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Agrotechnics for Seed Production of Maize Inbred line

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ABSTRACT

A field experiment was conducted for two years during *rabi* 2010-11 and 2011-12 to study the agrotechnics for optimum plant density and nutrient management for seed production of BML-6, the maize crop female parental line/inbred of maize hybrid, DHM 117. The experiment was laid out in split plot design with three replications including main plots as two plant density levels (i) 67×20 cm (75000 plants/ha) and (ii) 67×25 cm (60,000 plants/ha) and sub plots as four fertility level, i.e., F_1 - 200–75–75 kg NPK/ha, F_2 –FYM (15 t/ha) + 200–75–75 kg NPK/ha, F_3 – FYM (15 t/ha) + 250–90–90 kg NPK/ha and F_4 – FYM (15 t/ha) + 300–105–105 kg NPK/ha. The results indicated that the seed and cob yield of BML-6 were found to be one par with plant density of 67 × 25 cm (75,000 plant/ha) (3119 and 4107 kg/ha) or 60 × 20 cm (60,000 plant/ha) (3,104 and 4,012 kg/ha respectively). The influence of fertility levels on the seed yield of BML-6 parental line indicated significantly higher seed yield with application of FYM (15 t/ha) + 250–90–90 kg NPK/ha (3,316 kg/ha) which inturn was on par with application FYM (15 t/ha)+200–75–75 kg NPK/ha (3,207 kg/ha) and FYM (15 t/ha)+300–105–105 kg NPK/ha (3,175 kg/ha), while significantly lower seed yield was recorded with 200–750–75 kg NPK/ha (2,748 kg/ha). Significantly higher net returns were recorded with application of FYM 15 t/ha+250–90–90 kg NPK/ha (Rs 292,500/ha) and was on par with FYM (15 t/ha)+200–75–75 kg NPK/ha (Rs 282, 265/ha). The B : C ratio resulted significantly higher with FYM (15 t/ha)+200–90–90 kg NPK/ha (4.05) and was on par with 200–75–75 kg NPK/ha (4.02) and with application FYM (15 t/ha)+200–75–75 kg NPK/ha (4.01).

Keywords Maize, Plant population, Fertility levels, Density, Growth.

INTRODUCTION

Maize (*Zea mays* L.) is an important cereal food crop of the world with highest production and productivity as compared to rice and wheat. It is the most versatile crop which is being grown in more than 166 countries across the global including tropical, sub-tropical and temperature regions from sea level to 3000 m above mean sea level maize is the third most important cereal after rice and wheat. Maize is the third most important grain crop in India after paddy and wheat. It is grown in diverse ecologies for various benefits as food, feed, fodder, biofuel and main source of diversi-

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fied products obtained from industrial inputs such as starch, cornoil, glucose. The demand of maize crop has been constantly mounting as it adopts easily to a wide range of production environment situations and fits well in the existing cropping systems.

The productivity in the states, in different zones need to be enhanced with development and adoption of improved technology. Amongst the agronomic practices, the plant density and nutrient management play a vital role in augmenting maize yields. Optimum plant density is one of the important factor for higher production by efficient utilization of under-ground resources and also harvesting as much as solar radiation and inturn better photosynthetic efficiency (Monneveux *et al.* 2005, Bruns and Abbas 2005). Maximum yield can be expected only when plant population allows individual plant to achieve their maximum inherent potential (Aravinth *et al.* 2011). Maize is characterized as a exhaustive feeder of nutrients as its nutrient requirements are high specially nitrogen, phosphorus and potassium from the soil. Balanced nutrition is an essential component of nutrient management and plays significant role in increasing crop production and its quality. The major processes of plant development and yield formation the prescence of nutrients like N, P and K in balanced form is essential. Hence, in this context the present study is executed to study the agro technics for optimum plant density and nutrient management for seed production of BML-6, the female parental line/inbred of maize hybrid, DHM 117, which is a popular medium maturity hybrid released from Professor Jayashanker Telangana State Agricultural University and is popular and cultivated all over India particularly in Telangana, Andhra Pradesh, West Bengal, Bihar, Rajasthan.

