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Research Article

Effect of Planting Density and Nutrient Management Practices on the Performance of Maize Hybrids in Kharif Season

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Abstract

Field experiment was carried out at Department of Millets, Tamil Nadu Agricultural University, Coimbatore, during *Kharif*, 2015 in sandy clay loam soil to study the genotype x planting density x nutrient interactions for achieving higher yield in hybrid maize. Based on the results, it is concluded that Maize hybrid COH (M) 6 under 50 x 20 cm spacing with the RDF(250:75:75 NPK kg/ha) is the best management practice for achieving higher grain yield (8289 kg ha^{-1}), net return (Rs.72,780 ha^{-1}) and B:C ratio (2.47).

Keywords: Maize, hybrids, density, nutrient management, growth and yield

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Introduction

Maize (*Zea mays* L.) is the most promising grain crop becoming popular in India after rice and wheat having wide ecological adaptability and is grown in almost all parts of India. It has the highest yield potential and used as human food, animal feed and as a source of large number of industrial by-products. Hence, it is called as "Queen of cereals". In India, about 59% of the total production is used as feed, while the remaining is used as industrial raw material (17%), food (10%), exports (10%), and other purposes (4%). The demand and production of maize is increasing more rapidly as compared to other major commodities. It is estimated that the demand for maize will continue to increase in coming days [1]. Thus, in the next 10 years there is a necessity and opportunity for doubling India's maize production from the current level of approximately 26 million MT.

The yield potential of maize depends on its genetic makeup as well as the environment in which it is grown. Nevertheless, the genetic potential can be exploited to the maximum by providing favourable growth environments as the yield is the result of the interaction of genotype, management and environmental factors. Management practices viz., tillage, planting density, irrigation, nutrient management and pest and disease management strive to maximize economic yield but responses to these practices vary across environments. Among these practices, planting density and nutrient management plays a vital role in increasing the yield of maize. Planting density decides the yield of a crop and should be maintained to avert yield loss as it is one of the major causes which directly affect the yield. Maize being an exhaustive crop requires a large quantity of nutrients during different growth periods. Balanced and optimum use of nitrogen, phosphorus and potassium fertilizers plays a pivotal role in increasing the yield of maize [2] and their contribution is 40 - 45 per cent. [3]. Keeping in view the above facts, the present experimentation was conducted to study the genotype x planting density x nutrient interactions for achieving higher yield in hybrid maize.

Materials and Methods

Field experiment was carried out at Department of Millets, Tamil Nadu Agricultural University, Coimbatore, during *Kharif*, 2015 to study the genotype x planting density x nutrient interactions for achieving higher yield in hybrid maize. The soil was sandy clay loam and low in available N (149 kg/ha), medium in available P (11.7 kg/ha) and high in available K (492 kg/ha) with a pH of 8.20. The experiment was laid out in a split – split plot design. In the main plot, two hybrids *viz.*,H_1- CO H(M) 6 and H_2 – CO H(M) 8 and in the sub plot, two planting densities *viz.*,D_1- 60 x 20 cm and D_2 - 50 x 20 cm and in the sub sub plot, three nutrient management practices *viz.*, RDF(N_1- 250:75:75 NPK kg/ha),STCR(N_2-232:99:37.5 NPK kg/ha) and SSNM (N_3-110:61:90 NPK kg/ha) were tried in three replications. Based on the soil analysis, the nutrient requirement for maize hybrid through Soil Test Crop Response (STCR) approach was worked out by using fertilizer prescription equations. For Site Specific Nutrient Management (SSNM), the nutrient status of soil after analysis, previous crops etc. are used for computing the nutrient requirement by using

IPNI (International Plant Nutrition Institute) Nutrient expert for hybrid maize software. Observations on plant height, 50% tasseling, yield attributes and yield were recorded.

