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Effect of Seeding Density on the Fodder Yield and Quality of Two Maize Varieties

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Abstract

Two varieties of maize viz., Neelum and Akbar were compared at seed rates of 75, 100, 125 and 150 kg ha^{-1} in Faisalabad conditions. Varieties showed non-significant differences for all parameters studied except dry matter yield. Cultivar Akbar gave significantly more DM yield (7.18 t ha^{-1}) than Neelum (6.09 t ha^{-1}). Seeding densities showed significant effects growth and yield parameters. Plant height, green fodder yield, dry matter yield and crude fibre percentage was increasing with increasing seed density, whereas, the increase in crude fibre percentage could not reach to a significant level. While stem diameter, leaf area $plant^{-1}$, crude protein percentage, total ash percentage and ether extractable fat percentage decreased significantly with increased seed rate. The cultivar Akbar and seed rate of 150 kg ha^{-1} seems to be the best for producing higher fodder yield of maize in Faisalabad conditions.

Introduction

Fodder scarcity is a major limiting factor for the development of livestock industry in Pakistan. Available fodder production is approximately 52-54 percent less than the actual requirement for animals (Bhatti, 1988).

Among the various factors responsible for low fodder yield, low seeding density is of immense importance. Kang and Park (1986) reported that with increasing plant population fresh matter yield increased. Patel *et al*. (1990) compared two maize cultivars at 40, 50 or 60 kg seeds ha^{-1} and obtained average fresh fodder yields of 25.3, 27.7 and 29.5 t ha^{-1} and dry matter yields of 5.14, 5.78 and 6.1 t ha^{-1} respectively. Graybill *et al*. (1991) has reported the highest silage yields at 26000 or 32000 plants $acre^{-1}$. Fodder yields increased with increasing plant density (Roy and Biswas, 1992). Sencor *et al*. (1993) compared seven maize (*Zea mays* L.) cultivars sown at planting densities of 25, 12.5 and 8.3 plants m^{-2}, and concluded that fodder and hay yields were increased with increased plant density. For all cultivars a density of 25 plants m^{-2} gave the highest fodder and hay yield.

Varieties may vary in growth characteristics, fodder yield and quality. Ayub *et al*. (1998) observed significant differences among the maize cultivars for plant height, leaf area per plant, stem diameter, fresh fodder yield and ether extractable fat percentage. Whereas, crude protein and crude fibre percentage was statistically similar of all cultivars. However, forage yield potential and quality traits of cultivars vary under different environmental conditions (Roth, 1994). Responses of maize cultivars vary to seeding densities depending upon the environmental conditions. Cox (1997) reported that hybrid responses to plant density varied most in the dry year when optimum silage and grain densities ranged from about 27500 to above 36000 plants $acre^{-1}$. Similarly Thomison and Jordan (1995) reported a significant hybrid x plant density interaction for grain yield in a cool, wet year but no interaction in dry year. Whereas, Nafziger (1994), who evaluated two hybrid with reportedly different responses to plant density, found non-significant hybrid x plant density interaction. The research work on the effect of seeding density on fodder yield and quality maize in Pakistan is limited. The present study was therefore, planned to evaluate the effects of seeding density on fodder yield and quality of two maize (*Zea mays* L.) cultivars.

Materials and Methods

Experiment was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad, during spring season 1998, on a sandy clay loam soil having 0.04 percent nitrogen, 10.67 ppm available phosphorus and 22 ppm available potassium. Two varieties of maize yield Neelum and Akbar were sown at seeding densities of 71, 100, 125 and 150 kg ha^{-1}. Experiment was triplicated in split plot design with a net plot size of 3.0 m x 7.0 m Varieties and seed rates were randomized in the main and sub-plots, respectively. A basal dose of 80 kg N ha^{-1} an 60 kg P_2O_5 ha^{-1} was applied at the time of seedbed preparation. Forty kilograms nitrogen was also applied with first irrigation. The crop was sown on March 6, 1998 on well-prepared seedbed with help of single row hand drill 30-cm spaced rows. All other cultural practices were key normal and uniform for all the treatments. Data on growth fodder yield and yield parameters, viz., plant height, stem diameter, leaf area per plant, green fodder yield and matter yield were recorded by using standard procedure. Quality parameters like crude protein percentage, crude fibre percentage, total ash percentage and ether extracts fat percentage were determined by using method recommended by AOAC (1984). Data collected were analyzed statistically by using Fisher's analysis variance technique and Duncan's New Multiple Range T at $p<0.05$ was used to compare the significance treatments means (Steel and Torrie, 1984).

