Effect of planting material on the growth and yield of elephant foot yam (*Amorphophallus campanulatus* Bl.)

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Abstract: The present experiment was carried out to investigate the effect of planting material on the growth and yield of elephant foot yam at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh during the period from April to August, 2012. Four types of planting materials viz. large corm (250±1g), small corm (100±1g), large cormel (35±1g) and small cormel (20±1g) were taken into consideration for the investigation. The experiment was laid out in Randomized Complete Block Design (RCBD) with 3 replications. The minimum time required for emergence of plant (27.35 days) with the highest plant height (71.70cm), number of side shoots (6.00), length of leaf blade (51.29cm), length (49.73cm) and diameter (3.80cm) of pseudostem, fresh (791.68gm) and dry (81.08gm) weights of leaves, length (13.59cm) and diameter (16.03cm) of corm, fresh weights of corm (1254.4gm),yields per plot (24.93kg) as well as yield per hectare (41.56t/ha) were observed in planting large corm (250±1g) while small cormel (20±1g) required the highest time for emergence of plant (31.88 days) with the lowest plant height (37.73cm), number of side shoots(2.18), length of leaf blade (29.46cm), length (25.28cm) and diameter (1.60cm) of pseudostem, fresh (146.46gm) and dry (11.72gm) weights of leaves, length (6.50cm) and diameter (6.44cm) of corm, fresh weights of corm (139.26gm), yields per plot (2.86kg) and per hectare (4.77t/ha). Considering these parameters the large sized seed corm (250±1g) appeared to be recommendable.
Key words: Elephant foot yam, growth and yield.

Introduction

Elephant foot yam (*Amorphophallus campanulatus* Bl.) a member of the family Araceae is herbaceous, perennial crop. It is basically a crop of south eastern Asian origin. It serves as a source of starch as well as protein. It is rich in carbohydrates, minerals and vitamin A and vitamin B. It has long been used as a local staple food in many countries such as the Philippines, Java, Indonesia, Sumatra, Malaysia, Bangladesh, India, China and south eastern Asian countries (Chandra, 1984; Sugiyama and Santosa, 2008). It is commonly known as Ol Kachu in Bangladesh. Local cultivars grown are generally being used for making vegetable pickles and medicine preparations for various ailments.

Elephant foot yam belongs to one of the high yielding tuber crops with medicinal properties. *A. campanulatus* is a perennial herb with rounded tuberous root stock (corm) that is widely distributed in Bangladesh, India, and Africa. The plants are used traditionally for the treatment of piles, abdominal pain, tumors, and enlargement of the spleen, asthma, and rheumatism. The tuberous roots of the plant also have tonic, stomachic and appetizer properties with antibacterial,

Amorphophallus campanulatus tuber has a carbohydrate content of about 18%, protein between 1-5% and fat up to 2%. The tuber contains higher quantities of fat than other aroids and the vitamin A content is also quite high. The starch content in *A. campanulatus* varies between 4-12%. It contains sufficient quantity of glucomannan, a hemicelluloses made up of glucose and mannose unit. Leaves of *Amorphophallus* contain 2-3% crude fibre. The tubers and leaves contain large amounts of oxalate and they are quite acrid and require a long time of cooking before consumption. The starch grains of *Amorphophallus* vary in size from 5.5-18.7µm and they have different shapes (Gosh et al., 1988).

As a food crop it compares favourably in nutritional value with other root crops such as cassava, yam, sweet potato and other edible aroids (Plucknett *et al.,* 1970) having 24.54% carbohydrates (Rashid and Daunicht, 1979). In Bangladesh, supplies of vegetables are plentiful in winter but during the Kharif season specially in the late period its availability becomes very limited. Aroids occupy an important position as vegetable in the scarce period of this Kharif season (Basak and Maleque, 1992).

Elephant foot yam plants grow well in medium to light soils (coarse-textured sandy soils) with adequate amounts of organic matter because they prefer well-aerated soils. The crop can tolerate temporary flooding, but anaerobic water logging causes corm rot (Dhua *et al.,* 1988).

Our fanners grow this crop according to their own choice due to the absence of standard production techniques. The general tendency is to select large seed corm or cormels with close or wide spacing. It is well documented that seed size and plant spacing have significant influence on the growth and yield of different crops (Mannan and Rashid, 1983).

