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Effect of density on grain yield, biological yield and harvest index on corn hybrids of SC 301 and SC 320

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Abstract

Corn (*Zea mays* L.) is the world's most widely grown cereal, and it is ranked third among major cereal crops. The increase in consumption of maize is also due to the renewed interest in traditional dishes and diversified maize products. In order to study the "Effect of density on grain yield, biological yield and harvest index on corn hybrids of SC301 and SC 320" an experiment was carried out at Research Station of Islamic azad university of Miandoab in 2012. The experiment was conducted as factorial based on completely randomized block design with four replications. Cultivars included hybrids of SC301 and SC320 (early hybrids of corn). plant densities were (60000, 70000, 80000 and 90000 plants ha^{-1}). Grain yield and biological yield hybrid of SC320 was higher than SC301 but there was no significant difference in the harvest index between hybrids. The highest and lowest grain yield were observed in 80 and 60 thousand plants per hectare respectively. Density of 90 thousand plants per hectar had the highest biological yield. The highest harves index were observed in 80 thousand plants per hectare.

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Introduction

Maize (*Zea mays* L.) is the world's most widely grown cereal, and it is ranked third among major cereal crops (Tollenaar *et al*, 1994; Ayisi and Poswell, 1997). The increase in consumption of maize is also due to the renewed interest in traditional dishes and diversified maize products (Abouziena *et al*, 2007). Maize can be grown for biomass production, that can be used for livestock feed or industrial energy (Carruthers *et al*, 2000; Fageria and Baligar, 2005). Maize is grown almost everywhere in the world because it is adapted to a wide range of environmental conditions (Lemcoff and Loomis,1994). Maize plant population for maximum economic grain yield varies from 30,000 to 90,000 plants ha^{-1} depending on planting date, water availability, soil fertility and maturity (Sangoi, 2001). Improved endurance in high stands has allowed maize to intercept and use solar radiation more efficiently, contributing to the remarkable increase in grain yield potential (Pal *et al*, 1993; Sepehri *et al*, 2002). Pepper (1974) reported that increased plant densities promote utilization of solar radiation by maize canopies. However, efficiency of conversion of intercepted solar radiation into economic maize yield will decrease with high plant density because of mutual shading of plants.

The best management options for short-season corn producers are to choose large and vigorous hybrids and row them at plant densities greater than ideal for grain production (Daynard, 1978; Blumenthal *et al*, 2003). The optimum population density for short-season corn production is determined by plant size and leaf area per plant (Hunter *et al*, 1980; Daynard and Muldoon, 1981). Plant size and leaf area have been reduced as hybrids are selected for early silking dates in an attempt to arrive at grain maturity within short growing seasons (Daynard and Muldoon, 1981). Thus, higher densities are required for smaller, earlier-maturing hybrids than for taller, later and leafier ones to maximize yield (Duncan, 1984; Stanton *et al*, 2007). Increasing plant density (40 000 to 100 000 plants ha^{-1}) in corn is a method used to increase grain and wholeplant yield, because in the process, LAI, light interception and crop growth rate are increased (Tollenaar and Aguilera, 1992; Bavec and Bavec, 2002). Increasing plant densities increase whole-plant fiber concentrations and slightly decrease digestibility, resulting in lesser animal production such as reduced milk yield per cow compared with the lower population densities used for grain production (Cox *et al*, 1998; Cusicanqui and Lauer, 1999).

Material and methods

In order to study the "Effect of density on grain yield, biological yield and harvest index on corn hybrids of SC301 and SC 320" an experiment was carried out at Research Station of Islamic azad university of Miandoab in 2012. The experiment was conducted as factorial based on completely randomized block design with four replications. Cultivars hybrids included SC301 and SC320 (early hybrids of corn). plant densities were (60000, 70000, 80000 and 90000 plants ha^{-1}).

Grain yield

For measuring of grain yield, plants in a square meter were selected from the middle per plots , then seeds were harvested and weighed on laboratory scale. Based on gram per square meter was calculated (Malaviarachchi *et al*, 2007).

Biological yield

In this regard ,the physiological maturity ,Whole shoots harvested and placed in the oven for 48 hours at 70 ° C was performed ,followed by a weighting function. Based on gram per square meter was calculated (Bavec and Bavec, 2002).

Harvest index

The harvest index of the crop obtained from the following equation (Lemcoff and Loomis, 1994): Harvest index (%)= (Economic yield / Biological yield) × 100.

Analysis of variance (ANOVA) method was applied to determine the significance of the results among different treatments and then Duncan test (Duncan's multiple range test) were evaluated. All the statistical

analyses were done using the SPSS and MSTATC softwares (Poorter and Garnier, 1996).

