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Research Article

CROP YIELD AND WEED BIOMASS AS AFFECTED BY SEEDING RATE AND NITROGENOUS FERTILIZER CASE STUDY: SC640; A NEW RELEASED CULTIVAR

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ABSTRACT
In order to study the effect of seeding rate and nitrogenous fertilizer on weeds biomass and some of the agronomic traits in grain maize 640, an experiment was conducted in 2013 at the research field of Khosroshahr Jahad-e-Keshavarzi in Nojedeh village based on factorial in a randomized complete block design with three replications. First factors was included crop density at three levels (8, 10 and 12 plants per square meter) and second factor was involved nitrogen fertilizer at three levels (100, 200 and 300 kg per hectare). Results demonstrated that augmentation of density caused reduction in weeds biomass (27.2%) and enhanced grain weight per square meter (28.2%) and in cob diameter. Increase of nitrogen lead to augmentation in 300-grains weight, ear diameter and cob diameter. Enhancement of maize density until 10-12 plants per unit of area simultaneous with the use of nitrogen fertilizers recommend as a technique to prevent redaction of yield due to weeds competition. According to the results, it can be stated that the appropriate density for this genotype of maize is 12 plants per square meters that, proper yield can be achieved with 300 kg nitrogen. Also, more weeds can be grown with reduction in number of maize plants per area unit and eventually will be lead to reduction in maize grain yield.

Keywords: *Seeding Rate, Nitrogenous Fertilizer, Weed Biomass, Maize*

INTRODUCTION
Maize is considered as the third most important cereal, after wheat and rice. Thus, enhancement of maize production has a particular importance. Meanwhile, weeds competition are caused to reduce production and increase charge (Nurse and Ditommaso, 2005). In this regard, appropriate planting method and space between plants; play a crucial role in plant yield and reduction of interference with weeds. Adjustment of space between rows and within rows is one of the most important management attempts to increase vegetative growth and crop yield and reduce weeds competition (Evans *et al*., 2003; Abubakr, 2008).

Weidong and Tollenear (2009) after investigation of the density increase in maize; expressed that density increment until reaching to the optimal level caused to yield augmentation and this desirable density is different for varieties. Many researchers have reported that increase in crop density lead to limit the competitive effects of weeds (Gimplinger *et al*., 2008).

In the condition, where soil fertility increase by adding nitrogen at constant density, competition ability of weeds may be augment due to high absorption efficiency (Carlson and Hill, 1986; Cathcart and Swanton, 2004; Saberi *et al*., 2006). Carlson and Hill (1986) stated that increase nitrogen fertilizer to wheat crop contaminated with wild oat in constant planting density caused to augmentation of weeds density and reduction of crop yield.

In the experiment, Teyker *et al.*, (1991) observed that by increasing the amount of nitrogen, it's absorption in redroot pigweed was more than maize. Tollenaar *et al.*, (1994) reported, interference of some weeds that germinated shortly after maize, considerably decreased biomass, harvest index and crop final yield in low nitrogen condition compared with high nitrogen.

The purpose of this study was to evaluate the simultaneous effects of nitrogen fertilizer and planting density of grain maize in reduction of weed biomass and the damages caused by it in grain maize 640.

MATERIALS AND METHODS

This probe was performed in the cropping year of 2013 at the fields of Nojedeh village in Khosroshahr (longitude: 46°2' E, latitude: 38°3'N, height from sea level: 1370 meters). According to the results of soil test at zero to 30 cm depth, there were 30% clay, 32% silt and 38% sand. Based on soil texture triangle, the area soil is included as loamy sandy soil. Organic matter content was 0.8% and the pH was 7.8-8. The electrical conductivity (EC) of saturation soil extract is equivalent 1.79 ds/m^2 and there is no risk of soil salinity. There were 4.9 mg/kg of absorbable phosphorus, 255 mg/kg of absorbable potassium and 12.25% of neutral material.

