International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(4): 1766-1769

Received: 21-05-2017
Accepted: 22-06-2017

Navya K
Dept. of Vegetable Science, ASPEE College of Horticulture and Forestry, N.A.U., Gujarat, India

Desai KD
Dept. of Vegetable Science, ASPEE College of Horticulture and Forestry, N.A.U., Gujarat, India

Tandel YN
Dept. of Fruit Science, ASPEE College of Horticulture and Forestry, N.A.U., Gujarat, India

Sheth SG
Dept. of Vegetable Science, ASPEE College of Horticulture and Forestry, N.A.U., Gujarat

Correspondence
Navya K
Dept. of Vegetable Science, ASPEE College of Horticulture and Forestry, N.A.U., Gujarat, India

Effect of integrated nutrient management on growth, yield and quality of elephant foot yam [*Amorphophalluspaeoniifolius* (Dennst.) Nicolson]

Navya K, Desai KD, Tandel YN and Sheth SG

Abstract
The effect of different levels of integrated nutrient sources and bio-fertilizers on growth, yield and quality parameters of elephant foot yam was evaluated at RHRS farm Navsari, Gujarat. The application of 50 % RDN through inorganic fertilizers + 50 % RDN through vermicompost (T_2) had shown significant impact on most of the parameters studied like plant height (73.02 cm and 78.87 cm), canopy spread E-W (88.17 cm and 90.27 cm) and N-S (88.87 cm and 89.82), and number of leaflets per plant (362.07 and 318.90) which recorded maximum values given in the brackets at the age of 120 and 150 DAP, respectively. These values were statistically remained at par with T_3 treatment. Yield and quality attributes *viz.*, harvest index (51.77 %), fresh corm weight (1.267 kg) and yield per hectare (26.37 t) were recorded highest with treatment T_2 and were also on par with T_3 treatment while the starch content was highest (16.57 %) in T_3 treatment. The application of bio-fertilizers also gave significantly the highest results for the all the parameters discussed with respect to organic and inorganic sources application. The treatment which received 50 % RDN through FYM along with combination of bio-fertilizers T_3B_1 realized highest benefit: cost ratio followed by the treatment receiving 50 % RDN through vermi-compost along with combination of bio-fertilizers (T_2B_1).

Keywords: Integrated nutrient sources, bio-fertilizers, Elephant foot yam

Introduction
Elephant foot yam (*Amorphophalluspaeoniifolius* Dennst. Nicolson), also known as "King of Tuber Crops" is belonging to the family Araceae. It is the most popular and widely cultivated member of the edible aroids. It is believed to be a native of South East Asia and is indigenous to tropical Asia and Africa with a diploid chromosome number of 28. It is considered as a famine food in the pacific Islands. It is gaining popularity as a cash crop among the farming community of our country due to its high production potential, higher biological efficiency, acceptable culinary properties, medicinal utility and therapeutic values. Its medicinal properties are found to be effective in the treatment of piles, dysentery, asthma, swelling of lungs, vomiting, abdominal disorders in addition to use as blood purifier. It is a long duration crop, taking about 7-8 months to realize full yield potential.In India, elephant foot yam is commonly known as Suran or Jimmikand and grown in almost all the states but commercially it is mainly cultivated in Andhra Pradesh, Tamil Nadu, Gujarat, Maharashtra, West Bengal, Jharkhand, Kerala, Karnataka, Bihar and Uttar Pradesh (Nedunchezhiyan and Byju, 2005) [11]. While in Gujarat it is mainly cultivated in southern and middle region comprising Valsad, Navsari, Surat, The Dangs, Tapi, Vadodara, Anand, Kheda, Nadiad etc. districts.

Fertilizer is one of the most important inputs for increasing the productivity of crops (Anon., 1997) [2] including elephant foot yam. It has been repeatedly confirmed that continuous, sole and imbalanced use of chemical fertilizers deteriorates soil health and ecological balance which leads to decrease in nutrient uptake efficiency (Saravaiya *et al*., 2010) [15].

