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Studies of integrated nutrient management on growth and physiological characters of elephant foot yam cv. Gajendra

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Abstract
The field study to observe the influence of organic manures, recommended dose of fertilizer and consortium biofertilizer on elephant foot yam was carried out in Thirukkanur village, Puducherry during 2019-2020. The study on integrated nutrient management was carried out by the application of three different organic manures such as FYM, vermicompost, RDF and consortium bio fertilizer where applied after planting in 13 treatment combinations in RBD with three replications. The bio metric observation on growth and physiological characters. All the treatments significantly influenced the biometric characters of elephant foot yam and the results revealed that the treatment combination T_{11} was found to be best with the growth and physiological characters. From the experiment, it was concluded that the integrated nutrient management *viz*., combination of vermicompost, RDF along with consortium biofertilizer were identified as the best treatment.

Keywords: Nutrient management, growth, physiological characters

Introduction
Elephant foot yam belongs to the family Dioscoreaceae. Elephant foot yam otherwise called as "King of Tuber Crops" is a tropical under-ground tuber grown in Africa, South Asia, South East Asia because of modified root, medicinal and therapeutic values. In Southern India, especially Kerala it is known as Chena and in Tamil Nadu it is called as Kaaraa and Karunai Kizhangu. Also grown as intercrop with turmeric, coconut, banana. It is widely used as traditional vegetable by rural population and used as secondary food during the period of scarcity of other vegetable. In India, elephant foot yam is cultivated among all the states but majorly grown as cash crop in Andhra Pradesh, Tamil Nadu, Gujarat, Maharashtra (Neduchezhiyan and Byju 2005) [8]. Whereas in Tamil Nadu, Erode, Salem, Thiruvannamalai, Thoothukudi, Cuddalore and Thanjavur districts are widely cultivated areas. Until 1980 it was widely supposed that inorganic fertilizers were a viable means of increasing land productivity in the low fertility soils of the humid tropics. Also shown the various reports on use of inorganic fertilizers in the tropics had stagnated and explained by low marketing and profitability (Patel *et al.*, 2010) [9]. Organic manures were observed as important, but due to their unavailability in large quantity alternative ways had to be found to to drastically increase food production. Consequently, combining the usage of organic waste with chemicals and bio-fertilizers had found to be the better alternative. Hence the study has been taken up to evaluate the usage of various organic and inorganic fertilizers on elephant foot yam.

Material and Methods
The present study entitled "Studies of integrated nutrient management on growth and physiological characters of Elephant foot yam (*Amorphophallus* (Dennst.) Nicolsan) cv. Gajendra' was conducted at farmers field at Thirukkanur village, Villianur, Puducherry during the year 2020 with 13 treatments, 60x60 cm spacing and 3 replications.

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

Observations were recorded at different stages of the crop. Fifteen plants were tagged randomly in each net plot of each treatment for recording the following observations *viz.*, Growth characters like Number of days taken for emergence, plant height (cm), number of leaflets per plant, canopy spread E-W and N-S (cm), petiole length, girth of pseudostem, chlorophyll content, dry matter content and ascorbic acid content.

Results

Among the various treatments, T_{11} recorded minimum number of days taken for emergence respectively. Whereas T_{13} recorded maximum number of days taken for emergence. Plant height and number of leaflets was observed to be higher in T_{11} followed by T_8.

Maximum canopy spread E-W and N-S was recorded in T_{11} 49.68 cm2 (E-W), 53.24 cm2 (N-S) which was followed by T_8 48.58 cm2 (E-W), 52.11 cm2 (N-S) respectively. Whereas maximum petiole length (cm) and pseudostem length (cm) was recorded in T_{11}

(52.61 cm) followed by T_8 (52.61 cm). Influence of integrated nutrient management has observed to significantly increase the physiological content. The highest value of dry matter production was observed in T_{11} (1983.72 Kg ha^{-1}) followed by the treatments T_8 (1920.18 Kg ha^{-1}). Chlorophyll content was found to be higher in T_{11} followed by T_8 and ascorbic acid content was recorded higher in T_{11} followed by T_8.

Discussion

The treatment combinations had influence on the growth characters such as plant height, pseudostem girth and canopy spread. All these growth characters were in general observed to increase rapidly after 80 of DAP. The reason might be due to vigorous growth period involving high physiological activity. The reduced rate of increase for growth characters may be attributed to the vigorous growth of corm and might be due to transfer of more photosynthates to corms, as it is found to be a common phenomenon in tuber crops.

The minimum days taken to emergence of elephant foot yam was observed in T_{11} followed by T_8 in comparison to the other treatments along with control. The early sprouting might be due to incorporation of vermicompost, FYM along with inorganic fertilizer as a result of which organic manures trapped the sunlight and induced physiological processes for sprouting of tubers. This might be due the availability of nutrients, especially N obtained from organic manures and inorganic fertilizers which resulted in increasing the growth by exerting its synergistic effect. Increase in growth (plant height) is due the enhanced cell division and cell elongation which occurs as a result of availability of nitrogen in higher amount. This is in line with earlier findings of Murthy *et al.* (2011) [13].

Due to high defoliation near to maturation, reduction was observed in number of leaflets. The canopy spread (the radical expansion) under different growth stages increased with the increase in the age of the crop upto 180 DAP. Subsequently, the canopy spread did not increase and later on the crop showed senescence. Hence the canopy spread was considered upto 180 DAP. The canopy spread increased with varied growth rate between any two successive stages. The canopy spread measured at 30, 60, 90, 120 and 180 DAP was significantly influenced by levels of FYM, vermicompost, RDF, biofertilizers and their combinations. However, as a result of moisture retention and better soil properties, leaf spread was found to be profoundly influenced in T_{11}.

