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Research Notes

Effect of integrated nitrogen management on growth and yield of maize *(Zea mays* L.) cv. PAC - 711

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Maize is globally the top ranking cereal in its potential grain productivity and is third after wheat and rice in total production. In India the area under maize cultivation increased from about 3 million ha in 1949 to about 7 million ha in 2003-04, while the production increase was from 2.05 million tonnes in 1949-50 to about 14.72 million tonnes in 2003-04 (Govila *et al.,* 2005). Indiscriminate use of chemical fertilizers and agro-chemicals rendered the arable soils unproductive as a consequence of unfavorable physical, chemical and biological characteristics of soil. To make farming sustainable, the integrated nutrient management (INM) was introduced two decades ago. Integrated nutrient management is defined as the judicious mix of organics, inorganics and biofertilizers to promote soil fertility and farm productivity without causing much deterioration in the nutrient status of soil. Mohamoud and Sharanappa (2002) reported that application of poultry manure in combination with inorganic nitrogenous fertilizer produces significantly higher grain and stover yield of maize. In another study, Singh and Totawat (2002) reported that integrated nitrogen management (including organic, chemical and biofertilizers) recorded highest grain and stover yield in maize. With these findings in view, a field experiment was conducted to optimize the integrated nitrogen management practices by including two organic manures *viz.,* poultry manure and vermicompost and biofertilizer in combination with inorganic nitrogen source to enhance the productivity of maize.

A field experiments was carried out at the Central Research Farm, Department of Agronomy, Allahabad Agricultural Institute - Deemed University, Allahabad, using maize hybrid PAC -711, during the rainy season of 2006. The experimental soil was sandy loam in texture, having a pH of 7.7, EC 0.22 dSm^{-1}, OC 0.84% and the available NPK were analyzed to be 200.0 kg/ha, 29 kg/ha and 160 kg/ha respectively. The experiment was laid out in Randomized Block Design (RBD) with eleven treatments, replicated thrice. The treatments consisted of two levels of nitrogen *viz.,* 130 and 150 kg/ha, which was maintained by substituting 30 kg nitrogen through poultry manure, vermicompost or by seed inoculation with azotobacter in combination with inorganic fertilizer (urea), which was compared with urea alone. In addition to the nitrogen, the recommended doses of P_2O_5 and K_2O were applied through Single Super Phosphate and Muriate of Potash in all the treatments. Urea was taken as the inorganic nitrogen source. Maize seeds were inoculated with azotobacter culture as per the standard procedure according to treatment requirements. Six packets (200 g) of *Azotobacter* culture was thoroughly mixed in rice gruel and the

Table 1. Effect of integrated nitrogen management on growth attributes of maize hybrid (PAC-711) at 90 DAS

	Treatment	Plant height (cm)	No.of leaves	Dry weight (g)	Relative growth Rate
T_1	130 kg N/ha(U)	197.6	10.2	255.7	0.0218
T_2	150 kg N/ha(U)	199.7	10.7	258.0	0.0241
T_3	100 kg N(U) + 30KgN(P.M.)	192.2	10.1	250.3	0.0216
T_4	120 Kg N (U) + 30 kg N (P.M.)	202.9	10.8	273.7	0.0284
T_5	100 Kg (U) + 30 kg N V.C.)	192.1	10.1	250.3	0.0215
T_6	120 Kg N (U) + 30 kg N (V.C.)	198.0	10.4	256.3	0.0227
T_7	100 kg N (U) + Azotobacter	190.1	10.1	246.7	0.0214
T_8	120 kg N (U) + Azotobacter	198.0	10.3	256.3	0.0222
T_9	90 Kg N (U) + 30 kg N (P.M.) + Azotobacter	196.6	10.1	252.7	0.0216
T_{10}	90 Kg N (U) + 30 kg N (V.C.) + Azotobacter	188.4	10.0	238.7	0.0198
T_{11}	40 Kg N (U) +30 kg N (P.M.) + 30 kg N (V.C.) + Azotobacter	184.8	9.2	222.0	0.0192
	CD. at 5%	10.4	0.8	14.8	0.003

Where: U: Urea, P.M.: Poultry manure, V.C: Vermicompost

required quantity of maize seeds were blended with bacterial culture and kept under shade for drying (20-30 minutes) before sowing. Irrigation and plant protection measures were carried out as and when required. The seeds were sown in rows at a spacing of 60 x 25 cm. Two seeds were dibbled at 4.5 cm depth in each sowing hole. One plant/ hill was maintained after the establishment. The entire doses of phosphorus and potassium were applied at the time of sowing and N through urea was applied as half dose at sowing time and two split doses of urea were applied as one fourth each at knee high and tasseling stage in all the treatments. During the course of experimentation, growth parameters (Plant height, no. of leaves/plant, dry weight and relative growth rate) and yield attributes (No. of cobs/plant, length of cobs, no. of grains/cob and test weight) and grain yield were determined by adopting a series of standard protocols. Data collected were subjected to statistical scrutiny.

