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Effects of Nitrogen Fertilizer on Chlorophyll Content and Other Leaf Indicate in Three Cultivars of Maize (*Zea mays* L.)

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Abstract: The study was carried out in order to explore the responses of nitrogen fertilizer on chlorophyll content and other leaf indicates in three cultivars of maize, a split plot experiment based on randomized complete block design with three replications was conducted in research field of Islamic Azad University, Ardabil branch, Ardabil, Iran, in 2009. Factors were: nitrogen levels in main plots (0, 60, 120 and 180 Kg N ha^{-1}) and maize cultivars in sub plots (Kenez410, Korduna and Konsur). Results showed that chlorophyll content, leaf area index, leaf dry weight and kernel yield were affected by maize cultivars and nitrogen fertilizer levels. Whit increasing nitrogen levels, chlorophyll significantly increased. Interaction effect of cultivars and nitrogen fertilizer levels showed that cultivar of korduna had highest value of chlorophyll content at ear leaf. Cultivar of korduna had highest value of leaf area, leaf dry weight and kernel yield in all levels of nitrogen fertilizer levels. Maximum of those traits were obtained at Korduna×180kg N ha^{-1}. Therefore results showed that cultivar of Korduna have more potential for many traits. Thus, it can be suggested that use korduna cultivar with 180 kg N/ha levels.

Key words: Chlorophyll content · Corn cultivars · Kernel yield · Leaf area and Nitrogen fertilizer

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops of the world extensively grown in irrigated and rain fed areas [1]. It ranks the third position among cereal crops after wheat and rice, which ranked as first and the second, respectively. Increasing maize production became one of most important goals of the world to face the human and animal demands. Maize is multipurpose crop and provides food for human beings, fodder for live stock and feed for poultry. It has great nutritional value as it contain about 66.70% starch, 10% protein, 4.8% oil, 8.5% fiber, 3% sugar and 7% ash [2]. This could be achieved through following the proper management systems which could lead to maximize its productivity. Growing new high yielding varieties under the most favorable cultural practices such as the application of the needed nutrients is considered as one of the successful ways. The highest maize yield production depended on many factors i.e. cultivars and nitrogen fertilization [3]. Nitrogen fertilizer is a key nutrient in the production of non legume crops. It is a component in many biological compounds that plays a major role in photosynthetic activity and crop yield capacity [4] and its deficiency constitutes one of the major yield limiting factors for cereal production [5]. McCullough *et al*. [6] reported that new maize hybrids were more tolerant than earlier hybrids to limited N supply during the early vegetative phase with respect to rate of leaf appearance, photosynthesis, stomatal conductance (g_s) and chlorophyll content. Nitrogen is part of the enzymes associated with chlorophyll synthesis [7] and the chlorophyll concentration reflects relative crop N status and yield level [8]. Leaf area influence the interception and utilization of solar radiation of maize crop canopies and, consequently, maize kernel yield. Rate of leaf expansion, maximum leaf area and rate of leaf senescence are important factors in the estimation of canopy photosynthesis in crop growth simulation models. Leaf area is influenced by genotype, plant population climate and soil fertility.

The aim of this research was to realize effect of nitrogen fertilizer levels on chlorophyll content and other leaf indicate in three cultivars of Maize in Ardabil region.