Growth attributes such as pseudostem girth and petiole length was influenced by different treatment combinations. Lowest pseudostem girth and canopy spread was recorded with the control. The reason might be due to the shortage of nitrogen and other nutrients which have resulted an increase in ABA content and minimal production of auxin, gibberllin and cytokinin essential for plant growth.

Dry matter production of *Amorphophallus* was observed to increase progressively with advancement in crop age up to harvest. The cumulative effect of gradual increase in plant height, pseudostem girth and canopy with increasing crop age might be responsible for increase in dry matter. Similar reports have been reported earlier in cassava (Amanullahkhan, 1997) [1] and sweet potato (Nedunchezhiyan and Srinivasulu reddy, 2004) [7]. Further, the rate of dry matter production was observed to be relatively high during 120-180 DAP compared to other growth stages and the dry matter accumulation largely occurs in economically important corms during maturity stages. Whatever the fraction of the product of photosynthesis is put down in the economically significant corms depend on the patten of assimilate translocation from the leaves which also dictates how dry matter was partitioned. Among the different treatment combinations, application of T_{11} was recorded to cause the interaction between vermicompost and inorganic fertilizers to produce higher dry matter content in both shoot and corms at all growth stages.

The maximum ascorbic acid content and chlorophyll content were observed under T_{11}. The continous production of glucose-6-phosphate may be the reason for higher ascorbic acid concentration through the growth and development of tubers which is thought to be precursor of ascorbic acid,

another reason for increased ascorbic acid contents is catalytic influence of ascorbic acid from sugar. Similar results in respect of ascorbic acid in accordance with the findings by Chettri and Thapa (2005) [3].

Table 2: Effect of integrated nutrient management on plant height and days taken for emergence in elephant foot yam

Treatments	Days of emergence	Plant height (cm)			
		60 DAP	90 DAP	120 DAP	180 DAP
T_1	22.80	30.27	35.14	45.63	45.61
T_2	21.24	33.56	43.58	54.26	60.33
T_3	22.61	31.93	40.89	49.88	53.21
T_4	22.41	30.81	39.08	47.12	48.55
T_5	21.04	34.10	44.47	55.62	62.74
T_6	21.81	32.46	41.79	51.42	55.82
T_7	22.20	31.35	39.96	48.49	50.86
T_8	20.85	34.63	45.35	57.02	65.08
T_9	22.00	33.00	42.67	52.76	58.10
T_{10}	21.44	31.38	40.01	48.53	51.02
T_{11}	20.20	35.17	46.23	58.41	67.31
T_{12}	21.62	33.54	43.56	54.11	60.32
T_{13}	23.00	27.41	33.28	39.53	34.26
S.Ed	0.09	0.26	0.43	0.66	1.09
CD (p=0.05)	0.18	0.52	0.85	1.32	2.18

Table 3: Effect of integrated nutrient management on number of leaflets, petiole length and pseudostem girth in elephant foot yam

Treatments	Number of leaflets plant-1	Petiole length	Pseudostem girth
T_1	151.38	47.11	14.00
T_2	197.21	51.37	17.73
T_3	175.64	49.20	15.89
T_4	158.28	47.86	14.66
T_5	203.59	51.96	18.35
T_6	182.13	49.79	16.49
T_7	165.62	48.46	15.27
T_8	211.18	52.61	18.96
T_9	188.52	50.38	17.10
T_{10}	168.35	40.59	15.30
T_{11}	219.53	53.17	19.68
T_{12}	195.42	50.99	17.70
T_{13}	109.17	44.52	11.26
S.Ed	3.12	0.27	0.29
CD (p=0.05)	6.24	0.54	0.58

Table 4: Effect of integrated nutrient management on canopy spread E-W and N-S in elephant foot

Treatments	E-W	N-S
T_1	36.87	30.65
T_2	46.29	49.86
T_3	41.66	45.34
T_4	38.05	41.83
T_5	47.43	51.00
T_6	42.84	46.49
T_7	39.21	43.01
T_8	48.58	52.11
T_9	44.00	47.58
T_{10}	40.37	44.12
T_{11}	49.68	53.24
T_{12}	45.12	48.69
T_{13}	34.24	38.19
S.Ed	0.55	0.53
CD (p=0.05)	1.10	1.06

Table 5: Effect of integrated nutrient management on physiological characters in elephant foot yam

Treatments	Dry matter production (Kg ha^{-1})	Chlorophyll content (mg g-1)	Vitamin C (mg g-1)
T_1	1281.17	2.05	4.57
T_2	1800.69	2.69	5.03
T_3	1570.93	2.37	4.82
T_4	1354.36	2.15	4.64
T_5	1860.88	2.81	5.03
T_6	1628.12	2.48	4.89
T_7	1450.55	2.24	4.72
T_8	1920.18	2.92	5.13
T_9	1687.31	2.57	4.90
T_{10}	1515.74	2.27	4.75
T_{11}	1983.72	3.02	5.21
T_{12}	1742.50	2.67	4.96
T_{13}	964.31	1.68	4.13
S.Ed	26.59	0.05	0.03
CD (p=0.05)	53.19	0.09	0.06

Conclusion

Based on the results of the current study, it was determined that adding 5 t ha^{-1} of vermicompost combined with 100% RDF (80:40:100 Kg NPK ha^{-1}) + 5 kg ha^{-1} of CBF was the best course of action for improving the growth and physiological characteristics of elephant foot yam cv. Gajendra.

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