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Yield, Nutrient Status and Economic Appraisal of Finger Millet-Potato Based Cropping Systems as Influenced by INM in Eastern Dry Zone of Karnataka

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Abstract

An experiment was conducted at farmer's field on Alfisol to study the effect of different nutrient management practices on changes in yield, available N, P and K status of soil and returns in finger millet-potato cropping system followed by farmers. The highest yield of finger millet and potato was obtained when fertilizers were applied with holistic approach of applying NPK along with deficient micronutrients based on soil test values. The available nitrogen content of soil after the harvest of potato was increased by 23.96% with holistic method of application of fertilizer compared to farmers practice similar was the trend with respect to phosphorus (52.13%) and potassium (8.25%) highest returns per rupee invested was obtained by application of all deficient nutrients along with NPK based on soil test values. Hence holistic approach of nutrient application based on soil test value can be considered as novel method of nutrient application and management practice for finger millet-potato cropping system.

Key words : Nutrient management, Holistic approach, Yield, Cost of cultivation, Finger millet-potato cropping system.

Finger millet-potato based cropping system is one of the important cropping system of southern Karnataka. The response of major rainfed crops to fertilizer application has been reviewed extensively (1). About 50% of increased yield is due to adoption of improved fertilizers, particularly of N and P has been demonstrated in sustaining the yield of rain fed crop. Large numbers of experiments at research stations and on farmer's field have demostrated the importance of soil test values, deficient nutrients, FYM and bio-fertilizers in supplementing the nutrient requirements of rainfed crops and providing yield stability (2). Hence the study was undertaken at farmer's field to evaluate the efficiency of different nutrient/ fertilizer application practices on yield, nutrient status economics of the cropping system followed by farmer.

Methods

Field experiments were conducted on finger millet (GPU-28) during 2002 and potato during 2003 in *kharif* season in Alfisol with eight treatments viz., T_1 : Farmer practice of fertilizer application, T_2 : Fertilizer applied as per POP of UAS Bangalore, T_3 : Fertilizer applied based on STCR (Soil test crop response), T_4 : NPK fertilizer applied as per STV recommendation, T_5 : T_4 + other deficient nutrient applied as per STV, here dolomite lime stone was applied before finger millet crop as initial calcium and magnesium content of soil were low, T_6 : 50% of recommended N through fertilizer and 50% through FYM, T_7 : 100% of recommended N through FYM, T_8 : Control. Details of quantity of fertilizer applied/manure applied is given in Table 1.

Finger millet and potato were grown in plots of 8 × 5 sq m in fixed randomized complete block design with three replications. FYM and dolomite limestone were applied in respective treatments 30 days before sowing; 50% of recommended dose of N, full dose of P and K were applied as basal for both crops and remaining 50% N top dressed.

The experimental soil was sandy clayloam having pH 5.6, EC 0.10 dS/m, organic carbon 6.1 g/kg, available nitrogen 243.96 kg/ha, available phosphorus 139.65 kg/ha, available potassium 367.50 kg/ha, exchangeable Ca, Mg and available S contents of soil

Table 1. Details of treatments in the cropping system of finger millet-potato.

Treatments	Finger millet (kg/ha)	Potato (kg/ha)
T_1 : Farmer practice	17.78 N+45.43 P_2O_5 + 0 K_2O+0.74 tonnes FYM/ha	26.67 N+68.15 P_2O_5 + 0 K_2O
T_2 : Package of practices	100 N + 50 P_2O_5 + 50 K_2O + 10 tonnes FYM/ha	125 N + 100 P_2O_5 + 125 K_2O + 25 tonnes FYM/ha
T_3 : STCR approach	66.62 N + 25 P_2O_5 + 25 K_2O	55.20 N + 28.91 P_2O_5 + 34.93 K_2O
T_4 : STV recommendation without other nutrients	100 N + 37.48 P_2O_5 + 37.04 K_2O	100 N + 40.71 P_2O_5 + 45.49 K_2O
T_5 : STV recommendation + other deficient nutrient	100 N + 37.48 P_2O_5 + 37.04 K_2O + 15 kg $ZnSO_4$/ha	100 N + 40.71 P_2O_5 + 45.49 K_2O + 60 kg $ZnSO_4$/ha
T_6 : 50% N through fertilizer + 50% through FYM	50 N + 25 P_2O_5 + 25 K_2O + 5 tonnes FYM/ha	42.69 N + 37.54 P_2O_5 + 41.56 K_2O + 12.5 tonnes FYM/ha
T_7 : 100% N through FYM	10 tonnes FYM/ha	25 tonnes FYM/ha
T_8 : Control	No fertilizers and mannures	No fertilizers and mannures

were 2.15 c mol (p+)/kg, 1.2 c mol(p+)/kg and 23 mg/kg respectively. DTPA extractable Fe, Mn, Zn and Cu was 12.9, 30, 0.86, 0.51 mg/kg, respectively. After each crop (finger millet and potato) soil samples were collected and analyzed for available N, P and K following standard procedure (3). At the end of each season grain yield and tuber yield of finger millet and potato were recorded.

Results and Discussion

Yield

Grain Yield of Finger Millet. The grain yield of finger millet differed significantly due to treatments (Table 2). A 22.74% increase in yield of finger millet was obtained in treatment T_5 (5.33 t/ha) involving holistic approach of applying NPK along with different nutrients based on STV compared to farmers practice (T_1 : 4.3 t/ha).

Tuber Yield of Potato. The potato crop grown during *rabi* season also resulted in significant yield difference due to treatments with highest yield of 24.92% increase in T_5 treatment over farmers practice (T_1) of nutrient application. These results are in conformity with findings of Anil kumar et al. (4). The highest yield recorded in treatment T_5 due to balanced supply of nutrients from inorganic fertilizer, FYM and all deficient nutrient elements.

