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Effect of planting density and nutrient management on performance of khafif hybrid maize (*Zea mays*)

M.V. SINGH, NEERAJ KUMAR AND R.K. SRIVASTAVA

N.D. University of Agriculture & Technology, Crop Research Station, Bahraich -271 801 (U.P.)

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ABSTRACT

A field experiment was conducted at Crop Research Station, Bahraich (Uttar Pradesh) during Kharif season of 2014 and 2015 to study the effect of planting density and nutrient management on performance of Kharif hybrid maize. Two hybrid of maize viz., MM- 849 and MM-1107 were located in main plot and two plant geometry viz., 60 x 20 cm and 50 x 20 cm in sub-plot and three levels of nutrients viz., RDF (120:60:60 kg NPK ha^{-1}), soil test crop response (STCR) (200:60:60 kg NPK ha^{-1}) and site specific nutrient management (SSNM) (245:60:85 kg NPK ha^{-1}) were located in sub-sub plot. The experiment was conducted in split plot design with three replications. The results revealed that the highest values of plant height (195.6cm), length of cob (21.7cm), grains/row (32.8), grains row /cob (18.2), test weight (251.66g), yield of cob (67.15qha^{-1}), shelling percentage (82.4 %), yield of grain (56.40q ha^{-1}) and stover yield (63.40q ha^{-1}) were recorded with the hybrid MM-1107. The results also indicated that highest values of plant height (195 cm), length of cob (21.2 cm), grains/row (34.5), grains row/cob (18.6), test weight (251 g), shelling percentage (83%) with grain yield (50.37 q ha^{-1}) and net profit of (Rs. 54778 ha^{-1}) were recorded under 60 x 20 cm plant geometry. The SSNM practice produced tallest plant (198 cm), higher length of cob (22.2cm), grains/row (33.4), grains row /cob (19.8), test weight (252.75g), shelling percentage (83.5%) with higher grain (54.65q ha^{-1}) and stover (63.40q ha^{-1}) yield as well as net profit Rs.59864.00 and B:C ratio 3.59 were noted with the application of nutrients on the basis of SSNM practice. The SSNM practice produced 24.8%higher yield over the state recommendation and 8.3 % over soil test crop response (SRCR), respectively.

Keywords: Planting density, nutrients management, economics, yield, Kharif maize.

INTRODUCTION

In India, maize (*Zea mays* L.) is the third most important food crop after rice and wheat. Maize is cultivated over 8.55 m ha (2014-15) area under a wide range of agro-ecological situations ranging from sea level to an altitude of more than 3000 meters. Maize contributes 8% in the national food basket and more than Rs.100 billion to the agricultural gross domestic products (GDP) at the current prices apart from providing employment to nearly 100 million man-days at the farm, and downstream agricultural and industrial sectors. In addition to staple food for human population and quality feed for animals, maize serves as basic raw materials to the industries for production of starch, oil, protein, alcoholic beverages, food sweeteners and, more recently, bio-fuel. It is used as ingredient in more than 3000 products. In U.P., maize covers an area of 1.8 m ha^{-1} with production and productivity of 4.8 mt and 1.4 t ha^{-1}, respectively (Anonymous, 2015). Though, Bahraich and adjoining districts were having potential area where maximum cultivation of maize is undertaken by farmers. The cultivars under cultivation among farmers were mainly land races. The farmers were facing problem of drought during Kharif, non-availability of high yielding cultivars and unorganized crop production programme. This undoubtedly increased the financial status of the farmers. The maize crop in kharif season requires comparatively less input as compare to most competing paddy crop of the season where farmers are harvesting double yield of maize than rice. Introduction of single cross maize hybrids having high yield potential with the assured supply of nutrient play a vital role in enhancing the productivity of maize crop. The low productivity of kharif maize in U.P. is due to non-availability of suitable production technology. The plant geometry and optimum plant population play an important role in plant growth, yield attributing characters and yield of crop. At present there is lack of nutrient recommendation according to area based climatic situation as well as nutrients

status of soil. There is wide gap between nutrient addition and nutrient removal. This is one of the major reasons for lower production at farmer's field. Without knowing soil fertility status and nutrient requirement of maize hybrids it is not possible to harvest potential yield. Keeping this view in mind, an experiment was undertaken to study the effect of hybrid, plant geometry and levels of nutrients on growth and yield of kharif maize.

