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Effect of Integrated Nutrient Management on Soil Fertility, Uptake of Nutrients and Yield of Maize in Southern Tansitional Zone of Karnataka

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Abstract

Higher fertility levels were observed in T_8 which received 75 kg N through inorganic fertilizer, 25 kg N through compost, *Azospirillum*, recommended P and K with French bean intercrop. Similarly, higher nitrogen uptake (139 kg/ha), phosphorus uptake (58 kg/ha) and potassium uptake (131 kg/ha) and highest grain and stover yield of maize (4,689 kg/ha and 6.68 t/ha, respectively) was observed in T_8. Addition of compost, French bean green manure and *Azospirillum* favored higher fertilizer use efficiency when applied in combination, thus leading to higher yields.

Key words : Integrated nutrient management, Bio-fertilizers, Fertility management, Nutrient uptake, Yield of maize.

Maize (*Zea mays* L.) is one of the most important food crop, ranks third after wheat and rice in the world. In recent years maize is occupying vast area of southern transitional zone of Karnataka due to well distributed rainfall, and better soil condition, which helps to harvest bumper yield under rainfed condition. In Karnataka, it is cultivated over an area of 9.61 lakh ha with annual production of 26.42 lakh tonnes (1). Maize crop requires large quantities of nitrogen, the deficiency of which limits growth, yield and quality of the crop. In order to meet the crop requirement of nutrients, farmers are applying large quantities of inorganic fertilizers without understanding the crop nutrient requirement and its impact on soil health. The importance of organic manures has been demonstrated by number of studies all over the world. Manures not only supplies major and micro nutrients, but also improve soil physico-chemical characters. Looking at the speed in which soils are being deteriorated, it is not possible to depend only on chemical fertilizers, though it supplies nutrients in readily available form. Therefore to maintain soil productivity on a sustainable basis, an integrated approach using both organic and inorganic sources of nutrients coupled with suitable bio-fertilizers are essential. In view of the increased cost of fertilizers and fast deterioration of soil, the present study was formulated to study the effect of integrated nutrient management on soil fertility, uptake of nutrients and yield of maize in southern transitional zone of Karnataka at Zonal Agricultural Research Station, Shimoga during 2003.

Methods

The field experiment was initiated with ten treatments in randomized complete block design with three replications. Treatment details are given in Table 1. The initial fertility level of the experimental site was analyzed before initiation of the experiment (pH 6.5, EC 0.25 dS/m, OC 0.53%, avail N 210 kg/ha, avail P_2O_5 150.4 kg/ha, avail K_2O 290 kg/ha). Land preparation was done following regular practice and experimental layout was prepared based on the plan. The organic manure (compost) was incorporated following the treatments before sowing. The recommended dose of 50 kg/ha P and 25 Kg/ha K was applied as basal dose. Nitrogen was applied in two equal splits, one as basal and the other as top dressing on 35 days after sowing. Urea, super phosphate and murite of potash were used as sources of N, P and K respectively. For the fertilizer treatment (T_5, T_6, T_7 and T_8), *Azospirillum* and *Phosphobacte-rium* each at 2 kg/ha (10 pockets)

Table 1. Effect of integrated nitrogen sources on soil properties and nutrient status of soil after harvest of maize crop.

Treatments	Details	pH	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
T_1	Rec practice 7.5 ton compost/ha + 100:50:25 kg NPK/ha	6.80	0.74	280	205	271
T_2	125 kg N through inorganic source (I_0) + rec. P & K	6.40	0.65	224	155	224
T_3	100 kg N (I_0) + 25 kg N though compost (N_c) + rec. P & K	6.50	0.67	235	183	243
T_4	75 kg N (I_0) + 50 kg N though compost (N_c) + rec. P & K	6.60	0.68	24	196	252
T_5	75 kg N (I_0) + 25 kg N though compost (N_c) + rec. P & K + *Azospirillim*	6.60	0.68	239	175	232
T_6	100 kg N (I_0) + frenchbean intercrop + rec. P & K + *Azospirillum*	6.70	0.75	306	181	263
T_7	75 kg N (I_0) + 50 kg N though compost (N_c) + rec. P & K + *Azospirillum*	6.70	0.73	275	180	235
T_8	75 kg N (I_0) + frenchbean intercrop + 25 kg N (N_c) + rec. P & K + *Azospirillum*	6.90	0.76	312	187	272
T_9	100 kg N (N_c) + rec. P & K	6.90	0.70	225	211	266
T_{10}	125 kg N (N_c) + rec. P & K	7.00	0.71	234	217	281
Initial status of soil		6.50	0.53	210	158	290

