RESEARCH ON THE INFLUENCE OF WEED CONTROL ON THE SOYBEAN YIELD

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Abstract

Soy is known as a crop very sensitive to the presence of weeds, because initially slow growth rate and long growing season.Experience field has been placed in the experimental field of USAMVB Teaching Station Timisoara, during the years 2011 and 2012, being placed after the bifactorial experience subdivided parcels method, with 16 variants in III repetitions. Experimental factors were: factor a pre-emergent herbicides and factor b maintenance work + postemergent ***herbicide.*** *In 2011, due to drought conditions, weed growth was relatively low, 159 weeds / m^2, the most common species being: Setaria glauca, Echinochloa crus-galli, Amaranthus retroflexus şi Hibiscus trionum. The following year, the presence of weeds in soybean crop was more pronounced, 214 weeds / m^2, predominantly the same species. The best harvest results in the two years were recorded in the variants: a_2b_4-Stomp 330 EC 5 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha and a_3b_4-Relay 2 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha. Soybean yields obtained were correlated with the effectiveness of herbicides and agro-technical measures applied, and with the climatic conditions of the two experimental years, considered less favorable for this crop.*

Key word: soybean, herbicides, weed control, production.

INTRODUCTION

Soybean is one of the main crops in the Western Plain of Romania, due to favorable soil and climatic conditions (Popa, 2006).

Soy contributes decisively to ensure protein on planetary scale and the production of best quality vegetable oil (Mohammadi, Amiri, 2011). In addition, a soybean plant is "green", "and" economically "" through large quantities of nitrogen fixed, and from the point of view of plant technology is valuable in any crop rotation system.

At the same time, soybeans are known as a very sensitive crop to weeds, in particular in the first part of the growing season, characterized by the slow growth of the plant. In our country, most soy is grown on different plots, strong weeding and unfavorable climatic conditions in some years, are responsible for the low yields obtained in this culture, well below biological potential of varieties cultivated (Berca, 1998). Weed control is one of the major maintenance works in order to obtain high yields of soybean (El-Gizawy et al., 2012).

The need to reduce as much the negative impact of weeds on crop, research and farming practice along with farmers have sought and created

technology to combat them. Therefore an experience was placed in order to study the effectiveness of pre-emergent and post-emergent herbicides through the production of soybeans.

Soybean yields obtained were correlated with the effectiveness of herbicides and agro-technical measures applied, and the climatic conditions of the two experimental years, considered less favorable for this crop.

MATERIAL AND METHODS

Cultivated variety was Triumph being placed in the midLSDe group of precocity. It has a high height (90-115 cm), broad beans (160-190 g) is falling, shaking, drought and disease (soybean mosaic burns, bacterial blight) resistant. It has a good production capacity (3900 kg / ha), high protein (37.5 to 42%) and fat (19-23%). The used herbicides were: Stomp 330 EC, Relay, Dual S 960 EC, Lexone, Agil, Basagran.

Experience field has been placed in the experimental field of USAMVB Teaching Station Timisoara, during the years 2011 and 2012, being placed after the bifactorial experience subdivided parcels method, with 16 variants in III repetitions, 48 experimental plots.

The area of a parcel was 24.30 m^2.

Experimental factors were:

- ***Factor a*:** preemergent herbicides

a_1 - unherbicided preemergent;

a_2 - Stomp 330 EC (pendimetalin)-5 l/ha + Lexone (mertibuzin)-0,3 kg/ha

a_3 -Relay (acetoclor)-2 l/h + Lexone (mertibuzin)-0,3 kg/ha;

a_4 - Dual S 960 (metolaclor)-2 l/ha+ Lexone(mertibuzin70%)-0,3 kg/ha

- ***Factorul b:*** maintenance work + postemergent herbicide

b_1 - unhoed, unherbicided post emergent;

b_2 -2 mechanical hoeing;

b_3 -2 mechanical hoeing + Agil (propaquizafop) -1 l/ha;

b_4 -2 mechanical hoeing + Basagran (bentazon)-3 l/ha.