MATERIALS AND METHODS

The experiment was conducted at the Crop Research Station, Bahraich (Uttar Pradesh) during kharif 2014 and 2015. Bahraich district is situated at 22^0 45^0 N, 88^0 16 E^0 and 30 m altitude. Average rainfall of the district ranged from 850 to 1120 mm. The soil of experimental plot was sandy loam in texture having neutral reaction (pH 7.6), available nitrogen (210 kg ha^{-1}) and medium in phosphorus (12.5 kg ha^{-1}) and potassium (260 kg ha^{-1}). Treatment comprised of two maize hybrids *viz*., MM-849 and MM-1107, two plant geometry (50 x 20 cm and 60 x 20 cm) along with three levels of nutrients *viz*., recommended dose (RDF) (120:60:60 kg NPK ha^{-1}), soil test crop response (STCR) (200:60:60 kg NPK ha^{-1}) and site specific nutrient management (SSNM) (245:60:85 kg NPK ha^{-1}). The experiment was laid out in split plot design and treatment was replicated thrice. The hybrids were in main plot, plant geometry located in sub plot and nutrients level in sub-sub plots. The crop was sown on July 10 in both the years. One third dose of N and full dose of P and K were applied as basal placement at the time of sowing as urea, single superphosphate and muriate of potash, respectively and remaining 2/3 dose of nitrogen was applied as top dressing in two equal splits, first at time of knee high and second at tassling stage of the crop. The irrigations and weed control measures were adopted in crop according to need of crop from time to time. Intercultural operations were also done two times during the crop season. Biometric observations such as plant height, cobs/plot, length of cobs, grains row/cob, grains/row, test weight were recorded at maturity. The grain and stover yield were recorded after harvesting of crop. Economics of each treatment was calculated on the basis of nearest market price of inputs and outputs. The data of each character were pooled and analyzed as per procedure advocated by Gomez and Gomez, (1984).

RESULTS AND DISCUSSION

Effect of maize hybrids

Growth and yield attributes: The data indicated that the significant differences were observed in growth and yield attributes between the hybrids (Table 1). The tallest plant (195.6 cm) were noted under the hybrid MM-1107, while the lowest plant height (193.3 cm) was recorded in hybrid MM-849. The, higher days (46.3days) were recorded for days to silking with hybrid MM-849 and 45.3 days in MM-1107. The higher length of cobs (21.7 cm), grain/row (32.8), grains row/cob (18.2), test weight (251.6), shelling percentage (82.4%) and cob yield (67.15) were recorded with hybrid-MM-1107 over hybrid MM-849. The lower values of length of cob (18.53cm, grain/row (30.5), grains row/cob (16.4) test weight (249.8g), shelling percentage (80.2%), and cob yield (64.18 q ha^{-1}) were recorded with hybrid MM-849.This might be due to genetic differences between these two hybrids. The difference between maize hybrids in relation to growth and yield attributes were also reported by Singh *et al.* (2006), Ramchadrappa *et al.* (2007) and Singh *et al.* (2014, 2016).

Yield: Data on grain and stover yield (Table 2) revealed that the maximum grain (56.40 q ha^{-1}) and stover (58.65q ha^{-1}) yields were recorded under the hybrid MM-1107, while minimum grain yield (45.51q ha^{-1}) and stover yield (56.26 q ha^{-1}) were recorded under the hybrid MM-849. The variation in yield between both the hybrids might be due to genetical potential variation of the hybrid (Singh *et al.* 2014).

Economics: Data (Table 2) showed that maximum net profit of Rs.53725 with B:C ratio of 3.46 were recorded with maize hybrid MM-1107, while net profit of Rs.50461/ha and B:C ratio 3.31 was noted under hybrid MM-849. The hybrid MM-1109 gave 6% higher net profit over the hybrid MM-849. About 4.3% increase in B:C ratio was noted under the hybrid MM-1107 over the hybrid MM-849. This might be due to yield variation within the hybrids. Similar findings were reported by Ramchandrappa *et al.* (2007), Singh, *et al.* (2014) and Singh *et al.* (2016).

Table 1: Effect of hybrids, plant geometry, nutrient levels on growth, yield attributes of maize (mean of two years)

Treatments	Plant height (cm)	Days to Silking	Length of cobs (cm)	Grains /row	Grains row /cob	Test weight (g)	Shelling Percentage
Hybrid							
MM-849	193.3	46.3	18.5	30.5	16.4	249.83	80.2
MM-1107	195.6	45.3	21.7	32.8	18.2	251.66	82.4
CD (P=0.05)	1.15	0.4	1.14	1.35	1.42	1.18	1.12
Plant geometry							
60 x 20 cm	195.5	46.8	21.2	34.5	18.6	251.66	83.0
50 x 20 cm	193.5	44.8	18.5	29.8	17.2	249.66	81.0
CD (P=0.05)	1.15	0.52	1.36	2.15	1.12	1.85	1.0
N, P and K (Kg ha^{-1})							
RDF (120:60:60)	190	47.5	18.4	28.6	15.8	248	80.1
STCR (200:60:60)	195	45.5	20.6	31.5	17.6	252.75	82.0
SSNM (245:60:85)	198	44.5	22.2	33.4	19.8	252.75	83.5
CD (P=0.05)	1.45	0.42	1.20	1.85	1.18	1.5	1.26

