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Integrated Nutrient Management Improves Yield and Quality in Elephant Foot Yam

Elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson) is a robust herbaceous plant, with an erect, solitary long pseudostem bearing a tripartite leaf at the top and the underground corm is large and globulose. The crop can tolerate temporary flooding, but continuous waterlogging causes corm rot. It is believed to be a native of South-East Asia and is indigenous to tropical Asia and Africa. It is considered as a famine food in the Pacific Islands. It is becoming very much popular in different parts of India due to its palatability and better cooking quality. In India, it is cultivated as a food crop in Andhra Pradesh, Bihar, Odisha, West Bengal, Gujarat, Kerala, Tamil Nadu, Maharashtra, Uttar Pradesh and Jharkhand (Nedunchezhiyan and Byju, 2005), whereas in northern and eastern states, wild, local cultivars are generally grown for making pickles. It has several medicinal properties and found to be effective in the treatment of piles, dysentery, asthma, swelling of lungs, vomiting and gastrointestinal disorders (Raghu et al., 1999). There is ample scope for its adoption as a cash crop due to its high production potential and popularity as a vegetable (Srinivas and Ramanathan, 2005). In addition, it is used in pharmaceutical preparations, especially in ayurvedic medicines. The crop is vegetatively propagated by corms.

It is a remunerative crop which has high dry matter production capability per unit area than most of the other vegetables. Several factors affect the growth and yield of elephant foot yam (Ravi et al., 2011; Suja et al., 2012). It has been repeatedly confirmed that continuous sole and imbalanced use of chemical fertilizers leads to deterioration of the soil health and ecological imbalance due to decrease in the nutrient uptake efficiency (Saravaiya et al., 2010). In this way it might eventually result in stagnation or plateauing of crop yield and threat to environmental safety (Virmani, 1994). The integrated nutrient supply includes the use of chemical fertilizers, organic sources like farmyard manure, crop residues and biofertilizers. This helps in bridging the existing gap between nutrient removal and addition ensuring balanced nutrient management, which will eventually result in better nutrient response and higher crop productivity of desired quality (Singh and Kalloo, 2000). An integrated nutrient management strategy recognizes that soils are the storehouse of most of the plant nutrients essential for plant growth and that the way in which nutrients are managed will have a major impact on plant growth, soil fertility and sustainability (Jansen, 1993). Hence, the objective of the present study was to find out the effect of integrated nutrient management on growth and yield characters of elephant foot yam.

A field experiment was conducted at the Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, during July-February in 2006-2007. The soil of experimental site is sandy clay loam. The soil was slightly alkaline with pH 7.96 and electrical conductivity (EC) 1.92 dS m^{-1}. The organic C, available N, P and K contents were 0.40% (low), 130 kg ha^{-1}(low) 20 kg ha^{-1} (medium) and 660 kg ha^{-1} (high), respectively. The weather parameters during the crop growth period was: temperature 23-32°C, relative humidity 66.5% and rainfall 38 cm. The test variety was "Gajendra". The experiment was laid out in randomized block design with 10 treatments and three replications. Corms of 500 g size were planted at a spacing of 60 x 60 cm. Farmyard manure was applied @25 t ha^{-1} as basal dose. The following were the treatments tested:

T_1: 50% recommended dose of fertilizers (RDF) (as inorganic) + 25% RDF (as organic) + phosphorus solubilizing bacteria (PSB) @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}

T_2: 50% RDF (as inorganic) + 25% RDF (as organic) + arbuscular mycorrhizal fungi (AMF) @ 5 kg ha^{-1} + *Azospirillum* @5 kg ha^{-1}

T_3: 75% RDF (as inorganic) + 25% RDF (as organic) + PSB @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}

T_4: 75% RDF (as inorganic) + 25% RDF (as organic) + AMF @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}

T_5: 75% RDF (as inorganic) + 25% RDF (as organic) + *Pseudomonas* @ 5 kg ha^{-1} + *Trichoderma* @ 5 kg ha^{-1}

T_6: 50% RDF (as inorganic) + 25% RDF (as organic)

T_7: 75% RDF (as inorganic) + 25% RDF (as organic)

T_8: 75% RDF (as inorganic)

T_9: 100% RDF (as inorganic) ie., NPK @ 80:40:100 kg ha^{-1}

T_{10}: Absolute control

Observations on growth, yield and quality were taken. The data were analyzed statistically and critical difference values were computed for comparison and interpretation of data (Panse and Sukhatme, 1978).

The effect of INM practices on yield and quality of elephant foot yam is given in Table 1. Significantly, tallest plants (65.27 cm) were observed in T_9 (100% RDF (as inorganic) ie., NPK @ 80:40:100 kg ha^{-1} followed by T_3 (application of 75% RDF (as inorganic) + 25% RDF (as organic) + PSB @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1} (57.15 cm).

