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Influence of Nutrient Management Practices on the Growth and Yield of Taro *(Colocasia esculenta)*

Taro (*Colocasia esculenta*) also called as the potato of the tropics, is an integral component of different farming systems adopted in the state of Kerala. The tubers are rich in starch and are good sources of protein and minerals. Leaves and petiole are also used as green vegetables (Choudhury et al., 2011). With scope for a higher plant density compared to other tuber crops and suitability to different cropping systems, taro has immense potential for cultivation as a commercial crop. The crop responds well to nutrients and hence farmers are adopting varying nutrient management practices. Keeping this in view, a field experiment was conducted to assess the influence of nutrient management practices emphasizing on the use of varied sources and forms of application on the growth and yield of taro.

The experiment was conducted at Farming Systems Research Station, Sadanandapuram in randomised block design with five treatments and four replications during June to November 2014. Soil type was lateritic and chemical analysis of initial soil samples revealed a pH of 6.0, organic carbon 0.09%, available P and K 37.2 and 825kg ha^{-1} respectively. The variety tried was the local variety Thamarakannan. The different sources of nutrients used to satisfy the recommended dose of 80:50:100 kg ha^{-1} NPK included straight fertilisers (urea, rajphos and muriate of potash), water soluble multi nutrient fertilisers (19:19:19 and 13:0:45) and organic fertilisers (poultry manure, vermicompost, PGPR Mix I, ash and vermiwash) The treatments were

T_1: 100% RNPK as straight chemical fertilizers (urea, rajphos, muriate of potash) - soil application in two splits, 1 and 2 MAP

T_2: 100% RNPK as organic manures- soil application (poultry manure, vermicompost + PGPR Mix I and ash) and foliar spray (vermiwash at 1:5 dilution)

T_3: 50% NK and full P basal - soil application (urea, rajphos, muriate of potash) and 50% NK –foliar spray (urea -2% and sulphate of potash- 2%)

T_4: 50% NPK basal - soil application (urea, rajphos, muriate of potash) and 50% NPK- foliar spray (19:19:19 - 0.5% and 13:0:45- 0.5%)

T_5: 100% RNPK as straight chemical fertilizers (urea, rajphos, muriate of potash)-soil application in three splits, 1, 2 and 3 MAP.

*Four foliar sprays were given from the second month onwards at two weeks interval.

Corms weighing 25-30g were planted at 60 cm x 45 cm spacing with basal dose of farm yard manure @ 12.5 t ha^{-1}. Weeding was done at monthly intervals twice and earthing up, at 2 and 3 MAP. The crop came to maturity in 130 days and was harvested by uprooting after loosening the soil around the base. Biometric observations on the height, length of leaf lamina, number of leaves were taken at the second and third month of planting and yield and yield attributes at final harvest. The per cent yield response was computed with the recommended dose yield as control

$$\text{Yield response (\%)} = \frac{\text{(Treatment yield-Control yield)}}{\text{Control yield}} \text{ X } 100$$

The influence of the nutrient sources and application methods on taro crop growth are presented in Table1. It was observed that the effect was significant only after three months of planting. There was no significant variation in the leaf number and leaf length at one, two and three months after planting while significantly higher values were recorded for the petiole length (plant height) three months after planting and at harvest, in the treatment in which foliar nutrition with urea and SOP (T_3) was done as top dressing and it was on par with the use of 19:19:19 and 13:0:45 (T_4). The slight decrease in the height noticed at harvest compared to that of three months after planting was attributed to the senescence of the older leaves and these being absent at the time of harvest. The reduced number of leaves at harvest also bears testimony to this observation.

Table 1. Influence of nutrient sources and application methods on growth parameters of taro

Treatments	Petiole length (cm)				Leaf length (cm)			Leaf number		
	1MAP	2MAP	3MAP	at harvest	1MAP	2MAP	3 MAP	1 MAP	2 MAP	3 MAP
T_1	34.45	49.97	93.46	72.71	12.95	36.48	48.05	3.5	4.62	3.39
T_2	28.35	46.20	98.42	71.46	13.08	33.48	55.15	2.5	3.78	3.36
T_3	32.63	52.63	116.64	95.53	13.26	34.13	53.43	2.5	4.58	3.69
T_4	30.65	47.83	106.37	83.13	13.35	34.14	53.80	3.25	4.30	3.50
T_5	30.8	47.78	103.73	65.35	15.03	32.63	48.92	2.75	4.55	3.78
CD	ns	ns	12.71	13.14	ns	ns	ns	ns	ns	ns

Variations in the tuber characters and yields are presented in Table.2. Significantly higher yields were observed in the treatments in which foliar application was adopted with inorganic sources. Maximum yield of 8.52 t ha^{-1} was recorded in the treatment in which 50 per cent N and K were given as foliar sprays of urea and sulphate of potash, on par with the treatment with the multi nutrient fertilisers, 19:19:19 and 13:0:45. Lowest yields were observed in the organically grown plots but on par with the treatments of soil application alone. It should also be noted that despite the soil showing high values for K, the response was to the foliar applied K. The superiority of potassium nitrate (13:0:45) as foliar spray over soil application in Amorphophallus has been documented by Santosa et al. (2013).

