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Research Communication

Effect of integrated nutrient management on growth, productivity and economics of maize (*Zea mays*)

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ABSTRACT

The experiment was conducted at instructional farm of the Rajasthan College of Agriculture, Udaipur, Rajasthan to study the effect of integrated nutrient management on growth, productivity and economics of maize (*Zea mays* L.) variety 'PEHM 2'. The crop produced significantly higher number and weight/cob of grains, test weight and grain and stover yields with conjoin application of recommended dose of NPK + 10 t FYM/ha compared to either inorganic fertilizer alone or organic sources or 50% of recommended dose of inorganic fertilizers. Application of recommended dose of NPK along with seed inoculation of *Azotobacter* resulted in higher net returns and B:C ratio of maize crop.

***Key words**:* Farm yard manure, Integrated nutrient management, Maize

Maize is most versatile emerging crop having high yield potential, wider adaptability to diverse ecologies and adverse environment. Amongst various agricultural inputs, fertilizer is and will remain as a chief source in achieving the food production targets. For higher productivity, there is a need for the application of higher dose of fertilizers but the increased use of high analysis fertilizers and adaptation of high yielding cultivars demanding more secondary and micro nutrients for enhancing food grain production has resulted in their deficiencies and declined growth and productivity of crop due to continued removal of nutrients from soil. From the results of the long term fertilizer experiments conducted in different parts of the country, it has been well established that under high input production system, where crop productivity can not be further increased with incremental use of fertilizer alone, addition of organic sources could again increase the yield through increased soil productivity and fertilizer use efficiency. Thus sustainable agriculture, in years to come should ideally be based on integrated plant nutrient supply (Makinde and Ayoola, 2010).

A field experiment was therefore conducted during *kharif* season 2010 in the long term fertilizer experiments at the instructional farm of the Rajasthan College of Agriculture, Udaipur, Rajasthan on sandy clay loam soil having pH 8.2 (1:2.5 soil water ratio), 0.85% organic carbon, 425.75 kg/ha alkaline permanganate oxidizable N, 22.4 kg/ha available P (Olsen), 671 kg/ha in ammonium acetate exchangeable K, 21 mg/kg available S and 3.76 mg/kg DTPA extractable Zn. Total rainfall received during maize crop growth was 758 mm. 'PEHM 2' was the test variety of maize in the experiment. Twelve treatments consisting of integrated nutrient management as per detailed in table 1 were replicated four times in randomized block design. The crop was sown on 9 July 2010 at the spacing of 60 × 20 cm. Urea, diammonium phosphate and murate of potash were used as sources of N, P and K, respectively. Mineral gypsum and zinc sulphate ($ZnSO_4.7H_2O$) were used to supply S and Zn. According to soil-test fertilizer recommendation, the 100% NPK for maize was 120:60:30 kg/ha. The biofertilizer for seed inoculation was used at 600 g/ha. Sulphur and zinc were applied @ 40 and 5 kg/ha, respectively. The economics was worked out on the basis of prevailing rates of inputs and produce. The half dose of N and full dose of P, K, Zn and S was applied as basal and remaining nitrogen was applied in two equal splits at knee high and tasseling stage. Growth parameters *viz.* leaf area index, dry matter accumulation were measured from three randomly selected plants. The cobs were harvested at maturity to work out yield and other yield attributes.

Plant height recorded at harvest differed significantly

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due to application of various treatments and was maximum with application of recommended dose of NPK + FYM @ 10 t/ha. The extent of increase of LAI at 45 DAS was 21.0 to 96.5% under the influence of various treatments over absolute control (Table 1). Application of recommended dose of NPK + FYM @ 10 t/ha resulted in maximum LAI value (3.36), which was 96.5% higher over control and significantly superior over all other treatments. At 60 DAS the SPAD 502 chlorophyll meter readings are related to chlorophyll content of crop. With increasing crop growth stages the SPAD 502 chlorophyll meter readings increased and was recorded maximum at 45 DAS. The higher amount of N increases the chlorophyll content to the maximum and results in higher yield. The similar findings were also observed by Szeles (2007) and Janos (2010). The SPAD 502 chlorophyll meter reading was maximum with 150% NPK, but it was on par with 100% NPK + FYM @ 10 t/ha. The superiority of combined application of inorganic and organic sources in respect to growth parameters might be attributed to better root growth, consequently better uptake of nutrient by the plants. The study also revealed that 100% NPK along with FYM @ 10 t/ha recorded significantly the highest dry matter production over rest of the treatments at 60 DAS (Table 1). It might be due to interactive effect of FYM and fertilizer provided congenial soil environment for better plant growth resulting into increased biomass production of the crop. The maximum values for almost all growth parameters *viz*; number of cobs/plant, test weight, weight of cob and weight of grains/cob were obtained with the application of 100% NPK + FYM @ 10 t/ha (Table 1). This is probably due to better translocation of photosynthates, which consequently improved the yield attributes.

