The Andhra Agric. J 57(3):287-289, 2010

Response of Maize (*Zea mays* L.) Plant Population and Fertilizer Levels in Rabi Under No Till Condition

Key words : Azotobactor, Fertilizer Levels, No till condition (Zero tillage), NPK, PSB, Spacing

Maize (*Zea mays* L.) is a versatile crop, which finds it's use in the human food, animal feed, fodder and industrial raw material. It is an exhaustive crop and requires high quantities of fertilizers for higher productivity. Of late, farmers are growing *rabi* maize in rice fallows under no till condition (zero tillage) to avoid problems in land preparation; ensure timely sowing and saving in cost of cultivation. Maize is grown under no till condition in rice fallows in about 2.5 lakh acres in Andhra Pradesh (Western delta, Nalgonda, Warangal and Khammam). Among the various cultural practices, fertilizer levels and spacing are the key factors, which affect the growth and yield of maize (Sahoo and Mahapatra, 2007a). There are diversified reports about the effect of plant population and fertilizer levels on yield of maize. Viswanatha *et al.,* (2000) reported maximum green-cob yield with planting at 60 x 30 cm spacing, whereas Raja (2001) recommended a population of 88, 888 with 120 kg N ha^{-1} to get the maximum yield. Different plant growth promoting rhizobacteria including free-living and associative bacteria such as *Azospirillum, Azotobactor, Bacillus* and *Pseudomonas* have been used in different crops as biofertilizers for the beneficial effect on crop growth. Improved growth, nutrient uptake and yield of maize by the inoculation of *Azotobactor* and *Azospirillum* were reported by Biari *et al.* (2008). Seed treatment with phosphate solubilizing bacteria (PSB) before sowing helps in solubilizing the unavailable form of phosphorus to available form, resulting in better growth. Research on the response of *rabi* maize to plant population, fertilizer levels and biofertilizers under no till condition in India is meager.Therefore, this experiment to study the optimum plant population and nutrition requirement for maize during *rabi* under no till condition in clay loam.

A field experiment was conducted during *rabi* 2007-08 at Regional Agricultural Research Station, Warangal on clay loam soil with P^H 8.1, OC 0.3%, available N (253 kg ha^{-1}), available P_2O_5 (28 kg ha^{-1}) and available K_2O (392 kg ha^{-1}) with 0.12 EC (d S m^{-1}). The experiment was laid out in randomized block design with factorial concept and replicated thrice. There are 15 treatments in the study. The treatment combinations comprised three spacings (S) and five fertilizer levels (F); *viz.,* S1: 60 x 20 cm (66,666 plants ha^{-1}), S_2: 50 x 25 cm (80,000 plants ha^{-1}) and S_3: 40 x 25 cm (1,00,000 plants ha^{-1}); F_1 : Seed treatment with *Azotobactor* + Phosphate solubilizing bacteria (PSB) + 100% recommended NPK fertilizers, F_2: 100% recommended NPK fertilizers, F_3:75% recommended NPK fertilizers, F_4: 125% recommended NPK fertilizers, F5: 150% recommended NPK fertilizers. Maize hybrid "Dekalb Super 900 M" was sown on 15.11.2007 under zero tillage and harvested on 17.03.2008. A total of 14.9 mm rainfall was received in two rainy days during the study period. The mean monthly maximum and minimum temperatures ranged from 30.9-32.20C and 16.5-23.30C, respectively during the crop period.

Maize was sown under no till condition (zero tillage) after kharif rice by dibbling @ 2 seeds $hill^{-1}$ with help of pointed peg and marked plastic rope as per the spacings. Thinning and gap filling was taken up at 10 DAS by keeping one seedling $hill^{-1}$. For proper germination, a light pre- sowing irrigation was given after harvest of *kharif* rice. Maize seed was treated with *Azotobactor* @ 3 g and PSB @ 3 g kg^{-1} seed as wet seed treatment before sowing in F1 treatment. The calculated quantity of N, P_2O_5 and K_2O in the form of urea, DAP and muriate of potash, respectively were applied as per the treatments. The recommended dose of NPK (100% RDF) for *rabi* maize was 120, 60, 50 kg ha^{-1} for Telangana region of Andhra Pradesh. Full dose of P_2O_5 and half dose of K_2O were applied as pocketing near seedling at 15 DAS. Nitrogen was applied in 3 splits *i.e,* at 25, 45 and 65 days after sowing. Remaining half dose of K_2O was applied along with first split of N at 25 days after sowing as pocketing near seedling. While applying fertilizers as top dressing, required moisture was ensured in the soil by giving light irrigation. During the study period, five irrigations were given to maize. Recommended package of practices was followed.