Growth components

Data on plant height, number of leaves/plant, dry matter production and relative growth rate are presented in table 1. The data clearly indicated that plant height, number of leaves/ plant, dry weight and relative growth rate were influenced significantly by different treatments. The tallest plants (202.9 cm) and the highest number of leaves/plant (10.8) at 90 DAS were observed under the treatment T_4 (120 kg nitrogen supplied through urea + 30 kg nitrogen supplied

Table 2. Effect of integrated nitrogen management on growth attributes of maize hybrid (PAC-711).

	Treatment	No.of cobs/plant	Length of cob (cm)	No.of grains/cob	Test weight (g)
T_1	130 kg N/ha(U)	1.1	14.7	386.7	248.0
T_2	150 kg N/ha(U)	1.2	15.5	438.0	266.7
T_3	100 kg N(U) + 30KgN(P.M.)	1.0	14.1	360.1	246.7
T_4	120 Kg N (U) + 30 kg N (P.M.)	1.2	16.6	483.4	348.7
T_5	100 Kg (U) + 30 kg N V.C.)	1.0	13.9	350.7	245.3
T_6	120 Kg N (U) + 30 kg N (V.C.)	1.1	15.3	420.0	259.7
T_7	100 kg N (U) + Azotobacter	1.0	13.7	343.3	244.7
T_8	120 kg N (U) + Azotobacter	1.1	15.1	392.3	251.0
T_9	90 Kg N (U) + 30 kg N (P.M.) + Azotobacter	1.0	14.6	363.0	246.7
T_{10}	90 Kg N (U) + 30 kg N (V.C.) + Azotobacter	1.0	13.3	293.9	243.7
T_{11}	40 Kg N (U) +30 kg N (P.M.) + 30 kg N (V.C.) + Azotobacter	1.0	12.2	265.8	238.3
	C.D. at 5%	0.1	0.8	42.0	7.8

Where: U: Urea, P.M.: Poultry manure, V.C: Vermicompost

through poultry manure), however it was statistically at par with the treatments T_2 (150 kg N/ha through urea), T_6 (120 kg nitrogen supplied through urea + 30 kg nitrogen supplied through vermicompost), T8 (120 kg nitrogen supplied through urea + seed inoculation with azotobacter), T_1 (130 kg nitrogen supplied through urea) and T_9(90 kg nitrogen supplied through urea + 30 kg nitrogen supplied through poultry manure + seed inoculation with azotobacter) respectively. The maximum dry weight (273.7 g/plant) and the highest relative growth rate (0.0284 g/plant/day) was observed under the treatment T_4 (120 kg nitrogen supplied through urea + 30 kg nitrogen supplied through poultry manure) which was significantly higher than all the other treatments. Thus, the growth parameters were found to be the highest under the treatment where 120 kg nitrogen was supplied through urea + 30 kg nitrogen supplied through poultry manure. Vasanthi and Kumaraswamy (2000) reported that application of poultry manure in addition to inorganic nitrogenous fertilizers helps in increasing the uptake of nitrogen by plants due to reduced leaching losses and higher retention in the soil.

Yield components

Yield contributory parameters such as no. of cobs/plant, length of cobs (cm), no. of grains/cob and test weight of seeds were found to differ significantly under the various treatments as shown in table 2. The highest no. of cobs/plant (1.20) was observed in the treatment T_4(120

kg nitrogen supplied through urea + 30 kg nitrogen supplied through poultry manure) which was statistically at par to the treatments T_2 (150 kg N/ha applied through urea) and T_6(120 Kg N supplied through urea + 30 kg N supplied through Vermicompost) respectively. The highest length of cobs (16.6 cm), maximum number of grains/cob (483.4) and the highest test weight (348.7 g.) was observed under the treatment T_4 (120 kg nitrogen supplied through urea + 30 kg nitrogen supplied through poultry manure) which was significantly higher than all the other treatments.

The highest values for all the yield contributing factors like no. of cobs/plant, length of cobs, no. of grains/cob and test weight were obtained with the application of 30 kg N through poultry manure in addition to 120 kg N through urea. Mehana (1998) has reported that application of chicken manure increases the extractable micronutrients from the soil in addition to the available N, P and K. Silva and Tuivavologi (1996) have reported that application of chicken manure with inorganic fertilizers significantly increased the concentration of nitrate - N, Zn and Ca in the soil. Thus the higher availability of micronutrients and nitrate nitrogen might have resulted in better growth and metabolism in maize plants leading to better seed filling, higher no. of cobs/plant and higher cob length.

