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Research Article

Evaluation of the Response of Spring Maize Varieties in Different Plant Geometry at Sundarbazar, Lamjung

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Abstract

A field experiment in this study was conducted in Agronomy farm of Lamjung Campus during 2015 in 2 factorial Randomized Complete Block Design with 4 replications and six treatments. Factor A was the variety (Arun-2 and Arun-4) and B was three levels of spacing (80 cm x 25 cm, 60 cm x 25 cm and 40 cm x 25 cm). Results showed that there was non-significant difference between two varieties while differences were found in different spacing on grain yield. The highest grain yield (4.93 t ha^{-1}) was obtained from the highest plant population (100000 plants ha^{-1}) followed by lowest plant population (50000 plants ha^{-1}) (4.38 t ha^{-1}) and medium plant population (66666 plants ha-1) (3.83 t ha^{-1}). Regarding the interaction effect between variety x spacing, there was statistically highly significant effect found on grain yield. The comparison of the mean values of the grain yield for interaction between variety and spacing showed that Arun-4 cultivar in 40 x 25 cm plant had the highest grain yield (5.1 t ha^{-1}) followed by Arun-2 with the same spacing (4.8 t ha^{-1}). The higher grain yield in high plant density plots might be due to higher number of effective plants ha-1 (73281) with high number of cobs ha-1 compared to medium plant density (50104 plants ha^{-1}) and low plant density (38946 plants ha^{-1}). Comparatively, the variety Arun-4 was found superior on final grain yield (4.43 t ha^{-1}) compared to Arun-2 (4.34 t ha^{-1}). From the results, it is concluded that Arun-4 variety with the highest plant population (100000 plants ha^{-1}) is better to grow in rainfed lowland (Khet land) as spring maize in western mid hills of Nepal.

Keywords: Spring Maize; Arun-4; Geometry; Stover

Introduction

Maize (*Zea mays* L.) is the world's widely grown cereal and is common in many developing countries as primary staple food crop. This is second most important food crops of Nepal. Maize area, production and productivity in Nepal are 849635 ha, 1999010 tons, and 2.35 tons ha^{-1}, respectively. It contributes 3.15% to national GDP and 9.5% to AGDP [1]. There are a number of biotic and abiotic factors which affect maize yield considerably; however, it is greatly affected by the variations brought in plant density [2]. Use of narrow rows with high population densities hastens the rapidity of closure of the canopy and enhances canopy radiation interception, thereby increasing rate of crop growth, yield [3] and suppresses weed growth and competition [4].

Tolera., *et al.* [5] suggested the breeders need to identify and select those maize varieties which combine high grain yield and desirable stover characteristics due to the large differences that exist between cultivars. In Nepal, the yield gap on maize between national average (2.35 t ha^{-1}) and attainable yield under on-farm trials (3.5 tons ha^{-1}) is big due to cultivation of low yielding varieties, low seed replacement rate (SRR) and obsolete poor agronomic management practices. Therefore, there is high potential to increase maize productivity in Nepal through replacement of local seeds with quality improved seeds of domain specific improved varieties with the improved crop management practices. The research on early maize varieties with improved management practices are very limited for mid hill areas of Nepal. Therefore, this experiment was designed to identify the best variety with suitable plant geometry under rainfed lowland (Khet land) condition in

Materials and Methods

The experiment was carried out in Agronomy farm of Lamjung campus in rainfed lowland condition (*Khet land*) at 775 masl under two factorial (variety and spacing) RCBD with six treatments

and four replications. The two short duration varieties (Arun-2 and Arun-4) were tested in different three plant geometry (80 x 25 cm, 60 x 25 cm, and 40 x 25 cm) with different plant population (50000, 66666 and 100000 plants ha^{-1}). A total of 24 plots were laid out in which gross plot size was chosen to 4.8 m x 2 m = 9.6 m^2 where harvesting was done from the net plot leaving one border row on east and west side of all the plots. Well rotten Farmyard Manure 20 tons ha^{-1} plus 80:40:20 kg NPK ha^{-1} was applied. Half dose of N and full dose of P and K was applied at the time of final field preparation and remaining 40 kg N ha^{-1} was splitted two times as first and second top dressing. Line sowing was done by putting two seeds per hole by maintaining given plant geometry in 3 - 4 cm planting depth. Two weeding, topdressing and earthing up were done as required on 30 days and 60 days after sowing, respectively. The phenological, growth, yield and yield attributing characters were observed by using different methods.

Results and Discussion

Days to Tasseling and Silking

There were no differences with respect to number of days taken for 50% tasseling (DAS) between two varieties, spacing and interaction between varieties x spacing. Likewise, 50% silking (DAS) showed non-significant effect on varieties and spacing, however varieties x spacing interaction was found significant ($P < 0.05$) (Table 1).

Treatments	Days to		Plant height (cm)	Number of harvested		
	50% tasseling (DAS)	50% silking (DAS)		Total plants/ha	Effective plants/ha	Non-effective plants/ha
a) Variety						
Arun-4	59	66	220	52746	48919	2994
Arun-2	58	65	231	63739	59302	4437
F-test	NS	NS	**	**	**	*
b) Spacing						
80 x 25 cm	59	65	232	40821	38946	1875
60 x 25 cm	60	66	222	54688	50104	3334
40 x 25 cm	58	65	222	79219	73281	5938
F-test	NS	NS	**	**	**	**
Interaction (A x B)	NS	*	NS	NS	NS	**
CV%	2.64	2.74	2.44	7.12	6.38	43.28
Grand mean	59	66	226	58243	54110	3716

Table 1: *Effect of variety and spacing on phenological, growth and yield attributing characters of maize during spring season, 2015. NS: Non-significant, *: Significant and **: Highly significant*

Plant Height

Significantly ($P < 0.01$) taller plant height (232 cm) was measured from the spacing of 80 x 25 cm (wider spacing). This could be due to more access of nutrient supply (N) at different stages of topdressing as compared to more number of plants at higher density/low spacing. Similarly plant height of varieties was also significantly different among each other. Maximum (231 cm) plant height was observed in variety Arun-2 whereas the shortest one was Arun-4 (220 cm). There was no significant interaction effect in plant height between varieties and sowing spacing.

