Plant Archives Vol. 17 No. 2, 2017 pp. 1577-1580 *ISSN 0972-5210*

STUDIES ON THE INFLUENCE OF SPACING AND NUTRIENT MANAGEMENT PRACTICES ON GROWTH AND YIELD ATTRIBUTES OF MAIZE HYBRIDS

A. P. Sivamurugan* and R. Ravikesavan

*Department of Millets, Tamil Nadu Agricultural University, Coimbatore- 641003 (T.N.) India

Abstract

Field experiments were carried out at Department of Millets, Tamil Nadu Agricultural University, Coimbatore during *Rabi*, 2015-16 and *Kharif*, 2016 in sandy clay loam soil to study the influence of spacing and nutrient management practices on growth and yield attributes of maize hybrids. During *Rabi*, 2015-16, in the main plot, two hybrids *viz.,* H_1- CO H (M)6 and H_2 - CO H (M)7 and in the sub plot, two spacing *viz*., D_1- 60 × 20 cm and D_2 - 50 × 20 cm and in the sub sub plot, three nutrient management practices *viz*., RDF (N_1- 250:75:75 NPK kg/ha), STCR (N_2-207:87:37.5 NPK kg/ha) and SSNM (N_3-110:61:90 NPK kg/ha) and during *Kharif*, 2016,in the main plot, two hybrids *viz.,* H_1- CO H(M) 6 and H_2 - CO H (M)7 and in the sub plot, two spacing *viz*., D_1- 60 × 20 cm and D_2 - 50 × 20 cm and in the sub sub plot, three nutrient management practices *viz*., RDF (N_1- 250: 75:75 NPK kg/ha), STCR (N_2-202:96:37.5 NPK kg/ha) and SSNM (N_3-110:61:90 NPK kg/ha) were tried in three replications. Based on the results of experimentation, it is concluded that Maize hybrid COH (M)7 under 50 × 20 cm spacing with the RDF (250:75:75 NPK kg/ha) recorded higher grain yield (8062 kg ha^{-1}), net return (Rs.73,924 ha^{-1}) and B : C ratio (2.40).

Key words: Maize hybrids, spacing, nutrient management, growth and yield.

Introduction

Maize (*Zea mays* L.) is the most important grain crop in India after rice and wheat with respect to area and production. The wide ecological adaptability favours the crop round the year in almost all parts of India. It has the highest yield potential and multi various uses as human food, animal feed and as a source of large number of industrial by-products. The yield potential of maize depends on its genetic makeup and the environment. 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.

Among the management practices, spacing and nutrient management plays a vital role in increasing the yield of maize. Plant population is the major factor in determining the degree of competition between plants which influences growthattributes of maize even under ideal environment.Spacing affects yield by influencing yield components such as number of cobs, number of grains per cob and cob weight. The ideal plant number per unit area depends on several factors such as water availability, soil fertility, row spacing and spatial arrangement. Under optimum water and nutrient supply, high plant density can result in an increased number of cobs per unit area, with eventual increase in grain yield.(Akbar *et al*., 2002). Maize being an exhaustive crop requires more nutrients during different phonological phases. The yield potential of crop, however, varies from variety to variety, location to location and also depends mainly on the availability of essential growth factors such as soil nutrient status and application of fertilizers. Increased yield of maize has been obtained in the tropics through the use of improved genotypes at higher planting densities and use of fertilizers.(Asghar *et al*., 2010). Hence, the experiments were conducted to study the genotype × spacing x nutrient interactions for achieving higher yield in hybrid maize.

