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Effect of Variety And Planting Geometry on the Growth and Yield of Hybrid Maize

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Abstract

To study the effect of planting geometry on yield and yield attributes of maize hybrids an experiment was conducted at the Regional Agricultural Research Station, Jamalpur during rabi 2009-2010 and 2010-2011. The results revealed that there was significant variation among the planting geometry during both years. There was no significant difference among the varieties in the first year but in the second year. The highest grain yield was obtained from the planting geometry 60cm × 20cm (83,333 plants m^{-2}) which was statistically similar to that of 75cm × 20cm (66,666 plants m^{-2}). The lowest grain yield was obtained from the planting geometry 75cm × 25cm (53,333 plants m^{-2}). Pacific-11 showed better performance during both years than the varieties BARI hybrid bhutta-5 and BARI hybrid bhutta-7. Significant variation was not found due to interaction effect of variety and planting geometry.

Introduction

Hybrid maize is an important cereal crop in Bangladesh. Its production area is increasing day-by-day due to its high yield potential. However, yield potentiality of varieties depends on growing season also. With the change in weather condition its growth duration and yield potentiality also change. It gives higher yield in *rabi* season with longer growth duration than that to *Kharif* season. Planting geometry has influence on canopy development as well as light interception.

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Therefore, the present experiment was conducted to find out season based appropriate planting geometry for hybrid maize varieties.

Materials and Methods

The experiment was conducted at the Regional Agricultural Research Station. Jamalpur during *rabi* 2009-2010 and 2010-2011 to find out season based appropriate planting geometry for hybrid maize varieties. The experiment comprised three maize hybrids viz. BARI hybrid bhutta-5, BARI hybrid bhutta-7 and Pacific-11, and three planting geometry viz. 75cm × 25cm (53333 plants ha^{-1}), 75cm × 20cm (66,666 plants ha^{-1}) and 60cm × 20cm (83333 plants ha^{-1}). The experiment was laid out in a Randomized Complete Block design with three replications. Seeds were sown on 19 November 2009 and 2010 maintaining spacing as per treatments. Fertilizers were applied @ 250-55-110-40-5-1.5 kg ha^{-1} of N-P-K-S-Zn-B in the form of urea, TSP, MOP, gypsum, zinc sulphate and boric acid, respectively. Half N along with full amount of other fertilizers was applied as basal during final land preparation. Remaining N was applied as top dress at 30 DAS after first irrigation. Weeding was done at 25 DAS while earthing-up was done at 45 DAS. Data were collected on leaf area and dry matter of plant parts at 35, 60, 75 and at 90 DAS. Ten plants were selected randomly at maturity stage to collect data on yield attributes. Yield data were recorded leaving one border line from each end of the plot. Grain yield was calculated at 14% moisture content. Grain yield was also adjusted for missing hills following the standard formula. Collected data were analyzed statistically with the help of a computer based program CROPSTAT and mean separation was done at 5% level of significance following LSD test.

Results and Discussion

Leaf area index (LAI)

Leaf area index increased progressively up to 90 DAS during both the years (Figure 1 & 2). In general, lower population density (53,333 plants ha^{-1}) had the lower LAI values at all sampling dates for all varieties. At 60 DAS, LAI started to increase very sharply in all varieties and it was continued up to 90 DAS during both seasons.

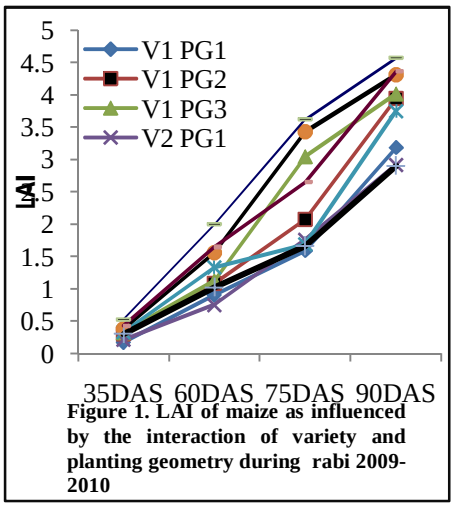

Figure 1. LAI of maize as influenced by the interaction of variety and planting geometry during rabi 2009-2010

