



P-ISSN: 2349-8528

E-ISSN: 2321-4902

www.chemijournal.com

IJCS 2020; 8(6): 252-255

© 2020 IJCS

Received: 12-08-2020

Accepted: 10-10-2020

Kamalkumaran PR

Assistant Professor,
Horticultural Research Station,
TNAU, Yercaud, Tamil Nadu,
India

M Velmurugan

Assistant Professor, Department
of Floriculture and Landscape
Architecture, TNAU,
Coimbatore, Tamil Nadu, India

M Anand

Assistant Professor,
Horticultural Research Station,
TNAU, Yercaud, Tamil Nadu,
India

T Arumugam

Dean (Horticulture), HC & RI,
TNAU, Periyakulam,
Tamil Nadu, India

Corresponding Author:**Kamalkumaran PR**

Assistant Professor,
Horticultural Research Station,
TNAU, Yercaud, Tamil Nadu,
India

Site specific nutrient management in elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson)

Kamalkumaran PR, M Velmurugan, M Anand and T Arumugam

DOI: <https://doi.org/10.22271/chemi.2020.v8.i6d.10777>

Abstract

Efforts were made to study the soil test based site-specific nutrient management (SSNM) practices in Elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson). Among the different treatments, application of nutrients based on soil test (T₂) recorded significantly higher plant height (81.33 cm), pseudostem girth (15.68 cm), number of leaves (4.81 nos.) and yield (48.94 t/ha) over control and was on par with the treatment T₁ (Recommended dose of NPK as per CTCRI package) with the plant height (79.74 cm), pseudostem girth (14.99 cm), leaf production (4.44 nos.) and yield (48.56 t/ha). Based on these findings, fertilizer use needs to be tailored as per the site specific soil test data instead of recommended doses of fertilizers (RDF) which has highest Benefit Cost Ratio of 2.58.

Keywords: SSNM-elephant foot yam-nutrients-yield-BCR

Introduction

Elephant foot yam, (*Amorphophallus paeoniifolius* (Dennst.) Nicolson) is among the important tropical tuber crop most generally cultivated edible aroids and its cultivation is prevailing in Philippines, India, Malaysia, Indonesia, China, Sri Lanka and plenty of different Southeast Asian countries. India is a major producer of this crop, is historically cultivated on commercial scales mainly in the states viz., Andhra Pradesh, Tamil Nadu, West Bengal and Kerala with productivity potential of 30-100 t/ha (Ravi *et al.*, 2011)^[14]. In India, it is commonly known as *Jimmikand* or *Suran* and in Tamil Nadu it is called as Karunai kilangu or Senai kilangu. The tubers of elephant foot yam are commonly used as a vegetable after cooking and as pickles after processing. The tubers of elephant foot yam is rich in calcium, phosphorus and vitamin A. The tubers are rich source of starch as well as good amount of protein and also used in the preparation of traditional ayurvedic medicines (Mishra *et al.*, 2002)^[7]. Compare to potato, the tubers of elephant foot yam are cheap source of starch, vitamins and minerals (Bradbury and Holloway 1988)^[1], and play a vital role as food security crop and are the important staple or subsidiary food for a large population of people in the tropical and subtropical regions of the world. The leaves of elephant foot yam are used as a vegetable after cooking by local tribes in India and Asian nations because they contain a high concentration of vitamin A (Rajalakshmi *et al.*, 2001)^[13]. The tubers of wild plants are highly acrid and cause physical irritation in tongue, mouth and throat due to excessive amount of calcium oxalate crystals present in the flesh. In India, owing to high productivity and financial gain the cultivation of elephant foot yam is slowly spreading to different states like Bihar and Uttar Pradesh also. In India, the foremost important variety for commercial cultivation is “*Gajendra*”, that is an improved selection from the Kovvur area of Andhra Pradesh. The tubers can be stored for long time and also offers excellent export potential from India, since it is not generally cultivated in commercial scale in other countries.

The quantity of chemical fertilizer to be applied to any crop depends upon the initial soil nutrient status and the yield targets to be achieved. A definite amount of nutrients must be applied to the crop for achieving the yield target of a crop and the quantity of nutrients can be calculated by taking into consideration of soil available nutrients. This forms the basis for the fertilizer recommendation of targeted yield of important crops (Subba Rao and Srivastava, 2001)^[15].

