Environment Conservation Journal 17(3) 91-96, 2016
ISSN 0972-3099 (Print) 2278-5124 (Online)
Abstracted and Indexed

The impact of different nitrogen amount and sources on the yield of three silage corn cultivar (KSC500 - KSC703- KSC704)

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Received: 5.03.2016 **Revised: 21.05.2016** **Accepted: 15.06.2016**

Abstract

Nitrogen is one of the most important elements required for grain production in different parts of the country. In order to investigate nitrogen consumption in planting three silage corn cultivar: medium Karaj KSC500, new serotinous KSC703 and local serotinous KSC704 were tested as factorial in the form of random blocks with three replications in the land located in Lamabad Village- Malard- Tehran. In this experiment, two factors have been considered the first one of which is factor (A) including three silage corn cultivars of local KSC704, KSC500 and KSC703 and factor (B) presenting different levels of nitrogen fertilizer at four treatments including: control (use of urea in accordance with local fields), spraying urea at one stage plus topdressing, spraying urea at two stages and the use of sulfur coated urea (granular) at the time of planting. The effect of nitrogen on plant height was significant at 1% level. Based on the comparison of the mean leaf length based on cultivar factor the maximum length of the leaf was 83.28 obtained by KSC 704 and there was no significant difference between KSC 703 and KSC 500. The results of variance analysis revealed that there was a significant difference between the cultivars at 1% level but the effect of nitrogen and the interaction between nitrogen and number of leaves was not significant.

Keywords: Performance, corn, nitrogen, analysis of variance

Introduction

Corn is in the Poaceae family that due to the enormous diversity in form, quality and growth habit, it is cultivated in a wide range of suitable areas around the world. The high yields obtained in terms of total dry matter and grain, enjoying a variety of nutritional value in terms of providing carbohydrates and edible oil and improved efficiency of water use have made it important in the agricultural economy (Rashed Mohassel *et al,* 2001). After wheat, barley and rice, corn has 226 thousand ha of grain cultivation area in the country (agricultural statistics, 2011). According to studies, the increased amount of nitrogen from zero to 42 grams per square meter (420 kg/ha), has doubled total dry weight of the plant, increased grain yield 4 times and increases harvest index2 times (Moscheler *et al., 1988*). Nitrogen is the most important macro nutrient that plays a role in different protein molecule, enzyme, coenzyme, nucleic acids and cytochrome. Nitrogen deficiency affects grain yield by reducing the number and weight of grains. The first sign of nitrogen deficiency appears as leaf yellowing or discoloration (chlorosis), especially in older leaves of the plant (Hassegawa *et al.,* 2008). The need to increase agricultural production at the same time of population growth as well as the country's development plans in recent years has been followed by the higher consumption of chemical fertilizers, especially nitrogen. However, low utilization due to nitrogen losses caused by volatilization; leaching and denitrification surface runoff and vegetation in addition to raising the cost of crop production have caused concerns in agriculture, environment, and health industry. This has made the nitrogen use efficiency as a major challenge for the world's agricultural (Doberman, 2006). According to Food and Agriculture Organization of the United Nations (FAO) NPK fertilizers is increased by 130% in developing countries, 25% in developed and 55% around the world within a 10-year period (1975-1985). Accordingly being aware of nitrogen use in agriculture is important for judging about the efficient use of fertilizer (Fageria and Baligar,

