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The Effect of Various Plant Densities on Competitiveness of Corn with Natural Population of Weeds

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ABSTRACT

In order to study the effects of increasing corn plant densities on competitive ability of corn with natural weed populations in Khouzestan climate, a split plot based on randomized Complete Block design with four replications were conducted in 2011 in a field experiment station at Ramin Agricultural and Natural Resources, University of Mollasani, Ahvaz. Treatments included pure stands of corn at three densities (40000, 70000 and 100000 plants ha^{-1}) and weed-interference period to v9 and v13 in any of plant densities (40000, 70000 and 100000 plants ha^{-1}). The following results were observed that there was significantly difference between studied characters, grain yield, biological yield, harvest index, grain number per and row number per ear, grain number per row and 1000-grains weight among treatments. The studied characters were severely reduced by increasing the duration of weed interference after corn emergence. In addition, results showed that with corn plant increasing densities, corn plants tolerated the presence of weeds until v_9 stage with approximately 6-15% in yield loss.

Introduction

Weeds are environmental limiting factors in many crops, and in the absence of appropriate and timely control reduced grain yield. The ability of damage weeds in corn fields is extremely high. Thus, despite the strict control weeds in agricultural ecosystems, 10 percent of agricultural production can be reduced due to weed competition with crop considered (Rahimian and Shariati, 1999). According to the Rajcan and Swanton reported (2001), but environmental changes in North America, the main cause of yield loss of maize plants is competing with the weeds. Sangakkara and Stamp (2006) with various species of weeds on corn growth and yield of narrow-leaf weeds reported that the most harmful damage on growth and yield of maize have a way that weeds alone decreased from 32 to 59 percent in corn grain yield. Also, other researchers in two different locations showed that weed competition with corn during the growing season, corn yield was reduced more than 90 percent (Dalley *et al.*, 2006).

Tamado et al (2002) with a two-year pilot in Ethiopia found that the different weed densities (0, 3, 7, 13, 27, 53 and 100 plants m^2) in sorghum grain yield 40 to 90 percent reduction finds. Studies showed that increased crop density reduces weed growth and reducing yield losses caused by the competition (Makarian *et al.*, 2003).Corn plant density increased effective factor in increasing the competitive ability against weeds, this plant was pigweed (Sheibani *et al.*, 2006).Recent findings in the initial size of seedlings advantage at plant competition, confirming the importance of plant density on reducing of weed growth (Schwinning and Weiner, 1998).

Begna et al (2001) stated weed dry matter production (two levels: low and high weed density) and narrow rows of corn plants grown at high density was reduced further. Due to growing corn in the Khuzestan region and the competitive ability of plants to weeds, determine the competitive ability of weeds in corn with different plant densities and critical times of natural population control weeds in corn fields in the Khuzestan region of SC 704 as a main objective of this study was considered. To investigate the diversity of weeds in corn fields, they can be competitive with the crop were evaluated and the effect of weeds on yield and yield components can be calculated.

Materials and Methods

The experiment was conducted in 2011 at the field experiment station at Ramin Agriculture and Natural Resources University, Mollasani, Ahwaz, Iran (31°,36′N 48°,53′ W, 50m) Experiment was established as a split plot based on randomized complete block design with four replications. Climatic classification of the area coupons is a dry area. During the experimental period rainfall 110.90 mm. Soil type was a clay-silt-sand with a pH of 7.5, and years ago were fallow. Organic matter content in field was 0.7%. The treatments included pure stands of corn (weed-free treatment) at three plant densities (40000, 70000, 100000 plants per ha^{-1}) and weeds interference period to V9 and V13 in each of plant densities (40000, 70000, 100000 plants per ha^{-1}). Corn hybrid used was single cross 704. Each plot was 7 meters in length and width of 25.5 m with 75 cm between rows. 7 lines were planted in each plot. To identify the phonological stages 9 and 13 leaves (V9 and V13) of corn and weed control in the beginning stages of plants selected randomly three plants of the final harvest lines and marked by a colored ribbon. Then count the number of leaves per plant and average of three plants in four replications and weeds controlled by hand. Thus detecting the phonological stages of the treatment was to hand weeding. It is necessary to count the leaves on the lower leaves nearly half of them were open; they came to count the leaves. Seedbed preparation and sowing operations performed in amounts of nitrogen, phosphorus and potassium soil test report in accordance with the net intake, 173, 35.75 and 100 kg respectively.

