

Effect of nutrient management practices and planting density on yield and nutrient uptake by hybrid maize (*Zea mays*)

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ABSTRACT

A field experiment was conducted at Crop Research Station, Bahraich (Uttar Pradesh) during Rabi season of 2015-16 and 2016-17 to study the effect of plant geometry and nutrient management practices on the performance of maize hybrids. Two maize Hybrids (H and 9682, Dekalb 900) were located in main plots, two plant geometry (60 x 20 cm and 50 x 20 cm) in sub plot and three nutrient management practices viz RDF (200:60:60 kg NPK ha⁻¹), STCR (250:50:50 kg NPK ha⁻¹), SSNM (225:60:80 kg NPK ha⁻¹) in sub-sub plot in split plot design with three replications. Results revealed that the higher maize yield (6804 kg ha⁻¹) was recorded in maize hybrid Dekalb 900. The maximum grain (6693 kg ha⁻¹) and stover yield (7391 kg ha⁻¹) were recorded under the plant geometry of 60 x 20 cm and SSNM (225:60:80 kg NPK ha⁻¹). The yield attributing characters as well as yield of the crop was benefited under hybrid Dekalb 900, Plant geometry of 60 x 20 cm and site specific nutrient management practice. The higher net return of Rs. 69680, Rs.71323 and Rs. 73483 ha⁻¹ were recorded with maize Hybrid Dekalb 900, plant geometry of 60x20 cm and SSNM practice, respectively. The highest plant nutrients uptake of N (159 kg ha⁻¹), P (33.9 kg ha⁻¹) and K (85.1 kg ha⁻¹) were found with (SSNM).

Keywords: Maize hybrid, plant geometry, nutrients management, yield, economics

INTRODUCTION

Maize (*Zea mays* L.) is one of the important cereal crop next to wheat and rice in the world. In India, it ranks fourth after rice, wheat and sorghum. Maize is being consumed both as food and fodder and also required by the various industries. In India, it is cultivated over an area of 1.61 million ha with an annual production of 5.27 million tones and productivity of 3765 kg ha⁻¹ during *rabi* season. Maize is also known as “queen of cereals” because it has very high yield potential. The productivity of maize is largely dependent on its nutrient management. It is well known that maize is a heavy feeder of nutrients and because of this nature; it is a very efficient converter of solar energy into dry matter and high genetic yield potential than other cereal crops. Hence, it is called as “miracle crop”. Being a C4 plant, it is very efficient in converting solar energy into dry matter. Food grain production needs to be increased from the available cropped area to sustain and feed ever growing population. In Uttar Pradesh the low yield of maize during *Rabi* season might be due to selection of poor genotypes. In India, single cross hybrid were developed which have the yield advantage of about 65 to 70 % over

traditional genotypes, However, still there is a lot of scope to improve the productivity of single cross hybrid through agronomic manipulation to realize the full genetic potential, Plant geometry also plays important role for growth of plant as well as development of yield attributing characters and yield of the crop in *Rabi* season. Generally farmers of Uttar Pradesh sow crops in low plant geometry broad casting of seed in *Rabi* season. it is the main reason for low yield of crop. Application of NPK fertilizers is very important to the crop in order to harvest high yield in *rabi* season. It responded up to 300 kg N:60 kg P₂O₅:80 kg K₂O ha⁻¹ depending upon the cultivar and soil fertility status of the soil (Maske *et al.* 2020) The imbalance use of nutrients to the crop is root causes for low yield of *rabi* crop (Kumar *et al.* 2014). Site specific nutrient management practice is very important for better growth as well as for yield of crop. In India much work has not been done on the production technology on site specific nutrient application only with plant geometry and important hybrid of maize crop. Keeping this in view, an experiment was undertaken to study the effect of different plant geometry and nutrient management practices on growth and yield of maize hybrid.

MATERIALS AND METHODS

The experiment was conducted at Crop Research Station, Bahraich (Uttar Pradesh) during 2015-16 and 2016-17 with two maize varieties (H 9682 and Dekalb 900) along with two plant geometries (60 x 20 cm and 50 x 20 cm) with three nutrients management practices viz. RDF (200 kg N:60 kg P₂O₅:60 kg K₂O ha⁻¹) STCR (250 kg N:50 kg P₂O₅:50 kg K₂O ha⁻¹) and SSNM (225kg N:60Kg P:80 Kg K ha⁻¹). The experiment was laid out in split plot design with three replications. The maize hybrids were located in main plot, plant geometry in sub plot and nutrients management practices in sub-sub plot. The soil of experimental field was sandy loam in texture having neutral reaction (pH 7.5), low in available N (230 kg ha⁻¹) and medium in available P (13.5 kg ha⁻¹) and K (240 kg ha⁻¹). The crop was sown on 15th November in both the years. One third dose of N and full dose of P and K were applied as basal at the time of sowing through 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 height stage and second at tassling stage of crop. The irrigation and weed control measures were adopted as per need of the crop from time to time. The intercultural operations were also done as per need of crop. Biometric observations such as plant height, cobs/plat, length of cobs, grains /cob, number of grains/row, test weight, grain and stover yield were recorded at the harvesting of the crop. Economics of each treatment was

calculated on the basis of local market prices of inputs and outputs. The data related to each character were pooled and analyzed as per procedure advocated by Gomez and Gomez, (1984). The N, P and K contents were determined by adopting standard methods (Jackson, 1973) and nutrient uptake was calculated by multiplying yield data with concentration of nutrients.