The methods of fertilizer application based on 'soil testing' is unique in the sense that this method not only indicates soil test based fertilizer dose but also the level of yield the farmer can possibly achieve if good horticultural practices are followed in cultivating the crop. This approach is also unique for soil plant system, because it provides a scientific basis for balanced fertilization not only among the nutrients from fertilizer but also soil available nutrients (Deshmukh, 2008)^[4]. The management of nutrients for any crop requires a new approach, which enables adjustments in applying N, P and K to accommodate the field specific needs of the crop for nutrients. The specific nutrient management (SSNM) provides an approach for need based 'feeding' of the crops with nutrients. The SSNM approach aims at increasing farmer's profit by achieving the goal of maximum yield of specific crop and also reducing the cost of cultivation.

Nevertheless, little research work has been done on the response of *Amorphophallus* to site specific nutrient management and this paper reports the response of *Amorphophallus* to site specific nutrient management practice. With this concept in mind, a study was conducted to quantify the variation in soil nutrient supply in fields of major elephant foot yam production regions of India, where elephant foot yam is cultivated on a large scale, and to develop a suitable approach for site-specific nutrient management (SSNM).

Material and Methods

Field Experiments

The experiment on the effect of site specific nutrient management on growth and productivity of elephant foot yam was conducted in the College Orchard, Department of Vegetable Crops, Horticultural College and Research Institute, TNAU, Coimbatore during 2012-13 to 2014-15. The experimental site is characterized with clay loamy soil texture rich in organic matter content. Coimbatore receives on an average 650- 700 mm rainfall annually and is situated at an elevation of 426 M (longitude: 77°E and latitude: 11°N). The average annual temperature ranges from 25 °C - 38 °C. The pooled data of three year study are given in the table 3.

In this experiment, 500 g of cut pieces of corm of the variety Gajendra was planted at a spacing of 90 cm either way in randomized block design (RBD) with three replications. The individual plot size is 12 m². There were six treatments, viz., T₁-Recommended dose of 80 kg N: 60 kg P: 100 kg K as per CTCRI package, T₂- Nutrients based on soil test data, T₃- Zero N and application of P and K based on soil test, T₄ - Zero P and application of N and K based on soil test, T₅ - Zero K and application of N and P based on soil test and T₆- No added fertilizers (Control). Adequate measures were taken in all the field experiments to control pests, diseases, and weeds. In unfertilized plots (T₆), no NPK fertilizers were applied, and all other crop management practices were followed uniformly to all the treatments. Observations on plant height (cm), pseudostem girth (cm), leaf production (nos.) and yield (t/ha) were recorded. Corm yield per plant was recorded at final harvest.

Data Collection

Various growth characters viz., plant height, pseudostem girth, leaf production and yield traits were recorded. Data were subjected to analysis of variance (ANOVA) using the AGRES statistical programme.

Soil and Plant Analysis

The amount of nutrient applied is determined based on soil test data (80 kg N, 50 kg P and 80 kg K). This approach

emphasizes short-term profitability from fertilization; high returns per kilogram of fertilizer applied, and reduced risk of fertilizer over-application by accepting a moderate risk of yield loss. Initial soil samples before the start of the experiments were collected from the top 0 to 15 cm soil layer, and a representative composite sample was prepared for different soil chemical analysis. The soil samples were air dried, sieved through a 2-mm sieve, and analyzed for pH (1:2.5 soil/water), organic carbon (Walkley and Black 1934)^[17], available N (Subbiah and Asija 1956)^[16], Bray P (Bray and Kurtz 1945)^[2], Olsen P (Olsen *et al.*, 1954)^[10], and exchangeable K (Knudsen, Peterson, and Pratt 1982)^[6]. The initial soil characteristics of the experimental site are presented in the table 1.

Table 1: Initial Soil Characteristics

Parameters	Value	Comments
Organic Carbon	0.65 (%)	Medium
pH	8.34	Slightly alkaline
EC	1.01 dS/m	Non Saline
Available N	173 kg/ha	Low
Available P (Olsen's)	32 kg/ha	High
Available K	1698 kg/ha	High

Results and Discussion

Significantly higher plant height (81.33 cm) was obtained in the treatment T₂ (nutrients based on soil test data) over control (65.10 cm) and was on par with all other treatments, T₁ (Recommended dose of 80 kg N: 60 kg P: 100 kg K as per CTCRI package) (79.74 cm) and T₃ with Zero N and application of P and K based on soil test (76.52 cm), T₄ with Zero P, N and K based on soil test (74.06 cm) and T₅ with Zero K, N and P based on soil test (74.14 cm) (Table 2).