For the economic use of seed corm and cormel it is necessary to determine its optimum size for planting and consequently getting higher yield of crop. It was reported that positive response on the yield was obtained due to use of larger seed of taro (Enyi, 1972) in Bangladesh the optimum size of planting material have not yet been standardized for elephant foot yam and, therefore, the study was taken to observed the effect of planting material on the growth and yield of elephant foot yam.

Materials and Methods

The research work was carried out at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh during the kharif season of 2012, which is situated at 24.6°N latitude and 90.5°E longitude (Edris *et al*., 1979) with a view to study the effect of planting materials on the growth and yield of Elephant foot yam. The soil of the experimental area was silty loam in texture belonging to the Old Brahmaputra Flood Plain of AEZ 9 (UNDP, 1988) having non-calcareous Dark Grey Flood Plain soil (FAO, 1988). The selected plot of the land was medium high land. It was fertile and well drained and slightly acidic with the pH varying from 5.5 to 6.8. The experimental area is situated under the sub-tropical monsoon climate, which is characterized by high temperature and heavy

rainfall during the months of April to August and scanty rainfall associated with moderately low temperature during the rest period of the year. The treatments were large corm (250±1g), small corm (100±1g), large cormel (35±1g) and small cormel (20±1g). The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. As the experiment was replicated thrice, the total number of unit plots was 36. The size of unit plot was 3m × 2m. A spacing of 0.5 m was provided between the plots and 0.75 m spacing was provided between two blocks. Statistical analyses were done following methods outlined by Gomez and Gomez (1984) with the help of computer package M-STAT-C.

Results and Discussion

Effect of size of planting materials

Emergence of plant: The different size of planting material had significant effect on the emergence of elephant foot yam. To attain 80% emergence of plant the lowest time (27.35 days) was required in case of the largest seed corms followed by small corm (28.07 days) and the highest time (31.88 days) was required in case of the smallest seed cormel followed by large cormel (30.74 days) (Table 1). Larger seed corms contained higher food reserve which might have favoured the initial growth of sprouts. This finding is agreed to the results of Rasul *et al.,* (1994) and Joseph *et al.,* (1981) in case of *Colocasia esculennta.*

Table 1. Effect of size of planting material on emergence and plant height

Size of planting material	Emergence (Days)	Plant height (cm) at DAP			
		30	60	90	120
Corm (Large)	27.35	33.87	50.43	68.87	71.70
Corm (Small)	28.07	31.12	42.98	58.62	61.00
Cormel (Large)	30.74	17.64	33.19	43.46	45.29
Cormel (Small)	31.88	14.49	23.47	35.49	37.73
$LSD_{0.05}$	0.075	0.299	0.868	1.041	0.597
$LSD_{0.01}$	0.102	0.407	1.180	1.416	0.811
Level of significance	**	**	**	**	**

** = Significant at 1% level of probability, DAP = Days after planting

Plant height: The planting materials of different sizes had significant effect in respect of plant height. At 120 days after planting the tallest plant (71.70 cm) was recorded from the large corm followed by small corm (61.00 cm) whereas the smallest (37.73 cm) plant was produced from the small cormel followed by large cormel (45.29 cm) at the same time (Table.1). Plant height is one of the important growth contributing characters for elephant foot yam. It was evident that plant height increased gradually with the increase of size of planting materials. Higher reserved food material of the larger seed corms might have resulted taller and vigourous plant at the early stages as well as later stages of growth. This finding is agreed with the result of Dalion *et al.,* (1988).

Number of side shoots per hill: Different sizes planting materials had a significant effect on the number of side shoots per hill. The highest number of side shoots (6.00) was obtained from the planting of large seed corm followed by small corm (4.46) whereas the lowest side shoots (2.18) was observed from the small cormel followed by (3.20) large cormel (Table.2). Dalion *et al.,* (1988) and Bourke and Perry (1976) observed similar findings in taro.