Herbicides spraying was done with the portable device and incorporation of pre-emergent herbicides with combiner. Calculation of doses of herbicides and water were based on the size of each experimental plot. Determination of weed infestation degree was performed using quantitative methods - numerical, for each experimental variant (Chirilă, 1989).

After application of the herbicide, observations were made at regular intervals on the effectiveness of the treatment in the control of various species of annual and perennial weeds. In addition, careful observations were made on the selectivity of the herbicide for soybean plants.

Each variant of the experiment was weighed and grain yield was reported at STAS. Production results were processed by the method of variance analysis.

RESULTS AND DISCUSSION

As it can be seen from the data presented in figure 1, the initial weed infestation in soy culture in the first experimental year was 159 weeds/m^2. The dominant weeds were the annual such as: *Setaria glauca* (21,3%), *Echinochloa crus – galli* (16,7%), *Amaranthus retroflexus* (15,4%) şi *Hibiscus trionum* (12,2%), and among perennials, *Convolvulus arvensis* (5,4%), *Sorghum halepense* (4,1%), *Cirsium arvense* (3,0%) şi *Rubus caesius* (1,7%). In total we identified 11 species of weeds.

In 2012, due to abundant rainfall in spring, the initially weeding degree present in the soybean crop was more pronounced, 214 weeds/m^2.

Dominant weeds were the annuals: *Setaria glauca* (18,5%), *Amaranthus retroflexus* (15,3%), *Chenopodium album* (12,4%) şi *Echinochloa crus - galli* (10,6%), and among perennials, *Sorghum halepense* (6,9%), *Cirsium arvense* (3,3%) and *Convolvulus arvensis* (2,5%). In total we identified 14 species of weeds.

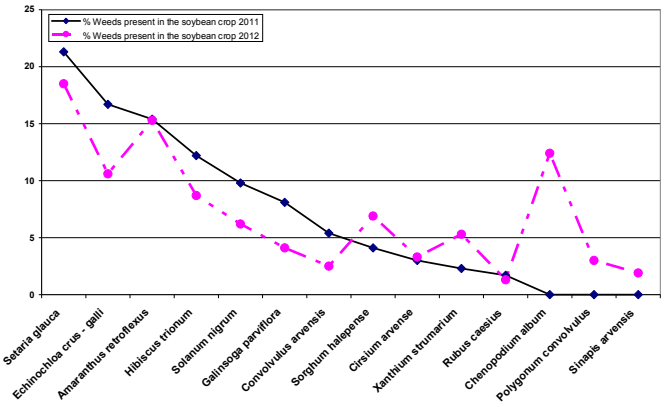

Fig. 1. Initial state of weed infestation in soybean crop in two experimental years

The production increases resulting from the application of herbicides compared to version preemergent unherbicided are between 9,26 q/ha (Relay 2,0 l/ha + Lexone 0,3 kg/ha) şi 10,75 q/ha (Stomp 330 EC 5 l/ha + Lexone0,3 kg/ha), being statistically assured as significantly positive (Table 1).

Looking at the data in table 2 can be seen that postemergent herbicides and mechanical hoeing increases production in range of 8.93 q / ha (2 mechanical hoeing) and 12,82 q/ha (2 mechanical hoeing + Basagran 3 l/ha).

Table 1

Unilateral analysis of factor a (pre-emergent herbicides) soybean in 2011

Variant	Production (q/ha)	Difference (q/ha)	Significance
a_2-a_1	22,81-12,06	+10,75	xxx
a_3 -a_1	21,32-12,06	+9,26	xxx
a_4- a_1	21,42-12,06	+9,36	xxx
a_3- a_2	21,32-22,81	-1,49	00
a_4- a_2	21,42-22,81	-1,39	00
a_4- a_3	21,42-21,32	-0,10	-

LSD 5% = 0,91 q/ha; LSD 1% = 1,32 q/ha; LSD 0,1%= 1,95 q/ha

Table 2

Unilateral analysis of factor b (maintenance work+postemergent herbicides) soybean in 2011

