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# Site-specific Nutrient Management in Elephant Foot Yam-A Review

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**A B S T R A C T**

Rice is the major crop cultivated during *kharif* in eastern region of India, particularly in Odisha. Inconsistent and erratic behaviour of monsoon, high input costs and low market price at farm gate for rice is becoming unremunerative at times. Crop diversification with high potential crops seems to be a viable solution for the above situations. Elephant foot yam is an important food crop with a variety of alternative uses, has not been tried much in this region. With vast production potential and wide agro-climatic adaptability, if elephant foot yam can fit into the cropping systems of this region, it becomes most suitable answer to the bereaved farmers. However, elephant foot yam exhaust lot of nutrients from the soil owing to its high yield. Alfisols, most predominant in eastern region of India, particularly Odisha is deficient in major nutrients i.e., nitrogen (N), phosphorus (P) and potassium (K) along with minor nutrients especially magnesium (Mg), zinc (Zn), and boron (B). Hence, optimization of site specific nutrient requirement is to be worked out to harness the maximum yield without harming soil health. The work done on these aspects in elephant foot yam and other related tuber crops have been reviewed and discussed below.

## Introduction

Rice is the major crop cultivated during *kharif* in eastern region of India, particularly in Odisha. Inconsistent and erratic behaviour of monsoon, high input costs and low market price at farm gate for rice is becoming unremunerative at times. Crop diversification with high potential crops seems to be a viable solution for the above situations. Tuber crops

play in the multifaceted needs of more than500 million people mostly in South and South East Asia, West Africa and the Pacific Ocean Islands contributing to their food, nutritional, social and economic security. The major tropical tuber crops include cassava (*Manihot esculenta* Crantz.), sweet potato [*Ipomoea batatas* (L.) Lam.], yams (*Dioscorea* spp.), aroids like elephant foot yam [ *Amorphophallus paeoniifolius* (Dennst.) Nicolson], taro [*Colocasia esculenta* (L.) Schott.] and tannia [*Xanthosoma sagittifolium* (L.) Schott.]. Elephant foot yam is an important food crop with a variety of alternative uses, has not been tried much in this region. With vast production potential and wide agro-climatic adaptability, if elephant foot yam can fit into the cropping systems of this region, it becomes most suitable answer to the bereaved farmers. However, elephant foot yam exhaust lot of nutrients from the soil owing to its high yield. Alfisols, most predominant in eastern region of India, particularly Odisha is deficient in major nutrients i.e., nitrogen (N), phosphorus (P) and potassium (K) along with minor nutrients especially magnesium (Mg), zinc (Zn), and boron (B). Hence, optimization of site specific nutrient requirement is to be worked out to harness the maximum yield.

Soil health is imperative to obtain high yield and quality in tuber crops. Both the chemical and physical condition of the soil can be changed to benefit the tuber production in tropical tuber crops. Judicious application of fertilizers and manures plays a pivotal role in the production technology of tropical tuber crops. The manures used to supplement organic matter to the soil, so that through decay, it furnish more or less continuous supply of nutrients to the crops and improve the soil condition for better tuber bulking. They supply practically all the elements of fertility which crop require, though not in adequate proportion. The application of fertilizers restores or increases the amount of deficient nutrients. They are applied mainly to increase the supply of the essential nutrients, e.g., N, P and K. The nitrogenous fertilizer promotes the vegetative growth of the crop by imparting a healthy green colour to the leaves and it also controls the efficient utilization of P and K. The phosphatic fertilizer influences the vigour of plants and improves its quality. The role of K may be associated with starch synthesis leading to promotion of tuber growth and accelerated translocation of photosynthates from source to sink.

## Uptake

The nutrient requirement of elephant foot yam is fairly high. In this context investigation carried out by Mohankumar *et al.,* (1984) revealed that the yield of 36 t $ha^{-1}$of elephant foot yam removed 121.9 kg N, 30.5 kg P and 176.4 kg K $ha^{-1}$ from the soil. It was observed that the absorption of nutrients was high at the third month for N and sixth for P while K uptake was steady throughout the crop growth.