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That were provided of urea, (46% N), diamoniom phosphate (18% N, 46% P_2O_5) and potassium sulfate (50% K_2O) respectively. Plantation which coincided with the first irrigation in this experiment was conducted in July and the rest of the irrigation interval was 5 to 6 days. At the end of the growing season to determine the yield components of maize taking the total marginal ears 10 randomly isolated levels sampling and then proceeded to count the number of rows per ear and grain number in the row. The final harvest for maize grain yield after removal of border lines, at 2.5 m^2 from the line took fourth with 14 percent humidity. The SAS software was used for data analysis and comparison of means by least significant difference test (LSD, α=5%).

Results and Discussion

1. **Grain Yield**: Statistical analysis of the results of this experiment showed that among pure cultures treatments, stage 9 and 13 leaves in the densities of weeds until the plants are very significant differences in the level 0.1% was observed (Table 1). So that corn grain yield in these treatments the groups were statistically separate, with increasing plant density and weed presence of different treatments have different results were obtained. Siadat and Hashemi-Dezfuli (2000) also reported that Plant density increased grain yield per plant is reduced linearly, but the yield per unit area increases. Also, the presence of weed treatments, up to 13 leaf stage of plant densities 100000, 70 000 and 40 000 plants ha^{-1} the lowest grain yield per unit area were proportion with the 5.34, 5.5 and 5.5 tons ha^{-1} respectively (figure 1).

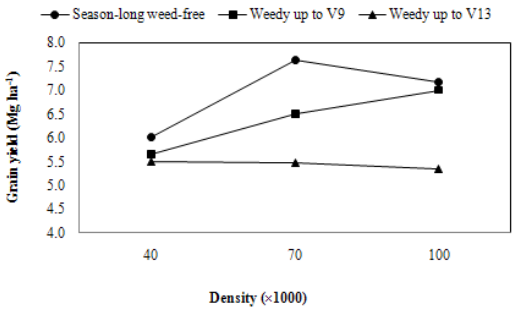

Figure 1. Mean corn (*Zea mays* L.) grain yield response to three densities in season-long weed free (●), weedy up to V9 (■) and weedy up to V13 (▲) experimental unit

Thus, field corn weed infestation, to Stages 9 and 13 leaves (40 and 60 days after planting) in a plant density of 40000 plants, reduced 6.1% and 8.8 percent, density of 70000 plant species, reduction of 14.9 percent and 28.5% and plant density 100000 plants cut 2.1 percent and 25.4 percent corn grain yield was lower than in pure culture treatments respectively. Several researchers have reported acceptable levels of yield loss in the period between 5-10 percent (Evans *et al.*, 2003; Knezevic *et al.*, 2003). However, the significant drop in, lower plant density of 40000 plants ha^{-1}, there are fewer plants per unit area. Appears in the density of competition within a species is negligible and in these conditions, only the dominant race, the competition was a way out. The same issue, thereby reducing the performance degradation due to interference by weeds. But, in general, a lack of plants per unit area, failed to compensate for reduced function and the density of the comment at the lowest level compared to other densities were available (figure 1). Chaab et al (2009) obtained the same results. In this connection, Hadizadeh and Alimorad (2006) reported that the presence of weeds up to 35 days after emergence (stage 9 leaf) for corn is tolerable, but then more than 5 percent yield loss was calculated. Agha Alikhani *et al* (2003) reported that pigweed removal in 40 days after the corn yield did not compensate.

On the other hand, the results of this study were not consistent by the study Eghtedary Nayyny and Ghadir (2000) based on the critical period of weed control in corn in the Fars province, that 40 and 50 days after corn emergence apply and remove weeds. What is certain the results of these studies, the effect of different species of weeds on corn, and various environmental factors that influence their outcome change the results that depending on environmental conditions and biological research. As seen in figure 1, the 13-leaf weed control treatments than, weed removal treatments in the nine-leaf stage in three plant densities used a reduction in yield are higher.

