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Integrating the Cultural, Mechanical and Chemical Methods to Optimize Weed Control and Corn (*Zea mays* L.) Yield

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ABSTRACT

To evaluate the effects of different corn planting densities and weed control methods on weeds and corn yield, this experiment was conducted at the research farm of Islamic Azad University, Takestan branch, Iran. The experiment was conducted in factorial in the form of a randomized complete block design with four replications and two factors: corn planting density (the recommended density, +25% and +50% of the recommended one), and weeds control methods (no control, two times hand weeding, nicosulfuron SC 4% at 2-4 leaves stage, one time cultivator at corn 20 cm height and two times cultivator at corn 35 cm height). Results showed that corn planting density significantly affected ear weight and corn biological yield. The highest ear weight and biological yield were achieved in recommended density and +50%, respectively. Weeds control methods had also a significant effect on weeds; the lowest total weed density and biomass were achieved in two weedings and two cultivators.

Keywords: competition, cultivator, nicosulfuron, planting density.

INTRODUCTION

During the years, farmers have used different methods to manage weeds in their field. However, most of those methods were ignored when the chemical herbicides were introduced to agriculture [8, 10]. Today, different herbicides are developed for different crops; nicosulfuron is the one used in corn fields. Baghestani et al. (2007) evaluated the effect of different herbicides on weeds in corn field and concluded that nicosulfuron efficiently controlled weeds [6]. Hernandez et al. (2000) also studied the effect of nicosulfuron (30 g/ha) on weeds and reported that nicosulfuron had high effect on *Sorghum halepense*; however, it did not provide sufficient control on broad leave weeds [3].

Although herbicides are effective, cost effective and necessary component of weed management programs, but in last years, they have caused problems such as health problems and herbicide resistant weeds. So it is required to use herbicides along with other non chemical methods [4,

10]. One of the non chemical weed control methods is the selection of proper planting density of the crop plant. This is more important in wide row crops such as corn, that there are lots of free spaces for weeds to grow. Harbur and Owen (2004) reported that *Abutilon theophrasti* produced lower seeds when corn planting density was increased [7]. Tharp and Kells (2001) found that an increased corn planting density resulted in the reduction of *Chenopodium album* biomass production [2]. Finally, the objective of this study was to evaluate an integrated weed management system consists of cultural, mechanical and chemical methods in a corn field.

MATERIALS AND METHODS

This experiment was conducted in 2009, at the research filed of Islamic Azad University, Takestan branch, Iran. The experiment was carried out in factorial in the form of randomized complete block design with four replications and two factors: corn planting density (recommended, +25% and +50% of the recommended), and weed control methods (no control, two times hand weeding, nicosulfuron SC 4% at 2-4 leaves stage, one time cultivator at corn 20 cm height and two times cultivator at corn 35 cm height).

Corn (*Zea mays* L. SC 600) was planted on June 30th, 2009, and the field was irrigated. Sampling was conducted for weeds during the growing season and for corn at the end of the growing season. Samples were dried in a 75^{o}C oven for 48-72 h, and were then weighted. Finally, data were analyzed using SAS software and means were compared according to the Duncan's multiple range test.

RESULTS AND DISCUSSION

Corn yield and biological yield. Results indicated that corn planting density significantly affected single ear weight ($P\leq0.05$) and biological yield ($P\leq0.01$). However, weed control method and the interaction of planting density × weed control method had no effect on the measured traits. The highest single ear weight (167 g) was achieved in the recommended planting density and the highest biological yield (39155 kg/ha) was achieved in +50% planting density. However, +25% planting density gave significantly the same results compared with the recommended and +50% densities (Table1).

Mehrabi et al. (2006) reported that corn planting density had effect on plant yield [1]. Mean comparison of the effect of different weed control methods indicated that they had no effect on corn yield (Table 2).

Table 1. The effects of different planting densities on corn

Treatment	Single ear weight (g)	Biological yield (kg/ha)
The recommended	167.00a	29412.00b
+25% of the recommended	155.82ab	33808.00ab
+50% of the recommended	133.95b	39155.00a

Means in a column followed by the same letter are not significantly different at P≤0.05.

Table 2. The effects of different control methods on corn

Treatment	Single ear weight (g)	Biological yield (kg/ha)
Two weedings	161.40a	35857.00a
No weeding	163.49a	33096.00a
Nicosulfuron	153.23a	36695.00a
One cultivator	140.33a	30636.00a
Two cultivators	142.83a	34341.00a

Means in a column followed by the same letter are not significantly different at P≤0.05.

Total weed density. Both corn planting density and weed control method significantly affected the total weed density in one and two months after the treatments (P≤0.01); however, the interaction of the two factors had no effect. Among the three corn planting densities, the lowest weed density, which means the best control, was achieved in +50% and no significant difference was observed between the recommended density and +25% (Table 3). These results are in agreement with the findings of other studies [9].

The best control method for the reduction of weeds density was one time and two times cultivator, however, in two months after the treatment, two times hand weeding gave significantly the same result compared to the results of cultivators (Table 4).

Table 3. The effects of different planting densities on the total weed density

Treatment	Total weed density after 1 month	Total weed density after 2 months
The recommended	2.80a	2.37a
+25% of the recommended	2.80a	2.20a
+50% of the recommended	2.33b	1.91b

Means in a column followed by the same letter are not significantly different at P≤0.05.

Table 4. The effects of different control methods on the total weed density

Treatment	Total weed density after 1 month	Total weed density after 2 months
Two weedings	2.53c	1.14c
No weeding	4.23a	3.66a
Nicosulfuron	3.19b	3.12b
One cultivator	1.74d	1.48c
Two cultivators	1.52d	1.39c

Means in a column followed by the same letter are not significantly different at P≤0.05.

Total weed biomass. Analysis of the variances indicated the significant effect of corn planting density on weeds biomass in one month after treatment (P≤0.01) and two months after treatments (P≤0.05). Moreover, weed control methods had a significant effect on the total weed biomass in one and two months after treatments (P≤0.01). On the contrary, the interaction of the two factors had no effect on the measured traits.

Table 5. The effects of different planting densities on the total weed biomass

Treatment	Total weed biomass after 1 month	Total weed biomass after 2 months
The recommended	2.28a	7.03a
+25% of the recommended	2.41a	6.12a
+50% of the recommended	1.84b	4.80b

Means in a column followed by the same letter are not significantly different at P≤0.05.

Table 6. The effects of different control methods on the total weed biomass

Treatment	Total weed biomass after 1 month	Total weed biomass after 2 months
Two weedings	1.71c	2.67c
No weeding	3.40a	11.90a
Nicosulfuron	2.46b	8.62b
One cultivator	1.79c	3.62c
Two cultivators	1.65c	3.70c

Means in a column followed by the same letter are not significantly different at P≤0.05.

The best planting density was +50% of the recommended and the best control methods were two times hand weeding, one cultivator and two cultivators, with no significant differences (Tables 5 and 6). Planting corn at higher density leaves lower free space for weeds growth and results in

the reduction of weeds density and biomass. Mehrabi et al. (2006) reported that corn planting pattern and planting density had effect on the reduction of weeds growth [1]. Tollenaar et al. (1994) also reported that doubling corn planting density reduced weeds biomass by 50% [5].

CONCLUSION

Planting corn +50% of the recommended density increased biological yield but reduced the ears weight. This treatment was the best for the reduction of weeds density and biomass. On the other hand, different weed control methods had no effect on corn yield; however, they had significant effect on weeds density and biomass reduction.

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