General view of experimental field

$H_1D_2N_1$ – 45DAS

$H_1D_2N_1$ at harvest

Size of cob as influenced by hybrid, spacing and nutrient management practices

Results and Discussion

Effect of planting density and nutrient management practices on plants/ha, 50% tasseling and plant height of maize (Table 1)

Experimental results revealed that planting densities and nutrient management practices evinced significant influence on growth and yield attributes and yield of maize hybrids. The interaction effect was not significant. With respect to plants/ha, no significant difference was observed in hybrids and nutrient management practices. Nevertheless, the planting density 50 x 20 cm (D_2) was significantly superior to the planting density 60 x 20 cm (D_1).The tasseling (50%) was found to be much earlier in COH (M) 8 (H_2) than COH (M) 6 (H_1). Among the hybrids, COH (M) 6 (H_1) recorded significantly the higher plant height (249.4 cm) at harvest and it was comparable with COH (M) 8 (H_2).This was mainly due to the genetic makeup of plants. In respect of planting density, 50 x 20 cm (D_2) recorded higher plant height (249.6 cm), which was comparable with 60 x 20 cm (D_1). Increased competition for space, sunlight and available nutrients resulted in higher plant height. The results are in accordance with the findings of Pal and Bhatnagar (2012) [4]. With respect to nutrient management practices, RDF- 250:75:75 NPK kg/ha (N_1) recorded the highest plant height (252.8 cm) and it was on par with STCR - 232:99:37.5 NPK kg/ha (N_2) but was superior to SSNM -110:61:90 NPK kg/ha (N_3). This might be due to prolonged vegetative growth which increased the plant height. These results are in agreement with those of Khalil *et al*.,1988, Bakht *et al*., 2006, Masood *et al*., 2011[5-7] who reported that plant height increased with increase in nitrogen, phosphorus and potassium rates.

Table 1 Effect of planting density and nutrient management practices on plants/ha, 50% tasseling and plant height of maize

Treatments	Plants ('000/ha)	50% tasseling (Days)	Plant height (cm) At harvest
Main plot			
H_1	89.06	51.50	249.4
H_2	88.54	45.61	245.3
SEd	0.35	0.58	4.55
CD (p=0.05)	NS	2.49	NS
Sub plot			
D_1	80.89	49.0	245.1
D_2	96.70	48.11	249.6
SEd	0.62	0.44	3.6
CD (p=0.05)	1.71	NS	NS
Sub sub plot			
N_1	89.09	49.25	252.8
N_2	88.77	48.92	249.8
N_3	88.54	47.5	239.5
SEd	0.78	0.35	4.58
CD (p=0.05)	NS	0.74	9.7

Effect of planting density and nutrient management practices on yield attributes, grain and stover yield of maize (Table 2)

In respect of yield attributes, COH(M)6 (H_1) registered higher cob length (17.2 cm), cob girth(14.1 cm), no. of grain rows/cob(13.8), no. of grains/row (34.9) and 100 seed weight (38.1g) and it was comparable with COH(M) 8 (H_2). With regard to planting density, 60 x 20 cm (D_1) registered higher cob length (17.3 cm), cob girth (14.1 cm), no. of grain rows/cob (13.9), no. of grains/row (34.4) and 100 seed weight (37.6 g) and it was comparable with 50 x 20 cm (D_2).Better performance of yield attributes in 60 cm x 20 cm spacing was mainly due to better availability of light, aeration and nutrients than 50cm x 20cm.Similar findings were reported by Lashkari *et al*. (2011) [8]. The nutrient management practices had significant influence on yield attributes of both the hybrids (H_1 and H_2).RDF(N_1) registered the highest cob length(18.2 cm), cob girth(14.5 cm), no. of grain rows/cob (14.6), no. of grains/row (35.7) and 100 seed weight (38g) and it was comparable with STCR (N_2) but was superior to SSNM (N_3).The result confirms the findings of Sharar *et al*. 2003 [9], who reported that the yield attributes increased with increased levels of fertilizer.