Under controlled conditions, the uptake of nutrients N, P and K studied under three different levels of N, P and K alone and along with FYM and the mean uptake of N, P and K were 26.89, 4.23 and 36.63 g $m^{-2}$ respectively. A crop of elephant foot yam producing a tuber yield of 43 t $ha^{-1}$ removed 124.8 kg N, 26.1 kg P and 222.4 kg K respectively (Kabeerathumma *et al.,* 1987).

Kabeerathumma *et al.,* (1987) studied the N, P and K utilization pattern of elephant foot yam during different growth stages of the crop and found a progressive increase in the uptake of the nutrients with increase in the age of the crop. The rate of uptake of N and P was found to be maximum between 3-5 months after planting (MAP). After 7 months after planting (MAP), no conspicuous increase in N and P uptake was noticed. Though K uptake was

maximum during 3-5 months after planting (MAP), it continued to increase with the age of the crop with the highest during the tuber bulking period.

Nair *et al.*,(1990) reported that elephant foot yam producing a corm yield of 43.0 t $ha^{-1}$ removed 124.8 kg N, 26.1 kg P and 222.4 kg K $ha^{-1}$ underrainfed, upland conditions in acid ultisol.

Pushpakumari and Sasidhar (1996) studied the uptake of N, P and K by elephant foot yam under shade and found that N and P uptake decreased with increasing shade intensities and K uptake was uniform at shade levels from 0-50%, but significantly higher at 75% shade.

Further studies on the N, P and K content of different plant parts at various growth stages revealed that the nutrient content changes with increase in age of the crop. The N and K content in the foliage of elephant foot yam were the highest after 5 MAP and thereafter it decreased with maturity. The N content of root, corm and pseudostem decreased towards maturity of the crop. Among the different plant portions, leaf was having higher amount of N (2-4%) and pseudostem had the highest K content (>4%).

The K content of corm was maximum during corm initiation which decreased towards bulking. The P content was maximum in leaves with maximum concentration during the early growth stage and further declined towards the maturity stage.

Verma *et al.,* (1995) reported that the N and K contents were the highest in shoots and corms at 150 days after planting (DAP).

He further reported that concentration of N in shoots and corms decreased with growth stage and increased with N application rate.

## Response

Mandal and Saraswat (1968) worked out the response of FYM and NPK fertilization on elephant foot yam and found that plots which received FYM 25 t $ha^{-1}$ with NPK 80:80:120 $kgha^{-1}$ respectively gave the highest corm yield of 34.6 t $ha^{-1}$ against 11.6 $tha^{-1}$recorded in manure control (no application of fertilizers) plot. Though yield response to potassium was noticed up to 120 kg $K_2O$ $ha^{-1}$, yield beyond 80 kg $K_2O$ $ha^{-1}$ was not significant. A dose of FYM 25 t $ha^{-1}$and NPK 40:40:80 $kgha^{-1}$ was however found to be economical for elephant foot yam.

Hrishi and Nair (1972) also shared similar observation and suggested 40 kg each of N and P and 80 kg K in combination with FYM 12 t for high yield of good quality corms of elephant foot yam in Kerala.

The trials conducted at Central Tuber Crops Research Institute (CTCRI), Trivandrum revealed that NPK combination of 100:80:120 kg $ha^{-1}$ gave higher corm yield of 32.92 $tha^{-1}$, though different levels of fertility (N:P:K 80:60:100, 80:80:120,100:60:100 and100:80:120 kg $ha^{-1}$) showed no significant effect on the corm production of elephant foot yam. However, Mohankumar *et al.,* (1984) viewed that the crop when given 25 t $ha^{-1}$ of FYM along with 80, 60 and 100 $kgha^{-1}$ of N, P and K, respectively enhanced corm production. Under sandy loam soils of West Bengal, Mukhopadhyay and Sen (1986) studied the response of elephant foot yam to N and K nutrition ranging from 50 to 150 kg with uniform dosage of $P_2O_5$60 kg $ha^{-1}$. The results suggested that nitrogen influenced the growth and yield up to 150 kg $ha^{-1}$ and potassium application beyond 50 kg $ha^{-1}$did not show any significant response on the corm yield, a maximum corm yield of 110.6 $tha^{-1}$was recorded under NPK dosage of 150:60:50 kg $ha^{-1}$ in crop duration of six months.