The factorial experiment based on randomized complete block design was applied with three replications and two factors included planting density at three levels: 8, 10 and 12 plants per unit of area and nitrogen at three levels: 100, 200 and 300 kg/ha. Each plot consisted of six planting rows with 6 m length; spaces between rows and between blocks were considered 75 cm and 1 m, respectively. Storage stage was performed, which was included thinning, irrigation based on 70 mm evaporation from class A and fertilization of phosphorus and potassium with amount of 120 and 100 kg/ha, respectively and according to the soil analysis result in the form of triple super phosphate (in the autumn) and sulphate of potash (at planting). Hybrid 640NS of maize was used which was prepared from Agriculture Organization of Eastern Azerbaijan.

Planting was done on 2013.04.29 and after maturation of maize plants and take the last notes; the crop was harvested on 2013.09.05. For take samples, 10 plants per plot were selected randomly from three central rows, after removing two marginal rows and a half meters of the two sides in each rows as margins. Then taking necessary notes was applied. Traits such as weed biomass dry weight, grain weight per square meter, corncob diameter, corn ear diameter, thirty-grain weight, number of grain rows per ear and grain depth were measured. Data analysis were carried out by using MSTAT-C statistical software and mean comparisons were done on the basis of Duncan test at 5% probability level. Also, Excel was used for charting graphs.

RESULTS AND DISCUSSION

Weeds biomass: According to the analysis of variance (Table 1), interaction between planting density and nitrogen rate on weeds dry weight was significant ($P \leq 5\%$). The highest dry weight was in density of 8 plants with 300 kg/ha nitrogen (Figure 1). In the density with 8 plants per unit of area, competition between maize plants and weeds was lower than the other levels and with enhancement of nitrogen rate until 300 kg/ha, weeds growth increase due to amount augmentation of available nutrients. Teymuri *et al.*, (2011) in their investigation have reported decline of weeds dry weight due to increment of maize plants density. With augmentation of maize density, competitive pressure of crops on weeds increase that cause to reduction in weeds biomass (Makrian *et al.*, 2003). Tharp and Kells (2001) also emphasized decrease of *Chenopodium* biomass and its grain production with increase of crop plant density.

Number of Grain Rows per Ear: The analysis of variance (Table 1) showed that the interaction between plant density and nitrogen rate on number of grain rows per ear is significant ($P \leq 5\%$). Based on the means comparison (Figure 2) the highest number of grain rows with 14.7 rows, was related to density of 10 plants per unit of area and 300 kg/ha nitrogen. The least number of grain rows per ear with 13 rows was belonged to 8 plants per square meter with 100 kg/ha nitrogen. Saberi *et al.,* (2010) have reported reduction in number of grain and number of grain row per ear due to increase in maize density. It appears, decline number of grain and number of row per ear is because of enhancement in maize density and failure to control of weeds caused by competition increase between plants or competition augmentation between maize and weeds. The rate of photosynthesis and plant production reduces by limiting production factors for maize, eventually leading to smaller ears with less number of grains (Abubakr, 2008).

Corn ear Diameter: Corn ear diameter was influenced by different levels of plant density ($P \leq 5\%$) and nitrogen levels ($P \leq 5\%$) (Table 1). Means comparison (Figure 3) revealed that in the density of 10 plants per square meter, corn ear diameter had the highest level (4.5 cm) and corn ear diameter decreased with increment of the density from 10 to 12 plants but no significant difference was observed with a density of 8 plants per unit of area. The lowest ear diameter was equal 4.2 cm. Reduction in number of row per ear due to increase of plant density, caused decline in ear diameter. Observations from the means comparison in Figure (4) show that with increment of nitrogen application, ear diameter increases, so that the greatest values of it were equivalent 4.16 and 4.18 cm in 200 and 300 kg/ha nitrogen. Due to enhancement of consumable nitrogen, more nutrients are available for plants and ear grains become larger and 100-grains weight increases and followed by it, ear diameter become greater. Thus, ear diameter was influenced by the number of row per ear so that, with augmentation in number of row per ear, ear diameter has been increased.