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MATERIALS AND METHODS

This experiment was conducted in research field of Islamic Azad University, Ardabil branch, Ardabil, Iran, in 2009. The climate is semi-arid. It has 1350 meters altitude from sea level. The soil was loamy-sand textured, pH was about 7.2 and the preceding crop was wheat in the two seasons. Results of soil analysis samples were taken from the surface 30 are presented in Table 1.This investigation was arranged as split-plot experiment based on the randomized complete block design with three replications. Main-plots were assigned to nitrogen levels (0, 60, 120 and 180 kg ha^{-1}) and sub-plots to corn cultivars (Kenez410, Korduna and Konsur). Each sub-plot included five rows which their length and spaces from each other were 5 and 0.75 meters. Planting date was on 5 May in 2009 growing season. Three kernels were hand planted at depth of 3 to 5 cm in each hill. Phosphorus fertilizer was applied before planting at the rate of 80 kg/ha super phosphate triple (44 % P2O5). Plots were hand-thinned at the 3-4 leaf stage to one plant per hill. Hand hoeing twice was done for controlling weeds before the first and second irrigations. Nondestructive chlorophyll measurements were performed using a chlorophyll meter (SPAD-CMM 200) at five stages (10, 20, 30, 40 and 50 day after Silking) according to the method described by Dwyer *et al*. [9]. Average of thirty chlorophyll meter readings of the ear leaf were taken in each plot using a portable chlorophyll meter. In order to measure yield, plants of middle rows of each plot randomly were harvested in the surface of 2.5 m^2 at the physiological maturity. Ears were husked, dried and weighed. To determine leaf area index in each sampling stage, leaves area of samples were estimated by leaf area meter. Data were subjected to analysis by the SAS software and graphs were drawn using Excel program.

Table 1: The analysis of Physico-chemical properties of the soil.

K (PPm)	355.2
P (PPm)	29.9
(%T.N.)	0.02
(% Os)	0.2
Tex (%)	Clay-loam
Sand (%)	21
Silt (%)	44
Clay (%)	35
Sp (%)	54
PH	7.7
EC (M mhos)	1.37
Sampling depth (cm)	0-30

RESULTS AND DISCUSSION

Varietal Differences: Results showed that chlorophyll content, leaf area index, leaf dry weight and kernel yield each differed significantly ($P<0.01$) among the three maize hybrids (Table 2). Data also indicated that Korduna gave the highest values of chlorophyll content, leaf area, leaf dry weight and kernel yield with high significant differences compared attributed to differences in the genetic constitution of the tested varieties. Similar results were also reported by Mehasen and Alfageh [10]. Moreover, it is clear from Table 3 Koruna significantly surpassed the other hybrids in maximum chlorophyll and maximum leaf area index. Maximum chlorophyll content in ear leaf (29.4 SPAD-units) and minimum of this trait (26.75 SPAD-units) was obtained in Korduna and Konsur cultivars receptivity. Kebez40 has middle (32.16) chlorophyll content. Also kordona and Konsur have maximum (7.09) and minimum of leaf area index (3.72). Some experiments have shown that a LAI between 3 and 4 may be optimal for achieving maximum yield [11]. Results showed that kernels yield was significantly affected by nitrogen cultivars at 1% probably (Table 2). Korduna, Kenez410 and Konsur significantly produced maximum kernels yield, respectively. Values of yield were 5876.2, 4763 and 4098.75 kg for above cultivars, respectively. Maximum yield belonged to Korduna cultivar at 180 kg N ha^{-1} and differences between were greater for it (Figure 7).

Effect of Nitrogen Fertilizer: Data presented in Tables 2 showed that ear leaf chlorophyll content, leaf area index, leaf dry weight and kernel weight were significantly affected by Nitrogen fertilizer levels. It was noticed that maximum values of ear leaf chlorophyll content, leaf area index, leaf dry weight and kernel weight were obtained