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2005). The use of nitrogen increases grain weight, yield, head and stem diameter, economic and biological performance of sunflower. Adding nitrogen increased root and shoot and leaf weight. Changes in weight was such a way that the stem, leaf and root (with some delay) weight began to increase. Increasing nitrogen application increased root growth rate compared to the stem (Kazem *et al.,* 1992). Studying the effect of nitrogen on quantitative and qualitative characteristics of corn showed that nitrogen increased the dry weight of corn (Cox *et al., 1993*). Nitrogen has a significant positive effect the stem diameter, leaf area, ear, number of grains and ear (Hamid and Khodabande, 1996). Arzani et al. (2006) reported nitrogen fertilizer increased the growing period, days to maturity, plant height, stem and head diameter of sunflower. Nitrogen increased grain and biological yield up to 150 kg per hectare whereas higher levels of fertilizer reduced it. Nitrogen affected yield by increasing the number of grains in per head, and density by increasing the number of heads per unit. In another study conducted on corn cultivar 704, the maximum grain yields of 7603.67 kg per ha by adding 225 kg nitrogen and the minimum grain yield of 6744 kg per ha in the absence of nitrogen were obtained (Ghadiri and Majidian 2003). Applying nitrogen has a significant effect on the quantitative and qualitative performance of corn (Sanjeevand And Bangarwa, 1997) and (Hardas and Aragiaanne-Hrestous, 1985). Tollenaar (1977) and Uhart and Andrade (1995) believe that the increase in yield per plant by nitrogen may be associated with the increase in the number of grains per ear and grain weight. Mucho (1994) believes that the reduction of nitrogen, the grain weight is reduced. However, Purcino *et al* (2000) suggest that grain yield is not affected by nitrogen. This inconsistency may be due to differences between corn hybrids in response to nitrogen fertilizer (Smiciklas and Below, 1990). Dlamini (1990) reported that in order to reach corn yield within the range of 3.5-5 tons per hectare, 65-75 kg of nitrogen per hectare is enough.

Materials and Methods

The experience was conducted in 2014-2015 in Lamabad- Mallard. The regional climate is relatively warm and dry in summer and cold and dry in winter. The altitude is 1156 m above the sea level and located in 35°38'30"N 50°57'32"E. In order to evaluate the effect of different amounts of nitrogen on quantitative and qualitative characteristics three silage corn cultivars of local KSC704, KSC500 and KSC703, factorial experiment in completely randomized blocks in three replications were tested. In this experiment, two factors have been considered the first one of which is factor (A) including three silage corn cultivars of local KSC704, KSC500 and KSC703 and factor (B) presenting different levels of nitrogen fertilizer at four treatments including: control (use of urea in accordance with local fields), spraying urea at one stage plus topdressing, spraying urea at two stages and the use of sulfur coated urea (granular) at the time of planting. The means are compared by LSD test by calculating the least significant difference of 1% and 5%. For the analysis of data and draw the charts SPSS v 17 and Excel programs were used.

Results and Discussion

Plant height

Based on analysis of variance between the cultivars, there was no significant difference in plant height. The effect of nitrogen on the plant height was significant at 1% level of probability. Also the interaction of cultivar and nitrogen had no significant effect on plant height (Table 1). The results of comparison between the average heights of the plant under the influence of nitrogen factor indicated that applying nitrogen as spraying at one stage along with topdressing and spraying at two stages reduced the height of the plant compared to control plant such that they were in the same statistic group. Similarly, the use of sulfur-coated nitrogen fertilizer at the time of planting had no significant difference with the control group (Table 4). The increase in nitrogen increases plant height and growth rate (Khodadadi and Mazaheri, 1998).

Leaf length

According to Table (1) the results of variance analysis indicated that there was a significant difference between cultivars at the level of 5%. Also the interaction between cultivar and nitrogen and leaf length was significant at 5% level but nitrogen had no significant effect on the leaf length.

Based on the results of comparing the average leaf length under the effect of cultivar factor (Table 5) the maximum leaf length of 83.28 cm was obtained in cultivar KSC704 and there was no significant difference between KSC704 and KSC500 (Figure 1). Information obtained by comparing the average length of leaves under the effect of interaction between cultivar and nitrogen showed that highest leaf length was associated with applying urea based on the local custom, application of spraying and topdressing and spraying in two steps in KSC 704 and also the use of sulfur-coated urea fertilizer at the time of planting cultivar KSC 703 respectively (Table 6).