were used of which 400 g each was used for seed inoculation and remaining was (1,600 kg) was applied after germination. Intercrop of French bean in T_6 and T_8 was sown on the day of sowing of main crop and incorporated at 30 days after sowing. Seeds of Deccan 103, hybrid maize was used at the rate of 15 kg/ha for sowing by opening shallow furrows of 5 cm deep and 60 cm apart and 2—3 seeds were dibbled at 30 cm distance in the furrows. Regular intercultural operations and plant protection were followed till harvesting crop yields were recorded in all the treatments. Yield data on maize crop were analyzed statistically. Soil samples were collected after the harvest of maize crop and analyzed for different parameters like pH, electrical conductivity, organic carbon, available phosphorus and available potash content by following standard methods to study the changes in the soil fertility levels. The plant samples (grain and straw samples separately) were collected after the harvest of crop and anlyzed for uptake of nitrogen, phosphorus and potassium content by following standard methods and plant uptake of nutrients was calibrated using grain and straw yields data. All the results were then analyzed statistically for drawing conclusion using standard statistical analysis tools.

Results and Discussion

Soil Fertility Status

The data on soil properties are given in Table 1. There was no change in soil pH when compared to the initial level. Organic carbon content has increased in all the treatments with highest organic carbon (0.76%) in T_8 which received 75 kg N through inorganic fertilizer, 25 kg N through compost, *Azospirillum*, recommended P and K with French bean intercrop followed by T_6 (0.75%) which received 100% N through inorganic and rest similar to T_8. Application of 125 kg N through compost (T_{10}) recorded 0.71% organic carbon when compared to T_2 (65%) which received 125 kg N through inorganic fertilizer. This may be due to the direct addition of organic matter through compost to soil which has favored in increasing the root biomass of plant in soil (2).

Higher available N was observed in T_8 (312.25 kg/ha) followed by T_6 (305.50) and T_1 (280.200) which could be due to addition of both organic and inorganic sources which helps in release of nutrients throughout the crop growth period. Lowest available N was recorded in T_2 (224.08 kg/ha) which received only inorganic sources as nutrients are released at faster rate leading to leaching losses.

Available phosphorus and potassium was highest in T_{10} (217 and 281 kg/ha, respectively) in treatment receiving 125 kg N through organic sources and recommended P and K through inorganic sources with least in T_2 (155 and 224 kg/ha, respectively). The higher NPK, could be attributed to increased population of beneficial micro organisms as result of appli-

Table 2. Nutrient uptake (kg/ha) as integrated nitrogen sources after harvest of maize crop.

Treatments	Nutrient uptake (kg/ha) N	P	K
T_1	134	57	127
T_2	90	48	85
T_3	97	49	96
T_4	103	50	102
T_5	108	51	105
T_6	120	53	116
T_7	122	54	119
T_8	139	58	131
T_9	111	51	108
T_{10}	116	52	110
SE ±	1.1	0.9	1.3
CD 5%	3.4	2.8	3.8

cation of organic manures as observed by Bhatnagar et al. (3).

Uptake of Nutrients

The results of plant analysis are given in Table 2. Application of 75 kg N through inorganic + French bean intercrop + 25 kg N through compost + recommended P and K + *Azospirillum* (T_8) recorded higher N uptake (139 kg/ha) followed by T_1 (134 kg/ha) with least in T_2 (90 kg/ha). The higher N uptake in T_8 may be attributed to legume crop association along with *Azospirillum* which lelps in buildup of N facilitating higher uptake similar to the studies of Sharma and Choubey (4). Phosphorus uptake also followed similar trend with highest P uptake in T_8 (58 kg/ha) followed by T_1 (57 kg/ha) and least in T_2 (48 kg/ha). The results are in accordance with the observations made by Chopra and Ganguly (5). The potassium uptake was highest in T_8 (131 kg/ha) followed by T_1 (127 kg/ha) with least in T_2 (85 kg/ha).

The combined application of organic manure, legume crops, biofertilizer and inorganic fertilizer has favored in higher biomass production resulting in higher uptake of all the three major nutrients.

Yield of Maize

Grain and straw yield of maize differed significantly due to treatments. Highest grain and stover yield of maize (4,689 kg/ha and 6.68 t/ha, respectively) was observed in T_8 followed by T_1 (4,469 kg/ha and 6.56 t/ha, respectively) and T_{10} (4,141 kg/ha and 6.39 t/ha respectively). Addition of compost, French bean green manure and *Azospirillum* has favored higher fertilizer use efficiency when applied in combination, thus leading to higher yields confirming the results of Singh et al. (6).

Thus for obtaining maximum benefit, combination of organic and inorganic sources along with biofertilizers are the best nutrient management practices especially for the crop like maize which requires higher nutrients. Integrated nutrient management helps in maintaining soil fertility levels in addition to higher crops yields.

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