MATERIALS AND METHODS

A field experiment was conducted at Agricultural Research Station, Karimnagar, Telangana, India for two years during *rabi* 2010-11 and 2011-12 under all India Coordinated Research Project on Maize Improvement Scheme of this Research Station. The experimental site comes under tropical semi arid climate with dry hot summers and cool winters. The farm is geographically situated 1826´N longituded 79°54´E latitude and altitude of 259 m above mean sea level. The soil of the experimental site is red sandy loam soils with neutral pH 7.09, Electrical conductivity of 0.26 dSm^{-1}, Organic Carbon of 0.71%, low in available Nitrogen (176 kg/ha), high in available phosphorus (37 kg/ha) and available K (392 kg/ha), available Sulfur 46.8 ppm, Iron 2.4 ppm, Copper 0.28 ppm, Manganese 6.50 ppm, Zinc 1.11 ppm and Boran 0.24 ppm. The total rainfall during this cropping period (June to October) was 564 and 594.7 mm respectively during 2010 and 2011 with 49 rainy days during both years. The experiment was laid out in split plot design with three replications including main plots as two plant density levels i.e., S_1– 67×20 cm (75,000 plants/ha) and S_2–67×25 cm (60,000 plants/ha) and sub plots as four fertility level, i.e., F_1 – 200–75–75 kg NPK/ha, F_2 – FYM (15 t/ha) + 200–75–75 kg NPK/ha, F_3– FYM (15 t/ha) + 250–90–90 kg NPK/ha and F_4– FYM (15t/ha) + 300–105–105 kg NPK/ha and Zinc Sulfate @ 50 kg/ha is applied commonly to all the treatments. The net plot size is 4.0×4.5 m. The BML-6 the female inbred parent of maize hybrid DHM 117 is sown during June last week in both years. Spacing is adopted as per treatment. In order to maintain plant to plant distance of 20 and 25 cm, to get desired plant population as per treatment, thinning was done at 15 DAS. Nitrogen, phosphorus, potassium were applied as per treatment in the form of Urea, DAP and MOP. Full dose of phosphorus and potassium and $1/4^{th}$ amount of nitrogen were applied of basal at sowing time and remaining nitrogen was given in three equal splits through top dressing at 25, 40–45, 55–60 DAS. The Zinc Sulfate @ 50 kg/ha is applied as basal at last ploughing stage. The pre-emergence application of atrazine herbicide was applied uniformly @ 1 kg a.i./ha, in 1000l of water. All other cultural practices and plant protection measures were adopted as per recommended package of practices. The data recording of growth parameters was carried out from five plants randomly selected from the penultimate rows. Yield attributes were recorded from five plants samples randomly selected from each plot at maturity and data on seed yield was recorded plot wise and calculated to hectare basis. The economic returns were compared by calculating the net returns and benefit cost ratio for plant density and fertility levels. The year wise data on growth, yield attributes, yield and

Table 1. Effect of plant density and nutrient management on growth parameters of BML-6, maize crop female parental line of DHM 117 (pooled data).

Plant density	Plant height at harvest (cm)	Ear height at harvest (cm)	Days to 50% flowering	LAI at knee high stage
S_1–67 × 20 cm (75,000 plants/ha)	158.0	80.4	57.3	2.30
S_2– 67 × 25 cm (60,000 plants/ha)	159.4	81.3	57.4	2.21
SEm (±)	3.7	2.2	0.7	0.10
CD (0.05)	NS	NS	NS	NS
Fertility levels				
F_1–200–75–75 kg NPK/ha	153.3	77	56.7	2.00
F_2–FYM (15 t/ha)+200–75–75 kg NPK/ha	160.0	83.2	60	2.25
F_3–FYM (15 t/ha)+250–90–90 kg NPK/ha	160.2	83.3	57.5	2.35
F_4–FYM (15 t/ha)+300–105–105 kg NPK/ha	161.2	79.9	55.2	2.42
SEm (±)	2.2	2.3	0.3	0.03
CD (0.05)	6.6	NS	0.8	0.08

economics were recorded and pooled for two years and is reported and discussed. The sale price of F_1 maize seed of BML-6 is taken as Rs 80/kg. All the data were subjected to statistical analysis by adopting appropriate method of analysis of variance as described by Cochran and Cox (1967). The F value at 5% level of probability the critical difference value was computed for comparing treatment means.

RESULTS AND DISCUSSION

Effect of growth parameters

The growth parameters, plant height at harvest, ear height at harvest, leaf area index and days to 50% flowering were not significantly affected by the plant density (population) under study. While, the growth parameters were significantly affected by the fertility levels. The interaction was found to be non significant (Table 1).

