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Dhanalakshmi VN
Ph. D Scholar, Department of Agronomy, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India

Rajasree G
Associate Professor, Department of Agronomy, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India

Sheeba Rebecca Isaac
Professor, Department of Agronomy, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India

Corresponding Author:
Dhanalakshmi VN
Ph. D Scholar, Department of Agronomy, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India

Effect of corm size and integrated nutrient management practices on yield attributes of elephant foot yam [(*Amorphophallus paeoniifolius* (Dennst.) Nicolson]

Dhanalakshmi VN, Rajasree G and Sheeba Rebecca Isaac

Abstract
A field experiment to evaluate the effect of size of minisett and integrated nutrient management practices on the yield attributes of elephant foot yam was carried out at College of Agriculture, Vellayani, Thiruvananthapuram, Kerala during April 2018-November 2018. The treatment combinations included three minisett sizes (s_1: 200 g, s_2: 300 g and s_3: 400 g) planted at 60 x 60 cm spacing and five integrated nutrient management practices (i_1- 100 % NPK, i_2-75 % NPK with 50 % N substitution through coir pith compost, i_3- 75% NPK with 50% N substitution through coir pith compost + PGPR-I+ AMF, i_4- 50 % NPK with 50 % N substitution through coir pith compost, i_5- 50 % NPK with 50% N substitution through coir pith compost + PGPR-I + AMF) and a control of 1 kg planted at a spacing of 90 x 90 cm. The results indicated that the minisett size 400 g recorded the highest corm yield per plant (1279.43 g), volume of corm (975.38 ml) and diameter of corm (14.13 cm). In case of different integrated nutrient management practices, application of 100 % NPK recorded the highest corm yield per plant (1187.67 g), volume of corm (945.17 ml) and diameter of corm (14.07 cm). Among different interactions of minisett size and integrated nutrient management practices, the combination of 400 g + 100 % NPK recorded the highest corm yield per plant (2053.00 g) and volume of corm (1588.00 ml).

Keywords: elephant foot yam, minisett, integrated nutrient management, yield attributes

Introduction

Elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson) is basically an important tuber crop of the tropical and sub-tropical countries and it belongs to Araceae family. It is regarded as the king of tuber crops because of its higher yield potential and biological efficiency, culinary properties, medicinal uses and therapeutic values. The corm is the economic part of elephant foot yam which is an underground modified stem. It is a rich source of carbohydrates, minerals, vitamins, protein as well as starch.

According to George (2006) [5], the multiplication ratio in elephant foot yam could be enhanced to 1:15 from the conventional 1:3 by adopting minisett technique and these corms are having a weight of 600 g to 1.5 kg, which is ideal for home consumption and has greater consumer acceptance. Mini-sett (cutting of large corm into small setts) technology is the main factor that decisively affects the production of elephant foot yam seed corm as reported from previous studies (Nath *et al*., 2007; Ravi *et al*., 2011; Salam *et al*., 2016) [12, 14, 16]. The relation between planting material size and corm yield has been reported by Ravi *et al*. (2011) [14]. The nutrient schedule for normal corm planting, 100:50:150 kg NPK ha^{-1} is recommended (KAU, 2016) [9] as such for minisett cultivation of elephant foot yam. So that, it is necessary to standardise the nutrient dose integrating it with organic and microbial fertilizers so as to have a cost effective and eco-friendly recommendation for the farming community. Therefore, the present study was aimed to standardise the minisett size in elephant foot yam and to study the effect of integrated nutrient management practices on yield attributes in comparison with normal corm planting.

Materials and methods

The present investigation was carried out on elephant foot yam at Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala. The experiment was laid out in factorial RBD with 15 treatment combinations and a control, with three replications.

The treatment combinations included three corm sizes and five integrated nutrient management practices. The healthy seed corms of three sizes *viz*., s_1: 200 g, s_2: 300 g and s_3: 400 g at a spacing of 60 x 60 cm and a control of 1 kg at a spacing of 90 x 90 cm were planted during April 2018-November 2018. The nutrient management practices included i_1- 100 % NPK, i_2-75 % NPK with 50 % N substitution through coir pith compost, i_3- 75% NPK with 50% N substitution through coir pith compost + PGPR-I + AMF, i_4- 50 % NPK with 50 % N substitution through coir pith compost, i_5- 50 % NPK with 50% N substitution through coir pith compost + PGPR-I + AMF. Recommended dose of N, P and K for elephant foot yam is 100:50:150 kg NPK ha^{-1} and this was modified based on soil test data. The initial soil test revealed it to be moderately acidic (pH 5.7), normal in EC (0.074), medium in organic carbon (0.33 %) and available N (285.32 kg ha^{-1}), high in available P (78.81 kg ha^{-1}) and available K (259.39 kg ha^{-1}). Lime @ 250 kg ha^{-1} was applied to correct the soil acidity (KAU, 2016) [9]. A uniform dose of farmyard manure @ 2 kg pit^{-1} was given at the time of land preparation. Coir pith compost (1.06 %) was used as the organic source in the study and was substituted on N equivalent basis as per the treatments, and P and K were given through chemical sources. Full dose of P and half the dose of N and K were applied 45 days after planting. The N substituted through organic source was applied in full quantity at 45 days after planting. The second dose of N and K was applied one month after first application. Corm treatment with 5 per cent suspension of PGPR-1 (Plant Growth-Promoting Rhizobacteria - which is a consortium of *Azospirillum lipoferum*, *Azotobacter chroococcum*, *Bacillus megaterium* and *Bacillus sporothermodurans* (Gopi *et al*., 2019) [7], followed by soil application of PGPR enriched cow dung @ 10 g pit^{-1} (mixture of dry cow dung and PGPR-1 in 50:1 proportion) was done at planting and 2 months after planting in treatments i_3 and i_5. AMF (Arbuscular Mycorrhizal Fungus) was applied @ 10 g pit^{-1} at the time of planting in i_3 and i_5. Yield attributes were recorded at harvest. Data generated were statistically analysed for analysis of variance technique (ANOVA), for randomised block design using F-test (Gomez and Gomez, 1984) [6]. The significance of treatment *vs* control was tested using SAS Software.

