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Determination of the best weeds control period in a soybean (*Glycine max*) new released hybrid: *Williams*

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Abstract

In order to determine the critical period of weeds control in soybean in semi-arid regions two experiments were conducted at Tabriz, Iran, on soybean hybrid *Williams,* based on randomized complete block design. For weed-infested plots, weeds were hand removed after 20, 40 and 60 days after emergence (DAE) and were kept weed free thereafter. For weed-free plots, weeds were allowed to compete with crop plants from 20, 40 and 60 DAE thereafter. Weeds interference duration of 40 DAE or more and weed-free period of less than 40 DAE greatly reduced the number of pod bearing branches per plant. Significant reduction in soybean yield up to 50% with increasing of weeds interference duration indicates that weeds is highly competitive with crop, and their competition beyond 40 WAE, results in greater crop yield loss than 24%, compared to control. A Gompertz model provided the best fit for the maximum weed-infested experiment. The relationship of crop yield with weed-free period was best described by the Logistic equation. The best weeds control period in soybean field using 5% permissible yield loss was between 40-60 DAE.

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Introduction

Weeds are considered to be responsible for about 10% reduction of crop yield (Froud-Williams, 2002). Critical period of weed control (CPWC) program depends on many factors such as dominant weeds in the region (Martin *et al.*, 2001; Seem *et al.*, 2003) and weed interference duration (Massinga *et al.*, 2001). Information on the time of weed emergence is necessary to develop effective models to predict the consequences of weed management in soybean. Weeds usually are very competitive, when they emerge before or along with the crop. When only two redroot pigweeds plants per meter of row emerged with soybean [*Glycine max* (L.) Merr.], crop yield reduced by 12%, but weeds emergence at the second nodal stage of soybean did not cause significant effect on its yield (Dielman et a., 1995). Redroot pigweed that emerges in June grew faster by 0.03 cm for each growing degree day than the plants emerged one month later (Horak and Loughin, 2000). Full season competition of 120 ragweed plants per square meter with snap bean reduced crop yield 75% (Evanylo and Zehnder, 1989). Earlier emergence of times of common lambsquarters can be highly competitive with sugar beet. Emergemce time of common lambsquarters n 45 days after sugar beet did not cause a substantial reduction in white sugar yield of sugar beet (Heidari *et al.*, 2011). Soybean is a poor competitive plant and it's weeds control heavily relies on herbicides in Iran. This study was aimed to determine the best weeds control period in soybean fields.

Materials and methods

Field experiments were conducted at the Agricultural Research Station of Islamic Azad University, Tabriz Branch, Iran, based on randomized complete block design. The experimental fields had been in a potato-wheat rotation cycle for the last two years. Each plot consisted of 5 soybean rows spaced 60 cm apart with 5 cm intra-row spacing. The soybean hybrid *Williams*, was inoculated with *Rhizobium japonicum* and sown at four cm depth on 8th June. Dominant weeds in the region were redroot pigweed (*Amaranthus retroflexus*), velvetleaf (*Abutilon theophrasti*), bindweed (*Convolvulus arvensis*) and burweed (*Xanthium spinosum*). The treatments were weed-infested and weed-free in same periods. For weed-infested plots, weeds were hand removed after 20, 40 and 60 DAE and were kept weed free thereafter. For weed-free experiment, weeds were allowed to compete with crop plants from 20, 40 and 60 DAE thereafter (Dabbagh Mohammady Nasab *et al.*, 2000). Also, all plots were hand removed for other weed species during growing season. At harvesting stages, the 3 middle rows of each plot were hand harvested. Treatment means were separated using Duncan's Multiple Range Test at P= 0.05 level. A Gompertz model provided the best fit for the maximum weed-infested experiment.

The model was as follows:

$$Y = A\times exp(-B\times exp(-K\times x)),$$

where, Y: soybean yield (kg ha^{-1}), A: asymptotic curve, B, K: coefficients of the model and X: weed-infested period. The relationship of crop yield with weed-free period was best described by the Logistic equation as follows:

$$Y = C+D/(1+exp(-A+B\times x)),$$

where, Y: crop yield (kg ha^{-1}), A, B, C: coefficients of the model and X: weed-infested period.

Results and discussion

Weed interference duration of 40 DAE or more and weed-free period of less than 40 DAE greatly reduced the number of pod bearing branches per plant (Table 1). Eftekhari *et al.* (2006) reported that the number of side branches per plant in soybean decreased significantly when the period of weed interference increased. Soybean biomass, as reported by Eftekhari *et al.* (2006), was also affected by earlier weeds emergence. However, its emergence at 60 DAE did not cause a substantial reduction in green bean biomass (Table 1). This result might be due to the late emergence of weed plants that grow slower and are weaker than crop during growing season. It has been also reported that with decreasing of 100 g m^{-2} biomass, bean yield decreased 1.4 kg ha^{-1} (Burnside *et* *al*., 1998). Crop grain yield intensively affected by weeds interference duration and increased from 1627, 2472 kg ha-1 in weedy check plots and weeds interference up to 60 DAE, respectively, to 3117, 3165, 3232 kg ha-1 in weeds interference up to 40, 20 DAE and weed free plots, respectively (Table 1). Weeds removal until 60 DAE provided a similar yield to the season-long weed-free control (Table 1). Percent yield loss of soybean varied with weeds interference duration. Crop yield from season-long weed-free plots was 3.2 t ha-1 (Table 1). When the crop grew in weed-free plots up to 60 DAE, did not decrease crop productivity, significantly (Table 1). Based on Mirshekari *et al*. (2010) reports, yield loss of green bean due to redroot pigweed interference duration ranged from 3% in weed removal in 2 WAE to 68% in full-season weed-infested plots. As late emerging weeds was not as competitive as early emerging ones, the yield reductions at ≥ 40 WAE based on weed-infested periods or < 60 DAE based on weed-free periods (Table 1) would not be acceptable to commercial growers. Significant reduction in soybean yield with increasing of weeds interference duration indicates that weeds is highly competitive with crop, and their competition beyond 40 WAE, results in greater crop yield loss. Similar results have been reported by Aguyoh and Masiunas (2003), Blackshaw (1991) on dry bean, Itulya *et al*. (1997) on cowpea and Eftekhari *et al*. (2006) on soybean.

