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Effect of nitrogen rates and weed interferenceon yield and yield components of corn (*Zea mays* L.)

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Abstract

Time of weed control and fertilizer application usually decide the profitability of crop production. The effects of nitrogen and weed interference duration on yield and yield components of corn was studied in the Research Station of University of Tabriz, Iran, in 2009. The experiments were carried out as split-plot, based on randomized complete block design with three replications. Nitrogen application rates (0, 70 and 140 kg/ha) were included in the main plots and 10 weed interference periods(two sets: weedy control and weed-free control) in subplots. Results showed that with increasing weed interference period, number of grain per ear, number of grain rows per ear, 1000 seed weight and grain yield decreased. The most sensitive yield components to weed interference were the number of grain per ear. Also, nitrogen levels had not significant effect on yield and yield components. However,the maximum corn grain yield (970 g/m^2) was obtained with the control treatment full season weed-free.

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Introduction

Corn is an important crop in Iran and weed competition is a major limitation for corn production. Weeds infestation reduces the yield of various crops by 15 to 100 percent and also deteriorates quality of produce (Bakht*et al.,* 1989). Farmers are aware of losses caused by insects and diseases but they pay little or no attention to weed control. The longer the weeds remain in competition with crop, the greater is the damage caused to the crop (Anderson, 2000).Weeds compete for essential nutrients and decrease the crop yield even at high rate of fertilization (Vengris*et al.,* 1955). So, the time of weed removal is important as competitiveness of weeds depends upon duration of its interference with the crop (Akhtar *et al.,* 2000).

Also the most weeds use nutritive ingredients more than its need and so lux consumers may use fertilizer rather than agriculture plant. Instead nutritive ingredients make plants growth improvement, many studies indicate that adding more fertilizer has some benefit for weeds (Thomas *et al.,* 2002). Among macronutrients, nitrogen is the most important nutrient for increased crop yield but it is not always recognized that altered soil nitrogen levels can affect crop-weed competitive interactions (Camara*et al.,* 2003). Many weeds are high- nitrogen consumers (Hans and Johnson, 2002) thus limiting nitrogen for crop growth. Weeds not only reduce the amount of nitrogen available to crops, but also the growth of many weed species is enhanced by higher soil nitrogen levels (Blackshaw*et al.,* 2003).

Abouziena*et al.,* (2008) reported that increasing amount of nitrogen can cause the enhancement of plant performance, but weed may have a negative effect on performance.Toller *et al.,* (1994)observed that biomass reduces harvesting index and final corn performance is low nitrogen condition in contrast to high nitrogen and this is a short time after greening weed and its intervention with corn.

This study was conductedto determine the critical period of weed-crop competition in maize crop under different nitrogen levels and its effect on yield and yield components.

Materials and methods

Site description and experimental design

The field experiment was conducted in 2009 at the Research Farm of the Faculty of Agriculture, Tabriz University, Iran (latitude 38.05° N, longitude 46.17° E, Altitude 1360 m above sea level).The climate is characterized by mean annual precipitation of 245.75 mm per year and mean annual temperature of 10°C. The experiment was arranged as split plot on the basis of randomized complete block in three replicates, with nitrogen levels treatments(0, 70 and 140 kg/ha) in main plots andtwo sets of weed interference periods in the subplots.In the first set, the plots were kept weed-free (from beginning of the growing season) for an increasing duration of time 14, 28, 42 and 56 days after corn emergence and weed were allowed to infest the crop, later. In the second set, weed were allowed to infest the crop in the corresponding period and subsequently kept weed free.

Each plot consisted of 4 rows of 3 meters long with row spacing 50 cm which were away 50 cm from the adjacent plot.The row spacing for corn seed was considered 25 cm. As a result, the final density obtained 8 plants/m^2 for corn. All plots were irrigated immediately following planting and next irrigations were conducted once a week.For measuring the yield and yield components, in each plot 10 plants of corn accidently were selected after removing marginal effects and traits were measured.

Statistical analysis

All the data were analyzed on the basis of the experimental design, using SPSS software.The means of each trait were compared according to least significant difference (LSD) test at $P \leq 0.05$.

Results and discussion

Analyses of variance

Analysis of the data (Table 1) showed that durations of weed interference had significant effects on number of grain per ear, number of grain rows per ear,1000 Kernal weight,
ear weight andgrain yield of corn. Whereas, nitrogen levels and the interaction of N × P were not significant effect for these traits.

Number of grain per ear

Number of grain per ear decreased with increasing length of weed interference duration and increased with decreasing length of weed-free period.Although, no significant difference was observed between all periods. Number of grain per ear in weed-free period was increased 51% compared with the weed infested conditions. The maximum number of grain per ear (605.72) was obtained with the control treatment full season weed-free. Also, with increasing nitrogen levels the number of grain per earincreased, but no significant difference was observed between nitrogen levels (Table 2). Evans *et al.,* (2003) reported increasing the duration of weed interference reduced seed number per ear of corn.

Table 1. Analysis of variance for the effects of different nitrogen levels and period of weed interference on corn yield and yield components.