Results and discussion

Yield attributes

1. Weight of the corm $plant^{-1}$

Size of minisett and integrated nutrient management practices exerted significant effect on corm yield $plant^{-1}$ and the effect is presented in the Table 1a and 1b. The weight of corm $plant^{-1}$ was significantly influenced by the size of minisett. The minisett having higher weight (400 g) produced significantly higher corm yield of 1279.43 g $plant^{-1}$ compared to 300 g (693.17 g $plant^{-1}$) and 200 g (537.20 g $plant^{-1}$). Among different integrated nutrient management practices, 100 % NPK (i_1) recorded significantly higher corm yield $plant^{-1}$ (1187.67 g) followed by i_3 - 75 % NPK with 50 % N substitution through coir pith compost + PGPR-I+ AMF (818.83 g) which was on par with i_2 - 75 % NPK with 50 % N substitution through coir pith compost (799.72 g). The S x I interactions significantly influenced the corm yield $plant^{-1}$ of elephant foot yam. Corm weight was found to be the highest in s_3i_1 - 400 g minisett planted with 100 % NPK (2053.00 g) followed by s_3i_3 - 400 g minisett planted with 75 % NPK with 50 % N substitution through coir pith compost + PGPR-I+ AMF (1156.50 g) which was on par with s_3i_2 - 400 g minisett planted with 75 % NPK with 50 % N substitution through coir pith compost (1154.50 g). Comparing the treatments with control, it was found that there was significant difference between treatments (minisetts) and control (normal corm-1 kg) and the normal corm plants produced higher corm yield (2273.00 g $plant^{-1}$) than the minisetts (836.60 g $plant^{-1}$).

The effect of size of planting material in increasing the corm weight has been reported by several workers. Mondal and Sen (2004) [11], Dev (2012) [4], Salam *et al*. (2016) [16] and Pathak *et al*. (2018) [13] have reported that the largest sett size resulted in highest average corm weight than small sett size. In case of nutrient management, the corm yield increased gradually with increase in fertility levels and full dose of NPK resulted in the highest yield. Sahoo *et al*. (2015) [15] also reported similar results. Application of inorganic source of nutrients is essential for immediate availability of nutrients to the crops. Krishnakumar *et al*. (2013) [10] also found similar results wherein the application of 50% NPK + biofertilizers+ vermicompost was found to be on par with full dose of fertilizers in terms of yield in elephant foot yam. Perusal of the data indicated that planting of larger conventional corms yielded more, compared to the minisetts. These results are in conformity with those of earlier workers (Ashokan *et al*., 1984, Sen *et al*., 1996, Sethi *et al*., 2002, Mondal and Sen, 2004) [1, 17, 18, 11]. Higher corm size is attributed to better crop growth as a consequence of more food reserve at the initial stage, and higher translocation of photosynthates from source to sink, resulting in higher corm yield.

2. Volume of corm

Results (Table 1a and 1b) showed that volume of corm was significantly influenced by size of minisett and integrated nutrient management practices. The maximum volume was obtained in 400 g minisett planted corm (975.38 ml) compared to 300 g (536.87 ml) and 200 g (399.67 ml). Application of 100 % NPK (i_1) to the elephant foot yam recorded significantly higher corm volume (945.17 ml) followed by i_2, 75 % NPK with 50 % N substitution through coir pith compost (601.56 ml) which was on par with i_3, 75 % NPK with 50 % N substitution through coir pith compost + PGPR-I+ AMF (580.42 ml). Among different S x I interactions, the s_3i_1 recorded the highest corm volume of 1588.00 ml (400 g minisett + 100 % NPK) followed by s_3i_5, which was 400 g minisett planted with 50 % NPK with 50% N substitution through coir pith compost + PGPR-I + AMF (850.00 ml) which was on par with s_3i_3 - 400 g minisett planted with 75 % NPK with 50 % N substitution through coir pith compost + PGPR-I+ AMF (839.25 ml) and s_3i_2 - 400 g + 75 % NPK with 50 % N substitution through coir pith compost (828.00 ml). While comparing treatments with control, significant difference was observed and the control (1853 ml) recorded the highest corm volume than minisetts (637.31 ml). The higher volume resulted from the higher weight of corm might be due to more accumulation of photosynthates in the harvested corm, owing to the initial vigour of the plant due to the presence of higher quantity of food materials in the planting material (seed corm). Nath *et al*. (2007) [2], Dev (2012) [4] and Bairagi and Singh (2014) [2] reported similar results.