Corm parameters such as girth, number and weights were also significantly higher when N and K were applied on the foliage as sprays compared to soil application. This may be attributed to the ease in absorption and utilization for their specific functions within the plant when applied in liquid form on foliage. It is inferred that foliar nutrients usually penetrate the cuticle of the leaf or stomata, enter the cells rapidly and fulfill the nutrient demand of the growing plant more rapidly than soil applied nutrients. Potassium is crucial for the transport of assimilates and nutrients (Allison et al., 2001) and this has a significant bearing on yields, especially in tubers.

The yield attributes viz. corm and cormel numbers, average corm and cormel weights and size had positive correlation with the yields. Among foliar fertilisers, the better response observed was with urea and SOP over multi nutrient fertilisers would be due to the presence of sulphur in the former fertilizer which is also a secondary nutrient essential for plant growth and development. Significant increase in tuber yields with foliar fertilisers has been reported in potato over solid applications (Jasim et al., 2013).

Top dressing of fertilizers in three splits (soil application) did not record significant variations in yield per plant, and per hectare yields were slightly better when applied in two splits, that is 1 and 2 months after planting.

The yield responses for foliar treatments were worked out, based on the yields from the recommended dose of NPK given as soil application 1 and 2 MAP (T_1- control), and the values were 65 and 44 % greater for T_3 and T_4 respectively, highlighting the relative importance of foliar nutrition in taro.

Economic analysis was done computing the cost of cultivation and returns taking into account the prevailing

Table 2. Effect of nutrient sources and application methods on the yield and yield attributes in Taro

Treatments	Average corm weight (g)	Average cormel weight (g)	Corm no.	Corm length (cm)	Corm girth(cm)	Corm yield (g/plant)	Corm yield (tha^{-1})
T_1	17.90	4.46	9.08	8.76	7.60	258.33	5.16
T_2	13.38	5.38	10.48	8.91	7.69	269.83	4.25
T_3	21.40	9.50	16.81	9.45	8.92	440.31	8.52
T_4	18.73	8.33	15.81	9.12	8.81	399.45	7.43
T_5	17.45	7.48	11.11	8.78	7.10	313.47	4.43
CD	3.36	2.44	2.79	ns	1.36	89.91	2.21

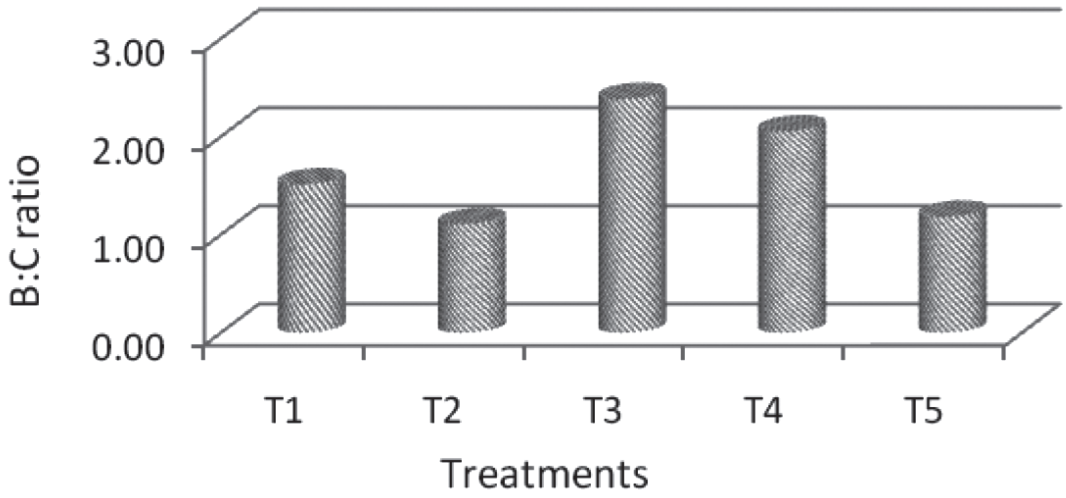

Fig.1. Benefit cost ratio of taro cultivation with varying nutrient management practices

wage rates and market prices and it was observed that maximum net returns and benefit cost ratios were fetched with 50% nutrient recommendation as foliar sprays (Fig.1). Use of organic manures alone for 100% substitution was found to be most expensive, as the nutrient contents were lower in the organic sources and hence required in bulk quantities to satisfy the recommended doses of N, P and K in taro.

The study has brought to light the feasibility of foliar nutrition with water soluble inorganic fertilisers in taro to supplement the basal application in soil. Basal application of 50% recommended N, K and 100% P through straight fertilizers in soil and top dressing with foliar sprays of urea and SOP at 2% concentrations to supply the remaining 50% N and K or 50% N, P, K in soil and foliar nutrition with 19:19:19 and 13:0:45 at 5% concentrations, four times at weekly intervals from second month onwards can be recommended for taro cultivation.

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