Results and Discussion

Plant Height (cm): Plant height was not affected significantly by the varieties. Cultivar Akbar however

produced taller plants (175.56 cm) than Neelum. Contradictory results have been reported by Ayub *et al*. (1998).

The plots sown at the seed rate of 150 kg ha^{-1} produced significantly taller plants (193.18 cm) than all other seed rates. The minimum plant height (160.42 cm) was observed at the lowest seed rate (75 kg ha^{-1}) and it was statistically at par with seed rate of 100 and 125 kg ha^{-1}. The findings are in conformity with the results of Shun *et al*. (1989).

Stem Diameter (cm): The differences in stem diameter between varieties were not significant. The results contradict the findings of Kim *et al*. (1992). A progressive and significant decrease in stem diameter was observed with the increase in seed rate. Plots sown at a seed rate of 75 kg ha^{-1} found significantly higher stem diameter (1.52 cm) than all other seed rates. The minimum stem diameter (1.00 cm) was observed in plots sown at seed rate of 150 kg ha^{-1}. Decrease in stem diameter with increased seed rate has also been reported by Shun *et al*. (1989) and Sencor *et al*. (1993).

Leaf Area per Plant (cm^2): Varieties had statistically similar leaf area per plant and values recorded were 2258.27 and 2253.78 cm^2 for Akbar and Neelum, respectively. The seed rate of 75 kg ha^{-1} remaining at par with 100 kg ha^{-1} produced significantly higher leaf area plant than 125 and 150 kg ha^{-1}. Minimum leaf area $plant^{-1}$ (1954.13 cm^2) was observed at the highest seeding density (150 kg ha^{-1}). The plots sown at a seed rate of 125 kg ha^{-1} produced statistically similar leaf area to seed rate of 100 and 150 kg ha^{-1}. The highest leaf area plant (2538.53 cm^2) at low planting density might have been due to less competition for nutrients and sunlight among the plants.

Green Fodder Yield (t ha^{-1}): Green fodder yield was statistically similar of both the varieties and yields recorded were 49.01 and 52.14 t ha^{-1} for Neelum and Akbar respectively. Cox (1997) has also been reported similar results.

Significant increase in yield was observed with increased seed rate. Crop sown at a highest seed rate of 150 kg ha^{-1} produced significantly higher green fodder yield of 61.86 t ha^{-1} than all other seed rates. Minimum green fodder yield 41.23 t ha^{-1} was recorded at seed rate of 75 kg ha^{-1}. The higher yield at higher seeding densities has been due to higher plants number m^{-2} and plant height. The increase in yield with increased seed rate have also been reported by Sencor *et al*. (1993) and Graybill *et al*. (1991).

Dry Matter Yield (t ha^{-1}): Cultivar Akbar produced significantly more dry matter (7.18 t ha^{-1}) than Neelum (6.09 t ha^{-1}). Significant differences among the maize cultivars for dry matter yield have also been reported by Kim *et al*. (1992). The significant differences for dry matter yield and not for green matter yield indicated that varieties were having different moisture percentage at harvest.

Dry matter yield was also influenced significantly by the seeding densities. The maximum dry matter yield (8.39 t ha^{-1}) was obtained at highest seeding density (150 kg ha^{-1}) and minimum dry matter yield (4.83 t ha^{-1}) at lowest seed rate (75 kg ha^{-1}). The differences between seed rate of 100 and 120 kg ha^{-1} were not significant and yield were 6.46 and 6.88 t ha^{-1} respectively. Lopes and Maistri (1981) has also reported an increase in dry matter production with increased population density.