Table. Yield attributes and yield of *rabi* maize as influenced by spacings and fertilizer levels under no till condition in rice fallows

Treatments	No. of kernels cob^{-1}	Kernel weight plant^{-1} (g)	100-kernel weight (g)	Plant dry weight at harvest (g)	Stover yield (kg ha^{-1})	Kernel yield (kg ha^{-1})
Spacings (S)						
S_1-60x25 cm (66,666 plants/ha)	467	115	24.74	272	6378	4767
S_2-50x25 cm (80,000 plants/ha)	449	111	24.56	261	6036	4352
S_3-40x25 cm (1,00,000 plants/ha)	436	101	24.34	243	5845	4187
SEm±	4.4	3.17	0.13	8.3	149	71
CD (P=0.05)	12.9	9.18	0.36	25	NS	206
Fertilizer levels (F)						
F_1-100% RDF + ST	445	107	24.42	251	5882	4239
F_2-100% RDF	431	104	24.41	246	5712	4094
F_3-75% RDF	397	98	24.07	227	5396	3517
F_4-125 % RDF	479	115	24.86	274	6356	4860
F_5-150 % RDF	502	121	24.90	296	7087	5465
SEm±	5.8	4.1	0.16	10.7	193	289
CD (P=0.05)	16.7	11.9	0.47	30.9	559	838
Interaction (S x F)						
SEm±	10.0	7.1	0.28	18.5	334	501
CD (P=0.05)	NS	NS	NS	NS	NS	NS

RDF: Recommended dose of fertilizers, ST: Seed treatment with *Azotobactor* + PSB

Sowing maize at closer spacing *i.e,* plant population more than 66,666 plants ha^{-1} (60 x 25 cm) reduced the number of kernels cob^{-1} significantly (Table) under no till condition. However, kernel weight plant^{-1} (g) with 50 x 25 cm (111) was at par with 60 x 25 cm (115) but significantly more than 40 x 25 cm (101). Similarly, higher test weight (g) was recorded with 60 x 25 cm (24.74), significantly superior over 40 x 25 cm (24.34), but at par with 50 x 25 cm (24.56). Similar trend was maintained with respect to plant dry weight at harvest (g) (Table 1). The grain yield (kg ha^{-1}) recorded at 60 x 25 cm with 66,666 plants ha^{-1} (4767) was also significantly superior to 50 x 25 cm with 80,000 plants ha^{-1} (4352) and 40 x 25 cm with 1, 00,000 plants ha^{-1} (4187), both of which were at par with each other. Reducing spacing, there by higher population beyond 66,666 plants ha^{-1} might have increased competition between plants for resources and created a stress environment for the plant growth, which resulted in lighter cobs, less number of kernels cob^{-1} and test weight in case of higher plant density (Sahoo and Mahapatra, 2007a). Kar et al. (2006) also reported similar findings in sweet corn. There was no significant difference in stover yields (kg ha^{-1}) at wider or closer spacing of maize under no till condition.

Application of 150 per cent of the recommended dose of fertilizers produced maximum number of kernels cob^{-1} (502) superior to all the other levels. Additional seed treatment with Azotobactor and PSB could not increase the number of kernels cob^{-1} (445) over the application 100 percent recommended fertilizers alone. Similarly, increasing the recommended dose of fertilizers by 50 per cent could register the higher kernel weight cob^{-1} (g) (121), superior to all the other fertilizer levels except the 125 percent RDF (115), the later being at par with 100 per cent RDF with (107) or without (104) the seed treatment with *Azotobactor* and PSB. Similar

trend was recorded with respect to 100-kernel weight (g) and plant dry weight at harvest (g) also (Table 1). Increasing the recommended fertilizer doses by 25 per cent or 50 per cent registered the at par kernel yields. Maximum kernel yield (kg ha^{-1}) was obtained at 150 per cent RDF (5465), significantly more than 75% RDF (3517), 100% RDF (4094) and 100% RDF + Seed treatment (4239). Higher fertilizer level had more number of heavier kernels resulting in increased kernel yield. This is in agreement with Mishra *et al.,* (1994), Raja (2001) and Sahoo and Mahapatra (2007_b). Additional seed treatment with Azotobactor and PSB could not increase the yield of maize significantly over the recommended dose of fertilizers alone. Similar results were obtained by Padmaja (1997). Stover yield (kg ha^{-1}) recorded was also found to follow the similar trend to that of kernel yield. The interaction effect between the spacings and fertilizer levels was not significant with respect to yield attributes and yield of maize.

Thus, the present study revealed that under no till condition, adoption of a spacing 60 x 25cm with the application of 180:90:75kg N:P_2O_5:K_2O ha^{-1} (150% of RDF) was found to be optimum for rabi maize in Telangana region of Andhra Pradesh for getting higher yields.

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(Received on 29.12.2009 and revised on 10.01.2010)