3. Diameter of corm

Diameter of corm was significantly influenced by size of minisett as well as integrated nutrient management practices (Table 1a and 1b). Among three minisett sizes, 400 g recorded the highest corm diameter (14.13 cm), followed by 300 g

(11.24 cm) which was on par with 200 g (10.64 cm). Among different integrated nutrient management practices, application of 100 % NPK (i_1) resulted in maximum corm diameter of 14.07 cm followed by application of 75 % NPK with 50 % N substitution through coir pith compost + PGPR-I+ AMF (12.67 cm). S x I interactions were found to be non significant in case of corm diameter but the highest corm diameter was noted in s_3i_1 - 400 g minisett + 100 % NPK (17.85 cm). The treatment *vs* control effect was significant and the normal corm plants produced the highest diameter of 19.13 cm compared with minisett produced corm diameter (12.00 cm).

There was a significant effect on the diameter of corm due to different sizes of planting material. This finding is in agreement with the result of Das *et al*. (1995) [3], Hossain *et al*. (2014) [8] and Salam *et al*. (2016) [16] in elephant foot yam. Large sized seed corm produced the corm with maximum diameter probably due to more build-up of photosynthates in the corm. Elephant foot yam responds more to fertilizers and manures and application of different dose of fertilizers significantly affects plant and corm development. Immediate requirement of nutrients is met with the inorganic fertilizers and larger corms are produced with application of full dose of fertilizers.

Table 1a: Effect of size of minisett corm and integrated nutrient management on weight of corm per plant, volume of corm and diameter of corm of elephant foot yam

Treatments	Weight of corm (g plant^{-1})	Volume of corm (ml)	Diameter of corm (cm)
Size of minisett corm (S)			
s_1-200g	537.20	399.67	10.64
s_2-300g	693.17	536.87	11.24
s_3-400g	1279.43	975.38	14.13
SEm (±)	8.10	7.69	0.31
CD(0.05)	23.454	22.269	0.909
Integrated Nutrient Management (I)			
i_1- 100 % NPK	1187.67	945.17	14.07
i_2- 75 % NPK with 50 % N substitution through coir pith compost	799.72	601.56	11.23
i_3- 75% NPK with 50% N substitution through coir pith compost + PGPR-I+ AMF	818.83	580.42	12.67
i_4- 50 % NPK with 50 % N substitution through coir pith compost	622.28	494.83	11.03
i_5- 50 % NPK with 50% N substitution through coir pith compost + PGPR-I + AMF	754.50	564.56	11.03
SEm (±)	10.45	9.92	0.41
CD(0.05)	30.279	28.749	1.173

Table 1b: Interaction effect of size of minisett corm and integrated nutrient management on weight of corm per plant, volume of corm and diameter of corm of elephant foot yam

Treatments	Weight of corm (g plant^{-1})	Volume of corm (ml)	Diameter of corm (cm)
S x I interaction			
s_1i_1	610.00	440.00	11.98
s_1i_2	533.00	414.00	10.43
s_1i_3	550.00	421.00	11.10
s_1i_4	426.67	343.33	10.00
s_1i_5	566.33	380.00	9.70
s_2i_1	900.00	807.50	12.38
s_2i_2	711.67	562.67	10.80
s_2i_3	750.00	481.00	12.05
s_2i_4	491.50	369.50	10.35
s_2i_5	612.67	463.67	10.63
s_3i_1	2053.00	1588.00	17.85
s_3i_2	1154.50	828.00	12.45
s_3i_3	1156.50	839.25	14.85
s_3i_4	948.67	771.67	12.73
s_3i_5	1084.50	850.00	12.75
SEm (±)	18.10	17.19	0.70
CD(0.05)	52.445	49. 795	NS
Treatment mean	836.60	637.31	12.00
Control mean	2273.00	1853.00	19.13
Treatment *vs* Control	S	S	S

Conclusion

The results of the present study advocated that 400 g minisett produced better yield attributes and yield compared to 300 g and 200 g minisetts. Among five different integrated nutrient management practices, application of 100% NPK resulted in higher yield attributes and yield. Hence the present study suggested that highest corm yield, volume and diameter of elephant foot yam can be achieved by planting 400g minisett with full dose of fertilizers compared to smaller minisetts with lower doses of fertilizers.

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