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Short Communications

Response of Maize (*Zea mays* L.) to Organic Manures and *Azotobacter* in Conjuction with Nitrogen Levels

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Maize is one of the most important food crops grown under rainfed conditions in tribal areas of Gujarat. Application of bulky organic manures make the soil reach in organic matter as well as improves the porous structure which ultimately provides conducive conditions for beneficial microbes in their functioning resulting in more availability of nutrients. But low content of nutrients and their poor rate of mineralization opened a alternative avenue for costly chemical fertilizers. However, its integration is must so as to maintain good soil health and also make it productive for longer time by harvesting residual benefits. The crop consumes huge quantity of nutrients which are generally supplied through chemical fertilizers. But its use become cost prohibitive today. Hence, it is deemed essential to increase its efficiency through management. Among several bio-agents, *Azotobacter* is known to fix atmospheric nitrogen and help increase about 10-15 per cent grain yield in maize (Reddy *et al.*, 1977). Therefore, it is a time to focus on practical and profitable flexibility of manurial schedule in which organic manures and biofertilizers must be involved. Keeping these points in view, the field study was undertaken during *kharif* 1990 at the Agronomy Farm of Agricultural College, Gujarat Agricultural University, Anand Campus, Anand on loamy sand soil having good drainage and moderate moisture retentive capacity. The soil of the experimental site was low in total nitrogen (0.034%), medium in available phosphorus (43.5 kg/ha) and high in available potash (261.4 kg/ha) with pH 7.6. Eighteen treatments were embeded in factorial randomised block design with four replications. The details of the treatments are given in Table 1. Bio-culture *Azotobacter* was procured from the Bio-fertilizer Research Project, Gujarat Agricultural University, Anand Campus, Anand. The seeds of maize were treated with the culture having 10^7 vaiable cells/ml @ 5 ml/kg of maize seeds. The required quantity of well decomposed FYM (0.79% N) and gober gas manure (1.74% N) each @ 5 t/ha and one-third of the total quantity of nitrogen (urea) were applied as basal application in furrows as per treatments alongwith common dose of 30 kg P_2O_5/ha (SSP). Remaining two-third quantity of total nitrogen was applied in two equal splits, one at knee high (30 days after sowing) and another at tasseling stage (62 days after sowing). The Gujarat Maize-1 was sown @ 20 kg seeds/ha by following 60 cm x 20 cm spacing in July

TABLE 1

Growth yield and quality of Gujarat maize-1 as influenced by different treatments.

Treatment	Plant height (cm)	Length of cob (cm)	Number of kernels/ cob	Test weight (g)	Shelling (5%)	Grain yield (kg/ha)	Protein %	% barren-ness/ plot
Organic manures (M)								
No organic manure (M_0)	108.3	14.7	229	174.4	73.8	1558	6.03	14.2
FYM @ 5 t/ha (M_1)	117.3	17.1	260	195.0	77.0	1905	6.76	12.3
GGM @ 5 t/ha (M_2)	115.6	16.9	261	199.5	76.4	1861	6.59	12.1
C. D. (P = 0.05)	2.3	0.6	8.3	2.0	2.2	59	0.16	NS
Azotobacter (E)								
No inoculation (E_0)	113.9	16.1	246	187.3	75.7	1768	6.30	12.9
Inoculation (E_1)	113.6	16.5	252	192.0	75.7	1781	6.61	12.8
C. D. (P = 0.05)	NS	NS	NS	1.7	NS	NS	0.13	NS
Nitrogen levels (N)								
30 kg/ha (N_1)	105.7	12.7	212	163.0	73.7	1273	5.69	17.6
45 kg/ha (N_2)	113.6	16.1	252	192.0	76.3	1895	6.80	11.3
60 kg/ha (N_3)	121.9	19.9	283	214.0	77.2	2156	6.89	9.8
C. D (P = 0.05)	2.3	0.6	8.3	2.0	2.2	59	0.16	1.4
Sig. interaction	—	M x N	M x N	M x N E x N M x E x N	—	M x N	M x E M x N E x N M x E x N	—

N.B.: FYM = Farm yard manure. GGM = Gobar gas manure.

1990 and harvested on Nov. '90. Data pertaining to growth, yield and economics are presented in Table 1 and 2.