***Author for correspondence :** E-mail:apacsivamurugan @gmail.com

Materials and methods

Field experiment was carried out at Department of Millets, Tamil Nadu Agricultural University, Coimbatore during *Rabi*, 2015-16 and *Kharif*, 2016 to study the genotype × spacing × nutrient interactions for achieving

higher yield in hybrid maize. During *Rabi*, 2015-16, the soil was sandy clay loam and low in available N (176 kg/ha), medium in available P (17.5 kg/ha) and high in available K (668 kg/ha) with a pH of 9.20. During *Kharif*, 2016, the soil was sandy clay loam and low in available N (165 kg/ha), low in available P (6.2 kg/ha) and high in available K (744 kg/ha) with a pH of 8.30. The experiment was laid out in a split-split plot design and replicated thrice. During *Rabi*, 2015-16, in the main plot, two hybrids *viz.,* H_1- CO H (M) 6 and H_2-COH(M)7 and in the sub plot, two spacing *viz*., D_1- 60 × 20 cm and D_2-50 × 20 cm and in the sub sub plot, three nutrient management practices *viz*., RDF (N_1- 250 : 75 : 75 NPK kg/ha), STCR (N_2-207 : 87 : 37.5 NPK kg/ha) and SSNM (N_3-110 : 61 : 90 NPK kg/ha) and during *Kharif*, 2016, in the main plot, two hybrids *viz.,* H_1- CO H (M) 6 and H_2-CO H (M)7 and in the sub plot, two spacing *viz*., D_1- 60 × 20 cm and D_2 - 50 × 20 cm and in the sub sub plot, three nutrient management practices *viz*., RDF (N_1- 250 : 75 : 75 NPK kg/ha), STCR (N_2-202 : 96 : 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, grain andstoveryield were recorded.

Results and Discussion

Effect of spacing and nutrient management practices on 50% tasseling, 50% silking and plant height of maize (table 1)

Experimental results revealed that spacing and nutrient management practices evinced influence on growth and yield attributes and yield of maize hybrids. The interaction effect was not significant. The tasseling and silking(50%) were found to be earlier in COH (M) 6 (H_1) than COH (M) 7 (H_2) in both the seasons. Anthesissilking intervalalso did not vary among the hybrids under different treatments. No significant difference was observed in respect of spacing. Among the nutrient management practices, the tasseling and silking were earlier in SSNM (N_3) than other practices. The results were in conformity with the findings of Farnham (2001).

Table 1: Effect of spacing and nutrient management practices on 50% tasseling, 50% silking and plant height of maizehybrids.

Treatments	50 % Tasseling (days)		50 % Silking (days)		Plant height at harvest (cm)	
	Rabi' 15	*Kharif'* 16	*Rabi'* 15	*Kharif'* 16	*Rabi'* 15	*Kharif'* 16
Main plot						
H_1	52.6	51.6	56.8	55.7	260.1	212.0
H_2	53.5	52.6	57.4	56.4	264.3	216.7
SEd	0.11	0.20	0.19	0.10	1.90	2.27
CD (p=0.05)	0.48	0.90	NS	0.41	NS	NS
Sub plot						
D_1	53.3	52.4	57.4	56.4	260.9	213.6
D_2	52.7	51.8	56.8	55.7	263.4	215.1
SEd	0.55	0.06	0.56	0.46	1.40	0.89
CD (p=0.05)	NS	0.20	NS	NS	NS	NS
Sub sub plot						
N_1	53.9	52.9	57.9	56.9	267.4	216.6
N_2	53.5	52.5	57.6	56.6	264.1	214.8
N_3	51.7	50.8	55.8	54.7	255.1	211.6
SEd	0.38	0.41	0.49	0.47	1.70	1.65
CD (p=0.05)	0.81	0.87	1.04	0.99	3.50	NS

With respect to plant height, no significant difference was observed between hybrids at varied levels of spacing. Nevertheless, COH (M)7 (H_2) under 50 × 20 cm (D_2) recorded higher plant height at harvest in both the seasons. This was mainly due to the genetic makeup of plants and more competition for space, sunlight and available nutrients. The results were in accordance with the findings of Pal and Bhatnagar (2012). Among the nutrient management practices, RDF (N_1) recorded the highest plant height and it was on par with STCR (N_2) but was superior to SSNM (N_3) during 2015. There was no significant difference among the hybrids, spacing and nutrient management practices in respect of plant height during 2016. However, RDF (N_1) recorded the highest plant height. This might be ascribed to prolonged vegetative growth which favouredthe plant height. These results were in agreement with those of Khalil *et al*.,1988, Bakht *et al*., 2006 and Masood *et al*., 2011 who reported that plant height increased with increase in rate of fertilizers.