The pseudostem girth was also significantly higher (15.68 cm) in the treatment T₂ (nutrients based on soil test data) over control (11.92 cm), and was on par with the T₁ with recommended dose of 80 kg N: 60 kg P: 100 kg K as per CTCRI package (14.99 cm) and T₃ with Zero N and application of P and K based on soil test (13.80 cm) and T₄ with Zero P, N and K based on soil test (12.48 cm).

Same trend was followed in number of leaf produced per plant and significantly higher leaf production (4.81nos.) was obtained in the treatment T₂ (nutrients based on soil test data) over control (3.55), and was on par with all other treatments.

The corm yield obtained in the treatment, T₂ (48.94 t/ha) was on par with T₁ (48.56 t/ha) and significantly higher than all other treatments and control.

The findings of Phonde and Zende (2007)^[12]; Nerkar and Phonde (2009)^[8]; Pampolino *et al.*, (2007)^[11] and Khurana *et al.*, (2008)^[5] who reported that the sugarcane yields were higher in the site specific nutrient management treatment (160 t/ha) than in the soil testing laboratory fertilizer recommendation (139.7 t/ha). The higher yield advantage was recorded in nutrients based on soil test data. Further they stated that, there was no significant difference among the treatments with respect to plant height, stem girth, leaf production, yield and quality parameters viz., brix, pol percent, purity coefficient, recovery and CCS per cent in sugarcane. However, plant height, pseudostem girth, leaf production and yield were numerically higher in the treatments T₂ (81.33cm, 15.68 cm, 4.81nos. and 48.94 t/ha respectively) (Table 2). One of the reasons attributed to the lower yield in elephant foot yam is the imbalanced application of essential plant nutrients. Site specific nutrient management (SSNM) is the application of plant nutrients based on the soil

and crop needs (Byju *et al.*, 2016) [3]. The balanced application of all the major nutrients in required quantity (based on soil test data) might have resulted in higher tuber

yield. Similar results were recorded by earlier workers (Phonde and Zende, 2007 [12]; Nerkar and Phonde, 2009 [8] and Oad *et al.* 2009) [9].

Table 2: Site specific nutrient management of elephant foot yam variety Gajendra on growth and yield parameters

Treatments	Plant Height (cm)	Pseudostem girth (cm)	Leaf production (nos.)	Yield (t/ha)
T ₁ Recommended dose of NPK as per CTCRI package	79.74	14.99	4.44	48.56
T ₂ Nutrients based on soil test data	81.33	15.68	4.81	48.94
T ₃ Zero N, P and K based on soil test	76.52	13.80	4.28	31.32
T ₄ Zero P, N and K based on soil test	74.06	12.48	4.32	35.13
T ₅ Zero K, N and P based on soil test	74.14	12.02	4.33	35.76
T ₆ No added fertilizers	65.10	11.92	3.55	24.49
Mean	35.07	13.48	4.30	36.53
CD(0.05%)	8.31	3.32	0.81	3.23
SEd	4.15	1.63	0.41	1.63

Table 3: Effect of site specific nutrient management treatments on the economics of cultivation of elephant foot yam variety Gajendra

Treatments	Yield (t/ha)				B:C ratio
	2012-13	2013-14	2014-15	Pooled	
T ₁ Recommended dose of NPK as per CTCRI package	49.72	48.23	48.56	48.84	2.42
T ₂ Nutrients based on soil test data (80:48:80 kg NPK/ha)	51.43	50.35	48.94	50.24	2.58
T ₃ Zero N, P and K based on soil test	32.26	34.56	31.32	32.71	1.71
T ₄ Zero P, N and K based on soil test	38.34	37.25	35.13	36.91	1.89
T ₅ Zero K, N and P based on soil test	40.27	38.78	35.76	38.27	1.86
T ₆ No added fertilizers	25.69	26.45	24.49	25.54	1.65
Mean	39.62	39.27	36.53	38.75	
CD(0.05%)	4.66	3.21	3.23	7.42	
SEd	1.90	1.52	1.63	3.87	

Highest benefit cost ratio (2.58) was obtained in T₂ (nutrients based on soil test data) with the net return of Rs 1,83,000/ha due to the reduced cost of cultivation followed by T₁ (2.42) compared to the lowest BC ratio of 1.65 recorded in T₆ (No added fertilizers) (Table 3).