Table 2. Effect of size of planting material on number of side shoots

Size of planting material	Number of side shoots at DAP			
	30	60	90	120
Corm (Large)	1.31	3.20	4.46	6.00
Corm (Small)	1.00	3.12	4.00	4.46
Cormel (Large)	1.00	2.26	2.86	3.20
Cormel (Small)	1.00	1.13	1.73	2.18
$LSD_{0.05}$	0.031	0.120	0.161	0.062
$LSD_{0.01}$	0.042	0.163	0.218	0.084
Level of significance	**	**	**	**

Table 3. Effect of size of planting material on length of leaf blade

Size of planting material	Length of leaf blade (cm) at DAP			
	30	60	90	120
Corm (Large)	24.69	47.31	49.50	51.29
Corm (Small)	18.26	38.69	43.22	45.36
Cormel (Large)	13.90	32.90	35.69	38.46
Cormel (Small)	10.81	24.51	27.19	29.46
$LSD_{0.05}$	0.376	0.422	0.810	0.880
$LSD_{0.01}$	0.511	0.575	1.101	1.197
Level of significance	**	**	**	**

Length of leaf blade: The length of leaf blade was influenced statistically due to the effects of different sizes planting materials. The highest (51.29 cm) was obtained from the large seed corm followed by small corm (45.36 cm) and the lowest length of leaf blade (29.46cm) was recorded from the small cormel followed by (38.46 cm) large cormel ((Table.3). The length of leaf blade was increased with the increase in seed corm size which was probably due to more reserved food materials in the seed corm. An increasing trend was always observed due to increase seed size. Joseph *et al.,* (1981) and Bourke and Perry (1976) found a similar trend in Mukhi Kachu.

Length of Pseudostem: The different sizes of planting materials had significant effect in respect of length of pseudostem. At 120 days after planting the maximum length of pseudostem (49.73 cm) was recorded from the large seed corm followed by small corm (38.22 cm) whereas the minimum (25.28 cm) length of pseudostem was produced from the small size seed cormel followed by large cormel (29.46 cm) at the same time (Table.4).

Table 4. Effect of size of planting material on length of pseudostem

Size of planting material	Length of pseudostem (cm) at DAP			
	30	60	90	120
Corm (Large)	14.15	43.89	48.34	49.73
Corm (Small)	12.26	34.58	36.64	38.22
Cormel (Large)	9.70	25.56	27.70	29.46
Cormel (Small)	8.29	20.70	23.58	25.28
$LSD_{0.05}$	0.595	0.845	0.869	1.131
$LSD_{0.01}$	0.809	1.150	1.182	1.538
Level of significance	**	**	**	**

Diameter of Pseudostem: The planting material had a significant effect on in the diameter of pseudostem at different vegetative growth stage. The maximum diameter of pseudostem (3.80 cm) was observed from planting the large seed corm followed by small corm (3.42 cm) (Fig.1).The small seed cormel produced minimum diameter of pseudostem (1.60 cm) followed by large cormel (2.25 cm).

Fresh weight of leaves per hill: The different sizes of planting materials had significant effect on the fresh weight of leaves per hill. The highest fresh weight (791.68 gm) of leaves was recorded from the planting of large seed corm followed by small corm (500.60gm) whereas the lowest was obtained from small cormel (146.46 gm) followed by large cormel (268.06 gm) (Table 5).

Dry weight of leaves per hill: Significant variations in the dry weight of leaves were found due to the effect of different sizes of planting materials. The maximum dry weight of leaves per hill (80.08 gm) was obtained from planting the large seed followed by small corm (47.17 gm) whereas the minimum was found from the small cormel (11.72 gm) followed by large cormel (19.20 gm) (Table 5).

Table 5. Effect of size of planting material on fresh wt. of leaves, dry wt. of leaves, length of corm and diameter of corm

Size of planting material	Fresh weight of leaves(g)	Dry weight of leaves(g)	Length of corm (cm)	Diameter of corm (cm)
Corm (Large)	791.68	81.08	13.59	16.03
Corm (Small)	500.60	47.17	11.65	14.62
Cormel (Large)	268.06	19.20	8.74	10.30
Cormel (Small)	146.46	11.72	6.50	6.44
$LSD_{0.05}$	13.915	0.916	0.273	0.069
$LSD_{0.01}$	18.928	1.246	0.371	0.094
Level of significance	**	**	**	**

Table 6. Effect of size of planting material on fresh weight of corm and yield

Size of planting material	Fresh weight of corm (g)	Yield/plot (kg)	Yield (t/ha)
Corm (Large)	1254.40	24.93	41.56
Corm (Small)	818.66	16.46	27.43
Cormel (Large)	430.33	4.11	6.86
Cormel (Small)	139.26	2.86	4.77
$LSD_{0.05}$	29.14	0.555	1.105
$LSD_{0.01}$	39.63	0.755	1.503
Level of significance	**	**	**

Length of corm: The planting materials of different sizes had significant influenced on the length of corm. The highest length of corm (13.59 cm) was obtained from the planting of large sized seed corm followed by small corm (11.65 cm) and the lowest (6.50 cm) was ob recorded from the small sized seed cormel followed by large cormel (8.74 cm) (Table 5). Large sized seed corm produced the corm with maximum length and diameter of corm possibly due to more accumulation of photosynthates in the corm. This finding is agreed with the result of Das *et al.,* (1995) in elephant foot yam.

