Original Research Article

Effect of the combined nutrient fertilization on elephant foot yam under coastal condition

.

ABSTRACT

As the demand for chemical fertilizers has seen a steep upward trend which has resulted in damage of soil as well as human health. Integrated use of chemical fertilizers along with organic manures has been seen as a alternative method to reduce the dependence upon chemical fertilizers. Hence a the field experiment was carried out to study the effect of intergrated nutrient management practices on available nitrogen, phosphorus, potash in soil along with uptake and economics of elephant foot yam (*Amorphophalluspaeonifolius* (Dennst.) Nicolsan) cv. Gajendra.The study was laid out in randomized block design with thirteen treatments with three replications. Corms were cut into pieces weighing 800 g for planting, dipped in cow dung slurry and placed for drying. After drying, they are placed in the pits and covered with soil. The treatments comprised of three levels of Farmyard manure (FYM) (20 t ha^{-1}), Vermicompost (5 t ha^{-1}), consortium bio fertilizer (5 Kg ha^{-1}) and organic manures of different combinations. The observations of soil propertieswere recorded before and after harvesting. From the study it was observed that soil organic content was increased significantly due to the application of organic manures along with biofertilizers, whereas soil physical and chemical properties were unaffected.

Keywords: [Elephant foot yam, farmyard manure, Vermicompost, benefit cost ratio]

1. INTRODUCTION

“Elephant foot yam, often known as the "King of Tuber Crops" is a tropical under-ground tuber that is grown in Africa and Southeast Asia. Mostly cultivated commercially in Andhra Pradesh, Tamil Nadu, Gujarat, Maharashtra, West Bengal, Jharkhand, Kerala, Karnataka, Bihar, Uttar Pradesh, and Puducherry” [1].“Elephant foot yam prefers well-aerated and well-drained soils and grows well with a suitable amount of organic matter. It has been consistently demonstrated that the continuous, exclusive, and unbalanced application of chemical fertilizers degrades soil health and ecological balance, resulting in a decline in nutrient uptake efficiency” [2].“Soils that solely get plant nutrients from chemical fertilizers have decreased production and a lack in secondary and micronutrients. The use of excessive chemical fertilizers degrades the physical state of the soil. Aside from harming the ozone layer through N_2O formation, excessive nitrogenous fertilizer use is also responsible for ground water contamination and environmental damage. On the other hand, the organic matter content of most soils is quite low, necessitating a rethinking of alternatives. Crop production potential is also influenced by soil physical and chemical qualities, as well as the dynamics of organic matter decomposition by soil microorganisms. The use of bio-fertilizers helps to increase soil micro-flora and fauna, which promotes the pace of decomposition, productivity, and sustainability of the soils” [2,13].

“Organic manures such as farm yard manure, vermicompost, and so on were recognized as important, but they were clearly insufficient in quantity to significantly boost food output. As a result, maximizing the use of organic waste by combining it with chemical and bio-fertilizers in an integrated manner was discovered to be the best solution. Bio-fertilizers are not substitutes for chemical fertilizers, although they can help” [1,2].

"An integrated nutrient management strategy recognizes that soils are the repository for the majority of plant nutrients required for plant growth, and that how nutrients are managed has a significant impact on plant growth, soil fertility, and sustainability" [3].As a result, using inorganic fertilizers in conjunction with organic manures is critical for achieving a sustainable and lucrative output of elephant foot yam. In India, the Green Revolution undoubtedly enhanced agricultural output. However, "productivity fell in many intensively cultivated areas where organic manures were either forbidden or restricted. The increased use of land combined with an increasing reliance on agrochemicals has resulted in agricultural yield stagnation in many situations, prompting a change to alternative farming system approaches that incorporate components of farming-nature harmony" [4]. As a result, the goal of this field experiment was to evaluate the impact of various organic and inorganic nutrient management systems, as well as biofertilizers, on soil accessible nutrients, post harvest nutrient uptake, and B:C ratio under coastal conditions.

