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Integrated Nutrient Management of Upland Taro in Assam

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Abstract

Field experiments were conducted for three years on integrated nutrient management in upland taro at the Experimental Farm (Horticulture), Assam Agricultural University, Jorhat, Assam, during 2009-2012 as well as in the farmers' field for on farm testing during 2011-2012. The experiment was conducted in RBD with nine treatments and three replications. The results showed that the treatments differed significantly. Application of vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} + 75% recommended dose of NPK (NPK @ 60:45:90) resulted in highest corm and cormel yield (17.07 t ha^{-1}), number of cormels (12 cormels plant^{-1}) and net return (₹ 3,34, 250 ha^{-1}). Besides, the same treatment also performed well in the farmers' fields with a mean yield of 16.70 t ha^{-1}. The results of the present study showed the superiority of integrated nutrient management for profitable production of upland taro in Assam.

Key words: Integrated nutrient management, taro, vermicompost, on farm trials

Introduction

Upland taro (*Colocasia esculenta* L.), a native of India, is grown in several countries and in India, it is cultivated mostly in the eastern and north-eastern states (Chandra, 1984). It is a staple or subsistence food in many developing countries of the world. The corms and cormels of taro are rich in minerals, starch and protein, while the young leaves are rich in vitamin C, niacin, oxalic acid, calcium oxalate and sapotoxin. Taro and tannia are grown in an area of 1.07 m ha in the world and majority of the area is in Africa and Asia.

Though taro is cultivated widely in Assam, its yield is low. One of the major reasons for the low yield is the lack of proper nutrient management practices. The farmers of Assam apply fertilizers at a very low rate or they do not apply any chemical fertilizers at all. But taro responds well to application of both organic and inorganic sources of nutrients. Development of an integrated nutrient management (INM) strategy will definitely increase the yield of taro in Assam. Hence the objective of the study was to develop INM technology for upland taro with a view to increase income and livelihood security of farmers in Assam.

Materials and Methods

The field experiment was conducted for three consecutive seasons in the Experimental farm (Horticulture), Assam Agricultural University, Jorhat, Assam, during 2009-2012. The climate of the study site is subtropical with warm summer and cold winter. The average maximum and minimum temperatures were in the range of 33-34°C and 26-28°C respectively. The average relative humidity was 93.08% in the morning and 76.83% in the evening. The region has an average annual rainfall of 1900 mm with heavy rainfall during June-August, moderate rainfall during September–November and February–April and less or no rainfall during December–January. The soil of the experimental site was low in organic C (0.31%), available N (166.48

kg ha^{-1}) and available K (120.96 kg ha^{-1}) and medium in available P (12.6 kg ha^{-1}). The experiment was conducted in randomized block design (RBD) with nine treatments and three replications. The nine treatments were as follows:

T_1: Vermicompost @ 1 t ha^{-1} + farmyard manure (FYM) @10 t ha^{-1} + 25% recommended dose (RD) of NPK (NPK @ 20:15:30)

T_2: Vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} + 50% RD of NPK (NPK @ 40:30:60)

T_3: Vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} + 75% RD of NPK (NPK @ 60:45:90)

T_4: FYM @ 10 t ha^{-1} + neem cake @ 1 t ha^{-1}

T_5: FYM @ 10 t ha^{-1} + neem cake @ 1 t ha^{-1} + mustard cake @ 1 t ha^{-1}

T_6: FYM @ 10 t ha^{-1} + RD of NPK (NPK @ 80:60:120 kg ha^{-1}),

T_7: FYM @ 10 t ha^{-1} + phosphorous solubilising bacteria (PSB) @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1},

T_8: FYM @ 10 t ha^{-1} + arbuscular mycorrhizal fungi (AMF) @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}

T_9: Control

Based on the results of the on station experiments, the best treatment was selected and was tested in three locations in farmers' fields along with the treatments, T_6 and T_9. The locations were Nayahilodhari gaon (L_1), Baotoli, Nakachari (L_2) and Bamunpukhuri (L_3) in Jorhat, Assam. At each location, on farm experiment was conducted in five farmers' fields with three replications. Observations on yield (corm and cormels) and yield attributes were recorded. Economics viz., gross return, net return and benefit: cost ratio (B:C) was worked out. The experimental data were analysed statistically by applying the analysis of variance (ANOVA) technique for randomized block design (Cochran and Cox, 1965).

Results and Discussion

The effect of different treatments on corm and cormel yield of taro is given in Table 1. The mean corm and cormel yield (17.07 t ha^{-1}) was significantly higher for T_3, vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} +