Results and discussion

Grain yield

Effects of plant density, cultivar, interaction in cultivar and plant were significant on grain yield (Table 1). Cultivar of SC320 grain yield was significantly higher than SC301 (Table 2). The highest yield was obtained at density of 80 thousand plants per hectar (Tab 3) .Hybrids grain yield of 80 thousand plants per hectar in SC 320 and SC301 were 1294.11 and 1253.57 g m^{-2} respectivly (Table 4). Density increased to 90 thousand plants per hectare cause decreased grain yield.

Table 1. Mean square analysis variance of traits.

SV	df	Grain yield ($g.m^{-2}$)	Biological yield ($g.m^{-2}$)	Harvest index (%)
Repeat	3	08 ^{ns}.5	83 ^{ns}.182	36.55 ^{ns}
Cultivar	1	*141.47	*549.25	0.09 ^{ns}
Density	3	**189.66	**952.19	17.59 *
density × cultivar	3	**224.60	623.5*	57.39**
Error	21	23.63	97.3	4.17
c.v (%)		10.87	15.39	7.45

ns, * and ** : non significant, significant at 5% and 1% respectively**.**

Table 2. Effect of cultivar on traits. Means followed by similar letters in each column are not significantly different at the 5% level of probability according to Duncan**.**

Treatment		Grain yield ($g.m^{-2}$)	Biological yield ($g.m^{-2}$)	Harvest index (%)
Cultivar	SC301	1179.78 b	3927.01 b	30.04 a
	SC320	1219.38 a	4148.54 a	29.39 a

Reported that grain yield increased with increasing density and the maximum yield were obtained from 80 thousand plants per hectar (Akmal *et al*, 2010). In a study reported that the highest seed yield of 16769 kg per hectare was obtained.with 90 thousand plants per hectare (Sigunga *et al*, 2002).

Biological yield

Effects of cultivar, plant density and interaction effect of plant density with cultivar were significant on biological yield (Table 1). Biological yield of SC320 was significantly higher than SC301 (Table 2).

Biological yield increased with increasing density (Tab 3) and density of 90 thousand plants per hectar had the highest dry matter for hybrids of SC320 and SC301 were 4386.85 and 4191.71 $g.m^{-2}$ (Table 4).

Table 3. Effect of plant density on traits. Means followed by similar letters in each column are not significantly different at the 5% level of probability according to Duncan**.**

Treatment		Grain yield ($g.m^{-2}$)	Biological yield ($g.m^{-2}$)	Harvest index (%)
plant density (plants ha^{-1})	60000	1062.01 c	3893.34 b	27.28 b
	70000	1205.7 b	3760.35 c	32.08 a
	80000	1273.84 a	4208.13 a	30.24 a
	90000	1256.77 ab	4289.28 a	29.3 ab

In a study of two plant densities of 90 and 130 thousand plants per hectare reported that the maximum biological yield of 130 thousand plants per hectare density is obtained (Stanton *et al*, 2007). In examining the effects of density include 5, 6 and 7 plants per square meter, reported that the yield increases with increasing density (Baron *et al*, 2006).

Harvest index

Effects of cultivar was not significant and plant density and interaction effect of plant density with cultivar were significant on harvest index (Table 1). The highest and lowest harvest index were observed in 70 thousand and 60 thousand plants per hectare, respectively (Table 2). Maximum harvest index on SC 320 and SC 301 were 31.33 and 32.84 percent respectively (Table 4).

Table 4. Iinteraction effect of cultivar and plant density on traits.

Cultivar	plant density (plants ha^{-1})	Grain yield ($g.m^{-2}$)	Biological yield ($g.m^{-2}$)	Harvest index (%)
SC 301	60000	1041.80 c	3795.92 d	27.44 c
	70000	1185.51 b	3608.90 d	32.84 a
	80000	1253.57 ab	4111.54 bc	30.48 ab
	90000	1238.23 ab	4191.71 b	29.53 b
SC 320	60000	1082.21c	3990.77 c	27.11 c
	70000	1225.90 ab	3911.81 cd	31.33 a
	80000	1294.11 a	4304.73 ab	30.06 ab
	90000	1275.32 a	4386.85 a	29.07 b

Means followed by similar letters in each column are not significantly different at the 5% level of probability according to Duncan.

Cox and Cherney (2001) and Sangoi (2001) found that the effect of density on harvest index was significant and stated that the consumption of 80 thousand plant per hactar.

Conclusion

Results presented in this study indicated that grain yield and biological yield hybrid of SC320 was higher than SC301 but there was no significant difference in the harvest index between hybrids. density of 80 thousand plants per hectare due to the beneficial use and optimal growth factor such as light, moisture, soil and growing medium, had the highest grain yield and harvest index. The density of 90 thousand plants per hectare has increased the number of plants per unit area and most biological yield, but due to competition for growth factors reducing grain yield. Grain yield and biological yield hybrid of SC320 was higher than SC301 but there was no significant difference in the harvest index between hybrids.

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