The better growth in terms of leaf area index, dry matter accumulation and more cobs/plant could be the reason for increased grain and stover yields. The minimum increase in grain yield was observed by applying 100% N only (2.34 t/ha), which was on par to FYM 20 t/ha (2.36 t/ha). The overall range of yield enhancement achieved by applying various treatments was 62.5 to 183.4% over absolute control (Table 1). Data revealed that the application of 100% NPK + FYM 10 t/ha resulted in maximum grain yield (4.08 t/ha), which was on par with 150% NPK (3.78 t/ha). Similarly combined application of 100% NPK + 10 t/ha FYM resulted in highest stover yield (6.05 t/ha), which was 170.2% higher over control (Table 1), but was on par with 150% NPK (5.57 t/ha) and 100% NPK + S + Zn (5.56 t/ha). Economic evaluation of treatments indicated that application of 100% NPK + FYM 10 t/ha gave highest net returns, which was on par with 100% NPK in combina-

Table 1. Effect of integrated nutrient management on growth and yield attributes, yield and economics of maize crop

Treatment	Plant height (cm) at harvest	Leaf area index at 45 DAS	SPAD 502 Chlorophyll meter readings at 60 DAS	Dry matter accumulation at 60 DAS (g/plant)	Test weight (g)	Weight/cob (g)	Cobs/plant	Grain wt/cob (g)	Yield (t/ha)		Cost of cultivation (× 10^3 ₹/ha)	Net returns (× 10^3 ₹/ha)	B:C ratio
									Grain	Stover			
RDF (120 N 60 P_2O_5 30 K_2O kg/ha)	208.5	2.6	43.5	81.0	193.4	117.9	1.05	82.8	3.41	5.22	14.4	26.6	1.84
RDF + Zn (5 kg/ha)	214.5	2.8	43.9	91.3	195.9	119.5	1.10	84.1	3.60	5.51	15.3	28.0	1.83
RDF + S (40 kg/ha) + Zn	215.7	2.9	46.6	93.7	197.6	120.8	1.05	86.6	3.70	5.56	15.7	28.6	1.82
RDF + S (40 kg/ha)	211.8	3.0	44.9	88.8	192.6	117.9	1.0	85.1	3.46	5.32	14.9	26.8	1.80
RDF + *Azotobacter* (600 g/ha)	208.4	2.9	44.4	86.6	196.8	117.1	1.0	83.4	3.51	5.34	14.5	27.7	1.91
FYM 10 t/ha + NPK (–NPK of FYM)	211.6	3.1	42.7	88.4	202.7	118.8	1.05	84.8	3.47	5.32	16.0	25.7	1.61
RDF + FYM 10 t/ha	230.8	3.4	48.8	101.1	212.1	130.6	1.10	95.1	4.08	6.06	17.4	31.3	1.79
FYM 20 t/ha	192.7	2.5	41.1	67.4	182.5	106.6	1.0	69.2	2.36	3.54	17.6	10.7	0.61
150 % of RDF	227.6	3.2	49.1	93.9	207.2	122.8	1.0	89.0	3.78	5.57	15.8	29.6	1.87
Recommended dose of NP	206.6	2.4	42.6	75.1	189.8	106.7	1.0	71.4	2.95	4.56	14.2	21.3	1.50
Recommended dose of N	186.3	2.1	42.7	62.4	180.3	92.6	1.0	59.3	2.34	3.69	12.9	15.3	1.18
Control	121.8	1.7	39.1	43.2	160.9	76.9	0.95	43.2	1.44	2.24	11.6	5.7	0.49
SEm±	4.12	0.04	0.93	0.49	4.36	3.09	0.04	1.16	0.124	0.189	1.42	1.42	0.09
CD (P=0.05)	11.88	0.12	2.67	1.41	12.56	8.91	NS	3.35	0.354	0.546	4.10	4.10	0.27

RDF=Recommended dose of fertilizer

tion with Zn or both Zn and S, seed inoculation with *Azotobacter* and 150% NPK (Table 1). However, application of 100% NPK + seed inoculation *Azotobacter* registered maximum value of B:C ratio.

From the foregoing discussion, it may be concluded that combination of recommended dose of inorganic source with either organic manures or *Azotobacter* seed inoculation resulted in better growth, productivity and economics of maize crop than sole application of recommended dose of NPK.

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