The plant population with 67×20 cm i.e., 75,000 plants/ha or 67×25 cm with 60,000 plants/ha recorded non-significant difference in plant and ear height at harvest (Table 1). The probable reason must be the tested plant population did not exhibit competition for resources i.e. light interception, space or nutrients and the crop in both the plant densities under study, used the available resources and put forth the canopy. The days to 50% flowering at 67×20 cm (75,000 plants/ha) is 57.3 days is on par with that of flowering at 67×25 cm (60,000 plant/ha) (57.4 days). The LAI at knee high stage in both the plant population was not significantly different which indicates no hindrance in better zones under both the densities. Ayman *et al.* (2019) also reported that the leaf area index was not significantly influenced by plant population at knee high stage. On the other hand, the nutrient management practices significantly affected the growth parameters. The plant height at harvest resulted significantly higher (161.2 cm) with application of FYM (15 t/ha) +300+105–105 kg NPK/ha and is found to be on par with FYM (15 t/ha)+250–90–90 kg NPK/ha (160.2 cm) and FYM (15 t/ha)+200–75–75 kg NPK/ha (160 cm). The lowest plant height recorded with 200–75–75 kg NPK/ha (153.3 cm). The increase in plant height at higher fertilizer levels might be due to increased interception, absorption and utilization of radiant energy and there by photo -synthesis due to better nutritionals environment by way of active cell division and elongation with nutrient availability. FYM (15 t/ha)+200–75–75 kg NPK/ha exhibited 50% flowering at 60 days, while the 50% flowering is early in all other fertilizer levels (Table 1). The LAI at knee high stage also observed to be significantly higher (2.42) with high fertility levels of FYM (15 t/ha)+300–105–105 kg NPK/ha and was on par with FYM (15 t/ha)+250–90–90 kg/ha (2.35) and LAI recorded significantly lower with 200–75–75 kg NPK/ha (2.00). The high LAI at high

Table 2. Effect of plant density and nutrient management on yield attributes of BML-6, maize crop female parental line of DHM 117 (pooled data).

Plant density	Cob length (cm)	Cob girth (cm)	No. of kernel rows	No. of kernels/ row of cob	Cob weight/ cob (g)	Shelling %	Grain wt/cob (g)
S_1–67×20 cm (75,000 plants/ha)	14.1	14.4	15.0	31.2	127.0	79	101.5
S_2 – 67×25 cm (60,000 plants/ha)	13.9	14.0	15.2	30.8	124.7	78.2	103.6
SEm (±)	0.7	0.6	0.3	1.0	5.1	1.3	4.4
CD (0.05)	NS	NS	NS	NS	NS	NS	NS
Fertility levels							
F_1 – 200–75–75 kg NPK/ha	13.4	13.9	14.9	29.4	112.4	78.5	94.8
F_2 – FYM (15 t/ha) + 200–75–75 kg NPK/ha	14.0	14.5	15.6	32.4	134	80.9	108.7
F_3–FYM (15 t/ha) + 250–90–90 kg NPK/ha	14.3	14.4	15.3	31.8	131	78.3	106.1
F_4 – FYM (15 t/ha) + 300–105–105 kg NPK/ha	14.3	13.9	15.0	30.3	126.1	76.9	100.8
SEm (±)	0.5	0.3	0.3	0.5	4.9	1.4	4.2
CD (0.05)	NS	NS	NS	1.4	13.9	NS	NS

fertilizer levels is due to increase in photo-synthesis by way of increase in leaf area (Bisht *et al*. 2013). Further conforming the results (Pereira *et al.* 2018, Bruns and Abbas 2005) also opined that the overall improvement in crop growth under the influence of optimum nutrition involving nutrient management practices could be ascribed to their potential role in modifying soil and plant environment conducive for better development of both morphological and bio-chemical component of the plant growth (Uhart and Andrade 1995) also reported increase in more growth rate by promoting the LAI and photo synthetic source and sink at high fertility level.

Effect of yield attributes

The yield attributes viz., cob length and girth, kernel rows and grain weight/cob resulted non significant with plant density levels under study this can be attributed to non-significant difference in growth parameters as LAI, plant and ear height under both the plant density levels (Table 2). While the fertility levels significantly influenced the kerenel no and cob weight. The fertility level of FYM (15 t/ha)+200–75–75 kg NPK/ha registered significantly higher cob weight/cob (134 g) and was found to be no par with application of highly fertility levels of FYM (15 t/ha)+250–90–90 kg NPK/ha (131 g) and FYM (15 t/ha)+300–105–105 kg NPK/ha (126.1). The fertilizer level of 200–75–75 kg NPK/ha resulted in significantly lower cob weight (112.4 g). The data on kernel no/cob was found significantly higher with application of FYM (15 t/ha) +200–75–75 kg/ha (32.4) and is on par with FYM (15 t/ha)+250–90–90 kg NPK/ha (31.8). The lowest no of kernels was obtained with 200–75–75 kg/ha (29.4). Better nutrition led to increase the crop growth rate which in turn showed increased source to sink there by the kernel no and cob weight were significantly increased with optimum nutrition. Bhatt (2012), Havlin *et al.* (2005), Brady and Weil (2002) also reported similarly that better development of plant growth increases efficiency of physiological process of plant system.