Maximum canopy spread in the East-West (E-W) (52.26 cm) and North-South (N-S) (46.63 cm) directions was observed under recommended dose of nutrients (NPK @ 80:40:100 kg ha^{-1}) through inorganic source. The highest corm yield (53.47 t ha^{-1}) was obtained in T_4 (application of 75% RDF (as inorganic) + 25% RDF (as organic) + AMF @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}) which was on par with T_3 (75% RDF (as inorganic) + 25% RDF (as organic) + PSB @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}).

Whereas, the oxalic acid content was the lowest (89.89 mg100 g^{-1}) in 75% RDF (as inorganic)+ 25% RDF (as organic) + AMF @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1} and highest (102.49 mg 100g^{-1}) in 100% RDF (as inorganic) NPK @ 80:40:100 kg ha^{-1}. Similar result was obtained by Henpithaksa (1993) in *A. oncophyllus* (*Amorphophallus paeoniifolius*) under soil amended with rice hulls, black rice hulls, maize cobs, cattle manure and coir peat. Tuber weight per plant and yield per hectare was found to increase in all the organic amendments.

Application of FYM @ 10 t ha^{-1} + N @ 100 kg ha^{-1} + P @ 75 kg ha^{-1}+ K @ 100 kg ha^{-1} + *Azospirillum* + foliar application of 0.5% $ZnSO_4$ and 1.0% $FeSO_4$ at 60, 75 and 90 days after planting in cassava produced highest tuber yield (Sucheta et al.,

Table 1. Effect of integrated nutrient management on growth and yield of elephant foot yam

Treatments	Plant height (cm)	Canopy spread E-W (cm)	Canopy spread N-S (cm)	Corm yield (t ha^{-1})	Oxalic acid (mg 100 g^{-1})
T_1 50% RDF (as inorganic) + 25% RDF (as organic) + PSB @ 5 kg ha^{-1} + *Azospirillum* @ 5 kgha^{-1}	41.10	43.50	36.62	30.30	94.10
T_2 50% RDF (as inorganic) + 25% RDF (as organic) + AMF @ 5 kgha^{-1} + *Azospirillum* @ 5 kgha^{-1}	43.56	38.87	40.99	34.34	96.30
T_3 75% RDF (as inorganic) + 25% RDF (as organic) + PSB @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	57.15	42.35	33.00	50.37	94.00
T_4 75% RDF (as inorganic) + 25% RDF(as organic) + AMF @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	53.54	40.21	43.26	53.47	89.89
T_5 75% RDF (as inorganic) + 25% RDF (as organic) + *Pseudomonas* @ 5 kgha^{-1} + *Trichoderma* @ 5 kgha^{-1}	39.53	36.28	40.10	41.11	92.15
T_6 50% RDF (as inorganic) + 25% RDF (as organic)	41.80	35.59	35.18	28.59	95.47
T_7 75% RDF (as inorganic) + 25% RDF (as organic)	42.47	39.55	36.07	42.56	95.10
T_8 75% RDF (as inorganic)	46.72	40.09	34.38	36.15	95.45
T_9 100% RDF (as inorganic) NPK @ 80:40:100 kg ha^{-1}	65.27	52.26	46.63	46.74	102.49
T_{10} Absolute control	39.54	31.40	32.30	25.73	91.42
CD (0.05)	5.39	5.10	4.04	3.97	2.27

1991). Rajamani et al. (2001) observed highest tuber yield in cassava due to application of recommended dose of fertilizer (N and K in 3 split doses) along with *Azospirillum* and phosphobacteria. Suja et al. (2005) reported that integrated use of biofertilizers (*Azospirillum and* phosphobacterium) with the full dose of organic manure and K and 50% of N and P produced tuber yields on par with the present nutrient recommendation for cassava implying the possibility to reduce N and P fertilizer input to 50%. Patel et al. (2010) observed maximum corm yield due to the application of 75% RDF (through inorganic source) + 25% RDF (through organic source) + AMF @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}. Judicious application of N by the addition of organic manures as primary sources of N and split application of N fertilizer is suggested for higher yield. Biofertilizers are known to release the bioactive substances having similar effect as that of growth regulators besides facilitating nutrient absorption. The combined application of arbuscular mycorhizal fungi (AMF) and *Azospirillum* increased the availability of soil N and P resulting in higher yield in the present study. This study proves the significance of integrated nutrient management involving the use of organic manures, chemical fertilizers and biofertilizers in elephant foot yam cultivation.

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