Effect of spacing and nutrient management practices on yield attributes, grain and stover yield of maize hybrids (table 2)

The yield attributes were not significantly influenced by hybrids.Nevertheless, COH(M)7 (H_2) registered higher cob

Table 2: Effect of spacing and nutrient management practices on yield attributes, grain and stover yield of maize hybrids.

Treatments	Cob length (cm)		Cob girth (cm)		No.of grain rows/cob		No. of grains/row		100 seed weight (g)		Grain yield (kgha^{-1})		Stover yield (kgha^{-1})	
	Rabi '15	*Kharif '16*	*Rabi '15*	*Kharif '16*	*Rabi '15*	*Kharif '16*	*Rabi '15*	*Kharif '16*	*Rabi '15*	*Kharif '16*	*Rabi '15*	*Kharif '16*	*Rabi '15*	*Kharif '16*
Main plot														
H_1	17.7	16.8	15.1	14.0	13.9	13.6	33.6	35.1	36.3	37.6	6672	6465	11419	11150
H_2	18.5	17.5	15.3	14.2	14.0	13.8	34.7	36.0	36.6	38.0	7060	6804	12163	11904
SEd	0.12	0.23	0.20	0.06	0.09	0.15	0.90	0.54	0.36	0.61	51.8	58.6	514.9	370.2
CD (p=0.05)	0.52	NS	NS	NS	NS	NS	NS	NS	NS	NS	223	252	2215	NS
Sub plot														
D_1	18.6	17.4	15.5	14.4	14.1	13.8	34.5	36.1	36.7	38.1	6508	6345	11217	10951
D_2	17.7	17.0	14.9	13.9	13.8	13.5	33.8	35.0	36.2	37.5	7224	6923	12365	12103
SEd	0.38	0.30	0.22	0.09	0.22	0.18	0.30	0.50	0.73	0.56	216.6	212.1	576.2	216.3
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	601	NS	1599	600
Sub sub plot														
N_1	19.5	18.3	15.7	14.5	14.9	14.5	35.2	36.4	36.9	38.3	7626	7356	12976	12716
N_2	18.9	17.7	15.5	14.3	14.6	14.2	34.7	36.0	36.6	37.9	7260	6997	12475	12170
N_3	16.1	15.6	14.5	13.6	12.3	12.3	32.7	34.3	35.8	37.2	5712	5549	9921	9694
SEd	0.45	0.40	0.45	0.12	0.29	0.21	0.64	0.83	1.31	0.94	371.2	325.9	613.6	650.1
CD (p=0.05)	0.96	0.90	0.95	0.30	0.61	0.40	1.35	NS	NS	NS	787	691	1301	1378

length, cob girth, no.of grain rows/cob, no. of grains/ row and 100 seed weight in both the seasons.Though 60 × 20 cm (D_1) recorded higher cob length, cob girth, no.of grain rows/cob, no. of grains/row and 100 seed weight, spacing had no significant influence on yield attributes. Better yield determinants in 60 × 20 cm spacing was mainly due to better availability of light, aeration and nutrients than 50 × 20cm. Similar findings were reported by Lashkari *et al*. (2011). 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, cob girth, no.of grain rows/cob, no. of grains/row and it was comparable with STCR (N_2) but was superior to SSNM (N_3) during both the seasons. The result confirms the findings of Sharar *et al*. (2003) who reported that the yield attributes increased with increased levels of fertilizer. The 100 seed weight was not significantly influenced by hybrids, spacing and nutrient management practices.