The integrated nutrient supply includes the use of chemical fertilizers with organic sources along with bio-fertilizers helps not only in bridging the existing wide gap between the nutrient removal and addition but also in ensuring balanced nutrient proportion, in enhancing nutrient response efficiency and in maximizing crop productivity of desired quality (Singh and Kalloo, 2000) [16]. Thus the use of inorganic fertilizers in conjunction with organic manures is essential for getting sustainable and profitable yield of elephant foot yam. Since the application of inorganic fertilizers alone cannot sustain the soil productivity, especially in cropping system, the only way to improve and sustain the yield of crops is the use of various sources of nutrients

in an integrated manner so as to make the system productive and profitable. Though the use of chemical fertilizers cannot be altogether avoided, their use should be reduced. Moreover, elephant foot yam being a long duration crop, needs a nutrient package which can supply nutrients for a longer duration till the maturity of the crop. This ispossible only through the incorporation of organic sources of nutrients in the soil. The bulking rate and tuber productivity in elephant foot yam depends on soils physio-chemical parameters such as bulk density, soil structure, organic carbon and population of beneficial micro-flora and micro-fauna.

Materials and methods

The experiment was arranged over 8 treatment combinations comprising 4 levels of integrated nutrient sources laid out in a Randomized Block Design (Factorial concept) with three replications.

T_1: RDF- 100: 50 : 150 NPK kg ha^{-1} + 25 t FYM ha^{-1}

T_2: 50 % RDN + 50 % N from vermi-compost along with RDF of P & K

T_3: 50 % RDN + 50 % N from FYM along with RDF of P & K

T_4: 50 % RDN + 50 % N from bio-compost along with RDF of P & K) and 2 levels of bio-fertilizers

B_0: without bio-fertilizers

B_1: with bio-fertilizers i.e. combination of

AZ, PSB and KMB each at 5 liters ha^{-1}.

Corms were planted on 14th mar, 2016 and required intercultural operations were carried out time to time. With respect to fertilizer application, nitrogen was substituted on the basis of N content of different organics. FYM was incorporated at the time of soil preparation in T_1 treatment. 50% of N in the form of organics will be applied at the time of planting. 100% P_2O_5 and 50% K_2O will be applied at 10 DAP in all the treatment combinations.50% of N for T_1 treatment in the form of chemical fertilizers was applied at 10 DAP. 25% N and K_2O (in form of CF) was applied at 30 DAP all the treatment combinations. Remaining 25% of N and K_2O (in form of CF) will be applied 60 DAP all the treatment combinations. Bio-fertilizers (PSB, *AZ* and KMB) was applied at the rate of 5 kg ha^{-1} each. The harvesting of the crop was done on 9th November, 2016.

The corms after harvest were bought to the laboratory for bio-chemical analysis. In which the starch and calcium oxalate content was analyzed with the procedure given by Padmaja *et al.* (2005) [12] while β-carotene content was analyzed with respect to the procedure of Biswas *et al.* (2011) [7]. The economic parameters with respect to each treatment combination was worked out based on the prevailing market price of 2017.

Result and Discussion

Growth parameters like plant height, canopy spread (E-W and N-S) and number of leaflets per plant were significantly influenced by application of organics, inorganics and bio-fertilizers. Data presented in Table-1, revealed significant differences in plant height at different growth stages at 120 and 150 days after planting. At 120 and 150 DAP maximum plant height (73.02 cm and 78.87 cm, respectively) was recorded in treatment T_2 - 50 % RDN + 50 % N from vermi-compost along with RDF of P & K and was closely followed by T_3 - 50 % RDN + 50 % N from FYM along with RDF of P & K treatment (67.93 cm and 74.23 cm, respectively). Venkatesan *et al.*, 2013 and Annepu, 2011 [18, 1] are also in conformity with the given results. Maximum canopy spread of 88.17 cm and 90.27 cm at 120 and 150 DAP, respectively was recorded at E-W direction while spread of 89.82 cm and 88.87 cm at 120 and 150 DAP, respectively was recorded at N-S direction in T_2 - 50 % RDN + 50 % N from vermi-compost along with RDF of P & K treatment and was at par with the treatment T_3 -50 % RDN + 50 % N from FYM along with RDF of P & K. Same results were obtained by Murthy *et al.* (2011) [10] substituting 75 % N with FYM and Bairagi and Singh, (2013) [6]. Number of leaflets per plant was maximum in T_2 treatment receiving 50 % RDN + 50 % N from vermi-compost along with RDF of P & K which recorded 362.07 leaflets per plant at 120 DAP and 318.90 leaflets at 150 DAP. The findings are similar with the research findings of Anonymous 2014, 2015 and 2016 [3, 4, 5]. Nitrogen has always been known to promote vegetative growth by increasing both the photosynthetic activity as well as the area. The photosynthetic activity is improved by increasing the concentration of chlorophyll in the cell whereas, the increase in photosynthetic area was brought about by increasing the plant height and more canopy spread.