		Mean squares				
Source of Variation	**df**	**Num. of grain perear**	**Num. of grain rows per ear**	**1000grainweight**	**Grainyield**	**Ear weight**
Replication	2	107631.87*	2.64^{ns}	6037.54^{ns}	585572.64*	11680.49*
Nitrogen level (N)	2	41055.26^{ns}	2.19^{ns}	1260.36^{ns}	92013.75^{ns}	2022.39^{ns}
Ea	4	11521.28	0.75	1138.64	51080.15	930.46
Period of weed interference (P)	9	85568.90**	2.29**	3558.28**	420502.68**	7984.57**
N*P	18	1763.64^{ns}	0.42^{ns}	203.47^{ns}	3085.41^{ns}	74.82^{ns}
Eb	54	3770.51	0.63	295.76	9826.50	192.04
CV (%)		13.02	5.83	9.49	14.71	14.17

ns,* and * *: No significant and significant at p≤0.05 and p≤0.01, respectively.

Number of grain rows per ear

Perusal of the data presented in table 2 indicated that the number of grain rows per ear was significantly decreased with increasing of weed-infested duration and decreasing of weed-free period.Also, the number of grain rows per ear of corn were not affected by nitrogen fertilizer levels and the number of grain rows per ear levels ranged between 13.44 – 13.98. The maximum and minimum number of grain rows per ear was related toweed-infested for 14 DAE and weedy control, respectively. The rate of photosynthesis and plant production reduces by limiting production factors for maize, eventually leading to smaller ears with less number of grain rows per ear (Abubakr, 2008). These results are in line with those of reported by Ansar*et al.,* (1996) and Evans *et al.,* (2013).

1000 Grain weight

The 1000 grain weight increased by increasing applied N rate and length of weed-free period and decreased by increasing length of weed interference duration.Based on the means comparison the maximum 1000 grain weight (203.02 g) was achieved in weed- infested for 14 DAE treatment, but there was no significant difference with weed- free for 56 DAE, weed-free control, weed- infested for 28 DAE and weed- infested for 42 DAE treatments. Also, the minimum 1000 grain weight was related to weedy control,whereas was no significant difference with weed- free for 14 DAE (Table 2). Makrian*et al.,* (2003) reported that significantly reduction in grain weight was observed in treatments ofinterference maize with pigweed compared with maize monoculture.

It appears that this decrease is dueto reduction in leaf area durability of maize and competition tension in grains filling stage. Evans *et al.,* (2003) reported that 1000 grain weight was negative correlation with weed interference duration and positive with weed free duration.

Ear weight

The results indicated that, with increase of weed-infested and reduction of weed-free duration, the ear weight of corn significantly reduced as compared to control (weed free).

Weed- infested for 14 DAE produced maximum ear weight (131.97 g) and was statistically at par with weed-free control. Also, minimum ear weight (47.96 g) was obtained fromweedy control.Means comparison demonstrated that, nitrogen levels from zero to 70 and 140 (kg/ha) had no significant effect on ear weight (Table 2). Increasing ear weight in corn by application of nitrogen fertilizer has been reported (Delibaltova, 2014). Sadeghi and Parsley (2001) were observed with increasing nitrogen fertilizer, increased ear weight of corn.

Table 2. Mean comparison of the traits under different nitrogen levels and periods of weed interference for corn.

Treatments	Number of grain perear	Number of grain rowsper ear	1000grainweight (g)	Grainyield(g/m2)	Earweight(g)
Nitrogen level (N kg/ha)					
0	435.25a	13.44a	174.23a	617.46a	89.34a
70	470.75a	13.69a	187.03a	675.97a	98.35a
140	509.21a	13.98a	182.38a	728.16a	105.73a
Mean	471.74	13.7	181.21	673.86	97.81
Period of weed interference (P)					
Weedy control	296.04e	12.72e	145.34e	323.06f	47.96h
Weed- free for 14 DAE	341.44e	13.17de	157.65de	396.96f	61.73g
Weed- free for 28 DAE	431.28d	13.78abcd	167.60cd	528.60e	77.75f
Weed- free for 42 DAE	466.96cd	13.38cde	176.20bc	652.85cd	91.89de
Weed- free for 56 DAE	515.01bc	13.81abcd	199.48a	807.48b	115.83bc
Weed-free control	605.72a	14.21ab	200.63a	970.42a	139.08a
Weed- infested for 14 DAE	569.78ab	14.46a	203.02a	926.36a	131.97a
Weed- infested for 28 DAE	536.18b	13.94abc	194.69a	823.49b	118.61b
Weed- infested for 42 DAE	512.17bc	13.90abcd	191.68ab	711.90c	104.62cd
Weed- infested for 56 DAE	442.78d	13.64bcd	175.87bc	597.50de	88.81ef
Mean	471.74	13.7	181.21	673.86	97.81

Different letters in each column indicate significant difference at P≤0.05.

Grain yield

The resultsrevealed that nitrogen levels had not significant effect on corn grain yield. However with increasing in nitrogen levels, grain yield increased. Also, grain yield decreased significantly with increasing length of weedinterference duration and decreasing length of weed-free period. The highest grain yield (970.42 g/m^2) and the lowest (323.06 g/m^2) was achieved in full season weed-freetreatment and full-season weed interference treatment, respectively (Table 2). Weed infested conditions for the entire growing season led to 67% reduction in grain yield, as compared with full season weed-free control treatments.Proper rate of N fertilizer application enables the crop to produce greater leaf area, light absorption and crop assimilation, thus contributing to increased grain yield.Increased grain yield in corn has been reported with the use of nitrogen fertilizer (Barlow and Young, 1977).

On the other hand, the reduction in grain yield in weed interference duration may be attributed to competition between corn and weeds for light, water and nutrient elements such as nitrogen. Lutz (2007) reported 40-60% grain yield reduction due to weedinterference.

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