The corn yield in the treatments is attributed to such as weeds ghosting, premature aging and loss of lower leaves canopy, competition, and the shadow in the lower parts canopy, greater allocation photosynthesis to vegetative growth (due to increased weed ghosting and plant height), and especially weed interference in corn going into the reproductive stage. Corn plant density increased from 40000 to 70000 and 100000 plants ha^{-1} could be through increased competitive ability of a product a considerable amount of weed interference reduces and may even tolerate or disposal. Overall, the researchers emphasized that with increasing plant density of maize, its competitive ability against weeds increases (Begna *et al.*, 2001).

Biological yield: the effect of different plant density and weed interference treatments and on biological yield was significant at the 5% level (Table 1). As on the treatment interfering with increased duration of competition, decreased biological yield and to its lowest level in weed removal in stage 13 (V13) in a plant density of 40000 plants ha^{-1} (9.41 tons ha^{-1}). Furthermore, weed removal treatments in stages 9 and 13 leaves in all pant densities used in this experiment showed, reducing the interval between removal of weed control (pure culture) and the V9 (40 days after planting) a reduction in biological yield was obtained, but when the time interval to remove weeds from the V13 (60 days after planting) increased, total plant dry matter loss reduced with more severely (figure 2).

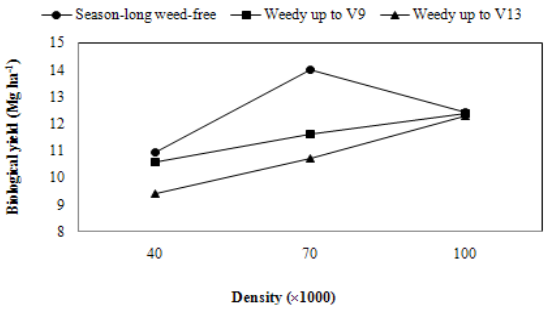

Figure 2. Mean corn (*Zea mays* L.) biological yield response to three densities in season-long weed free (●), weedy up to V9 (■) and weedy up to V13 (▲) experimental unit

Probably the reason, this is at this stage in the beginning stages of plant tassel (reproductive stage) has been weeds and plant more sensitive to the stress of weed presence and showed this required the removal of weeds before the stage 9 leaves. However, the presence of weeds to plant density of 100000 in stage 9 and 13 leaves per plant than the control (pure culture) showed a slight decrease; therefore, in all three treatment groups were statistically significant. This suggests that it is with increasing plant density per unit area due to ghosting and loss of light entering into canopy, weed growth has been limited and may ultimately lead to weed control. In this connection, some researchers showed that corn plant density increased (from 7.1 to 9.5 plants m^2) is the production of dense shading and the radiation reaching the weed crop was canopy pigweed below and pigweed further reduced weed dry matter (Makarian *et al.*, 2003).

Table 1. Analysis of variance for grain yield, biological yield, harvest index and component yield of corn

S.O.V.	d.f	Grain Yield	Biological Yield	Harvest index	Grain per ear	Row per ear	Grain per row	1000- grain weight
Block	3	0.036^{ns}	2.87^{ns}	80.09^{*}	715.04^{ns}	0.12^{*}	16.05^{ns}	69.14^{ns}
Density (A)	2	2.53^{***}	15.22^{***}	25.27^{ns}	46553.39^{***}	1.30^{***}	208.51^{***}	8804.58^{***}
Block×A	6	0.07^{ns}	0.79^{ns}	15.78^{ns}	773.64^{ns}	0.02^{ns}	9.28^{ns}	109.76^{ns}
Interference (B)	2	7.00^{***}	8.28^{***}	84.89^{*}	16028.33^{***}	1.05^{***}	77.40^{*}	1727.12^{*}
Block×B	6	0.096^{ns}	0.51^{ns}	10.26^{ns}	203.82^{ns}	0.06^{ns}	4.29^{ns}	110.61^{ns}
A×B	4	1.06^{***}	2.99^{*}	105.24^{***}	3120.14^{ns}	0.31^{ns}	23.04^{ns}	425.06^{ns}
Residual Error	12	0.07	0.88	12.48	1140.50	0.11	14.15	358.24
CV (%)	-	4.27	8.07	6.51	5.57	2.39	8.79	5.14

ns: non-significant, *, ***: significant at 5% and 0.1% probability levels, respectively.