Application of bio-fertilizers also showed significant influences at 120 and 150 DAP. Maximum plant height of 70.12 cm and 76.68 cm, E-W canopy spread of 83.91cm and 87.09 cm, N-S canopy spread of 83.84 cm and 86.88 cm and number of leaflets of 343.63 and 302.98 per plant, respectively at 120 DAP and 150 DAP was recorded with application of bio-fertilizers over without bio-fertilizer application. The results obtained in the present study are in conformity with Murthy *et al*. (2011) [10] in EFY cv. Gajendra. This may be attributed to the fact that rapid availability of nutrients, especially nitrogen through inorganics and production of growth promoting hormones through *Azospirillum* (Tien *et al*., 1979) [17]. The nitrogen fixing capacity of the *Azospirrillum*, increased mobility of phosphorous and potassium by PSB and KMB might also have helped in increasing the growth by exerting its synergistic effect with inorganic and organic manures.

Application of organics, inorganics and bio-fertilizers gave significant differences on yield and yield attributing characters like fresh corm weight and yield per hectare (Table 2). Treatment T_2 that received - 50 % RDN + 50 % N from vermi-compost along with RDF of P & K revealed the highest harvest index of 51.77 % and was at par with T_3 treatment (45.87 %). Maximum fresh corm weight of 1.267 kg was produced in the treatment T_2 and was statistically at par with treatment T_3 which produced corm weight of 1.107 kg. As influenced by fresh corm weight the highest yield of 26.37 t ha^{-1} was produced by the treatmentT_2 which was closely followed by the treatment T_3 which produced 24.28 t ha^{-1} corm yield. Krishnakumar *et al*. (2013) [8], Sahoo *et al*. (2014) [14] and Saravaiya *et al.* (2010) [15] are in conformity with the above results. While the application of bio-fertilizers also produced highest fresh corm weight of 1.186 kg and finally yield of 24.84 t ha^{-1} over without bio-fertilizer application. Thefindings are in conformity with Murthy *et al.* (2011) [10] and Venkatesan *et al*. (2013) [18]. The reason being that the application of vermi-compost and FYM had favored the activity of soil microflora, physical conditions besides supplementing the nutrients (Saravaiya*et al*. 2010) [15]. By applying 50 % N with inorganic fertilizers had met the plant nutrient requirement at initial stages of growth leading to increased vegetative growth and remaining 50 % N replaced through different organic sources had slowly satisfied the nutrient requirement of the plant at later stages of the growth mainly during corm development (Pillai *et al*., 1987) [13]. So

the supplement of nutrients through both inorganic and organic sources had conjointly helped the plants to produce higher yields (Saravaiya *et al*., 2010, Bairagi and singh, 2013) [15, 6].

Quality of elephant foot yam is decided by calcium oxalate content, starch content and β-carotene content. The maximum starch content of 16.57 % was found in T_3 - 50 % RDN + 50 % N from FYM along with RDF of P & K treatment and was on par with both T_2- 50 % RDN + 50 % N from vermi-compost along with RDF of P & K(16.54 %) and T_3- 50 % RDN + 50 % N from vermi-compost along with RDF of P & K(16.43 %) treatments whereas the application of bio-fertilizers did not show any significant influence on starch content. The increase in starch content of corms seems due to higher levels of potassium added through organic sources which helped the formation and transfer of starch from the leaves to the tubers (Mukhopadhyay and Sen, 1986) [9]. The other probable reason may be that the main constituent of starch is glucose whichis composed of carbon molecules, the organic manures added contains carbon which in turn may had increased the starch content of the corms.While the β-carotene content and calcium oxalate content did not show any significant influence due to different INMtreatments. However, the lowest calcium oxalate content of 0.213% and 0.218 % was found in treatment T_2 and with application of bio-fertilizers, respectively. While the highest β-carotene content of 684.513 µg g^{-1} and 685.408 µg g^{-1} was analysed in T_3 - 50 % RDN + 50 % N from FYM along with RDF of P & K treatment and with application of bio-fertilizers, respectively. Annepu, 2011 and Kumar *et al*. 2015 [1] got similar type of results.