Patel and Mehta (1987) also reported an increase in corm yield (31.81 to 36.73 t $ha^{-1}$) with the application of FYM 30 t $ha^{-1}$. Besides, they recorded increased corm yield from 33.24 to 34.40 t $ha^{-1}$ by increasing N rates from 0 to 100 and 150 kg $ha^{-1}$, respectively.

Ghosh *et al.,* (1988) reported that the presence of NPK fertilization, a linear response to FYM up to 25 t $ha^{-1}$ has been observed under rainfed conditions in acid lateritic soils of Kerala.

Nair *et al.,* (1990) in their experiments on fertilizer requirement of elephant foot yam with three levels of NPK viz. N 50,100 and 150 kg $ha^{-1}$; $P_2O_5$25, 50 and 75 kg $ha^{-1}$and $K_2O$ 75,150 and 225 kg$ha^{-1}$ obtained highest yield of 43.0 t$ha^{-1}$ by using 100:50:150 N, $P_2O_5$ and $K_2O$kg $ha^{-1}$, respectively.

Nair and Mohankumar (1991) found that the dry matter in the above ground portion increased up to 6 MAP and then decreased till harvest. In the underground portion, the dry matter accumulation continued up to 10 MAP. The crop growth rate (CGR) increased with increased N and K application up to 100 kg N and 150 kg $K_2O$ $ha^{-1}$. The CGR increased with age of the crop up to 10 MAP. They found that elephant foot yam required a fertilizer dose of 100:50:150 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$.The optimum NPK as per response fitted was 107:47:147 kg $ha^{-1}$.

Henpithaska (1993) tried different organic manure in Thailand and found that corm yield in elephant foot yam increased by organic amendments viz. cattle manure, maize cobs, castor meal, black rice hulls, coir and rice hulls. Verma *et al.,* (1995) studied the growth, tuber formation and uptake of N and K in a field experiment in West Bengal and reported maximum growth, dry matter production, tuber yield and N and K uptake with N and K @ 150 kg $ha^{-1}$, each applied in two splits.

In field experiment at West Bengal, Kundu *et al.,* (1998) determined the effect of NPK fertilizer dose on plant biomass, corm yield and total yield and indicated that NPK 200:100:100 kg $ha^{-1}$ was the optimum fertilizer dose for elephant foot yam.

Sen and Mukherjee (2002) investigated the effect of different levels and methods of application of N and K on corm production in elephant foot yam and application of the highest dose of N and K each @ 150 kg $ha^{-1}$ in three splits produced the maximum corm yield of 54 t $ha^{-1}$.

Sethi *et al.,* (2002) studied the effect of different levels of NPK on the yield of elephant foot yam at different locations of Orissa for two seasons and found that application of NPK 125:50:125 kg $ha^{-1}$ produced the highest yield of 35.29 t $ha^{-1}$.

Chattopadhyay *et al.,* (2006) found that the maximum plant height (89.5 cm), pseudo stemgirth (19.2 cm), diameter of corm (21.3cm), average weight of corm (2.2 kg) and yield (57.3 t $ha^{-1}$) were recorded with highest NPK level (175:125:175 kg $ha^{-1}$) but maximum canopy spread (123.1 cm) and breadth of corm (11.64 cm) were observed with NPK level (150:100:150kg $ha^{-1}$).

Suja *et al.,* (2015) standardized the organic production strategy as FYM @ 36 t/ha [cowdung + neem-cake mixture in (10:1) inoculated with *Trichoderma harzianum*], green manuring with cowpea to generate 20–25 t/ha green biomass in 45–60 days, neem cake @ 1 t/ha and ash @ 3 t/ha. Anjana Devi *et al.,* (2015) found that by integrating nutrient use efficient biofertlizers, viz. N-fixers, P- and K-solubilizers, with NPK fertilizers, N, P and K can be saved to the tune of 25, 50–75 and 25% respectively. Navya *et al.,* (2017) reported that the replacement of 50 % RDN with vermi-compost along with recommended

dose of fertilizers 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. Further they stated 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.

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