

Effect of Planting Ratio and Planting Geometry on Seed Quality Parameters of Drought Tolerant Pre-Released Maize Hybrid (*Zea-mays* L.)

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Received 5 May 2016; Accepted 10 June 2016; Published online 22 June 2016

Abstract An investigation was carried on hybrid seed production in maize during *rabi* to study the effect of planting ratio and planting geometry on seed quality like germination percentage (%), root length (cm), shoot length (cm), seedling vigor index, electrical conductivity (ds/m). In hybrid seed production the planting ratio of 3 : 1 with 60 cm × 20 cm spacing recorded the higher germination percentage (97.67%). The highest shoot length (10.67 cm) were recorded in planting ratio of 5 : 1 with 70 cm × 20 cm spacing and planting ratio of 5 : 1 with 90 cm × 20 cm spacing recorded the higher root length (22.67 cm) and electrical conductivity (0.63 dS/m). Seed-

ling vigor index (3200) were higher in the planting ratio of 4 : 1 with 70 cm × 20 cm spacing as compare to remaining treatments in maize inbreds like female inbred (NEI 92202B) and male inbred (HS-4).

Keywords Maize inbreds, Planting ratios, Planting geometry, Quality parameters.

Introduction

Maize (*Zea mays* L.) is an important food and fodder crop of the world. In India, maize is grown over an area of 70.49 million ha with a production of 123.88 million tonnes [1]. The seed of a maize plant is called the kernel made up of approximately 10% protein, 70% carbohydrate, 2.3% crude fiber and 1.4% ash. It is also a source of vitamins A and E, riboflavin and nicotinic acid. Maize being a C4 plant, water stresses one of most serious and severe conditions affecting crop productivity. There are a number of biotic and abiotic factors those affect maize yield considerably; however, it is more affected by variations in planting geometry. Water being an integral part of plant plays a vital role in the maintenance of plant life. Its deficiency modifies soil-plant water relationships by lowering tissue water potential and impairing metabolic processes. Planting ge-

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ometry determines the plant distribution in the field and thereby affects competition among crop plants for mineral nutrients and other essential for growth. In the latest production technology which emphasises the use of good quality seeds, planting geometry needs to be applied resourcefully and resolutely. Whereas, the lesser planting geometry increases interplant competition for light, water and nutrients, which may be determined the final yield.

Drought is the most pervasive limitation to the realization of yield potential in maize. Average annual global losses due to drought in maize range from 15% in temperate zone to 17% in tropical zone as estimated by empirical methods. A precise measurement of yield losses worldwide is not possible due to range of occurrences of drought from individual fields to regional in extent, range of severity from slight to catastrophic. Drought can affect maize production by decreasing plant stand during the seedling stage, by decreasing leaf area development and photosynthesis rate during the pre-flowering period, by decreasing ear and kernel set during the two weeks bracketing flowering, and by decreasing photosynthesis and inducing early leaf senescence during grain-filling. Additional reduction in production may come from an increased energy and nutrient consumption of drought adaptive responses, such as increased root growth under drought.

Planting geometry was inversely proportional to the plant density, that means the lesser planting geometry increases planting density. Decreasing planting geometry significantly influence on all the growth components. Planting geometry is inversely proportional to the seed yield and minimum planting ratio were produced pollen effectively distributed from male to female parent, while increase of planting ratios decreasing the sufficient pollen distribution to the female parent and variation of synchronization in between seed production parents is also affects the quality seed production.

Materials and Methods

To assess the seed quality of seeds obtained from the pollination of different sex ratio and different planting geometry in open pollinated varieties of

maize was carried out in the laboratory of the Department of Seed Science and Technology, College of Agriculture, Raichur during March 2012. Seed germination was determined by the standard germination test using between paper towel methods as prescribed by ISTA rules. Hundred seeds of four replications each were tested. The germination counts on the fourth day and seventh day for I and II counts respectively were made on normal seedlings and total germination percentage was calculated. Ten normal seedlings in each treatment were randomly selected from the germination test for measuring the root length on eighth day of germination. The root length was measured from the collar region to the tip of the root. Average root length of ten seedlings was computed and expressed in centimeters. The earlier ten seedlings used for the shoot length measurement were used for the measuring the shoot length also. The shoot length was measured from the collar region to the apex. The average shoot length of ten seedlings was computed and expressed in centimeters. The seedling vigor index values were calculated as per the method and expressed as whole number.

$$\text{Seedling vigor index} = \text{Germination (\%)} \times \text{Seedling length (cm)}$$

Electrical conductivity (dSm^{-1}) was measured by five grams of seed were treated with Acetone for half minute and were thoroughly washed in distilled water for several times, in order to remove the seed dressing chemicals. The seeds were then soaked in 25 ml distilled water and incubated at constant temperature of $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$ for 24 hours. The electrical conductivity of the leachate was measured by the digital conductivity meter.