Maize hybrid CO H(M) 6 (H_1) recorded the highest grain yield of 6971 kg ha^{-1} which was significantly superior to CO H(M) 8 (H_2). Among the planting densities, 50 x 20 cm (D_2) recorded higher yield (7099 kg ha^{-1}) and it was significantly higher than 60 x 20 cm (D_1).Among the nutrient management practices, RDF (N_1) recorded the highest yield (7366 kg ha^{-1}) which was comparable with STCR (N_2). This might be due to higher levels of NPK led to adequate supply of nutrients to the plant resulting in better growth which in turn led to better physiological process and movement of photosynthates to sink. The lowest grain yield of 5275 kg ha^{-1} was recorded in SSNM (N_3). The results are in accordance with the findings of Paramasivan *et al*. (2011) and Khalil *et al*. (1988) [5, 10].In respect of stover yield, maize hybrid CO H(M) 6 (H_1) recorded higher than CO H(M) 8 (H_2).The planting density of 50 x 20 cm (D_2) recorded higher stover yield of 12228 kg ha^{-1} and it was significantly higher than 60 x 20 cm (D_1). The highest stover yield of 12770 kg $ha^{-1}$was observed in RDF (N_1), which was on par with STCR (N_2) but was significantly superior to SSNM (N_3).The highest stover yield in RDF (N_1) was due to greater contribution of nitrogen, phosphorus and potassium to maize. Similar findings were reported by Khan *et al*., 2011[11]

Effect of planting density and nutrient management practices on economics of maize (Table 3)

In respect of economics, $H_1D_2N_1$ (Hybrid CO H(M) 6 under 50 x 20 cm with RDF) registered the highest net return (Rs.72780 ha^{-1}) and B:C ratio (2.47) which was followed by $H_1D_2N_2$ (Hybrid CO H(M) 6 under 50 x 20 cm with STCR) which registered a net return and B:C ratio of Rs.70747 $ha^{-1}$and 2.44, respectively.

Table 2 Effect of planting density and nutrient management practices on yield attributes, grain and stover yield of maize

Treatments	Cob length (cm)	Cob girth (cm)	No. of grain rows/cob	No. of grains/ row	100 seed weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
Main plot							
H_1	17.19	14.13	13.83	34.93	38.11	6971	12017
H_2	16.59	13.89	13.69	33.14	36.89	6282	10823
SEd	0.23	0.06	0.03	0.52	0.38	130.7	224.9
CD (p=0.05)	NS	NS	0.13	NS	NS	563	968
Sub plot							
D_1	17.25	14.09	13.87	34.37	37.62	6153	10611
D_2	16.53	13.93	13.66	33.71	37.38	7099	12228
SEd	0.26	0.16	0.14	0.06	0.76	193.5	333.2
CD (p=0.05)	NS	NS	NS	0.16	NS	537	925
Sub sub plot							
N_1	18.22	14.48	14.55	35.70	37.96	7366	12770
N_2	17.81	14.27	14.43	35.25	37.77	7237	12456
N_3	14.65	13.28	12.30	31.17	36.78	5275	9033
SEd	0.18	0.19	0.16	0.32	1.34	234.9	404.3
CD (p=0.05)	0.37	0.41	0.35	0.68	NS	498	857

Table 3 Effect of planting density and nutrient management practices on economics of maize

Treatments	Cost of production (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
$H_1D_1N_1$	46747	105826	59079	2.26
$H_1D_1N_2$	46566	103916	57350	2.23
$H_1D_1N_3$	44895	76387	31492	1.70
$H_1D_2N_1$	49347	122127	72780	2.47
$H_1D_2N_2$	49166	119913	70747	2.44
$H_1D_2N_3$	47495	87630	40135	1.84
$H_2D_1N_1$	46247	95581	49334	2.07
$H_2D_1N_2$	46066	93798	47732	2.04
$H_2D_1N_3$	44395	68059	23664	1.53
$H_2D_2N_1$	48847	110583	61736	2.27
$H_2D_2N_2$	48666	108532	59866	2.23
$H_2D_2N_3$	46995	78344	31349	1.67

Conclusion

From the experimental results, it could be concluded that Maize hybrid COH (M) 6 under 50 x 20 cm spacing with the RDF(250:75:75 NPK kg/ha) is the best management practice for achieving higher grain yield (8289 kg ha^{-1}), net return (Rs.72,780 ha^{-1}) and B:C ratio (2.47).

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