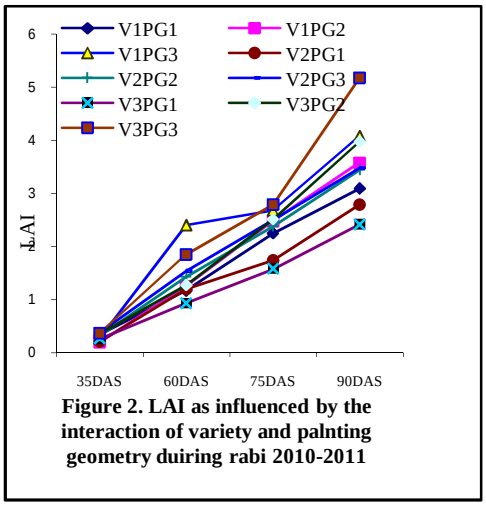

Figure 2. LAI as influenced by the interaction of variety and palnting geometry duiring rabi 2010-2011

Performance of Variety

The results presented in Table 1 revealed that plant height differed significantly among the varieties in both years. BARI hybrid bhutta-5 produced the shortest plant and it was similar to that of BARI hybrid-7. Pacific-11 produced the tallest plant during both seasons. Diameter of cob also differed significantly and the lowest cob diameter was found in BARI hybrid bhutta-5. BARI hybrid bhutta-7 had the highest cob diameter during both years. A moderate diameter of cob was obtained from Pacific-11. Significantly highest number of cob plant^{-1} was obtained from Pacific-11 while the lowest number of cob plant^{-1} was obtained from BARI hybrid bhutta-7. There was no significant difference among the varieties in terms of number of grain cob^{-1} in the first year but in the second year. BARI hybrid bhutta-7 produced the highest number of grain cob^{-1}. The highest 1000 grain weight was found in BARI hybrid bhutta-7 and it was statistically at par with that of Pacific-11. The variety BARI hybrid bhutta-5 produced the lowest 1000 grain weight during both years. There was no significant difference in terms of grain yield in 2009-2010 but Pacific-11 produced about 4.74% and 3.54% higher grain yield than BARI hybrid bhutta-5 and BARI hybrid bhutta-7, respectively. In 2010-2011, grain yield differed significantly among the varieties and Pacific-11 produced the highest grain yield which was at par with that of BARI hybrid bhutta-5. Higher number of cob plant^{-1} mainly compensated the grain yield in the varieties Pacific-11 and BARI hybrid bhutta-5 in spite of lower number of grain cob^{-1} and 1000 grain weight than BARI hybrid bhutta-7.

Table 1. Yield and Yield Attributes of Maize Varieties During Rabi 2009-2010

Variety	Plant height (cm)		Diameter of cob (cm)		No. of cob plant^{-1}	
	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011
V_1	214.6	212.6	4.68	4.39	1.13	1.38
V_2	218.9	215.8	5.11	5.03	1.07	1.24
V_3	225.1	229.5	4.99	4.62	1.20	1.46
CV(%)	3.50	3.20	1.29	2.2	7.99	8.0
Level of sig	*	**	**	**	*	**
$LSD_{0.05}$	7.69	6.95	0.063	0.10	0.089	0.11

Note: V_1 = BARI hybrid bhutta-5, V_2 = BARI hybrid bhutta-7, V_3= Pacific-11

Table 1. Contd

Variety	No. of grain cob^{-1}		1000 grain weight (g)		Grain yield (t ha^{-1})	
	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011
V_1	471.5	407.7	311.0	351.9	8.65	11.18
V_2	491.4	440.9	364.2	432.9	8.75	10.93
V_3	471.0	383.2	362.3	390.2	9.06	11.72
CV(%)	5.06	6.1	3.50	11.2	8.85	5.5
Level of sig	NS	**	**	**	NS	*
$LSD_{0.05}$	-	24.98	12.10	43.72	-	0.62