Effect of plant density

Growth and yield attributes: The significantly taller plants (195.5 cm) were noted under plant geometry of 60 x 20 cm and minimum plant height (193.5 cm) in 50 x 20 cm geometry. The yield attributes were significantly influenced by plant geometry and the highest value of length of cobs (21.2 cm), grains/ row (34.5), grain row/cob (18.6), test weight (251.66 g) and yield of cobs (67.80 q ha^{-1}) were recorded under plant geometry of 60 x 20 cm. While, lower values of length of cob (18.5cm), grains/row (29.8), grains row/cob (17.2), test weight (249.66g) and shelling percentage (81%) were noted under 50x20 cm geometry. Data (Table 1) indicated that higher days to silking (42.8days) were noted under plant geometry of 60x20 cm and 44.8days under 50x20 cm. This might be due to more plant row spacing as compared to row spacing 50 cm. The plant geometry provides the opportunity for better growth and yield attributes. The findings are in conformity with the result of Sahoo and Chandrappa (2007) and Singh *et al.* (2014) and Singh *et al.* (2016).

Table 2: Effect of hybrids, plant geometry, nutrient levels on yield and economics of maize (mean of two years)

Treatment	Yield of cobs (q ha^{-1})	Yields of grain (q ha^{-1})	Stover yield (q ha^{-1})	Net profit (Rs. ha^{-1})	B:C ratio
Hybrid					
MM-849	64.81	47.51	56.26	50461	3.31
MM-1107	67.15	56.40	58.65	53725	3.46
CD (P=0.05)	2.12	1.65	1.52	1250	0.10
Plant geometry					
60 x 20 cm	67.80	50.37	59.16	54778	3.51
50 x 20 cm	64.15	46.79	55.75	49409	3.26
CD (P=0.05)	2.28	1.75	2.25	1260	0.11
N, P and K (Kg ha^{-1})					
RDF (120:60:60)	56.95	41.01	50.20	42408	3.11
STCR (200:60:60)	67.90	50.09	58.75	54013	3.45
SSNM (245:60:85)	73.10	54.65	63.40	59864	3.59
CD (P=0.05)	2.58	1.85	2.15	1375	0.8

Yield: The data (Table 2) revealed that significantly higher yield of cob (67.80 q ha^{-1}) grain (50.37 q ha^{-1}) and stover (59.16 q ha^{-1}) were noted under the plant geometry of 60 x 20 cm and lower values (64.15 q ha^{-1}, 46.79 q ha^{-1} and (55.75 q ha^{-1}) of these characters in plant geometry of 50 x 20 cm. The higher yield of cob, grain and stover under plant geometry of 60 x 20

cm. might be due to better yield attributing characters noted under same spacing over the 50 x 20 cm plant geometry. Similar findings were reported by Sahoo *et al.* (2007) Singh *et al.* (2013) and Singh *et al.* (2016).

Economics: The economic data (Table 2) revealed that higher net income of Rs. 54778 and B:C ratio of 3.51 were noted under 60x20cm plant geometry and lower net profit Rs. 49409/ha and B:C ratio 3.26 in 50x20cm plant geometry. This increase was found 9.8 and 7.1% higher under plant geometry of 60x20 cm in net profit and B:C ratio, respectively. The difference in net income and B:C ratio might be due to yield variation between both the plant geometry. Similar findings were also reported by Singh *et al.*, (2013 and 2016).

Effect of nutrient management

G**rowth and yield attributes:** Data (Table 1) indicated that significant variations were recorded under different fertilizer practices to the crop. The tallest plants (198 cm) were recorded with SSNM practice (245:60:85 kg ha^{-1}) followed by 195cm in soil test crop response and minimum plant height (190 cm) under RDF (120:60:60 kg NPK ha^{-1}) and 195 cm in and soil test crop response (200:60:60 kg ha^{-1}).which was found 4.4 and 1.5% higher under SSNM fertilizer practice over the RDF and STCR practices, respectively. High yield attributes such as length of cobs (18.4 cm), grain/row (33.4), grains row/cob (19.8), test weight (252.75 g) and shelling percentage (83.8%0 were noted under SSNM practice. On the other hand, lower values of length of cob (918.4cm), grains/row (928.6) grains row/cob (15.8), test weight (248g) and shelling percentage (80.1%) were recorded with the RDF fertilizer practices. This might be due to availability of more nutrients to the crop under SSNM practice, which increased plant yield attributes in comparison to rest of nutrient levels. The data on days to silking showed that the maximum higher days (47.5days), (45.5days), (44.5days) with RDF, STCR and SSNM fertilizer practices, respectively. The similar findings were also reported by Singh *et al.* (2013), Kumar *et al.* (2014) and Singh *et al.* (2016). The lowest values of plant height and yield attributes were recorded under recommended dose of fertilizers which might be due to low availability of nutrients to the crop for development of height and yield attributes.