Effect of yield and economics

The seed (grain) and cob yield of BML-6 were found to be one par with plant density of 67×25 cm (75,000 plant/ha) (3119 and 4107 kg/ha) or 60×20 cm (60,000 plant/ha) (3104 and 4012 kg/ha respectively). This

Table 3. Effect of plant density and nutrient management on yield and economics of BML- 6, maize crop female parental line of DHM 117 (pooled data).

Plant density	Grain yield (kg/ha)	Cob yield (kg/ha)	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)	B : C ratio
S_1–67 × 20 cm (75,000 plants/ha)	3104	4012	341440	60540	280900	4.64
S_2 – 67 × 25 cm (60,000 plants/ha)	3119	4107	343035	60180	282855	4.70
SEm (±)	213	398	1994	749	1641	0.2
CD (0.05)	NS	NS	NS	NS	NS	NS
Fertility levels						
F_1– 200–75–75 kg NPK/ha	2748	3707	302225	60180	242045	4.02
F_2 – FYM (15 t/ha) + 200–75–75 kg NPK/ha	3207	4182	352715	70450	282265	4.01
F_3–FYM (15 t/ha) + 250–90–90 kg NPK/ha	3316	4303	364760	72260	292500	4.05
F_4 – FYM (15 t/ha) + 300–105–105 kg NPK/ha	3175	4047	349195	76070	273125	3.59
SEm ±	394	540	1858	590	1339	0.1
CD (0.05)	394	NS	5352	1685	3467	0.3

may be attributed to the BML-6 the inbred parental line in terms of its potentiality and also at both the plant densities must have received sufficient light interception, space, moisture, nutrients and this inturn might have led to more production of photosynthates and contribute to growth and inturn yield attributes and yield at both the plant densities. The net returns and B : C ratio at both the plant densities were also found to be similar due to non significant difference in grain yield of BML- 6, parental maize line at both plant density of 75,000 and 60,000 plant/ha (Table 3).

The influence of fertility levels on the seed yield of BML-6 parental line indicated significantly higher seed yield with application of FYM (15 t/ha)+250–90–90 kg NPK/ha (3,316 kg/ha) which inturn was on par with application FYM (15 t/ha)+200–75–75 kg NPK/ha (3,207 kg/ha) and FYM (15 t/ha)+300–105–105 kg NPK/ha (3, 175 kg/ha) while significantly lower seed yield was recorded with 200–750–75 kg NPK/ha (2,748 kg/ha).

Following the similar trend, significantly higher net returns were recorded with application of FYM 15 t/ha+250–90–90 kg NPK/ha (Rs 292, 500/ha) and was on par with FYM (15 t/ha)+200–75–75 kg NPK/ha (Rs 282, 265/ha) and while significantly lower net returns was recorded with 200–750–75 kg NPK/ha (Rs 242, 045/ha). This could be attributed to higher seed yield with better nutrition. On the other hand, the B : C ratio resulted significantly higher with FYM (15 t/ha)+200–90–90 kg NPK/ha (4.05) and was on par with 200–75–75 kg NPK/ha (4.02) and with application FYM (15 t/ha)+200–75–75 kg NPK/ha (4.01). Significantly lower B : C ratio was recorded with FYM (15 t/ha)+300–105–105 kg NPK/ha (3.59) because of high cost of cultivation with usage of increased fertilizer dose. Choudhary and Singh (2006), Modarris *et al.* (1998) also reported the similar results that low net returns and output : input ratio under equal amount of nitrogen through inorganic and organic was due to the high cost of cultivation.

CONCLUSION

The experiment can be concluded that in red sandy loam soils of Karimnagar dist of Telangana State,

India. The higher seed production of BML-6, maize crop female parental line of DHM-117 can be obtained with the application of fertilizer level of FYM (15 t/ha) + 200–75–75 kg NPK/ha at which the net returns as well as benefit cost ratio is higher and remunerative.

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