Conclusion

Productivity and profitability of elephant foot yam in the major production domains of Tamil Nadu could be increased through the closing of exploitable yield gaps using a site-specific approach to nutrient management. SSNM was able to approximate attainable yields in elephant foot yam with more optimal fertilizer rates and higher nutrient use efficiencies. A key next step to widespread adoption of site specific nutrient management (SSNM) is to incorporate its principles and strategies into simple decision support tools for practical use by farmers and crop advisors.

References

- Bradbury JH, Holloway WD. Chemistry of Topical Root Crops: Significance for National and Agriculture in the Pacific Australian Centre for International Agriculture Research 1988, 51-99.
- Bray RH, Kurtz LT. Determination of total, organic, and available forms of phosphorus in soils. Soil Science 1945;59:39-45.
- Byju G, Nedunchezhiyan M, James George, Sunitha S, Kamalkumaran PR, Singh PP, *et al.* Fertilizer best management practices by SSNM and customized fertilizers for elephant foot yam (*Amorphophallus paeoniifolius*) cultivation in India. Indian Journal of Agricultural Sciences 2016;86(4):485-93.
- Deshmukh AK. Response of chilli (*Capsicum annuum* L.) to site specific nutrient management through targeted yield approach in northern transition zone of Karnataka.

M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Dharwad, Karnataka 2008.

- Khurana HS, Philips SB, Singh B, Alley MM, Dobermann A, Sidhu AS *et al.* Agronomic and economic evaluation of site-specific nutrient management for irrigated wheat in northwest India. Nutr. Cycling Agroecosyst 2008;88:15-31.
- Knudsen D, Peterson GA, Pratt PF. Lithium, sodium, potassium. In Methods of soil analysis, part 2, ed. A. L. Page. Madison, Wisc.: ASA-SSSA 1982.
- Mishra RS, Nedunchezhiyan M, Swam TMS, Edison S. Mass multiplication technique for producing quality planting material of *Amorphophallus paeoniifolius*. Tropical Science 2002;34:371-376.
- Nerkar YS, Phonde DB. Site-specific nutrient management for maximum economic yield and quality of sugarcane in Maharashtra 2009. www.ipni.net.
- Oad FC, Buriro UA, Usmanikhail MU, Siddiqui MK. Qualitative and quantitative parameters of sugarcane crop under different sources of fertilizers. Pak. Sugar J 2009;24(1):10-14.
- Olsen SR, Cole CV, Wantanable FS, Dean LA. Estimation of available phosphorus in soil by extraction with Sodium bicarbonate. United State Dept. of Agric. CIRC., Washinton, D.C 1954, 939.
- Pampolino MF, Manguiat IJ, Ramanathan S, Gines HC, Tan PS, Chi TTN, *et al.* Environmental impact and economic benefits of site-specific nutrient management (SSNM) in irrigated rice systems. Agric. Syst 2007;93:1-24.
- Phonde DB, Zende NA. Site specific nutrient management for maximum yield and quality of sugarcane. Paper presented In: Nation. Seminar on Integrated Nutrient Management in Sugarcane Cultivation, Vasantdada Sugar Institute, Pune 2007, 27-28.

13. Rajalakshmi P, Vankatalaxmi K, Venkatalaksh Mamma, K, Jyothsna Y, Devi KB, Suneetha V *et al.* Total carotenoid and betacarotene contents of forest green leafy vegetables consumed by tribals of south India. *Plant Foods for Human Nutrition* 2001;56:225-38.
14. Ravi V, Ravindran CS, Suja G, James George, Nedunchezhiyan G, Byju G, Naskar SK *et al.* Crop physiology of elephant foot yam (*Amorphophallus paeoniifolius* (Dennst. Nicolson). *Advances in Horticulture Science* 2011;25(1):51-63.
15. Subba Rao A, Srivastava S. Soil Test-based Fertilizer Recommendations for targeted Yield of Crops. Indian Institute of Soil Science, Bhopal, Madhya Pradesh, India 2001, p. 326.
16. Subbaiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soil. *Curr. Sci* 1956;25:259.
17. Walkley A, IA Black. An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Sci* 1934;37:29-37.