Corn cob Diameter: Plant density per unit of area had no effect on cob diameter (Table 1). But different levels of nitrogen impacted on this trait (($P \leq 5\%$). Means comparison demonstrated that, with increment of nitrogen rate, cob diameter increased, which indicate amount augmentation of cumulative material in corncob. Because with enhancement of cob diameter, the number of row per ear increases and will has positive impact on grain weight. Therefore, the greatest cob diameter was belonged to level of 300 kg/h nitrogen with 2.6 cm. The least cob diameter was obtained in treatment of 100 kg/ha nitrogen with 2.2 cm which presented 9% decline in cob diameter (Figure 5).

Grain Yield per Square Meter: The analysis of variance (Table 1) revealed that grain weight was affected by plant density ($P \leq 1\%$) and different levels of nitrogen ($P \leq 5\%$). Means comparison (Figure 6) demonstrated that, density augmentation from 8 to 10 plants had no significant effect on grain weight per plant. With increment of plants number to 12 per square meter, grain weight reached to its maximum value per unit of area and was equal 619.5 g/m^2. With increase of plant density per unit of area, grain weight per plant decreased and this decline was compensated by increase in the number of plants per unit of area and thus, grain weight per unit of area was increased. Grain weight per unit of area was improved with augmentation of nitrogen rate and its value at level of 300 kg/ha nitrogen reached to 565.4 g/m^2. Saberi *et al.,* (2006) stated that increase of density and consequently shadow caused to reduction in pollination and eggs inoculated, therefore the number of grains per ear and plant yield reduced. With density enhancement and lack of weeds control, competition intensity between plants increased and therefore the share of each plant from production factors such as sunlight, water and nutrients and photosynthesis rate reduced and subsequent both grain yield and biological yield decreased (Amiri *et al*., 2011). Ydvy *et al.,* (2006) reported, augmentation of maize density until 1.5 times of recommended density increases grain yield significantly.

300-grain Weight: The analysis of variance (Table 1) demonstrated that different levels of nitrogen had significant effect on 300-grains weight ($P \leq 5\%$). Means comparison (Figure 10) shows, 300-grains weight increased with augmentation of nitrogen rate which, the amount of this increment from level of 100 to 200 kg/ha nitrogen with weight of 25g was not significant, but in level of 300 kg/ha nitrogen had the highest value (30g). Thus the reduction in 300-grains weight with decline of nitrogen was 16.6%. Makrian *et al.,* (2003) reported that significantly reduction in grain weight was observed in treatments of interference maize with pigweed compared with maize monoculture. It appears that this decrease is due to reduction in leaf area durability of maize and competition tension in grains filling stage.

Grain Depth: According to the analysis of variance (Table 1), grain depth was affected by different levels of nitrogen and also the interaction between plant density and different levels of nitrogen has been influenced grain depth. In the means comparison, interactions present that grain depth was equal in all applied terms except for simultaneous application of 10 plants density per area unit and 300 kg/ha nitrogen which, had the greatest grain depth.

According to the results, it can be stated that the appropriate density for this genotype of maize is 12 plants per square meters which, proper yield can be achieved with 300 kg nitrogen. Also, more weeds can be grown with reduction in number of maize plants per area unit and eventually will be lead to reduction in maize yield.

Table 1: Analysis of variance for effect of planting density and nitrogen rate on studied traits in maize

Treatment	Degree of freedom	Mean square							
		Dry weight of weed biomass	grain weight per square meter	Corn cob diameter	Number of grain rows per ear	100-grains Weight	Corn ear diameter	Grain depth	Grain yield
Replication	2	2398.79	28087.62**	0.002	0.265	7.308	0.110	0.027	25.548
Seeding rate	2	78996.34**	62693.27**	0.035	0.705	0.301	0.180*	0.016	652.200**
Nitrogenous fertilizer	2	7679.59	18568.38*	0.101*	0.485	3.309*	0.192*	0.037*	500.220*
Interaction	4	33207.56*	4944.99	0.035	2.375*	0.410	0.074	0.043**	253.264
Error	16	9285.45	3450.86	0.032	0.685	0.437	0.044	0.008	125.203
CV (%)		22.51	11.22	12.27	11.57	12.34	5.08	10.77	23.20