Grain yield

Grain yield of maize hybrid (PAC-711) was significantly influenced by integrated nitrogen management as shown in table 3. The highest grain yield (84.1 q/ha) was obtained under the treatment T_4(120 kg nitrogen supplied through urea + 30 kg nitrogen supplied through poultry manure) which was significantly higher than all the other treatments. This may be attributed to the favorable growth and yield contributing characteristics obtained under the same treatment. The treatment that received 30kg N through poultry manure along with 120 kg N through inorganic fertilizers showed the maximum dry matter accumulation along with the highest relative growth rate which would have assisted in the higher grain production. Besides the beneficial effect of nitrogen on growth contributing characters this treatment maintained improved nutritional status by increased availability of micronutrients that would have resulted in higher seed yield. Increase in grain yield due to the addition of poultry manure with inorganic nitrogenous fertilizers has been well documented (Vasanthi and Kumaraswamy, 2000; Channabasavanna *et al.,* 2002; Adeniyan and Ojeniyi, 2003 and Luikham *et al.,* 2003).

Economic analysis

The highest net profit (Rs. 48706/ha) and benefit cost ratio (3.28) was obtained under the treatment T_4(120 kg nitrogen supplied through urea + 30 kg nitrogen supplied through poultry manure) followed by the treatment T_2 (150 kg N through urea alone) as depicted in table 3.The highest net profit and benefit cost ratio obtained under the treatment T_4 would have been due to better yield attributes and yield of maize.

From the results, it can be concluded that maize hybrid PAC -711 responded to integrated nitrogen management significantly. From this study it is found that application of 120 kg N through urea along with 30 kg N through poultry manure in combination with the recommended doses of P and K produced the highest grain yield (84.1q/ha), net profit (Rs.48706/ha) and benefit cost ratio (3.28) with added advantage of higher micronutrient availability in soil.

Table 3. Effect of integrated nitrogen management on yield and economics of maize.

Treatment		Grain yield (q/ha)	Net Profit (Rs./ha)	Benefit Cost Ratio
T_1	130 kg N/ha(U)	64.5	36144	2.84
T_2	150 kg N/ha(U)	73.6	42558	3.15
T_3	100 kg N(U) + 30KgN(P.M.)	59.3	30768	2.43
T_4	120 Kg N (U) + 30 kg N (P.M.)	84.1	48706	3.28
T_5	100 Kg (U) + 30 kg N V.C.)	58.1	25811	2.02
T_6	120 Kg N (U) + 30 kg N (V.C.)	69.4	33787	2.32
T_7	100 kg N (U) + Azotobacter	56.5	30474	2.58
T_8	120 kg N (U) + Azotobacter	65.5	37184	2.91
T_9	90 Kg N (U) + 30 kg N (P.M.) + Azotobacter	60.0	31816	2.52
T_{10}	90 Kg N (U) + 30 kg N (V.C.) + Azotobacter	48.1	18253	1.72
T_{11}	40 Kg N (U) +30 kg N (P.M.) + 30 kg N (V.C.) + Azotobacter	42.6	12403	1.46
	C.D. at 5%	6.9		

Where: U: Urea, P.M.: Poultry manure, V.C: Vermicompost

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Research Notes

Influence of water management and cultural practices on the yield attributes and yield of rice

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Rice is the most important food crop of the world population. In Tamil Nadu, rice production is 3.22 million tonnes from an area of 1.40 million hectares with the productivity of 2,308 kg ha^{-1} (GOTN, 2006). The productivity is low when compared to the world average rice productivity. The major constraints in rice production are lack of integrated management practices involving land, water, crop and inputs. In the present investigation, efforts were made to find out the suitable method of water management and cultural practices to increase the rice productivity.

An experiment was conducted during the *kharif* 2004 and 2005 at the Tamil Nadu Rice Research Institute, Aduthurai. The experiment was laid with three water management practices (continuous submergence (5 ± 2 cm) (M_1), cyclic submergence (M_2) and saturation throughout crop growth (M_3) as main plot treatments and four cultural practices (transplanting + herbicide weed control + recommended fertilizer dose (T1), direct sowing of sprouted seeds on the same day + herbicide weed control + 1 spot weeding on 30DAS + recommended fertilizer dose (T2), direct sowing of sprouted seeds on same day + herbicide weed control + 1 conoweeding on 30 DAS + recommended fertilizer dose (T3) and direct sowing of sprouted seeds on second day + herbicide weed control + 1 conoweeding on 30 DAS + recommended fertilizer dose (T4) as sub