Table 1 – The results of variance analysis and the effect of the use of resources and different amounts of nitrogen on the qualitative and quantitative characteristics of three silage corn

Sources of changes	Degree of freedom	Plant height	Leaf length	Number of leavs
Block	2	4418.32 **	102.59 **	0.36 ns
Cultivar (a)	2	113.24 ns	35.93 *	8:07 **
Nitrogen (b)	3	202.56 **	9.15 ns	0.22 ns
a * b	6	23.43 ns	22.58 *	0.32 ns
Error	22	44.6	8.64	0.22
CV%		3.48	3.61	3.72

* **And** ** **level of significance at 5 and 1% ns: no significant effect**

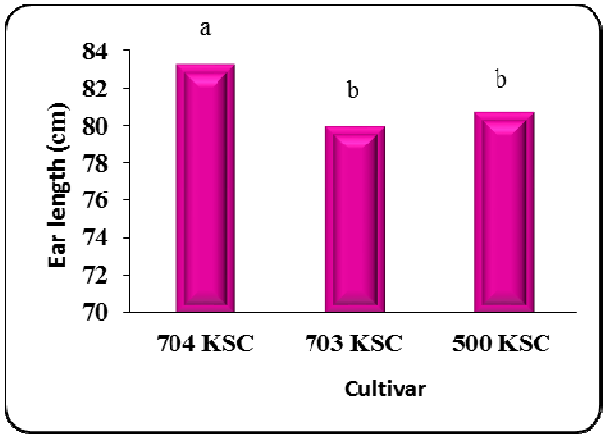

Figure 1. Average length of leaves affected by cultivar

The number of leaves

Variance analysis results showed a significant difference between the cultivars at 1% probability but the effect of nitrogen and the interaction between cultivar and nitrogen was not significant on the number of leaves. The results of the comparison of the average number of leaves affected by the cultivar factor indicated that the highest number of leaves was associated with KSC704 with the rate of 13.23 and KSC 500 with the rate of 13.02 and the lowest number was associated with KSC 703 with the rate of 11.72 (Table 7). Natarjan (1989) believes that the high number of ear is largely influenced by genes but sometimes it is seen that at high densities due to the reduced penetration of light in the canopy, the number of leaves appear is less than the genetic potential of plant which could indicate that these traits are influenced by both factors (gene density or penetration of light into the canopy). Increasing the number of ear leaves present the sagittal grain yield.

Ear height

Based on the variance analysis the effect of cultivar and nitrogen was not significant on ear height but the interaction between cultivar and nitrogen had a significant effect on ear height at 5% (Table 2). The result of comparison of the average ear height under the interaction between cultivar and nitrogen showed that there was a significant difference between treatments (Figure 2).

Table 2 - variance analysis of the use of resources and amounts of nitrogen on the quantity and quality of three silage corn cultivars

Sources of changes	Degree of freedom	Ear height	Ear length
Block	2	3274.88**	182.4**
Cultivar (a)	2	22.43ns	213.37**
Nitrogen (b)	3	71ns	3.16ns
a * b	6	76.55*	10.5ns
Error	22	28.15	9.68
CV%		6.65	9.49

(* And ** level of significance at 5 and 1% ns: no significant effect)

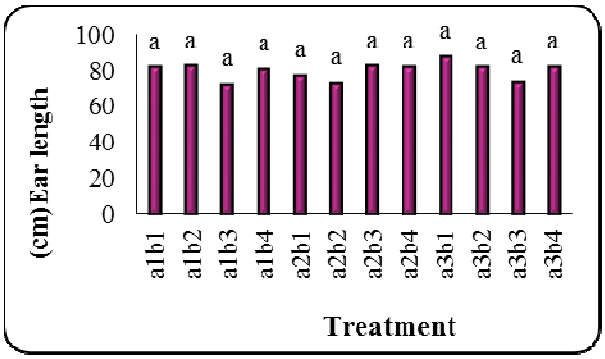

Figure 2. Analyzing ear height affected by the interaction between cultivar and nitrogen (a_1: KSC 704, a_2: KSC 703, a_3: KSC 500, b_1: applying urea in accordance with the local custom, b_2: Spraying and topdressing, b_3: Spraying at two stages, b_4: Sulfur coated simultaneously with planting)

Ear length

According to Table 6 variance analysis showed that there was a significant difference between different cultivars in terms of ear length at 1%. Also there was no significant effects was observed as the result of nitrogen and cultivar and nitrogen interaction. The comparison of average ear length affected by cultivar factor indicated that the highest ear length with 34.93 and 35.48 cm were related to KSC 704 and KSC 500 and minimum ear length of 27.92 cm was associated with KSC 703 (Table 8).