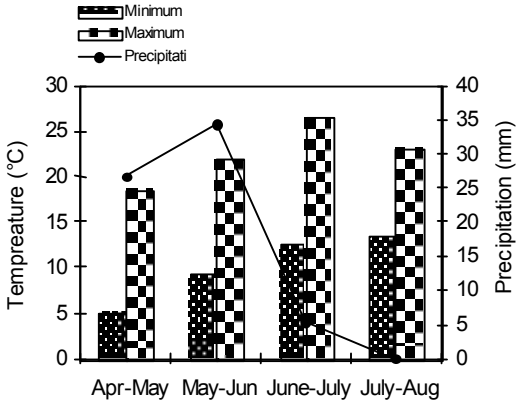

Fig. 1: Maximum and minimum temprature and precipitation rate at growth season

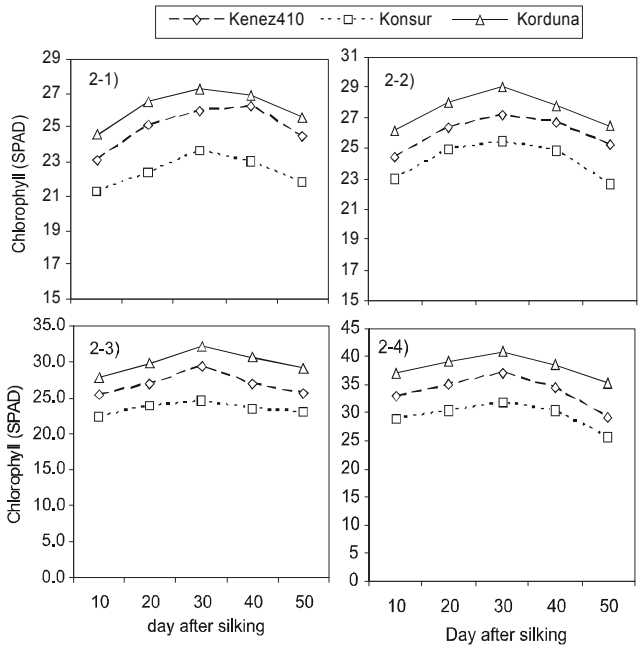

Fig. 2: Chlorophyll changes as affected by maize cultivars at 1-2) 0 kg N/ha, 2-2) 60 kg N/ha, 3-2) 120 kg N/ha and 4-2) 180 kg N/ha.

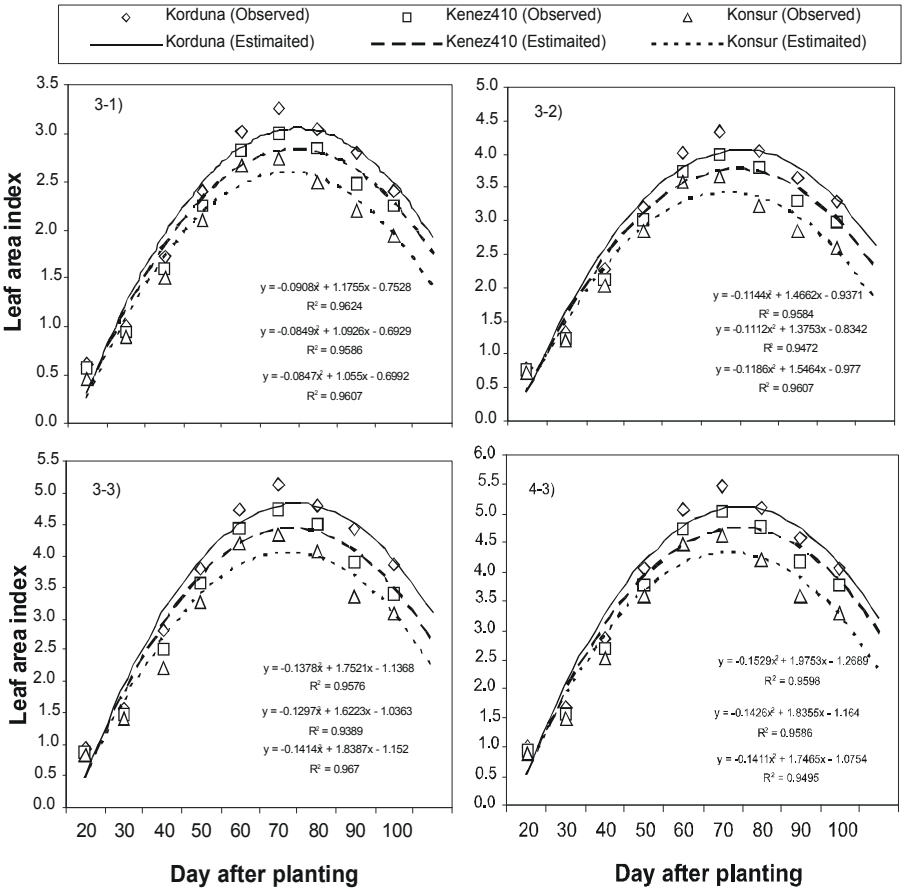

Fig. 3: Leaf area index trend changes as affected by maize cultivars at 1-3) 0 kg N/ha, 2-3) 60 kg N/ha, 3-3) 120 kg N/ha and 4-3) 180 kg N/ha.