Crude Protein (%): Both varieties have statistically similar crude protein content and values were 7.30 percent and 7.26 percent for Neelum and Akbar respectively. Similar results have been reported by Ayub *et al*. (1998).

Seeding densities also affected the crude protein percentage significantly. Crude protein contents were decreased with increased seed rate. Crop sown as a seed rate of 150 kg ha^{-1} remaining at par with 125 kg ha^{-1} produced the minimum protein contents of 7.13 percent. The seed rate of 100 kg ha^{-1} produced statistically similar protein contents to seed rate of 75 and 125 kg ha^{-1}. The maximum protein contents 7.39 percent were observed from plots sown at a seed rate of 75 kg ha^{-1}. The higher protein contents with low seed rate might have been due to less competition amongst plants for nutrients. Decrease in protein content with increased seed rate has also been reported by Verma and Singh (1976).

Crude Fibre (%): Neither the varieties nor the seeding densities affected the crude fibre percentage to a significant extent. The maximum (33.27%) and minimum (32.39%) crude fibre percentage was observed at seed rate of 150 and 75 kg ha^{-1} respectively. Similar crude fibre contents might have been due to the reason that all the plots were sown and harvested on the same day and may be having same growth stage. The results are strongly supported by the findings of Ayub *et al*. (1998). Shun *et al*. (1989) reported decrease in crude fibre content with increase in plant density.

Ether Extractable Fat (%): Fat percentage was 1.25 and 1.26 for Neelum and Akbar respectively and did not differ significantly from each other. The results are contradictory to those of Ayub *et al*. (1998). These contradictory results might have been due to variation in genetic traits of the crop plants. Fat percentage was influenced significantly by the seeding densities. The seed rate of 75 kg ha^{-1} remaining at par with 100 kg ha^{-1} produced significantly higher ether extractable fat percentage (1.32%) than the remaining seed rates. The differences among the seed rates of 100, 125 and 150 kg ha^{-1} were not significant. Minimum fat value (1.21%) was recorded at the maximum seeding density (150 kg ha^{-1}).

Total Ash (%): Non significant differences between varieties were observed for total ash percentage. The total ash percentage was 6.09 and 6.04 for Neelum and Akbar

Table 1: Fodder yield and quality parameters of two maize cultivars as influenced by seeding densities

Treatments	Plant height (cm)	Stem diameter (cm)	Leaf area plant^{-1} (cm)^2	Green fodder yield	Dry matter yield (t ha^{-1})	Crude protein (%)	Crude fiber (%)	Ether extractable fat (%)	Total ash (%)
				Varieties					
Neelum	169.42^{NS}	1.24^{NS}	2253.78^{NS}	49.01^{NS}	6.09b	7.30^{NS}	32.81^{NS}	1.25^{NS}	6.09
Akbar	175.56	1.27	2258.27	52.14	7.18a	7.26	32.75	1.26	6.04
				Seed rates					
75 kg ha^{-1}	160.42b	1.52a	2538.53a	41.23d	4.83c	7.39a	32.39^{NS}	1.32a	6.30
100 kg ha^{-1}	165.67b	1.32b	2394.55ab	46.54c	6.46b	7.36ab	32.58	1.27ab	6.19
125 kg ha^{-1}	170.69b	1.18c	2136.87bc	52.97b	6.88b	7.24bc	32.89	1.24b	6.02
150 kg ha^{-1}	193.18a	1.00d	1954.13c	61.86a	8.39a	7.13c	33.27	1.21b	5.74

Any two means with in each character followed by the same letter are not significantly different at 5 percent level probability using DNMRT

respectively. Kim *et al*. (1992) have also reported the nonsignificant differences among the maize cultivars for ash content of whole plant.

A decrease in ash percentage was observed with increase of seeding density. The differences among the seeding densities of 75, 100 and 125 kg ha^{-1} 'were not significant. The differences between seeding densities of 125 and 150 kg ha^{-1} were also non-significant. The maximum (6.30%) and minimum (5.74%) total ash percentage was recorded at seeding densities of 75 and 150 kg ha^{-1} respectively. Qureshi (1964) have also reported a decrease in ash content of maize as a result of increase in plant population but increase could not reach to a significant extent (Table 1).

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