Plants at Harvest (Total, effective and non-effective)

The grain yield is the product of number of harvested plants per hectare. Thus the establishment of optimum plant population is essential to get maximum grain yield. The interaction effect due to variety x spacing was not significant for the total harvested plants and effective plants per hectare. However, the interaction effect between variety x spacing on non-effective plants per hectare was highly significant ($P < 0.01$). The non-effective (barren plants) were observed more in the spacing of 40 x 25 cm row to row and plant to plant apart and in case of variety in Arun-2. It means that the closer spacing of Arun-2 was prone to produce more barren plants.

Treatments	Number. of ears/ha	No. of kernels/ear	Test weight (g)	Grain yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
a) Variety						
Arun-4	52533	384	241	4.43	11.90	37.25
Arun-2	60469	354	253	4.34	12.68	34.00
F-test	**	*	**	NS	NS	*
b) Spacing						
80 x 25 cm	44191	395	256	4.38	11.84	36.93
60 x 25 cm	51531	379	243	3.83	10.88	25.23
40 x 25 cm	73781	333	242	4.93	14.13	34.73
F-test	**	**	**	*	**	NS
Interaction (A x B)	NS	NS	**	**	NS	NS
CV%	6.10	7.62	3.49	17.64	10.89	8.00
Grand mean	56501	369	247	4.38	12.29	35.63

Table 2: Effect of variety and spacing on yield and yield attributes of early maize during spring season, 2015.

DAS: Days after Sowing; NS: Non-significant; *: Significant and **: Highly Significant

Cobs per hectare

The differences in the harvested cobs per hectare was significant (P < 0.05) due to varieties and spacing. The interaction effect of time of varieties x sowing spacing was not significant. Statistically more number of cobs were obtained from the spacing of 40 x 25 cm (73781 ha^{-1}) followed by 60 x 25 cm (51531 ha^{-1}). The higher number of harvested ear per hectare at higher density was because of more number of effective plants compared to medium and wide spacing. This might be the reason to obtain maximum grain yield from this plant geometry. Sahoo and Mahapatra [6] also reported that the increased number of effective cobs harvested of maize crop with increasing plant density where 111,100 plants ha^{-1} observed the higher (86,000 ears) as compared to 83,333 plants ha^{-1} (82.900) at 2002/03 that has supported with results obtained from this experiment.

Cobs per hectare

The kernels per ear was significant (P < 0.05) due to variety and highly significant (P < 0.01) differences among the plant spacing. However, variety x spacing interaction was not significant. Number of kernels per ear was significantly higher (384) in Arun-4. Similarly it was obtained more from the sowing spacing of 80 x 25 cm (395) whereas less from the spacing of 40 x 25 cm (333). The decreased kernels number per ear in the spacing of 40 x 25 cm might be nutrient competition due to less space per plot in the experiment. Tetio-kagho and Gardner [7] and Andrade., *et al.* [8] had also reported that kernel number per plant declines sharply when the plant density increases which support our research finding.

Test Weight

The test weight differed significantly (P < 0.01) due to variety and spacing. Also it showed the significant (P < 0.01) effect between the variety x spacing. The test weight recorded more in Arun-2 in case of variety while it was obtained significantly more from 80 x 25 cm spacing. Similar results of reduction in test weight due to high plant population density had also been reported by Tyagi., *et al* [9].

Biological Yield and Harvest Index

The highest biological yield (14.13 t ha-1) was produced by the spacing of 40 x 25 cm with the highest grain and stover yield. The interaction effect between the varieties x spacing showed non-significant results on biological yield. It was resulted that Harvest Index of Arun-4 was more (37.25%) and it was significantly higher than Arun-2 (34%).

Grain Yield

Statistically the maize yield was not affected significantly due to varieties but showed a significant effect between the different plant spacing. The highest grain yield (4.93 t ha^{-1}) was obtained from the lowest plant geometry (40 cm x 25 cm) with highest plant population (100000 plants ha^{-1}) followed by wider plant geometry (80 cm x 25 cm) with lowest plant population (50000 plants ha-1) (4.38 t ha^{-1}). The higher grain yield in high plant density plots might be due to higher number of effective plants per hectare (73281) compared to medium (50104 plants ha^{-1}) and low plant density (38946 plants ha^{-1}). Comparatively Arun-4 was found superior in

case of final grain yield (4.43 t ha^{-1}) compared to Arun-2 (4.34 t ha^{-1}). Similar type of findings were reported by Barthakur., *et al.* [10] in his experiment where it was observed that narrow inter-row spacing (50 cm) resulted higher yield than wider inter- row spacing (75 cm). Likewise Verma and Singh [11] had reported that grain yield of spring maize was significantly improved with the increase in plant population from 65000 plants ha-1 to 85000 plants ha^{-1} on sandy loam soils of Agra, India.

Conclusion

Among the different spring maize varieties, it is recommended to cultivate one of the most promising improved varieties Arun-4 at a planting density of 1,00,000 ha-1 with 40 x 25 row to plant spacing for obtaining higher yield of maize under rainfed lowland condition (khet land) in western mid hill areas of Nepal. Arun-2 nevertheless doesn't lack the potential for good grain and stover yield under the best spacing of 40 x 25 cm row to row and plant to plant.

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