Table 1: Effect of Integrated nutrient sources and bio-fertilizers on growth characters of elephant foot yam

Treat-ments	Growth Parameters											
	Plant height (cm)			Canopy spread (cm)						No. of leaflets/plant		
	90 DAP	120 DAP	150 DAP	90 DAP		120 DAP		150 DAP		90 DAP	120 DAP	150 DAP
				E-W	N-S	E-W	N-S	E-W	N-S			
T_1	55.88	63.52	72.28	76.41	78.83	74.13	78.80	81.39	80.75	449.6	311.78	272.0
T_2	56.80	73.02	78.87	79.10	81.00	88.17	88.87	90.27	89.82	491.7	362.07	318.9
T_3	56.46	67.93	74.23	77.53	80.37	76.77	79.12	83.43	84.87	466.1	344.27	295.7
T_4	54.78	60.13	69.44	72.47	72.77	76.35	75.48	78.45	78.37	409.5	288.29	250.7
SEm ±	2.015	2.677	2.095	2.679	3.046	3.427	2.685	2.662	2.706	22.227	14.976	13.177
C. D. (@ 5 %)	NS	8.121	6.354	NS	NS	NS	8.144	8.073	8.207	NS	45.425	39.969
B_0	55.22	62.19	70.71	74.34	76.17	73.80	77.29	79.68	80.03	433.3	309.57	265.7
B_1	56.75	70.12	76.68	78.42	80.32	83.91	83.84	87.09	86.88	475.2	343.63	302.9
SEm ±	1.425	1.893	1.481	1.894	2.154	2.423	1.889	1.882	1.913	15.717	10.590	9.318
C. D. (@ 5 %)	NS	5.743	4.493	NS	NS	NS	5.759	5.709	5.803	NS	32.120	28.262
T×B	NS	NS	S	NS	NS	NS	NS	NS	NS	NS	NS	NS
SEm ±	2.850	3.786	2.963	3.789	4.308	4.847	3.797	3.764	3.827	31.434	21.179	18.635
C. D. (@ 5 %)	NS	NS	8.99	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of Integrated nutrient sources and bio-fertilizers on yield and quality characters of elephant foot yam

Treatments	Yield parameters		Quality parameters		
	Fresh corm weight (kg)	Yield per ha (t)	Starch content (%)	β-carotene (Vit-A) content (µg g^{-1})	Calcium oxalate content (%)
T_1	1.033	21.77	15.49	677.492	0.233
T_2	1.267	26.37	16.54	679.663	0.213
T_3	1.107	24.28	16.57	684.153	0.217
T_4	0.971	21.48	16.43	674.277	0.220
SEm ±	0.064	1.175	0.273	11.504	0.005
C. D. (@ 5 %)	0.193	3.564	0.828	NS	NS
B_0	1.003	22.11	16.02	672.565	0.223
B_1	1.186	24.84	16.51	685.408	0.218
SEm ±	0.045	0.831	0.193	8.135	0.004
C. D. (@ 5 %)	0.137	2.520	NS	NS	NS
T×B	NS	NS	NS	NS	NS
SEm ±	0.090	1.662	0.386	16.270	0.007
C. D. (@ 5 %)	NS	NS	NS	NS	NS

Table 3: Effect of different organic nutrient sources and bio-fertilizers on quality parameters of sweet potato

Treatments	Quality Characters			
	Starch content (%)	Total sugar content (%)	Dry matter content (%)	Moisture content (%)
T_1	13.70	2.61	31.23	68.77
T_2	14.43	2.97	29.77	70.23
T_3	13.99	2.58	31.33	68.67
T_4	13.58	2.70	28.80	71.20
SEm ±	0.413	0.099	0.950	0.950
C. D. (@ 5 %)	NS	NS	NS	NS
B_0	13.52	2.81	29.68	70.32
B_1	14.33	2.62	30.88	69.12
SEm ±	0.292	0.070	0.672	0.672
C. D. (@ 5 %)	NS	NS	NS	NS
T×B	NS	NS	NS	NS
SEm ±	0.584	0.139	1.343	1.343
C. D. (@ 5 %)	NS	NS	NS	NS

Conclusion

The replacement of 50% RDN with vermi-compost along with recommended dose of fertilizers (T_2) and application of bio-fertilizers were very effective for improving vegetative, quality and yield characteristics. It has also been observed that integrated nutrient sources (mainly vermi-compost and FYM) and bio-fertilizers were effective in improving most majority of the growth parameters from 120 DAP which was reflected in producing higher corm weight and ultimately the highest yield. It can be concluded from the present investigation that the integrated use of organic manures, bio-fertilizers and inorganic fertilizers is efficient than application of inorganic fertilizers alone with respect to growth, yield and quality of elephant foot yam.