*** and * mean significant at the %1 and %5 probability levels, respectively.*

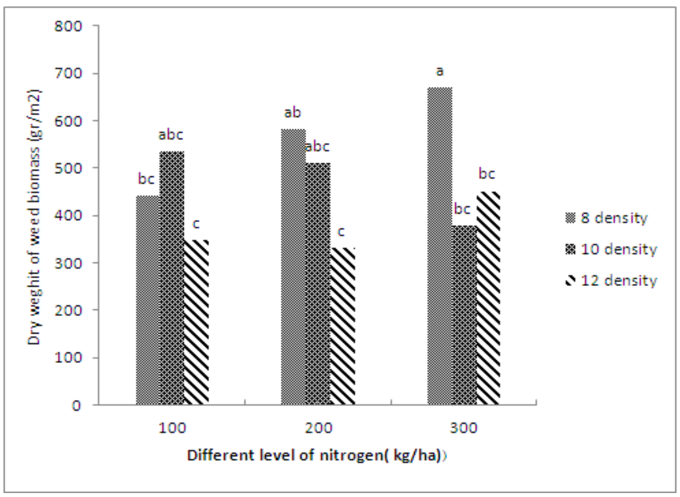

Figure 1: Dry weight of weed biomass at different levels of nitrogen and plant density per area unit

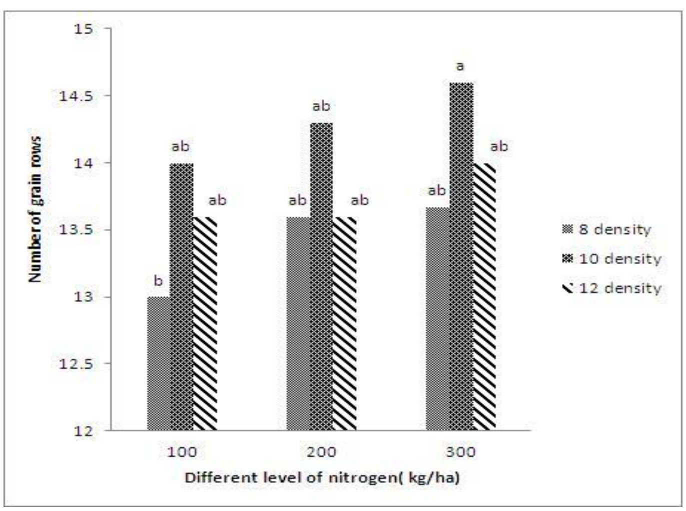

Figure 2: Number of grain rows per ear with different levels of nitrogen and plant density per area unit