Table 1. Effect of INM on yield and yield attributes of upland taro

Treatments		Yield (t ha^{-1})				Number of cormels			
		2009-2010	2010-2011	2011-2012	Mean	2009-2010	2010-2011	2011-2012	Mean
T_1	Vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} + 25% recommended dose (RD) of NPK (NPK @ 20:15:30)	14.45	14.28	13.49	14.07	11	12	12	12
T_2	Vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} + 50% RD of NPK (NPK @ 40:30:60)	15.26	16.24	14.50	15.33	12	12	13	12
T_3	Vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} + 75% RD of NPK (NPK @ 60:45:90)	16.54	17.57	17.10	17.07	12	13	13	12
T_4	FYM @ 10 t ha^{-1} + neem cake @ 1 t ha^{-1}	13.55	13.74	13.23	13.51	11	10	10	11
T_5	FYM @ 10 t ha^{-1} + neem cake @ 1 t ha^{-1} + mustard cake @ 1 t ha^{-1}	13.71	14.16	13.71	13.86	10	10	10	10
T_6	FYM @ 10 t ha^{-1} + RD of NPK (NPK @ 80:60:120 kg ha^{-1})	14.27	13.87	14.22	14.12	12	11	12	12
T_7	FYM @ 10 t ha^{-1} + PSB @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	12.06	11.59	12.86	12.17	11	11	11	11
T_8	FYM @ 10 t ha^{-1} + AMF @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	12.21	10.98	13.56	12.25	11	11	11	11
T_9	Control	11.75	11.58	11.10	11.48	10	9	10	10
	CD (0.05)	1.35	1.72	1.10	1.23	1.24	1.95	2.16	1.36

75% RD of NPK (NPK @ 60:45:90). The yield obtained for the present package of practices recommendations, T_6, FYM @ 10 t ha^{-1} + RD of NPK (NPK @ 80:60:120) was significantly lower (14.2 t ha^{-1}) compared to that of T_3. The control plot produced the lowest yield (11.48 t ha^{-1}). The beneficial effects of INM in increasing the yield of crops have been reported by earlier workers (Chianu and Tsujii, 2005; Rahman et al., 2009). Application of nutrients from organic source alone could not increase the yield of taro as revealed from the yields obtained for the treatments, T_4 (13.51 t ha^{-1}), T_5 (13.86 t ha^{-1}) and T_8 (12.25 t ha^{-1}). This was in conformity with the reports of Hartemink (2002) and Janssen (1993).

The influence of different treatments on number of cormels per plant is given in Table 1. The maximum number of cormels per plant was obtained for the treatment T_3, vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} + 75% RD of NPK. The recommended package of practices, T_6, FYM @ 10 t ha^{-1} + NPK @ 80:60:120 was on par with that of T_3. However, number of cormels obtained in the control treatment (T_9) was significantly low. The results of economic analysis of different treatments (Table 2) showed that INM of upland taro resulted in higher economic returns. Maximum profit was obtained for the treatment T_3, which resulted in net income of ₹ 3,34,250 ha^{-1} and B:C ratio of 4.61. For the general package of practices recommendations, T_6, all these economic parameters were lower compared to that of T_3 (net income: ₹ 2,63,000 ha^{-1} and B:C ratio: 3.92).

The results of the validation experiment conducted in farmers' fields at three locations of Assam is given in Table 3. The best treatment from the on station experiment, T_3 was compared with the general package of practices recommendations (T_6) and control (T_9). At all the three locations, maximum yield was obtained for the treatment, T_3, with a mean yield of 16.75 t ha^{-1}.

The results of the present study clearly showed that the yield and economic returns from upland taro, which is

Table 2. Economics of cultivation of upland taro under different INM treatments

Treatments		Gross income (₹ ha^{-1})	Net income (₹ ha^{-1})	B:C ratio
T_1	Vermicompost @ 1 t ha^{-1} + FYM @10 t ha^{-1} + 25% recommended dose (RD) of NPK (NPK @ 20:15:30)	351750	254250	3.61
T_2	Vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} + 50% RD of NPK (NPK @ 40:30:60)	383250	288250	4.03
T_3	Vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} + 75% RD of NPK (NPK @ 60:45:90)	426750	334250	4.61
T_4	FYM @ 10 t ha^{-1} + neem cake @ 1 t ha^{-1}	337750	217750	2.81
T_5	FYM @ 10 t ha^{-1} + neem cake @ 1 t ha^{-1} + mustard cake @ 1 t ha^{-1}	346500	216500	2.67
T_6	FYM @ 10 t ha^{-1} + RD of NPK (NPK @ 80:60:120 kg ha^{-1})	353000	263000	3.92
T_7	FYM @ 10 t ha^{-1} + PSB @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	304250	219250	3.57
T_8	FYM @ 10 t ha^{-1} + AMF @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	306250	221250	3.60
T_9	Control	287000	221000	4.34

Table 3. Results of validation experiments in farmers' fields

Treatments		Yield (t ha^{-1})			
		Location 1	Location 2	Location 3	Mean
T_3	Vermicompost @ 1 t ha^{-1} + FYM @ 10 t ha^{-1} + 75% RD of NPK (NPK@ 60:45:90)	16.50	16.10	17.50	16.75
T_6	FYM @ 10 t ha^{-1} + RD of NPK (NPK @ 80:60:120 kg ha^{-1})	13.50	14.20	14.90	14.20
T_9	Control	10.50	11.20	10.90	10.86

cultivated as a cash crop by the small and marginal farmers of Assam, can be maximised by adopting an integrated nutrient management practice involving vermicompost (1 t ha^{-1}), farmyard manure (10 t ha^{-1}) and NPK @ 60:45:90 as chemical fertilizers.

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