During *rabi* and *kharif*, maize hybrid CO H(M)7 (H_2) recorded the highest grain yield of 7060 kg ha^{-1}and 6804 kg ha^{-1}, respectively which was significantly superior to COH(M)6 (H_1). The spacing of 50 × 20 cm (D_2) recorded higher yield (7224 kg ha^{-1}) and it was significantly higher than 60 × 20 cm (D_1) during *rabi*, whereas, during *kharif* there was no significant influence of spacing on grain yield of maize. Among the nutrient management practices, RDF (N_1) recorded the highest yield of 7626 kg ha^{-1}and 7356 kg ha^{-1} during *rabi* and*kharif*, respectively. This was comparable with STCR (N_2). This might be due to favourable effect of increasing fertilizer level on yield attributes,which finally resulted in higher grain yield. The increase in yield owing to increasing level of fertilizer might be due to adequate quantities and balanced proportion of nutrients applied to the crop during the growth period. The lowest grain yield of 5712kg ha^{-1} and 5549kg ha^{-1} was recorded in SSNM (N_3) during *rabi* and *kharif*, respectively. The results were in accordance with the findings ofThakur *et al.* (1997) and Paramasivan *et al*. (2011).

With regard tostover yield, maize hybrid COH (M) 7 (H_2) registered higherstover than COH(M)6 (H_1) in both the seasons. The spacing of 50 × 20 cm (D_2) recorded the higheststover yield of 12365 kg ha^{-1}and was comparable with 60 × 20 cm (D_1) during *rabi*. In *kharif*, the spacing of 50 × 20 cm (D_2) recorded the higheststover yield of 12103 kg

Table 3: Effect of spacing and nutrient management practices on economic returns.

Treatments	*Rabi* '2015		*Kharif* '2016		Mean	
	Net return (Rs.ha^{-1})	B:C ratio	Net return (Rs.ha^{-1})	B:C ratio	Net return (Rs.ha^{-1})	B:C ratio
$H_1D_1N_1$	52671	2.03	65096	2.30	58884	2.17
$H_1D_1N_2$	48842	2.00	59826	2.20	54334	2.10
$H_1D_1N_3$	28903	1.60	39120	1.80	34012	1.70
$H_1D_2N_1$	61259	2.17	73057	2.40	67158	2.29
$H_1D_2N_2$	56901	2.10	67296	2.30	62099	2.20
$H_1D_2N_3$	34654	1.67	44496	1.90	39575	1.79
$H_2D_1N_1$	58763	2.17	71238	2.40	65001	2.29
$H_2D_1N_2$	54660	2.10	65832	2.30	60246	2.20
$H_2D_1N_3$	33440	1.70	43885	1.90	38663	1.80
$H_2D_2N_1$	68018	2.27	79829	2.53	73924	2.40
$H_2D_2N_2$	63340	2.23	73636	2.40	68488	2.32
$H_2D_2N_3$	39697	1.73	49474	2.00	44586	1.87

ha^{-1}, which was significantly superior to 60 × 20 cm (D_1). The highest stover yield of 12976 kg ha^{-1} and 12716kg ha^{-1} was registered in RDF (N_1), during *rabi* and *kharif*, respectively. This was comparable with STCR (N_2) but was significantly superior to SSNM (N_3) in both the seasons. 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 Azam *et al*.(2007) and Khan *et al*. (2011)

Effect of spacing and nutrient management practices on economic returns (table 3)

Among the treatments evaluated, $H_2D_2N_1$ (Hybrid COH(M) 7 under 50 × 20 cm with RDF) registered the highest net return (Rs.73924 ha^{-1}) and B:C ratio (2.40) followed by $H_2D_2N_2$ (Hybrid COH(M)7 under 50 × 20 cm with STCR) which registered a net return and B:C ratio of Rs.68488 ha^{-1}and 2.32,respectively. The lowest net return and B:C ratio was registered in $H_1D_1N_3$ (Hybrid COH(M) 6 under 60 × 20 cm with SSNM).