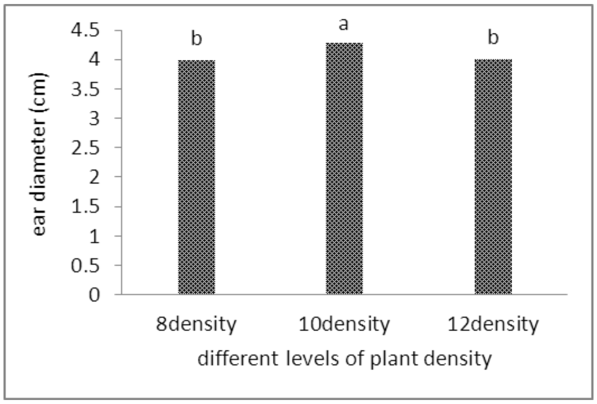

Figure 3: Ear diameter at different levels of plant density per area unit

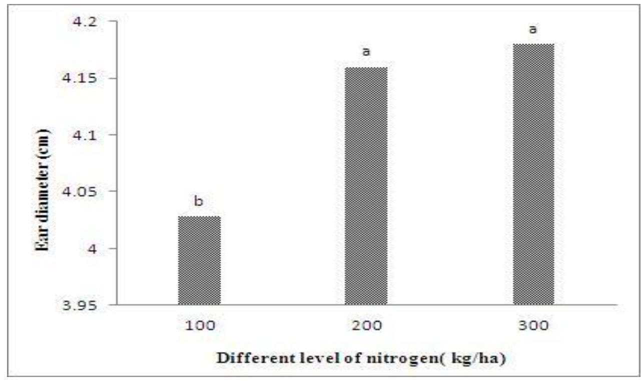

Figure 4: Ear diameter at different levels of nitrogen

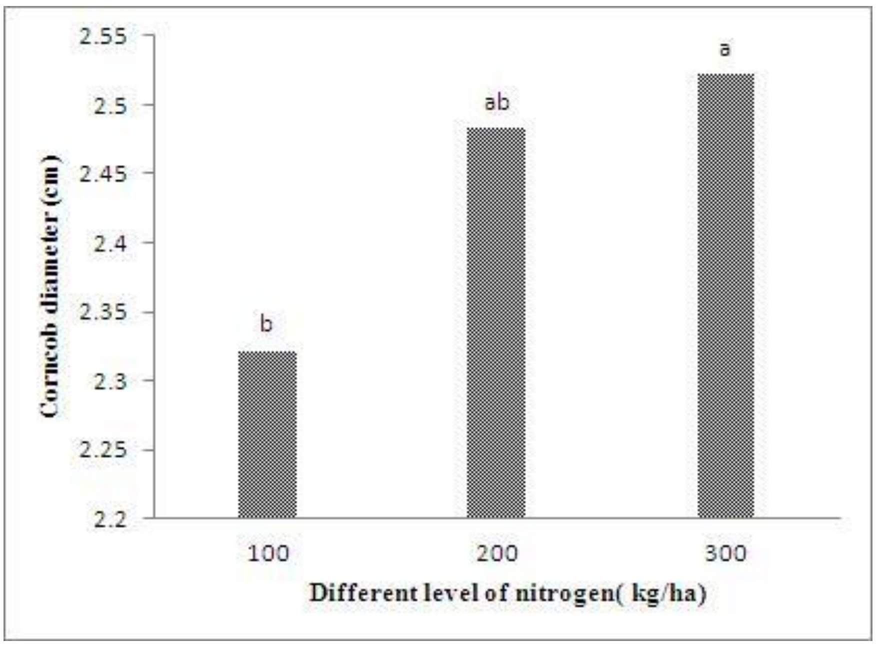

Figure 5: Corn cob diameter at different levels of nitrogen

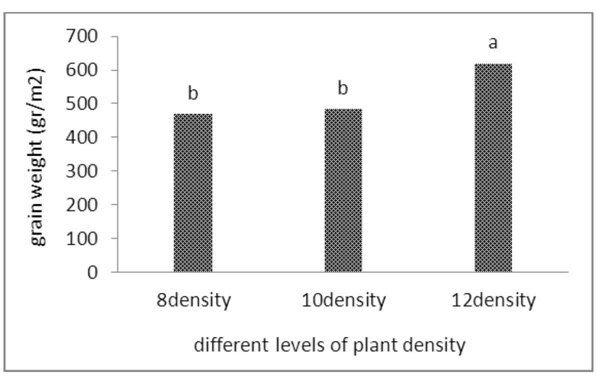

Figure 6: Grain weight at different levels of plant density per area unit