2. MATERIAL AND METHODS

The study was conducted in field at Thirukkanur village, Villianur, Puducherry during the year 2020-2022.Healthy and whole seed corms of elephant foot yam were selected from the seed material. The selected whole corms were cut at a size of 250 ±50 g and treated with cow dung slurry for 30 minutes. Then the corms were shade dried for 2-3 days before planting.Study was carried out in randomized block design in a plot size of 4x3 m with a spacing of 60x60 cm.Plant samples were dried in an oven at 60° ± 5°C and grounded into fine powder in a willey mill and used to determine the nutrient content (N, P, K). For analyzing the various nutrient content,Humphries Microkjeldhal method was followed to estimatetotal nitrogen content, total phosphorus content was estimated by using vanadomolybdate method of Jackson and potassium was estimated by using flame photometer method.

For analysing soil available nutrient, alkaline permanganate method for available nitrogen, calorimeter method for available phosphorus and flame photometer for available potassium were used.Cost economics were derived by calculating the various inputs of farmyard manure, vermicompost, labour, irrigation and other inputs for each and every treatment combination.Observation recorded were nutrient uptake by plants (Nitrogen, Phosphorus, Potassium), post harvest soil available nutrient analysis and cost economics.The data result of the field experimental hasbeen presented in (Table 2&3).

2.1 Treatment Details

The treatments comprised of three levels of recommended dose of fertilizers (RDF - 80:40:100 Kg NPK ha^{-1}) *viz*., 75%, 100% and 150% along with organic inputs *viz*., FYM (20 t ha^{-1}),Vermicompost (5 t ha^{-1}) and (Consortium bio fertilizer 5 Kg ha^{-1}) (Table 1).

TABLE 1 :Treatment Details

Treatment	Treatment Details
T_1	FYM 20 t ha^{-1} + 75% RDF (60:30:75 Kg NPK ha^{-1})
T_2	FYM 20 t ha^{-1} + 100% RDF (80:40:100 Kg NPK ha^{-1})
T_3	FYM 20 t ha^{-1} + 125% RDF (100:50:125 Kg NPK ha^{-1})
T_4	FYM 20 t ha^{-1} + 75% RDF (60:30:75 Kg NPK ha^{-1}) + CBF 5 Kg ha^{-1}
T_5	FYM 20 t ha^{-1} + 100% RDF (80:40:100 Kg NPK ha^{-1}) + CBF 5 Kg ha^{-1}
T_6	FYM 20 t ha^{-1} + 125% RDF (100:50:125 Kg NPK ha^{-1}) + CBF 5 Kg ha^{-1}

T_7	Vermicompost 5 t ha^{-1} + 75 % RDF (60:30:75 Kg NPK ha^{-1})
T_8	Vermicompost 5 t ha^{-1} + 100 % RDF (80:40:100 Kg NPK ha^{-1})
T_9	Vermicompost 5 t ha^{-1} + 125 % RDF (100:50:125 Kg NPK ha^{-1})
T_{10}	Vermicompost 5 t ha^{-1} + 75 % RDF (60:30:75 Kg NPK ha^{-1}) + CBF 5 Kg ha^{-1}
T_{11}	Vermicompost 5 t ha^{-1} + 100 % RDF (80:40:100 Kg NPK ha^{-1}) + CBF 5 Kg ha^{-1}
T_{12}	Vermicompost 5 t ha^{-1} + 125 % RDF (100:50:125 Kg NPK ha^{-1}) + CBF 5 Kg ha^{-1}
T_{13}	Control

3. RESULTS AND DISCUSSION

Table 2 shows the soil physical parameters, bulk density (BD) as well as the chemical properties, soil organic carbon, available N, P, K levels and post harvest soil nutrient status as modified by different treatments. The soil organic carbon concentration was highest when 50% of the N was replaced with vermicompost, which recorded 0.64% organic carbon content and was comparable to T_{12}. Replacing 50% N with diverse organic nutrient sources increased the amount of organic carbon in the soil, resulting in a considerable increase in soil organic carbon content. “The effect of bio-fertilizer application was found to be significant, with the highest organic carbon content of 0.64% found in the treatment with bio-fertilizer application, which may be due to well decomposition of organic manures by applied microbes, which may ultimately increase soil organic carbon content”(Suja G et al.,)[6,13]. Similar results have been also reported in other crops under Indian conditions by Mahapatra BS et al., [5], Srivastava AK et al., [8].Nedunchezhiyan M et al., [1] discovered that “manure treatment increased soil microbial bio-mass and carbon content. The enzymes found in organic manures may also directly boost soil enzymatic activity”.