Conclusion

From the experimental results, it could be concluded that Maize hybrid COH (M) 7 under 50 × 20 cm spacing with the RDF(250:75:75 NPK kg/ha) is the best management practice for achieving higher grain yield (8062 kg ha^{-1}), net return (Rs.73,924 ha^{-1}) and B:C ratio (2.40).

References

Akbar, H., M.T. Miftahullah Jan and Ihsanullah (2002). Yield potential of corn as influenced by different levels of nitrogen and plant population. ***Asian Journal of Plant Science*, 6**: 631-633.

Asghar, A. Ali ., W. H. Syed, M. Asif , T. Khaliq and A. A. Abid (2010). Growth and yield of maize (*Zea mays* L.) cultivars affected by NPK application in different proportion. *Pakistan Journal of Science,* **62(4)**: December, 2010.

Azam, S., Ali, M. Amin., S. Bibi and M. Arif (2007). Effect of plant population on maize hybrids. *J. Agron. Bio.Sci*., **(2)**: 13-16.

Bakht, J., S. Ahmad, M. Tariq, H. Akber and M. Shafi (2006). Response of Maize to planting methods and fertilizer N. *Journal of Agricultural and Biological Science*, **(1)**:8-14.

Farnham, D.E. (2001). Row spacing, plant population, and hybrid effects on corn grain yield and moisture.*Agron. J*., **93**: 1049-1053.

Khalil, S.K., M.S. Afridi and M. Iqbal (1988). Plant Height, Weeds Weight and Hay Yield of Maize and Mungbean in Mono and Associated Culture as Affected by NPK Application. *Sarhad Journal of Agriculture,* **(4)**: 377-385.

Khan, Z.H., S. Iqbal, A. Iqbal, N. Akbar and D.L. Jones (2011). Response of Maize (*Zea mays* L.) varieties to different levels of Nitrogen. *Crop and Environment,* **(2)**: 15-19.

Lashkari., Madani Mojgan, Ardakani Hmid, Reza Mohammad, Farid Golarardi and Keveh Zargari (2011). Effect of plant density on yield and yield components of different corn (Zea mays L.) hybrids. *American - Eurasian J. Agric. Environ. Sci.,* **10(3)**: 450-457.

Masood, T., R. Gul, F. Munsif, F. Jalal, Z. Hussain, N. Noreen, H. Khan and K.H. Nasiruddin (2011) Effect of Different Phosphorous Level on the Yield and Yield Component of Maize. *Sarhad Journal of Agriculture,* **(27)**: 167- 170.

Pal, M. S and A. Bhatnagar (2012). Productivity and profitability of pop corn, composite, and hybrid maize (Zea mays L.) under low nitrogen stress in mollisols of Uttrakhand. *Madras Agriculture Journal,* **99(4/6):** 259-262.

Paramasivan, M., K.R. Kumaresan, S. Malarvizhi, S. Thiyageswari, Mahimairaja and K. Velayudham (2011). Nutrient optimization strategy for sustainable productivity of hybrid maize (Zea mays L.) in palaviduthi (Pvd) series of soil of Tamil Nadu. *Res. Crops*, **12(1)** : 39-44.

Sharar, M.S., M. Ayub, M.A. Nadeem and N. Ahmad (2003). Effect of different rates of nitrogen and phosphorus on growth and grain yield of maize. *Asian J .Plant Sci*., **2(3)**: 347-349.

Thakur, D.R., O. Prakash, P.C. Kharwara and S.K. Bhalla (1997). Effect of nitrogen and plantspacing on yield, nitrogen uptake and economics in corn (Zea mays L.). *Ind. J. Agron*., **43(4)**: 668-671.