RESULTS AND DISCUSSION

Maize hybrids

The data (Table 1) indicated that the significant difference was observed in growth and yield attributes in both hybrids. The highest plant height (194.5 cm) was recorded with hybrid 9682 which was significantly higher to hybrid Dekalb 900 M Gold. The plant population ha⁻¹ indicated that highest plant population (90.2 thousand ha⁻¹) was recorded under hybrid Dekalb 900 and it was significantly superior to hybrid 9682, The number of cobs thousand ha⁻¹ was at par in both the maize hybrids. The length of cobs (17 cm), number of grains/row (29.6), test weight (230.6 g) were higher under hybrid Dekalb 900 over the hybrid 9682. It might be due to genetic potential of the hybrid. The lower barrenness percentage (0.16%) was recorded under Dekalb 900. The differences between maize hybrid in relation to growth and yield attributes were also reported by Singh et al. (2013) and Singh et al. (2014) and Singh et al. (2018).

Table 1: Effect plant geometries and nutrients management practices on growth, yield attributes of Rabi maize hybrids (Pooled data of 2 years)

Treatments	Plant Population (000) /ha	Plant height (cm)	Cobs (000) ha ⁻¹	Length of cobs (cm)	Grains rows/ cob	Grains/ row	Test weight (g)	Berreness (%)	Days of maturity
Maize Hybrids									
Hybrid 9682	87.2	195.4	91.5	16.6	16.4	27.8	225.3	0.38	157.3
Hybrid Dekals 900 M Gold	90.2	189.4	91.1	17.0	17.9	29.6	230.6	0.16	158.5
CD (P=0.05)	0.25	0.66	N.S.	0.14	0.49	0.44	0.77	0.1	0.60
Plant Geometry (cm)									
60x20	79.0	193.8	83.4	17.3	18.2	30.1	229.8	0.23	157.8
50x20	98.4	190.9	99.1	16.4	16.2	27.3	226.1	0.31	158.1
CD (P=0.05)	13.0	0.48	2.5	0.44	0.76	0.24	1.04	N.S.	N.S.
Nutrients Management Practices(kg ha ⁻¹)									
RFD (N200:P60:K60)	91.3	190.9	90.9	16.4	16.7	27.7	227.6	0.26	157.6
STCR (N250:P50:K50)	89.7	194.5	91.1	16.6	16.7	28.6	227.0	0.28	159.0
SSNM (N225:P60:K80)	85.1	192.1	92.90	17.4	18.1	29.7	229.30	0.27	157.2
CD (P=0.05)	NS	0.57	NS	0.16	0.30	0.73	0.99	NS	0.7

The data (Table 2) revealed that the maximum grain (6404 kg ha⁻¹) and stover yields (7529 kg ha⁻¹) were recorded in hybrid Dekalb-900 which was higher by 6.0 % in grain and 6.5 % in stover over the hybrid 9682. The variation in yield between these two hybrids might be due to genetical variation in the hybrids. The lowest grain (6414 kg ha⁻¹) and stover yields (7070 kg ha⁻¹) was recorded under hybrid 9682. Similarly maximum net income of Rs. 69680 ha⁻¹ was recorded under the hybrids Dekalb- 900. The variation in net income between two hybrids might be due to variation in grain and stover yields. The B:C ratio was also found in similar manner under both the maize hybrids. The similar findings were also reported by Singh, *et al.* (2014), Singh, (2016), Singh, *et al.* (2018). The higher uptake of N (159 kg ha⁻¹) P (9.3 kg ha⁻¹) and K (85.4 kg ha⁻¹) were recorded in hybrid Dekalb- 900 than that of hybrid 9682.

Plant geometry

The data (Table 1) indicated that higher plant population (98.4 thousand ha⁻¹) was recorded in plant geometry of 50x20 cm while lowest (79 thousand ha⁻¹) in 60x20 cm plant geometry. The maximum plant height (193.3 cm) was found with 60x20 cm plant geometry while lowest (190.9 cm) in 50x 20. Similarly number of cobs thousand ha⁻¹ was also found under both plant geometries. But maximum length of cobs (17.3 cm), number of grain rows /cob (18.2 cm), number of gains/rows (30.1), test weight (229.8 gm) barrenness percentage (0.23) were recorded under plant geometry of 60x20 cm while lowest value were found with 50x20 cm plant geometry. The difference between two plant geometries about growth and yield attributes may be due to effect of spacing between row to row and plant to plant. Similar findings were also reported by Singh *et al.* (2013) and Singh *et al.* (2016).