Better N, P, and K consumption was reported in treatments with integrated nutrition management or a higher level of vermicompost application. Control had the lowest nitrogen, phosphorus, and potassium intake. After two years of experiments, available P in the chemical plot was noticeably increased. This could be owing to the inclusion of synthetic fertilizers as well as FYM, which could limit P fixation. Bulk density was non-significant, but accessible N, P, and K were slightly higher in the treatments where 100% of the nitrogen was replaced with organic manures. Suja G et al., [10] obtained similar results in elephant foot yam. When compared to the initial soil status, the amount of accessible N, P, and K contents is about equal to or slightly higher.

According to the findings, elephant foot yam efficiently utilized the extra nitrogen for vegetative growth while phosphorus and potassium for improved quality and corm production. The post-harvest soil nutrient status revealed that maximum soil N, P_2O_5 and K_2O_5 was available in T_{11}. Elephant foot yam response to P_2O_5 was observed up to 60 kg ha^{-1}Sethi K et al., [7]. This might be due to un-utilization of applied N and K in this treatment. Whereas in case of P_2O_5 was as result of excess application of P and lesser utilization of P by the crop.

Table. 2. Effect of organic sources, recommended dose of fertilizers and biofertilizers on soil status of elephant foot yam.

Treatments	Bulk density (gcm^{-3})	Soil O.C.(%)	Nutrient uptake (Kg ha^{-1})			Post harvest soil nutrient status (Kg ha^{-1})		
			N	P	K	N	P_2O_5	K_2O
T_1	1.40	0.60	118.73	106.51	87.64	88.59	52.09	82.69
T_2	1.34	0.62	148.06	149.83	113.69	101.45	61.17	91.46
T_3	1.40	0.58	129.81	128.72	100.51	95.06	56.34	87.05
T_4	1.42	0.59	116.22	112.83	90.88	90.23	53.26	83.80
T_5	1.41	0.61	152.51	155.13	116.85	103.12	62.21	92.54
T_6	1.36	0.49	134.27	134.00	104.11	96.66	57.48	88.16
T_7	1.31	0.55	120.83	118.14	94.03	91.89	54.30	84.91
T_8	1.47	0.57	157.00	160.42	120.06	104.69	63.27	93.65
T_9	1.45	0.60	13.11	44.00	1670.40	98.31	59.02	89.02
T_{10}	1.60	0.54	12.00	41.89	1440.32	93.45	55.31	86.00
T_{11}	1.23	0.64	14.60	46.86	2009.17	106.31	64.29	94.83
T_{12}	1.11	0.63	13.46	44.68	1743.72	99.87	60.11	90.38
T_{13}	1.63	0.61	9.47	37.52	1068.26	85.28	50.17	79.51
CD (p=0.05)	NS	NS	0.34	0.68	2.35	1.53	0.98	1.03

*(Method of estimation of nitrogen, phosphorus, potash and post harvest soil nutrient status are given in material and methods)

The data presented in Table 3 revealed that the highest B:C ratio (4.46) was obtained in the treatment T_5 which was closely followed by the B:C ratio of 4.27, obtained in the treatment combination of T_{11}. The key explanation for this finding is the price differential between vermicompost and farm yard manure. The B: C ratio in all organic treatments can be increased if organic manures are created on the farm. One of the most significant aspects of organic farming is the natural fertility of each field/farm or region. As a result, effort should be taken to ensure that only a limited amount of nutrients exit the system, hence limiting "import" of nutrients. This can only be accomplished by recycling on-farm waste, which lowers input costs (Yadav AK et al.,)[12].

