield of elephant foot yam genotypes.

Variety	No of cormels plant^{-1}	Cormel length (cm)	Cormel breadth (cm)	Cormel weight plant^{-1} (kg)	Cormel yield (t ha^{-1})
Kolkata	5.33b	5.40a	3.33a	0.15bc	1.58bc
BAU-1	3.66cd	4.40bc	2.86bc	0.13cd	1.39cd
Satkhira bagha	3.33d	5.06ab	3.26ab	0.13cd	1.35cd
Jashore local	4.33bcd	4.66abc	3.06abc	0.18b	1.87b
Chuadanga	4.66bc	4.86abc	2.93abc	0.18b	1.85b
Madrasi	3.33d	4.13c	3.06abc	0.10e	1.04e
Bandarban ruma	10.33a	5.04a	3.33a	0.26a	2.66a
Satkhira local	4.00cd	5.00ab	3.33a	0.14c	1.49c
Sahebi lomba	3.66cd	4.73abc	2.66c	0.11de	1.11de
BAU-2	3.33d	4.46bc	3.20ab	0.13cde	1.32cde
Level of significa-nce	**	*	*	**	**
CV	13.45	8.99	7.58	11.03	11.03

Note: In a column figure having similar letters do not differ significantly whereas figure having dissimilar letter differ significantly as per DMRT. Data are means of three replications. In a column **= significant at p$\leq$0.01 and *= significant at p$\leq$0.05. CV=Co-efficient of variation.

Conclusion

This study concluded that, out of the 10 elephant foot yam varieties, no single variety was found to be superior in case of all quality parameters. However, Madrasi variety gave highest yield ascertaining maximum marketable corm yield in case of weight of corms and height of plants. In case of other attributes, Bandarban Ruma and BAU-2 of elephant foot yam also showed moderately congenial result. Consequently, considering the yield and marketable size of corm Madrasi variety of elephant foot yam may be selected for cultivating in Khulna region.

DECLARATIONS

Author contribution statement: Conceptualization: F.A.N., S.L.H. and S.L.H.; Methodology: F.A.N., N.P., S.R.H., S.L.H.; Software and validation: F.A.N. and N.P.; Formal analysis and investigation: S.R.H.; Resources: X S.L.H.; Data curation: N.P.; Writing—original draft preparation: N.P. and S.R.H.; Writing—review and editing: F.A.N. and S.L.H.; Visualization: F.A.N.; Supervision: S.L.H.; Project administration: S.L.H.; Funding acquisition: F.A.N. All authors have read and agreed to the published version of the manuscript.

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