The data obtained from various periodical observations were subjected to statistical analysis. The level of significance used in *F* and *T* tests was $p=0.05$. Critical difference values were calculated whenever *F* test was significant and then subjected to the statistical analysis.

Results and Discussion

Effect of planting geometry on quality parameters

Table 1. Planting ratio, planting geometry and their interaction effect on seed quality parameters of drought tolerant pre released maize hybrid (*Zea mays* L.).

Treatments	Germi- nation (%)	Shoot length (cm)	Root length (cm)	Seedl- ing vigor index	Ele- ctrical condu- ctivity (dSm ⁻¹)
Planting geometry					
G ₁ : 60 cm × 20 cm	97.11	9.56	18.78	2752	0.73
G ₂ : 75 cm × 20 cm	96.78	10.44	21.78	3118	0.72
G ₃ : 90 cm × 20 cm	97.22	9.67	21.00	2982	0.69
Mean	97.04	9.89	20.52	2950	0.71
SEm±	0.37	0.31	0.46	58.32	0.03
CD @ 5%	NS	NS	1.37	174.84	NS
Planting ratio					
P ₁ (3 : 1)	97.11	9.89	19.22	2827	0.71
P ₂ (4 : 1)	97.00	9.89	20.56	2953	0.70
P ₃ (5 : 1)	97.00	9.89	21.78	3071	0.73
Mean	97.04	9.89	20.52	2950	0.71
SEm±	0.37	0.31	0.46	58.32	0.03
CD @ 5%	Ns	NS	1.37	174.84	NS
Interaction (P × G)					
P ₁ G ₁	97.67	9.67	18.00	2703	0.70
P ₁ G ₂	96.67	10.33	20.67	2997	0.70
P ₁ G ₃	97.00	9.67	19.00	2781	0.73
P ₂ G ₁	96.67	9.67	17.67	2642	0.70
P ₂ G ₂	97.00	10.33	22.67	3200	0.70
P ₂ G ₃	97.33	9.67	21.33	3018	0.70
P ₃ G ₁	97.00	9.33	20.67	2910	0.80
P ₃ G ₂	96.67	10.67	22.00	3158	0.77
P ₃ G ₃	97.33	9.67	22.67	3146	0.63
Mean	97.04	9.89	20.52	2950	0.71
SEm±	0.64	0.54	0.54	101.01	0.05
CD at 5%	NS	NS	NS	Ns	NS

of maize seeds : The seed quality parameters such as root length (21.78 cm), shoot length (10.44 cm) and seedling vigor index (3118) were significantly higher in the planting geometry of 75 cm × 20 cm as compared to the 90 cm × 20 cm and 60 cm × 20 cm respectively. Germination percentage (%) and electrical conductivity (dSm⁻¹) exhibited non-significant difference among all the planting geometry but higher germination percentage (97.22%) and electrical conductivity (0.69 dSm⁻¹) was recorded in 90 cm × 20 cm as compared to 60 cm × 20 and 75 cm ×

20 cm. Effect of planting ratio on quality parameters on maize hybrid : The seed quality parameters such as root length (21.78 cm) and seedling vigor index (3071) were higher in the planting ratio of 5 : 1 as compared to the 3 : 1 and 4 : 1, this may be attributed to more root length and higher seed weight. These results are in conformity with the findings of Rajesh Dhungel et al. [2] who reported that nevertheless, the seed quality remained at par with all the row ratios tested in chilli hybrid CH-3. Germination percentage and shoot length (cm) and electrical conductivity showed non-significant difference among the planting ratio. Higher germination percentage was recorded in 3 : 1 (97.11%) and similar shoot length was recorded among the different planting ratios but highest electrical conductivity was recorded in 5 : 1 (0.73 dSm⁻¹) planting ratio as compared to the remaining planting ratio (Table 1).

Interaction effect of planting ratio and planting geometry on seed quality of pre released drought tolerant maize hybrid seed : Interaction effect between planting ratio and planting geometry was found non-significant on seed quality. However, the planting ratio of 3 : 1 with 60 cm × 20 cm spacing recorded the higher germination percentage (97.67%) as compared to other treatments. The highest shoot length (10.67 cm) were recorded in planting ratio of 5 : 1 with 70 cm × 20 cm spacing and planting ratio of 5 : 1 with 90 cm × 20 cm spacing recorded the higher root length (22.67 cm) and electrical conductivity (0.63dSm⁻¹). Seedling vigor index (3200) were higher in the planting ratio of 4 : 1 with 75 cm × 20 cm spacing as compare to remaining treatments.

Seed quality parameters such as germination percentage, shoot length, root length, seedling vigor index and electrical conductivity recorded the non-significant difference in the interaction of planting geometry and planting ratio.

References

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