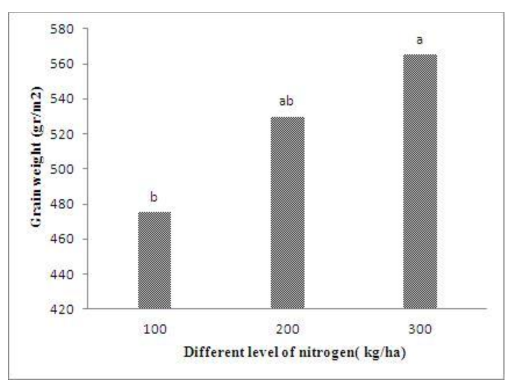

Figure 7: Grain weight at different levels of nitrogen

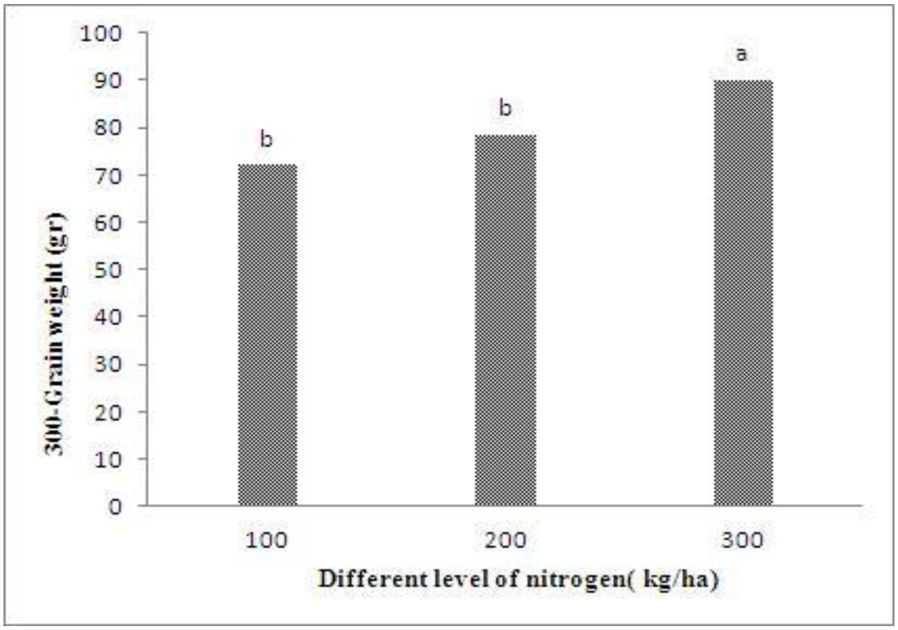

Figure 8: 300-grains Weight at different levels of nitrogen

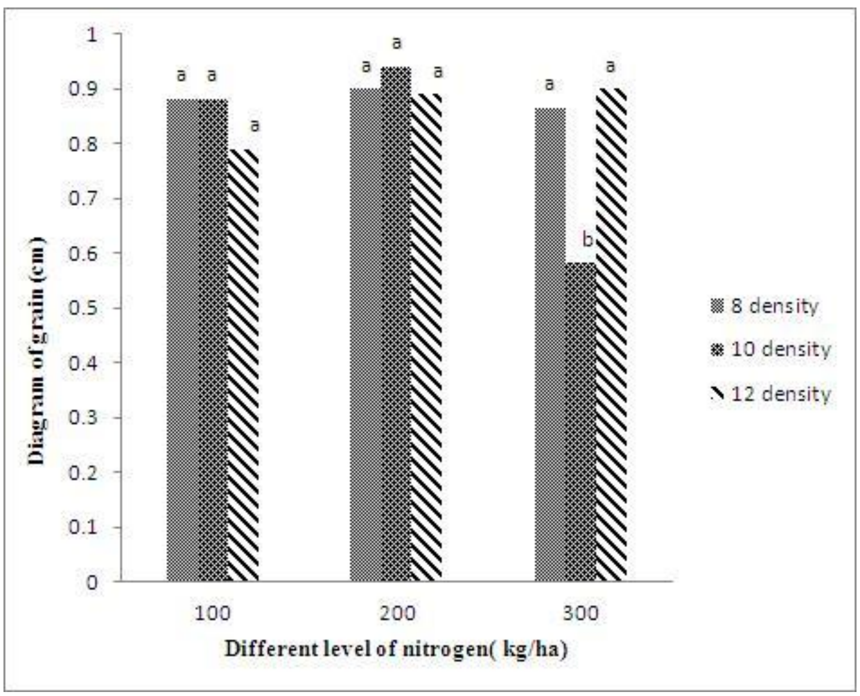

Figure 9: Grain depth at different levels of nitrogen and plant density per area unit.

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