Diameter of corm: There was a significant effect on the diameter of corm due to different sizes of planting material. The highest diameter of corm was found (16.03 cm) followed by small corm (14.62 cm) and the lowest diameter (6.44cm) was recorded from planting small

cormel (6.44 cm) followed by large cormel (10.30 cm) (Table 5). Large sized seed corm produced the corm with maximum diameter of corm possibly due to more accumulation of photosynthates in the corm. This finding is agreed with the result of Das *et al.,* (1995) in elephant foot yam.

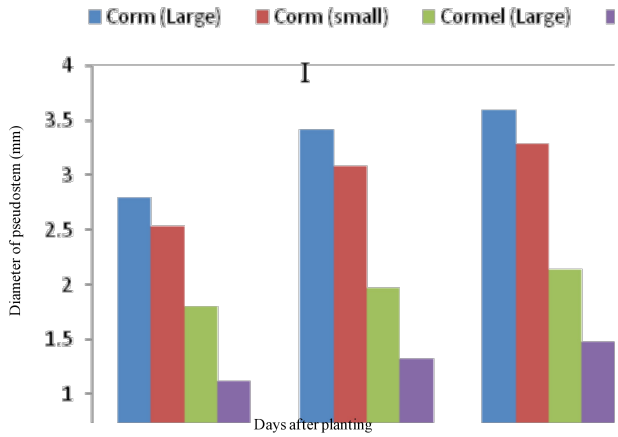

Fig.1. Effect of planting materials on the diameter of pseudostem at different days after planting (Vertical bar represents LSD at 1% level of significance).

Fresh weight of corm per hill: A significant effect was observed in the fresh weight of corm per hill due to the effect of different sizes of planting materials. The highest fresh weight of corm (1254.50 g) was obtained from the planting of large corm followed by small corm (818.66 g) whereas the lowest weight of corm per hill (139.26 g) was obtained from small cormel followed by large cormel (430.33 g) (Table 6). Ashokan *et al*., (1984) found almost similar result *in Amorphophallus.*

Yield per plot: The different sizes of planting material resulted a significant variation in the yield per plot. The highest yield per plot (24.93 kg) was obtained from the large corm followed by small corm (16.46 kg) and the lowest (2.86 kg) was obtained from the small sized seed cormel followed by large cormel (4.11 kg) (Table 6). The corm yield was significantly influenced by the size of seed corm and higher yields were recorded from planting materials of 1 kg size (Sen *et al*., 1984; Asokan, 1984; Sen and Das, 1991). Increase in size of planting material from 250 g to 1 kg increased mean corm weight per plant from 0.75 kg to 1.74 kg whereas the corm yield per ha increased from 21.6 to 77.34 t (Sen *et al.,* 1984; Asokan, 1984; Sen and Das, 1991; James George, and Nair, 1993; Das *et al*., 1995).

Yield per hectare: The different sizes of planting material had a significant variation in the yield per hectare. The highest yield per hectare (41.56 tons/h) was obtained from the large sized seed corm followed by small corm (27.43 tons/h) and the lowest yield (4.77 tons/h) was form the small sized seed cormel followed by large cormel (6.86 tons/h) (Table 6).

From the present study it is obvious that planting materials had significant effect on all growth parameters and yield of elephant foot yam. The objective of the experiment was to evaluate the effect of the planting materials on the growth and yield of elephant foot yam.

The results on the different parameters of the present study advocated that among the four different sizes of planting materials large corm showed the best results in all aspects. Hence the highest percentage of growth and maximum yield of elephant foot yam can be achieved if large sized seed corm is used as planting material but planting with small corm is considerable due to higher yield than the cormel.

The results showed that maximum yield of corm was obtained from the large sized seed corm with the widest plant spacing and the yield of corm increased with the increased size of planting materials. It was found from the investigation that a combination of large sized seed corm was best to obtain maximum yield of elephant foot yam. Therefore, further investigation also be needed regarding planting materials before final conclusion.

