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Evaluation of the Effect of Different Levels of Nitrogen Fertilizer and Cultivar on Morphological Traits on Corn Biomass in Isfahan

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ABSTRACT
To evaluate the effect of different nitrogen fertilizer on morphological properties of biomass of different corn cultivars, a field experiment was performed in a farm located in Kabutarabad area of Esfahan in 2014. Experiment was conducted in split plot design in complete randomized blocks layout with three replications. Different levels of nitrogen fertilizer in four levels of 100, 150, 200 and 250 Kg ha^{-1} of pure nitrogen from urea source and different varieties SC500, SC604, SC 700 and SC704 were considered as main and sub plots. The highest dry weights of leaf, stem and plant were obtained in 250 Kg N ha^{-1} treatment. SC704 due to longer growing period had the highest leaf, shoot, and plant dry weights relative to the other single crosses. With regard to sustainable agriculture and optimizing the use of fertilizer it seems under the same conditions of this study SC704 and 250 Kg ha^{-1} of nitrogen would give the best performance.

Keywords: Corn, Leaf Dry Weight, Nitrogen, Single Cross

INTRODUCTION

Corn is one of the oldest plants cultivated that provides about 70 percent of human food (Hochholdinger *et al.,* 2004). Nitrogen is one of the most important nutrients required by the plants (Salardiny, 2005) and more than any other nutrient affects the plant growth. However, due to the variability in soil and different environmental conditions during the growing season, the nitrogen availability is the most critical nutrient problems (Malakouti, 1990). Nitrogen affects the growth and quality of vegetative organs and lack of it in the plant results in reduced longitudinal growth and limited root system (Ayub, Tanveer, Liand and Azam, 1999). Nitrogen is the most important nutrient for crops and its deficiency is seen in the most calcareous soils (Malakouti *et al.,* 2004).

Nitrogen uptake in corn continues to maturity stage and the main part of nitrogen absorbed transfers into the grain (Anderson, 1984). Corn in about one to two weeks before and 3 to 4

weeks after formation of ears needs the most amounts of nitrogen. Also, corn in 14-leaf stage absorbs 37%, in the stage of male inflorescence development 50%, and in the emergence of female flower 60% of total nitrogen (Black, Aland and Aase, 1962). Since 60 to 70% of total nitrogen is absorbed after the advent of male inflorescence (Bauer, Frank and Blaek, 1985), fertilizer recommendation to yield eight to nine tons of grain per hectare, is taking 200 to 250 kg nitrogen per hectare (Ziaeyan and Malakuti, 2001). Iran is located in arid and semi-arid region with low soil organic matter and low levels of nitrogen (Malakouti and Homaiei, 2004). Therefore, this study was conducted to determine the best level of nitrogen fertilizer to increase the crop yield of corn.

MATERIALS AND METHODS

To evaluate the effect of different levels of nitrogen fertilizer and cultivar on morphological traits of corn, a field experiment was conducted in 2014 on a farm in 12 kilometers east of Esfahan located in Kabutarabad at latitude of 32^0, $73^/$ N and longitude of 51^0 and $78^/$ E and an altitude of 1555 meters above sea level. Experiment was performed in the form of split plot design in randomized complete blocks with three replications. Nitrogen fertilizer in four levels of 100, 150, 200 and 250 Kg ha^{-1} from urea source and different varieties SC500, SC604, SC700 and SC704 were the main and sub-plots, respectively. Half of the nitrogen fertilizer was used as pre-planting and other half was used at tassel emergence stage. Planting date was 11^{th} of July. The distance between rows was 75 cm and the distance on the row was 0.19 cm. Each plot consisted of five rows 6 m long. Thinning was done at double leaves stage to reach the desire density. Pre-planting herbicide Atrazine (wettable powder 80%) at a rate of 6.1 Kg ha^{-1} and Ardikan (emulsified liquid 82%) at a rate of 5 liters per hectare were used with the first irrigation. The first irrigation was immediately performed after planting and others were performed once every 6 days. At pollination, male inflorescence height, stem diameter, dry weight of plant components were determined for 10 randomly selected plants in each plot. Also, plant dry weight, leaf area index, wet and dry (80^0 C for 12 h) weights of leaf, stem and ear were determined. Mean comparison was based on Duncan's multiple range test at 5 percent probability level.

RESULT AND DISCUSSION

Initial Plant Height

The results of variance analysis indicated that the effect of nitrogen on plant height at early growth stage was significant at probability level of 5% (Table 1). The highest and lowest early plant heights were observed in 200 and 100 Kg N ha^{-1}, respectively (Table 2).

The effect of increased nitrogen fertilizers is to stimulate the growth, particularly by regulating auxin and cytokine hormones which increase the height and root growth, respectively. Kasperbaer and Carlene (1994) indicated that nitrogen increases plant height that leads to shadow between neighboring plants (Wolton, 2005).

No significant differences were observed between varieties with respect to plant height at early growth stage (Table 1). The maximum and minimum heights of plant were observed for SC704 and SC 500, respectively (Table 2). Rajput (1992) suggested that plant height is one of the important agronomical traits affected by genotypes and growth conditions.