Harvest index

Based on the results of variance analysis of the effect of cultivar, nitrogen and the interaction between cultivar and nitrogen on HI was not significant (Table 3).

Table 3 - variance analysis of the use of resources and amounts of nitrogen on the quantity and quality of three silage corn cultivars

Sources of changes	Degrees of freedom	HI	Percentage of crude protein
Block	2	5.64ns	7.67ns
Cultivar (a)	2	27.07ns	3.12ns
Nitrogen (b)	3	14.74ns	11.16*
a * b	6	12.4ns	0.6ns
Error	22	15.39	2.6
CV %		13.63	18.07

* And ** significant at the level 1 of 5 percent percentage ns: no significant effect

Naderi et al (2009), Baxrafshan (2005) and Zeraei (2003) stated that the harvest index is affected by cultivar, plant density and planting pattern so that the density reduces grain yield and harvest index. They also add that HI can be highly affected by genotype.

Percentage of crude protein

The results of variance analysis showed that the effect of nitrogen on crude protein was significant at the five percent level. Also the counter effect of cultivar and nitrogen had no significant effect on crude protein (Table 3). The results of mean

percentage of crude protein indicated that spraying and topdressing and urea spraying at two stages increased the percentage of crude protein compared to the control, so that the highest percentage of crude protein at 10.13% was associated with urea spraying at two stages (Table 9).

Table 4 – Comparing the mean effects of nitrogen on plant height of three silage corn cultivars

Nitrogen	Plant height (cm)
Control (b_1)	195.59[a]
Spraying and topdressing (b_2)	187.32[b]
Spraying at two stages. (b_3)	188.14[b]
Sulfur coating together with planting (b_4)	196.24[a]

Means with similar letters have no significant difference based on Duncan test at the level of 5%

Table 5 - Comparing the mean effects of cultivar on leaf length of three silage corn cultivars

Cultivar	Leaf length (cm)
704 KSC(a_1)	83.28[a]
703 KSC (a_2)	79.98[b]
500 KSC(a_3)	80.74[b]

Means with similar letters have no significant difference based on Duncan test at the level of 5%

Table 6 - Comparing the mean effects of cultivar and nitrogen interaction of three silage corn cultivars

Nitrogen and cultivar	Leaf length (cm)
a_1b_1	85.47[a]
a_1b_2	83.63[a]
a_1b_3	83.6[a]
a_1b_4	80.43[ab]
a_2b_1	79.9[ab]
a_2b_2	82.13[ab]
a_2b_3	74.95[b]
a_2b_4	82.93[a]
a_3b_1	82.9[ab]
a_3b_2	80.87[ab]
a_3b_3	81.7[ab]
a_3b_4	79.5[ab]

Means with similar letters have no significant difference based on Duncan test at the level of 5%

(a_1: KSC 704, a_2: KSC 703, a_3: KSC 500, b_1: applying urea in accordance with the local custom, b_2: Spraying and topdressing, b_3: Spraying at two stages, b_4: Sulfur coated simultaneously with planting)

Table 7 - Comparing the mean effects of cultivar on the leaf number of three silage corn cultivars

Cultivar	Leaves
704 KSC(a_1)	13.23[a]
703 KSC(a_2)	11.72[b]
500 KSC)(a_3)	13.02[a]

Means with similar letters have no significant difference based on Duncan test at the level of 5%

Table 8 - Comparing the mean effects of cultivar on the ear length of three silage corn cultivars

Cultivar	Ear length (cm)
704 KSC(a_1)	34.93[a]
703 KSC(a_2)	27.92[b]
500 KSC (a_3)	35.48[a]

Means with similar letters have no significant difference based on Duncan test at the level of 5%

Table 9 - Comparing the mean effects of nitrogen on crude protein content of three silage corn cultivars

Nitrogen	Percentage of crude protein
Control (b_1)	8.23[bc]
Spraying and topdressing (b_2)	9.58[ab]
Spraying at two stages. (b_3)	10.13[a]
Sulfur coating together with planting (b_4)	7.76[c]

Means with similar letters have no significant difference based on Duncan test at the level of 5%

Conclusion

According to the results of this test, KSC 704 cultivar had the highest yield among other cultivars discussed in this study and urea application based on local custom treatment increased dry matter.

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