Yield: The data (Table 2) revealed that the highest yields of cob (73.10 q ha^{-1}), grain (54.65 q ha^{-1}), stover (63.40 q ha^{-1}) were noted under site specific nutrient management (245:60:85 kg NPK ha^{-1}) which was higher by 22.9 and 7.1% in cob yield, 24.8 and 8.3 % in grain yield and 20.8 and 7.3 % in stover yield over the recommended dose (120:60:60 kg NPK ha^{-1}) and soil test crop response (200:60:60 kg NPK ha^{-1}), respectively. The performance of site specific nutrient management was better over recommended practice for maize. It indicates that the recommendation domain of maize owing to ever declining soil health specially for some of the macro nutrients, increasing level of nutrients probably exerted a positive effect on the development of source and sink strength of the plant which ultimately resulted in higher yield. These findings are in conformity with the findings of Parthipan *et al.* (2003), Singh and Singh (2006), Singh *et al.* (2013), Singh *et al.* (2014), Singh, *et al.* (2016).

Economics: The data (Table 2) showed that the higher net profit (Rs. 59864) and B:C ratio (3.59) were recorded under the SSNM practice (245:60:85 kg NPK ha^{-1}), while, net income of Rs.42408, 54013 and B:C ratio of 3.11 and 3.45 were noted under RDF and STCR, respectively, which was found 29.15 and 9.77% higher in net income and 13.37 and 3.89% in B:C ratio over RDF (120:60:60 kg NPK ha^{-1}) and soil test crop response (200:60:60 kg NPK ha^{-1}), respectively.

On the basis of results, it may be concluded that hybrid MM-1107 with plant geometry of 60x20cm and SSNM practice (245:60:85 kg NPK ha^{-1}**)** produced higher yield and gave more net profit with higher B:C ratio. It may be recommended that maize growers should adopt the same practice in Kharif season to obtain higher yield and remunerative profit in eastern Uttar Pradesh.

REFERENCES

Anonymous (2015) Annual Progress Report of Kharif maize. All India Coordinated research Project on Maize. Pusa Campus, New Delhi.

Gomez, K.A. and Gomez, A.A. (1984) Statistical procedures for agriculture research second edition. An International rice research institute book, A wiely, inter science publication, john Wiely and Sons, New York.

Kumar, V., Singh, A.K., Jat, S.L., Parihar, C.M., Poonia, V., Sharma, S. and Singh, B. (2014) Influence of site specific nutrient management on growth and yield of maize (*Zea mays*) under conservation tillage. *Indian Journal of Agronomy* **59**(4):657-660.

Parthipan, T. and Prem Sekhar, M. (2003) Response of hybrid maize to different levels and time of fertilization under irrigated condition. *Journal of Agricultural Management* **2** (1&2):41-46.

Ramachandrappa, B. K., Nanjappa, H. V. and Soumya, T. M. (2007) Sensory parameters, nutrient contents, yield and yield attributes of baby corn varieties as influenced by stages of harvest. *Mysore Journal of Agricultural Sciences* **41**(1)**:**1-7.

Sahoo, S.C. and Mahapatra, P.K. (2007) Response of sweet corn (*Zea mays L.*) to plant population and fertility levels during rabi season. *Indian Journal of Agricultural Sciences* **77**:711-14.

Singh, D. and Singh, S.M. (2006) Response of early maturity maize (Zea mays) hybrid to applied nutrients and plant densities under agro climatic condition of Udaipur in Rajasthan. *Indian Journal of Agricultural Sciences* **76**(6):372-374.

Singh, M. V. (2016) Effect of planting density and nutrient management on performance of Rabi hybrid maize. *Annals of Plant and Soil Research* **18**(3):275-279

Singh, M. V., Kumar, N. Singh, B. and Prakash, V. (2016) Productivity and profitability of rabi maize hybrids under nutrient management practices. *Annals of Plant and Soil Research* **18**(1):70-73.

Singh, M.V., Kumar, N. and Mishra, B.N. (2013) Integrated use of nitrogen and FYM on yield, nutrient uptake and economics of maize in eastern Uttar Pradesh. *Annals of Plant and Soil Research* **15**(2):128-130.

Singh, M.V., Prakash, V., Singh, B. and Shahi, H. N. (2014) Response of maize hybrids to integrated nutrient management. *Haryana Journal of Agronomy* **30**(1):65-69.