Table1. Analysis of variance for some traits of corn

		Mean Squares						
SOV	Degree of freedom	Initial plant height	Final plant height	Stem diameter	Leaf dry weight	Stem dry Weight	Ear dry weight	LAI
Replication	2	273.4 *	876.9	0.08	1212.3 *	217610.5	397.7	7.3 ns
Nitrogen (N)	3	303.1 *	70138.3*	0.5 *	1054.6 *	152715.9**	8362.8 *	75.85 *
Error (a)	6	29.7	808.5	0.075	20.70	7714.3	128.5	3.98
Cultivar (C)	3	61.2 ns	3.6 5 3 07 *	0.33 *	2146. 85 **	101345.5 *	12286.4 **	.4.12 *
N×C	9	12.6 ns	103.4 ns	0.001 ns	7.95 ns	29107.6 ns	1927.1 ns	3.74 ns
Error (b)	24	10.9	301.7	0.041	5.25	3318.04	63.9	1.51

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

Final Plant Height

In the stage of tassel emergence, differences of plant height in different nitrogen treatments were significant at 5% probability level (Table 1). The maximum and minimum plant heights were observed in 250 and 100 Kg treatments, respectively (Table 2). Nitrogen plays a major role in biochemical activity (e.g. plant hormone production) and vegetative growth and its application at the beginning of the growing season increases leaf area and enhances the photosynthesis in plants. The effect of variety on plant height was significant at 5% probability level (Table 1). The greatest and lowest heights were related to SC 704 and SC 500, respectively.

Stem Diameter

Effect of nitrogen on stem diameter was significant at 5% probability level (Table 1). The highest and lowest stem diameters were observed in 100 and 250 Kg N ha^{-1}, respectively (Table 2). Improvement of soil fertility on photosynthesis and positive role of fertilizers on photosynthesis and function photosystem of light are the reasons for increasing growth parameters such as stem diameter.

Leavitt (1980) stated that the large number of plants per unit area and nitrogen deficiency reduced the stem diameter and increased plant height. Alyari *et al.* (2003) concluded that there was a significant difference between different levels of nitrogen fertilizer in terms of stem diameter. The effect of cultivar on stem diameter was significant at 5% probability level (Table 1). The highest stem diameter was observed for SC 500 (Table 2). Plants with highest plant height had the thickest stem.

Leaf Dry Weight

The effect of nitrogen on leaf dry weight was significant at 5% probability level (Table 1). The highest and lowest leaf dry weights were observed in 200 and 100 Kg N ha^{-1} treatments, respectively (Table 2). Tehrani (1999) reported the same results.

The effect of cultivar on leaf dry weight was significant at 1% probability level (Table 1). The highest and lowest leaf dry weights were observed for SC 704 and SC 500, respectively (Table 2). With regard to the significance of cultivar differences and importance of leaf in yield formation, it seems that the increase of growth duration enhances the increase of leaf area but compensates with plant respiration and reduction of leaf dry weight.

Table 2. Mean comparison of nitrogen and cultivar effects on morphological traits in corn

	Nitrogen density (%)	Initial plant height (cm)	Final plant height (cm)	Stem diameter (cm)	Maximum leaf area index (m^2/ m^2)	Leaf dry weight (Kgh^{-1})	Stem dry weight (Kgh^{-1})	Ear dry weight (Kgh^{-1})
Nitrogen (Kgh^{-1})								
100	2.07c	36.30c	179.92d	2.53 a	4.07 c	1851.9d	2.4 2 60 c	3 5 67.9 d
150	3.63 b	37.36c	196.92c	2.50 a	5.14 b	2.6 20 7 c	2.5 4 77 b	3 8 57.4 c
200	4.49 a	47.95a	210.67 10 b	2.35 b	6.30 a	2.2 8 1 3 a	2.86 0 5 a	48922. a
250	4.68 a	44.60b	230.14 30 a	2.3 4 b	5.65 b	2.7 490 b	2.56 7 7 a	4 4 40.6 b
Cultivar								
SC 500	3.72 a	40.45a	195.50d	2.66 a	4.5 9 c	2.1085 c	2.5 301 c	3597.5 d
SC 604	3.83 a	40.74a	212.01 2 b	2.39 b	4.6 6c	2.2 19 7 b	2.7 419 b	3 8 90.0 c
SC 700	3.89 a	42.72a	214.501 4 b	2.35 b	5.36 b	2.5 294 a b	2.462 4 a	42375. b
SC704	3.95 a	42.90a	220.5020 a	2.30 b	6.06 a	2.33 38 a	2.565 9 a	4632.5 a

In each column the means of each factor that have at least one common letter, based on Duncan test are not tatistically significant at 5% probability level.

Shoot Dry Weight

The effect of nitrogen on shoot dry weight was significant at 1% probability level (Table 1). The highest shoot dry weight was related to 200 Kg N ha^{-1}. The dry weight of 100 Kg N ha^{-1} treatment had significant differences with other treatments (Table 2). Latifi and Damavand (2003) reported that extending of growth would increase the stem weight. It seems that increase of light absorption of the plant community will lead to increase plant height.

The effect of cultivar on shoot dry weight was significant at 1%probability level (Table 1). The highest shoot dry weight was related to cultivar SC 704 and the least dry weight was observed for SC 500 (Table 2). The results showed that shoot and stem dry weights increased with increasing of growth duration. Fathi (1999) reported the similar results.

Ear Dry Weight

The effect of nitrogen on ear dry weight was significant at 5% probability level (Table 1). The highest ear dry weight was obtained in 200 Kg N ha^{-1} treatment which was significantly different from other treatments. The lowest ear dry weight was obtained in 100 Kg N ha^{-1} treatment (Table 2). In studies of Moadab Shabestari *et al*. (1990) the increase of the growth period led to increase dry weight of ear per plant. However, Limon-Ortega *et al*. (2000) found that due to lack of environmental factors such as moisture and nutrients further and enhance of photosynthesis and therefore the increase of ear dry weight is limited. Imam *et al*. (1994) believed that ear dry weight gain was due to the raise of the components such as ear length and diameter. In the present experiment the trend of changing the ear dry weight was more concurrency with ear length than diameter.

The effect of variety on ear dry weight was significant at 1% probability level (Table 1). The highest ear dry weight was related to SC 704 that showed significant differences with the other cultivars. The least ear dry weight was related to SC 500 (Table 2).

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