Table 2: Effect of plant geometries and nutrients management practices on yield, net return and nutrient uptake (Pooled data of 2 years)

Treatments	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Net returns (Rs ha ⁻¹)	B:C Ratio	Nutrient uptake (kg ha ⁻¹)		
					N	P	K
Maize Hybrids							
H- 9682	6414	7070	67107	2.92	150.7	32.1	80.2
Dekalb 900	6804	7529	69680	3.10	159.9	34.0	85.4
CD = P(0.05)	20.1	24.7	480	0.01	0.47	0.10	0.75
Plant Geometry (cm)							
60x20	6693	7391	71323	3.05	157.3	33.5	83.6
50x20	6525	7208	65464	2.97	153.3	32.6	82.2
CD (P=0.05)	22.1	151.4	3315.8	0.02	0.53	0.11	1.23
Nutrients Management Practices (kg ha ⁻¹)							
RDF(N200:P60:K60)	6416	7070	64129	2.95	150.8	32.1	80.3
STCR(N250:P50:K50)	6638	7355	67568	3.06	156.0	33.2	83.0
SSNM(N225:P60:K80)	6772	7473	73483	3.02	159.1	33.9	85.1
CD (P=0.05)	27.3	36.4	4753.7	0.02	0.65	0.14	0.90

The data (Table 2) indicated that significantly higher grain (6693 kg ha⁻¹) and stover yield (7391 kg ha⁻¹) were recorded under plant geometry of 60x20 cm while lower value of (6525 kg ha⁻¹) grain and (7208 kg ha⁻¹) straw yield were recorded under plant geometry of 50x20 cm. The yield of grain and stover under plant geometry of 60x20 cm might be due to better yield attributing characters. Similar findings were also reported by Singh *et al.* (2013), and Singh *et al.* (2016). The nutrient uptake with different treatments (Table 2) indicated that higher plant nutrient uptake 157.3, 33.5, 83.6 kg NPK ha⁻¹ were noted under plant geometry of 60x20 cm while under 50x20 cm

nutrient uptake of 153.3, 32.6 and 82.0 kg NPK ha⁻¹ were recorded. The higher nutrients uptake by crop under plant geometry of 60x 20 cm might be due to better root development and plant growth. The data (Table 2), revealed that higher net income of Rs 71323 ha⁻¹ was found under 60x20 cm spacing while Rs 654464 ha⁻¹ was noted under 50x20 cm. The difference between net income under plant geometry might be due to yield variation between both the plant geometry. The B:C ratio with both the plant geometry were similar to trend of net return. The higher B:C ratio (3.05) was noted under plant geometry of 60x20cm.

Nutrients management practices

The data (Table 1) revealed that significant variations were recorded under different nutrient management practices. The highest plant height (194.5 cm) was recorded with STCR (250:50:50 kg ha⁻¹ NPK) which was higher over the RDF and SSNM practice. The plant population (91.3 thousand ha⁻¹) was recorded under RDF. The number of cobs thousand ha⁻¹ (92.9), length of cobs (17.4 cm), number of grain rows /cob (18.1), number of grains /row (29.7) and test weight (229.3 g) were recorded under SSNM practice. and it was found significantly superior over RDF and STCR. This might be due to availability of more nutrient to the crop.. Similar findings were also reported by Singh *et al.* (2013), Singh *et al.* (2014) and Singh *et al.* (2018).

The highest grain (6772 kg ha⁻¹) and stover yields (7473 kg ha⁻¹) were recorded under site specific nutrient management practice and it was higher by 5.5 and 2 % in grain and 5.7, 1.6

% in stover yield over the recommended dose of fertilizer and soil test crop response, respectively. These findings are in conformity with the findings of Singh *et al.* (2013), Singh *et al.* (2014) and Singh *et al.* (2018). The highest plant nutrients uptake of 159.1, 33.9, 85.1 kg NPK ha⁻¹ was found with application of 225:60:80 kg NPK ha⁻¹ (SSNM). The higher uptake of nutrients under this treatment might be due to more nutrients availability. The lower uptake of 150.8:32.1:80.3 kg NPK ha⁻¹ was found with recommended dose of nutrient. The higher net income of Rs.73483 ha⁻¹ was recorded under SSNM practice which was found 14.5 and 8.7 % higher over the RDF and STCR practice, respectively. The B:C ratio was also recorded in same manner.

From the results, it may be concluded that the hybrid Dekalb- 900 sown with plant geometry of 60x20 cm and plant nutrients on the basis of site specific nutrient management produced more yield and gave more net profit. It may be recommended for the farmer's of eastern U.P. for cultivation of maize in *Rabi* season.

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