Effect of Planting Geometry

Plant height, diameter of cob, number of grain cob^{-1} and 1000 grain weight did not differ significantly due to different planting geometry during both years (Table 2). Number of cob plant^{-1} decreased significantly beyond 53,333 plants ha^{-1} (75cm × 25cm) and the lowest and statistically similar number of cob plant^{-1} was obtained from 83,333 plants ha^{-1} (60cm × 20cm) in 2009-2010. Number of cob plant^{-1} did not differ significantly in 2010-2011. A decreasing tendency was observed in terms of number of grain cob^{-1} with increased plant population. Grain yield was significantly different among the planting geometry during both years (Table 2). Statistically similar grain yield was obtained from both the planting geometry 75cm × 20cm and 60cm × 20cm having the highest in 60cm × 20cm in both years. The lowest grain yield was obtained from the planting geometry 75cm × 25cm. Grain yield in the higher plant densities was possibly compensated by the higher plant population mainly in spite of lower number of cob plant^{-1}. Grain yield varied between 3.91 t ha^{-1} in 8 plants m^{-2} and 4.65 t ha^{-1} in 12 plants m^{-2} (Sharifi *et al*., 2009).

Similar trend in yield differences across planting density have been reported by Zhang *et al*. (2006). Xue *et al*. (2002) reported that grain yield increased with increasing plant density from 54000-94000 plants ha^{-1}, but decreased after 97000 plants ha^{-1}. Since, yield reduction ha^{-1} at high plant densities is due to the effects of interplant competition for light, water, nutrition and other potentially yield-limiting environmental factors, a plant population above a critical density has a negative effect on yield $plant^{-1}$ (Xue *et al*., 2002). Findings in this experiment are in agreement with observations made by many researchers (Bangarwa *et al*., 1988; Mobasser *et al*., 2007).

Table 2. Yield and Yield Attributes of Maize as Influenced by Planting Geometry During *Rabi* 2009-2010

Planting geometry	Plant height (cm)		Diameter of cob (cm)		No. of cob $plant^{-1}$	
	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011
PG_1	219.4	220.6	4.93	4.72	1.23a	1.38
PG_2	220.9	219.9	4.94	4.64	1.09b	1.37
PG_3	218.3	217.5	4.92	4.68	1.08b	1.33
CV(%)	3.50	3.20	1.29	2.2	7.99	8.0
Level of sig.	NS	NS	NS	NS	**	NS
$LSD_{0.05}$	-	6.95	-	0.10	0.089	0.11

Table 2. Contd

Planting geometry	No. of grain cob^{-1}		1000 grain weight (g)		Grain yield (t ha^{-1})	
	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011
PG_1	485.1	418.5	341.1	391.8	8.01b	10.15
PG_2	476.1	404.1	341.9	386.5	8.98a	11.53
PG_3	472.7	409.2	354.4	396.7	9.48a	12.15
CV(%)	5.06	6.1	3.50	11.2	8.85	5.5
Level of sig.	NS	NS	NS	NS	**	**
$LSD_{0.05}$	-	24.98	-	43.72	0.78	0.62

Note: PG_1 = 75cm × 25cm (53,333 plants ha^{-1}), PG_2 =75cm × 20cm (66,666 plants ha^{-1}), PG_3 = 60cm × 20cm (83,333 plants ha^{-1})

Interaction Effect of Variety and Planting Geometry

There was no considerable variation in terms of yield and yield attributes of maize due to effect of interaction between variety and planting geometry. This result indicated that all varieties will produce higher yield at the high plant densities (66,666-83,333 plants ha^{-1}).

Conclusions

In this experiment, planting geometry produced significant effect on yield of maize hybrids. The highest grain yield was recorded at the spacing 60cm × 20cm (83,333 plants ha^{-1}) and 75cm × 20cm (66,666 plants ha^{-1}) during both years. In conclusion, it can be suggested that any variety used in this experiment should be adjusted at 66,666-83,333 plants ha^{-1} to produce higher yield in this region. The variety Pacific-11 showed better performance than the varieties BARI hybrid bhutta-5 and BARI hybrid bhutta-7.

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