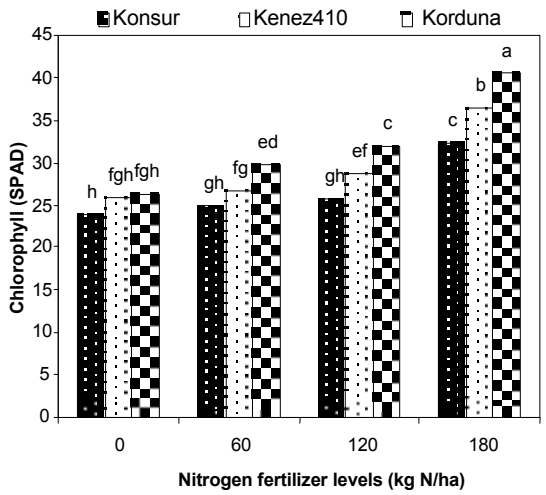

Fig. 4: Maximum chlorophyll (SPAD) as affected by cultivar and nitrogen fertilizer levels

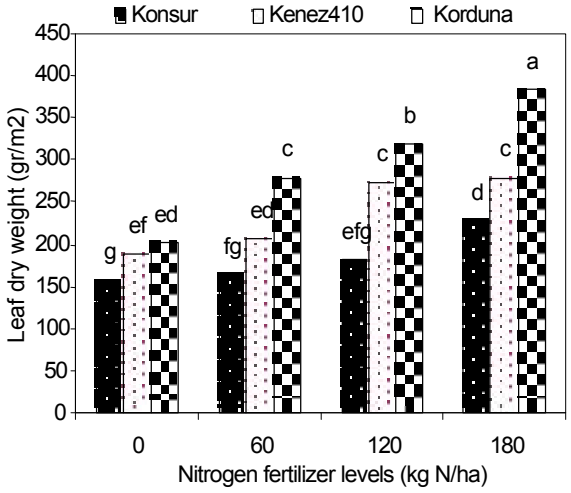

Fig. 6: Leaf dry weight as affected by cultivar and fertilizer levels nitrogen

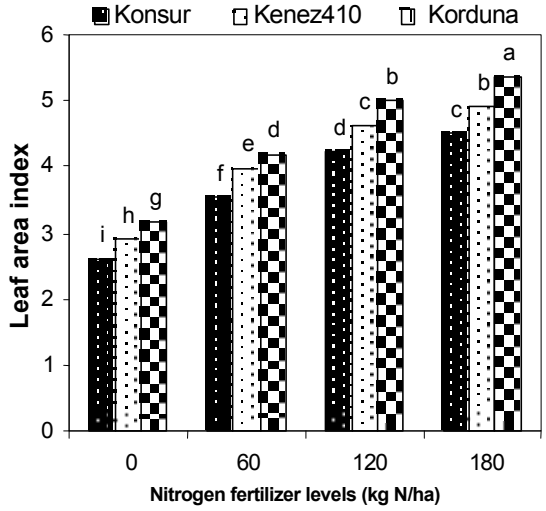

Fig. 5: Maximum Leaf area as affcted by cultivar and levels index changes

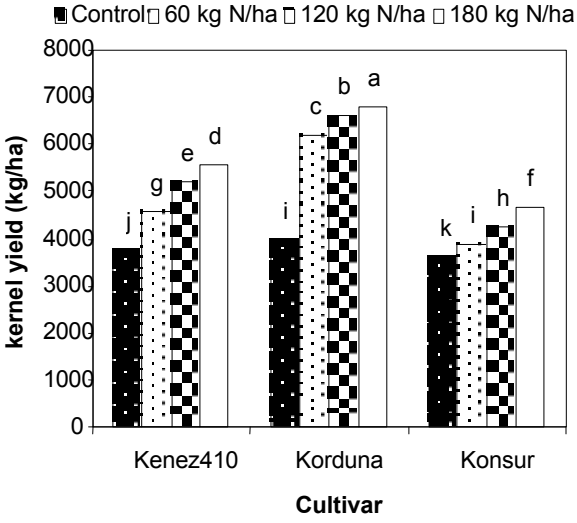

Fig. 7: Interaction effect of nitrogen levels and cultivars on kernel yield

from application of 180 kg N/ha. Also, these results indicate that maximum chlorophyll content in ear leaf (36.44 SPAD-units) and minimum of this trait (25.44 SPAD-units) were obtained in application of 180 kg N/ha and control level of nitrogen receptivity. Varvel *et al*. [12] demonstrated N fertilizer significantly increased SPAD reading. Increase in Leaf area index whit increasing nitrogen fertilizer was reported by Valadabadi A. and H, Aliabadi Farahani [13]. The present results indicated clearly the vital role of N in plant life and its contribution in increasing the grain yield. Such results clarified that N is essential for cell division and elongation as well as the root growth and dry matter content of maize plants [14].

The obtained results are in good agreement with those reported by Loecke *et al*. [15]. El-Gedwy [16] reported that application of 60kg N org. +120kg N min. fed gave the highest values of grain yield. Similar results were reported by Hokmalipour *et al*. [17].

Interaction Effects: Table 2 show that the effect of interaction between maize hybrids and nitrogen fertilizer was significant ($P<0.01$) for ear leaf chlorophyll content, leaf area index, leaf dry weight and kernel yield. Korduna with application of 180 kg N/ha gave the highest leaf area index (5.36), chlorophyll SPAD-units (40.66), leaf dry weight (382.67 gr/m^2) and kernel yield (kg/ha)

Table 2: Analysis of of kernel yield and some indicates of leaf.

Source of variation	df	Leaf area index	Chlorophyll content	Leaf dry weight	Kernel yield ha^{-1}
Replication	2	0.12**	21.36**	4186.7**	2523