In addition the economics of cultivation for finger millet-potato cropping system was worked out, the treatment involving holistic approach of application of N, P and K plus deficient secondary and micro nutrients based on soil test value gave highest return per rupee invested in cropping system. The package of practice recommendation (T_2) and soil test value based method of application of nutrients (T_4) were found to be at par.

Nutrient Status of Soil

Available Nitrogen. The available nitrogen con-

Table 2. Grain yield of finger millet, tuber yield of potato (kg/ha) and returns per rupee of cost obtained as influenced by different nutrient application practices in finger millet-potato cropping system. Figures in parentheses indicate per cent increase over farmers practice.

Treatments	Grain yield of finger millet during *kharif*	Tuber yield of potato during *rabi*	Returns per rupee of cost in finger millet	Returns per rupee of cost in potato
T_1	4344.66	14691.40	2.50	4.07
T_2	4586.33 (05.56)	19135.80 (30.25)	2.75	4.16
T_3	4778.66 (09.98)	18148.10 (23.52)	2.54	3.98
T_4	4796.66 (10.40)	15020.60 (02.24)	2.90	3.50
T_5	5333.00 (22.74)	18353.90 (24.92)	3.98	4.38
T_6	4478.33 (03.07)	17572.00 (19.60)	2.65	3.27
T_7	4023.66 (-07.38)	17592.00 (19.74)	2.42	2.76
T_8	3679 (-15.30)	11399.20 (-22.40)	2.10	2.42
SE ±	1.70	1.15		
CD 5%	5.18	4.32		

Table 3. Changes in available N, P and K content of experimental site soil due to different nutrient application practices in finger millet-potato cropping system.

Treatments	Avail N (kg/ha)		Avail P_2O_5 (kg/ha)		Avail K_2O (kg/ha)	
	After finger millet 2002	After potato 2003	After finger millet 2002	After potato 2003	After finger millet 2002	After potato 2003
Initial	243.96		139.65		367.50	
T_1	256.13 (4.98)	262.42 (7.57)	142.17 (12.94)	173.30 (24.09)	376.27 (2.38)	392.00 (6.66)
T_2	285.16 (16.88)	297.33 (21.83)	193.10 (38.27)	143.42 (2.69)	383.73 (4.41)	413.03 (12.08)
T_3	296.61 (21.58)	302.43 (23.96)	143.20 (2.54)	158.46 (13.46)	372.30 (2.91)	384.17 (4.53)
T_4	287.50 (17.84)	291.46 (19.47)	172.50 (23.54)	197.32 (41.29)	365.16 (-0.63)	397.83 (8.25)
T_5	274.76 (12.62)	294.17 (20.58)	192.62 (37.95)	195.17 (39.75)	375.60 (2.20)	395.23 (7.54)
T_6	265.32 (8.75)	278.34 (14.09)	197.65 (41.53)	212.46 (52.13)	388.42 (5.69)	386.12 (5.06)
T_7	248.13 (8.75)	259.65 (6.43)	161.43 (14.32)	87.42 (-37.40)	382.17 (3.99)	390.15 (6.16)
T_8	244.37 (1.70)	252.63 (3.55)	141.65 (15.59)	57.32 (-58.95)	377.42 (2.69)	381.47 (3.80)
SE ±	2.38	2.46	2.39	2.57	2.93	3.52
CD (5%)	6.42	7.78	8.17	8.42	8.34	8.25

tent of soil after the harvest of finger millet and potato crop increased significantly over the initial content (Table 3). The increase was maximum in treatment where NPK fertilizers were applied based on STV along with deficient nutrients in both the crops. It may be due to sufficient supply of nutrients by applied NPK fertilizers (5). The highest available nitrogen content of soil after harvest of potato was registered in T_5 (302.43 kg/ha). The results on available nitrogen content after finger millet and after potato indicated that potato cropping recorded higher build up of avail nitrogen content as compared to finger millet (296.61 kg/ha) may be due to addition of organic matter within stimulated growth and activity of micro organisms and improvement in root and shoot growth. Higher production of biomass might have increased the organic carbon content and thereby nitrogen content of soil (6).

Available Phosphorus. The available phosphorus content of soil increased significantly due to various nutrient management practices (Table 3). Application of nutrients based on STV + deficient nutrient recorded significantly higher available phosphorus after finger millet (197.65 kg/ha). Similar results were observed with potato with highest available phosphorus record of (212.46 kg/ha). These results are in conformity with findings of Acharya et al. (7) incorporation of FYM and deficient nutrients along with inorganic phosphorus increased the availability of phosphorus and this is attributed to reduction in fixation of water soluble phosphorus, increased mineralization of organic phosphorus due to microbial action.

Available Potassium. Significant increase in available potassium content of soil after both finger millet and potato over control was observed due to different nutrient management practices (Table 3). In treatment where fertilizers were applied based on STV + deficient nutrient recorded highest available potassium content 388.42 kg/ha over farmers practice 365.16 kg/ha. Similar trend of results was noticed after the harvest of potato. The higher availability of potassium might be ascribed to reduction of potassium fixation and release of potassium due to interaction of organic matter with clay beside direct addition of potassium to available pool of soil.

Conclusion

Based on yield of crop and available N, P and K content of soil after harvest of crops the holistic approach involving application of N, P and K plus deficient nutrients based on STV was found to be an ideal nutrition package for finger millet potato cropping system. Alternatively application of nutrients based on STCR approach by making targeted yield equation was second best method of nutrient management. Hence holistic approach of nutrient application based on STV can be considered as novel method of nutrient application and management practice for finger millet-potato cropping system.

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