Effect of organic manures

Different organic manures had exerted their significant influence on grain yield (Table 1). Treatment M_1 produced maximum grain yield (1905 kg/ha) but it was found to be at par with M_2 (1861 kg/ha). However, both these treatments were significantly superior over M_0 (1558 kg/ha). The magnitude of increase in grain yield under M_1 and M_2 was 22.27 and 19.44 per cent over that of M_0. Almost similar trend was noticed in growth, yield attributes and protein per cent. Organic manures add nutrients, improve physical condition of soil and assist in better uptake of nutrients, might have induced growth and yield attributes resulting in higher yield under organic manures (Ponsica *et al.*, 1983 and Bar and Cheema, (1988). Cost benefit analysis showed all most equal effectiveness of both these organic manures (Table 2).

Effect of azotobacter

Inoculation of seeds with *Azotobacter* did not influence the grain yield significantly. However, slight increase was observed in most of the yield attributes and yield due to seed inoculation (Table 1). Poor performance of *Azotobacter* might be due to lower growth of the organism as it is a heaviest breathing organism, requiring large amount of organic carbon for its growth which was perhaps not enough in the fixation of nitrogen released by the decomposition of organic matter inside the body of the micro-organisms. Also, this organism is a very poor competitor and therefore a slow grower in the soil which might not have fixed sufficient quantity of nitrogen to have any significant effect on yield and yield attributes (Goswami, 1976).

TABLE 2

Grain yield (kg/ha) and net realization (Rs/ha) of maize as influenced by different treatments.

Nitrogen (N) : *(kg/ha)* :	*Organic manures (M)*			
	M_0	M_1	M_2	*Mean*
N_1	940 (653)	1403 (1600)	1467 (1726)	1273 (1326)
N_2	1570 (2256)	2104 (3409)	2011 (3165)	1895 (2943)
N_3	2164 (3848)	2197 (3681)	2106 (3441)	2156 (3657)
Mean	1558 (2252)	1905 (2897)	1861 (2777)	—
	Effect M x N			CD (P = 0.05) 102

Figures in parentheses indicate net realization (Rs/ha) under respective treatment.

Effect of Nitrogen

There were conspicuous differences in grain yield of maize among different levels of nitrogen. The yield was gradually increased with increase in the level of nitrogen. The treatment N_3 was topped in the list by recording significantly the highest grain yield of 2156 kg/ha followed by N_2 (1895 kg/ha) and N_1 (1273 kg/ha). The per cent increase in grain yield under N_2 was 13.77 and 69.36 over that of treatments N_1 and N_1, respectively. The superiority of N_3 might be due to positive cumulative effect of yield attributes towards yield. Nitrogen is known to accumulate dry matter and translocate it to the reproductive parts in the plant might have resulted in significant increase in grain yield. Further, increased grain yield under higher level of nitrogen could be ascribed to the significant reduction in per cent barrenness at higher levels of nitrogen. These results are in conformity with those of Hegde *et al.* (19). Cost benefit analysis (Table 2) showed the linear trend in net gains under increased levels of nitrogen.

Interactive effect

Interactive effect (Table 2) between organic manure and nitrogen was found to be significant with respect to grain yield. The treatment combination M_1N_3 gave significantly higher grain yield (2197 kg/ha) than others except M_0N_3 (2164 kg/ha), M_2N_3 (2106 kg/ha) and M_1N_2 (2104 kg/ha). These results suggest that when fertilizer nitrogen is to be used for fertilizing maize, 60 kg N/ha is an optimum dose. However, under integration of nutrient management, the optimum requirement of N is 45 kg/ha + 5 t/ha of FYM or GGM. This implies that it is feasible to save 15 kg nitrogen (25 per cent of recommended dose of N) from inorganic source without much loss in quality grain yield by application of 5 t of FYM or GGM/ha. These results are akin to those reported by Nambiar and Abrol (1989).

Thus, it is concluded that maize crop fertilized either by FYM or GGM manure @ 5 t/ha coupled with 45 kg N/ha was found to be beneficial in view of fertilizer economy. By adopting this manurial schedule, it is feasible to save 15 kg N (25 per cent of the recommended dose of N) from inorganic source without much loss in quality grain yield.

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