nitrogen	3	7.31**	88.02**	22276.3**	6263286**
Experimental error	6	0.0014	0.402	23.59	11898
cultivar	2	1.505	212.6**	37653.7**	9679156**
Cultivar×Nitrogen	6	0.016**	5.25**	2272.14**	755790**
Experimental error	19	0.0027**	0.38	19.0	2247110
Cv.	-	1.29	2.11	1.83	39

*,** Significant in 5 and 1 percentage probability respectively.

Table 3: Main comparison of kernel yield and some indicates of leaf.

Traits Treatments	Levels	Leaf area index	Chlorophyll content	Leaf dry weight	Kernel yield(kg h^{-1})
Cultivars	Kenez410	4.09b	29.4b	236.25b	4763b
	Korduna	4.43a	32.16a	294.58a	5876.2a
	Konsur	3.72c	26.75c	182.6c	4098.7c
Nitrogen levels(kg h^{-1})	0	2.88a	25.44	182.0d	3758d
	60	3.91b	27.11c	215.4c	4882.6c
	120	4.6c	28.77b	257.4b	5343.6b
	180	4.92d	36.44a	296.3a	5666.2a

*Numbers with the same letter, have no significant difference.

(Figures 4, 5, 6 and 7). This might be due to the well utilization of N fertilizer in metabolism and meristimic activity which improved these traits. These results are in agreement with those obtained by El-Gizawy [16]. Kernels yield rose with increase in N rate in all three cultivars but slope of increase for Kenez410 was more than Konsur. Korduna cultivar significantly produced more yield at all three N levels than others. Maximum yield belonged to Korduna cultivar at 180 kg N ha^{-1} and differences between control and the other N levels were greater for it (Figure 7).

CONCLUSION

It could be concluded that under the conditions of the current experiment, application of nitrogen fertilizer has positive effects on chlorophyll content, leaf area index, leaf dry weight and kernels yield of maize cultivars. The investigation showed that maximum yield and highest level of leaf indicates obtained from korduna cultivar at highest level of nitrogen fertilizer (180 kg N/ha). Therefore results showed that cultivar of Korduna have more potential for many traits. Thus, in order to increasing of yield and other traits, it can be suggested that use korduna cultivar with 180 kg N/ha levels.

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