References

Ashokan PK, Gopinath UVK and Vikraman NR 1984: Response of Amorphophallus to size of seed corm and manuResearch Journal of Root Crops 10(1-2) 51-54.

Basak NC and Maleque MA 1992: Effect of spacing on the rhizome and stolen yield of Pani Kachu (var. Latiraj). Research Report, On-Farm Division, Kishoregonj, Bangladesh Agricultural Research Institute, pp. 1-7.

Bhuyan MAJ, Haque MM and Haque KR 1982: Effect of seed size and spacing on the yield of Mukhi Kachu (Colocasia esculenta). Bangladesh Horticulture 10(2) 5-8.

Bourke RM and Perry CH 1976: Influence of sett size on growth and yield of taro (*Colocasia esculenta*). Papua New Guinea Agricultural Journal 27 (4) 115-120.

Chandra S 1984: Edible aroids. Clarendor Press, Oxford, p. 252.

Dalion SS, Pardales JRJr. and Baliad ME 1988: Effect of sett size on the growth, development and yield of taro. Annals of Tropical Research 10(2) 121-125.

Das PK, Sen H, Banerjee NC and Panda PK 1995: Effect of seed corm production of elephant foot yam. Horticultural Journal 8(2) 131-139.

Dhua RS, Ghosh SK, Biswas J, Mitra SK, Sen H 1988: Effect of some chemicals on sprouting, growth and corm yield of *Amorphophallus campanulatus.* Journal of Root Crops 14 47-49.

Edris KM, Islam ATMT, Chowdhury MS and Haque AKMM 1979: Detailed soil survey, BAU Farm, Mymensingh. Depertment of Soil Survey. Government of the people's Republic of Bangladesh. P.118.

Enyi BAC 1972: The effects of seed size and spacing on growth and yield of lesser yam (*Colocasia esculenta*). Journal of Agricultural Sciences 78(2) 215-225.

FAO 1988: A Report of Food and Agricultural Organization of the United Nations, Rome, Italy. pp.52 59-60.

Gomez KA and Gomez AA 1984: Statistical Procedure for Agricultural Research (2nd edn.). A Willey Int. Sci. Pub., John Willey and Sons, New York,. pp.680.

Gosh SP, Ramanujam T, Jos JS, Moorthy SN and Nair RG 1988: Tuber crops. Published by Mohan Primlani for Oxford & IBH Publishing Co. Pvt. Ltd., 66 Janpath, New Delhi 110001. pp. 233-234, 305.

Joseph K, Kunju UM and Nair KPM 1981: Effect of different planting methods and seed sizes on the growth and yield of (*Colocasia esculenta* (L.) Schott.). Agricultural Research Journal of Kerala 19(1) 27-31.

Khan A, Rahman M and Islam S 2007: Antibacterial, Antifungal and Cytotoxic Activities of Tuberous Roots of Amorphophallus campanulatus. Turkish Journal of Biology 31 167-172.

Mannan MA and Rashid MM 1983: Effect of spacing and mulching on the yield and profitability of Panchamukhi Kachu (*Colocasia esculenta*). Bangladesh Journal of Agricultural Research 8(2) 69-73.

Plucknett DL, Pena RS-de-la and Obrero F 1970: Taro (Colocais esculenta). Field Crop Abstracts 23(4) 413-426.

Rashid MM and Daunicht HJ 1979: Chemical composition of edible aroid cultivar of Bangladesh. Scientia Horticulturae 19 127-134.

Rasul MG, Akter MS, Nahar MS, Marinan MA and Rashid MM 1994: Effect of mulches and seed types on the growth, yield attributes and yield of Mukhi Kachu. Bangladesh Journal of Scientific and Industrial Research 29(3) 53-61.

Sen H and Das PK 1991: Effect of cut and whole seed corm of same size on growth and yield of elephant foot yam. Journal of Root Crops 17 151-153.

Sen H, Roychoudhury N and Bose TK 1984: Effect of seed corm weight and spacing on the total corm yield of Amorphophallus. Journal of Root Crops 10(1-2) 37-39.

UNDP 1988: Land Resource Appraisal of Bangladesh for Agril. Dev. Report 2. Agro-ecological Region of Bangladesh. FAO, Rome, Italy. p.577.