Table 1. Influence of weed-infested and weed-free periods on soybean productivity.

Treatments	Number of branches per plant	Soybean biomass (g m-2)	Soybean yield (kg ha-1)	Number of branches per plant	Soybean biomass (g m-2)	Soybean yield (kg ha-1)
	Weed-infested periods (DAE)			Weed-free periods (DAE)		
20	8.8a	76.9a	3165.7a	8.3a	74.0b	3075.3a
40	4.2b	76.6a	3117.0a	4.0b	74.2b	2939.3a
60	3.8b	66.0b	2472.7b	7.8a	81.5a	3178.3a
Full-season interference	1.8c	62.4b	1627.0c	1.8c	62.4c	1627.0c
Control	8.7a	79.2a	3232.0a	8.7a	79.2a	3165.7a

DAE means days after soybean emergence.

Table 2. Estimated values for Logistic and Gompertz models parameters.

Logistic Model		Gompertz Model	
Parameter	Parameter value (±SE)	Parameter	Parameter value (±SE)
A	0.0313(±0.00791)	A	0.9466(±0.040)
B	-166.1(±41.2286)	B	0.7317(±0.142)
C	1.0048(±0.00041)	K	0.0707(±0.024)
R^2=0.93		R^2=0.98	

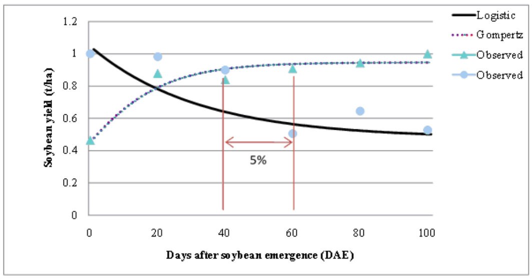

Fig. 1. Critical period of weeds control in soybean.

Conclusion

A maximum of 5% acceptable yield loss could be considered to determine the critical period of weeds control for most crops. It seems that soybean could tolerate presence of weeds studied in earlier 40 days of growth period, without any significant reduction in grain yield. Critical period of weeds control in soybean field using 5% yield loss was between 40-60 DAE.

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References

Aguyoh JN, Masiunas JB. 2003. Interference of redroot pigweed (*Amaranthus retroflexus*) with snap beans. Weed Science **51**, 202-207.

Blackshaw RE. 1991. Hairy nightshade (*Solanum sarrachoides*) interference in dry beans (*Phaseolus vulgaris*). Weed Science **39**, 48-53.

Burnside OC, Wiens MJ, Holder BJ, Weisberg S, Ristau EA, Johnson MM, Cameron JH. 1998. Critical period for wed control in dry beans (*Phaseolus vulgaris* L.). Weed Science **46**, 301-306.

Dabbagh Mohammady Nasab A, Javanshir A, Alyari H, Kazemi Arbat H, Moghaddam M. 2000. Interference of simulated weed (*Sorghum bicolor* L.) with soybean (*Glycine max* L.). Turkish Journal of Field Crops **5**, 7-11.

Dielman A, Hamill AS, Weise SF, Swanton CJ. 1995. Empirical models of redroot pigweed (*Amaranthus* spp.) interference in soybean (*Glycine max*). Weed Science **43**, 612-618.

Eftekhari A, Shirani Rad AH, Rezai AM, Salehian H, Ardakani MR. 2006. Determination of critical period of weeds control in soybean (*Glycine max* L.) in Sari. Iranian Journal of Crop Science **7(4),** 347-364.

Evanylo GK, Zehnder GW. 1989. Common ragweed (*Ambrosia artemisiifolia* L.) interference in snap bean at various soil potassium levels. Applied Agricultural Research **4**, 101-105.

Froud-Williams RJ. 2002. Weed competition. In: Naylor REL. Weed Management Handbook: ed., Oxford, UK: P. Blackwell Publishing, p. 48-90.

Heidari G, Sohrabi U, Mohammadi K. 2011. Interference of common lambsquarters (*Chenopodium album*) with sugar beet. American-Eurasian Journal of Agricultural and Environmental Science **11(3),** 451-455.

Horak MJ, Loughin TM. 2000. Growth analysis of four *Amaranthus* species. Weed Science **48**, 347-355.

Itulya FM, Mwaja VN, Masiunas JB. 1997. Collard-cowpea intercrop response to nitrogen fertilization, redroot pigweed density and collard harvest frequency. Horticultural Science **35**, 850-853.

Martin SG, Van Acker RC, Friesen LF. 2001. Critical period of weed control in spring canola. Weed Science **49**, 326-333.

Massinga RA, Currie RS, Horak MJ, Boyer J. 2001. Interference of palmer amaranth in corn. Weed Science **49**, 202-208.

Mirshekari B, Javanshir A, Kazemi Arbat H. 2010. Interference of redroot pigweed in green bean. Weed Biology and Management **10**, 120-125.

Seem JE, Cramer NG, Monks DV. 2003. Critical weed-free period for 'Beauregard' sweet potato (*Ipomoea batatas*). Weed Technology **17**, 686-695.