Intimate partner can be said in intercropping maize with weeds, intensified intra species competition, water availability and the food is low for corn and thus its biological function has been reduced. Thus, at treatments that weed interference in maize, the final biological yield of maize showed significant decrease compared to the pure culture. There are many researchers have been shown biological yield of corn in weed interference effects (Rajcan and Swanton, 2001; Cathcart and Swanton, 2004; Cox *et al.*, 2006).

Harvest index: Harvest index in fact is the distribution coefficient of photosynthetic material and shows how much of the material produced by photosynthetic plants has moved the seeds (sink). Analysis of variance table (Table 1) effect of plant density and weed interference treatments on harvest index was significant at 0.1 percent. As in weed interference treatments with corn up to 13 leaf stage, the corn plant density increased due to reduced out specious competition and dominance corn plants on weeds, vegetative growth of corn increased and declines harvest index and product performance (figure 3).

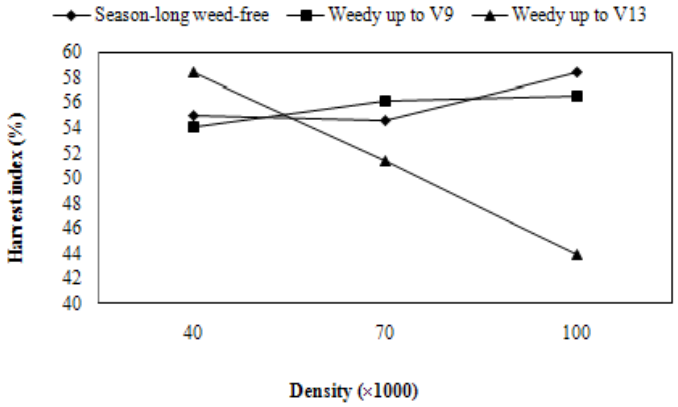

Figure 3. Mean corn (*Zea mays* L.) harvest index response to three densities in season-long weed free (●), weedy up to V9 (■) and weedy up to V13 (▲) experimental unit

In this relationship are expressed different reports in winter crops Samaei et al (2004) and Anafjeh (2008) respectively of soybean and pigweed competition, and canola with different densities of wild mustard reported that harvest index was affected by the weed plant density and significantly decreased.

Components

Yield components were not influenced by the interaction of different plant density and weed interference treatments. With increasing duration of weed interference with crop was reduced the amount of all yield components. So, the least amount of weed control treatments was observed in the 13 leaves. Yield component most sensitive to weed interference was the number of grains per ear and the reduction was greater. Similarly, increasing plant density of corn were also reduced yield components. However, excluding the number of rows per ear was observed at the highest densities of 40000, 70000 and 100000 plants ha^{-1}, respectively. But generally the highest performance of all components was in 40000 plants ha^{-1}.

Conclusion

This study confirms that supply of weed interference to a crop and weeds can significantly influence crop-weed interference relationships. Differences in the grain yield due to weed interference documented in this study highlight the importance of integrating decisions regarding competition management and the time of weed control. Practical implications of this study are that reductions in interference period may warrant more intensive competition management. Such a shift in cropping practices highlights the importance appropriately timed weed control. More generally, the existence of intra species competition between weeds and crop on environmental resources, were reduced maize yield per unit area. Furthermore, increasing plant density of maize also increased its share in the use of available resources has been largely due to reduced yield losses due to competition with weeds. Overall, the results of this experiment, which is endorsed on the corn plant is capable of reducing the yield of 2-15 percent compared to the treatment of pure culture, and depending corn plant density, presence of weeds can tolerate leaf to Stage 9.

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