References

1. Annepu SK. Effect of integrated nutrient management on growth, yield and quality of elephant foot yam [Amorphophalluspaeoniifolius (Dennst.) var. Gajendra].Thesis M.Sc., submitted to Acharya N. G. Ranga Agricultural Univeristy, Hyderabad, 2011.
2. Anonymous Fertilizer Recommendation Guide. Bangladesh Agriculture Research Council. Farmgate, New Airport Road, Dhaka -1215. 1997, 22.
3. Anonymous. Horticulture and Agroforestry Research Report, N. A. U. Navsari. 2014, 70-71.
4. Anonymous. Horticulture and Agroforestry Research Report, N. A. U. Navsari. 2015, 102-103.
5. Anonymous. Horticulture and Agroforestry Research Report, N. A. U. Navsari. 2016, 122-123.
6. Bairagi SK, Singh PK. Effect of different integrated nutrient management practices on elephant foot yam (Amorphophalluspaeoniifolius Dennst.) under eastern Uttar Pradesh conditions. The Asian J. Hort. 2013; 8(2):565-567.
7. Biswas AK, Sahoo J, Chatli MK. A simple UV-Vis spectrophotometric method for determination of β-carotene content in raw carrot, sweet potato and supplemented chicken meat nuggets. Food Sci. & Tech. 2011; 44(8):1809-1813.
8. Krishnakumar V, Dhanapal R, George V, Thomas. Integrated nutrient management for elephant foot yam.J. Root Crops. 2013; 39(2):263-264.
9. Mukhopadhyay SK, Sen H. Effect of nitrogen and potassium on yield and quality of elephant foot yam (Amorphophalluscampanulatus Blume). J. Root Crops. 1986; 12(2):103-106.
10. Murthy GN, Padma E, Bhagavan BVK, Naga Lakshmi R. Effect of integrated nutrient management on growth and yield of Amorphophalluspaeoniifolius (Dennst. Nicolson) CV. Gajendra. Proceedings - IX annual group meeting, AICRP on tuber crops. 2011, 294-297.
11. Nedunchezhiyan M, Byju G. Productivity potential and economics of elephant foot yam based cropping system. J. Root Crops. 2005; 31(1):34-35.
12. Padmaja G, Moorthy SN, Bala N, Lila Babu, Sundaresan S, Sanjeev MS, *et al.* Analytical methodologies for tropical tuber crops, CTCRI, Trivandrum. 2005, 9-12 & 26-27.
13. Pillai NG, Mohankumar B, Nair PG, Kabeerathummaand, Mohankumar CR. Effect of continuous application of manures and fertilizers on the yield and quality of cassava in laterite soil. In: Proc. Nat. Symp. On production and utilization of tropical tuber crops, CTCRI, Trivandrum, India. 1987, 109-114.
14. Sahoo B, Nedunchezhiyan M, Pinaki Acharyya. Effects of organic and inorganic fertilizers on yield of elephant foot yam and soil enzymes activity. J. Root Crops. 2014; 40(2):33-39.
15. Saravaiya SN, Chaudhary PP, Patel DA, Patel NB, Aahir MP, Patel VI. Influence of integrated nutrient management (INM) on growth and yield parameters of elephant foot yam under southGujarat condition. The Asian J. Hort. 2010; 5(1):58-60.
16. Singh KP, Kalloo G. Nutrient management in vegetable crops. Ferti. News. 2000; 45(4):77-81.
17. Tien TM, Gastins MGH, Hubbell DH. Plant growth substances produced by Azospirillumbrasilense and their effecton the growth of pearl millet (Pennisetumamericanum L.). Applied environ. Microbiol. 1979; 37(5):016-1024.
18. Venkatesan K, Saraswathi T, Jansirani P, Kamalkumar R, Sujatha R. Integrated nutrient management improves yield and quality in elephant foot yam. J. Root Crops. 2013; 39 (2):257-259.