Table. 3. Effect of integrated nutrient management on cost economics analysis in elephant foot yam

S.No		**Cost of cultivation (Rs ha^{-1})**	**Total yield (t ha^{-1})**	**Gross income (Rs ha^{-1})**	**Net income (Rs ha^{-1})**	**B:C ratio**
1	T_1	136257	24.21	484200	347943	2.55
2	T_2	138787	36.51	730200	591413	4.26
3	T_3	141781	30.20	604000	462219	3.26
4	T_4	137257	25.58	511600	374343	2.72
5	T_5	139787	38.18	763600	623813	4.46
6	T_6	142781	31.98	639600	496819	3.48
7	T_7	148757	27.37	547400	398643	2.68
8	T_8	151287	39.75	795000	643713	4.25
9	T_9	154281	33.38	667600	513319	3.33
10	T_{10}	149757	28.78	575600	425843	2.84
11	T_{11}	152287	40.15	803000	650713	4.27
12	T_{12}	155281	34.84	696800	541519	3.49
13	T_{13}	111475	21.34	426800	315325	2.83

List 1 :Cost of Experimental sources

Urea – 298/50 kg	FYM – 500/t	Labour cost – 200/day
SSP - 356/50 kg	Vermicompost – 5100/t	Seed cost – 20/kg
MOP – 565/50 kg	Irrigation charges – 50/hr	Bio fertilizers – 120/litre

4. CONCLUSION

It is concluded that individual effect of integrated nutrient sources and bio-fertilizers had been effective in improving the soil fertility status. The aforementioned list suggests that integrated nutrient management using vermicompost and biofertilizers significantly improves soil status when growing elephant foot yams. On par with T11, the highest B:C ratio was seen in T5.

REFERENCES

1. Nedunchezhiyan M, Byju G, Dash SN. Effects of organic production of orange fleshed sweet potato (*Ipomoea batatas*L.) on root yield, quality and soil biological health. International Research Journal of Plant Science. 2010; 1(6):136-143.

2. Saravaiya SN, Chaudhary PP, Patel DA, Patel NB, Aahir MP and Patel VI. Influence of intergrated nutrient management on growth and yield parameters of elephant foot yam under south Gujarat condition. Asian Journal of Horticulture. 2010; 5(1):58-60.

3. Janssen BH. Integrated nutrient management with the use of organic and mineral fertilizers. In: The role of Plant Nutrients for Sustainable Food Crop Production in Sub-Saharan Africa.1993; 89-105.

4. Alexander D. The Adhoc Package of Practices Recommendations for Organic Farming,Kerala Agricultural University, Thrissur, 2002; pp-209.

5. Mahapatra BS, Singh SP, Rajesh A, Vishwakarma VK, Bhushan C, Anil Kumar et al. Performance of lentil, chick pea and wheat under organic mode during initial years of conversion in relation to nutrient management practices. *Journal of EcofriendlyAgric*. 2006;1: 105-116.

6. Suja G, Sreekumar J, Susan John K and Sundaresan S. Organic production of tuberous vegetables: Agronomic, nutritional and economic benefits. *J. Root Crops.* 2012 a; 38: 135-141.

7. Sethi K, Mohanty A, Naskar SK, Byju G and Mukherjee A. Effect of set size, spacing and NPK fertilizer on yield of *Amorphophallus*in hilly areas of Orissa. Orissa Journal of Horticulture. 2002;30: 72-75.

8. Srivastava AK, Singh S, Shivankar VJ, Das AK and Rao CN. Organic Citrus Status. National Research Centre for Citrus, Nagpur, Maharashtra, 2006; pp.175.

9. Patel NB, Saravaiya SN, Patel BN and Desai KD. Studies in integrated nutrient management (INM) in elephant foot yam. The Asian Journal of Horticulture.2010; 5(1): 32-33.

10. Suja G, Sundaresan S, Susan John K, Sreekumar J and Misra RS. Higher yield, profit and soil quality from organic farming of elephant foot yam. *Agron. Sustain. Dev.* 2012 b; 32: 755-764.

11. Suja G, Susan John K, Ravindran CS, Prathapan K and Sundaresan S. On farm validation of organic farming technology in elephant foot yam [*Amorphophalluspaeoniifolius* (Dennst.) Nicolson]. *J. Root Crops.* 2010; 36: 59-64.

12. Yadav AK. *Organic Agriculture-Concept, Scenario, Principles and Practices*. National Centre for Organic Farming, Department ofAgriculture and Co-operation, Ministry of Agriculture, GOI,Ghaziabad, Uttar Pradesh, 2011; 60 p.

13. Navya K, Desai KD, Tandel YN, Sheth SG. Response of elephant foot yam to different INM sources and its effect on economics and soil health. Journal of Pharmacognosy and Phytochemistry. 2017;6(6S):246-51.