Variant	Production (q/ha)	Difference (q/ha)	Significance
b_2-b_1	20,14-11,21	+8,93	xxx
b_3-b_1	22,24-11,21	+11,03	xxx
b_4-b_1	24,03-11,21	+12,82	xxx
b_3-b_2	22,24-20,14	+2,10	x
b_4-b_2	24,03-20,14	+3,89	xx
b_4-b_3	24,03-22,24	+1,79	x

LSD 5% = 1,86 q/ha; LSD 1% = 2,91q/ha; LSD 0,1%= 3,95 q/ha

The combined action of the two experimental factors directly reflects on soybean production throughout production increases (Table 3).

Pre-emergent herbicides compared to preemergent unherbicided variant increases production up to 89,14% (Stomp 330 EC 5 l/ha + Lexone 0,3 kg/ha), 76,78% (Relay 2,0 l/ha + Lexone 0,3 kg/ha), respectively 77,61% (Dual S 960 2,0l/ha + Lexone 0,3 kg/ha).

Postemergent herbicides associated with two mechanical hoeing compared to the control variant (2 mechanical hoeing) achieved production increases of 10,43% (2 mechanical hoeing + Agil 1 l/ha), respectively 19,31% (2 mechanical hoeing + Basagran 3 l/ha).

Table 3

Combined analysis of the two experimental factors regarding soybean production in 2011

Factor *a* preemergent herbicides	Factor***b***: maintenance work + postemergent herbicides				Mean factor ***a***		Yield differ q/ha	Signific
	b_1 unhoed unherbicided postem.	**b_2** 2 mech. hoeing	**b_3** 2 mech. hoeing + Agil (1 l/ha)	**b_4** 2 mech. hoeing + Basagran (3 l/ha)	Mean of production (q/ha)	Relative production (%)		
a_1 – unherbicided preem	6,33	9,44	15,02	17,45	12,06	100,0	Mt	-
a_2 – Stomp 330 EC (5 l/ha) +Lexone (0,3 kg/ha)	14,92	24,02	25,76	26,55	22,81	189,1	+10,7	xxx
a_3 Relay (2 l/ha) + Lexone (0,3 kg/ha)	11,37	23,26	24,41	26,25	21,32	176,7	+9,26	xxx
a_4 - Dual S 960 2 l/ha + Lexone (0,3 kg/ha)	12,22	23,85	23,76	25,88	21,42	177,6	+9,36	xxx

LSD 5% = 0,81 q/ha; LSD 1% = 1,22 q/ha; LSD 0,1% = 1,97 q/ha

Mean factor ***b***: maintenance work + postemergent herbicides

Average production (q/ha)	11,21	20,14	22,24	24,03
Relative production (%)	55,66	100,00	110,43	119,31
Yield differences (q/ha)	-8,93	Mt	+2,10	+3,89
Significance	000	-	x	xx

LSD5% = 1,57 q/ha; LSD 1% =2,38 q/ha; LSD 0,1% = 3, 29q/ha.

Synthesis of production results (Table 4), shows a wide range of soybean production values between 6.33 tons/ha and 26.55 tons/ha.

The best results were registered in the variants: a_2b_4-Stomp 330 EC 5 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha (26,55 q/ha), a_3b_4-Relay 2 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha (26,25 q/ha), a_4b_4 -Dual S 960 - 2 l /ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha (25,88 q/ha) and a_2b_3 -Stomp 330 EC 5 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing +Agil 1 l/ha (25,76 q/ha). Production increases achieved in comparison to the control (a_1b_2) were 17,11 q/ha, 16,81 q/ha, 16,36 q/ha respectively 16,32 q/ha, statistically assured as very positive significant differences.

Table 4

Synthesis of experimental results on soybean production in 2011

Variant	Absolute production (q/ha)	Relative production (%)	Difference in production (q/ha)	Significance
a_2b_4	26,55	281,25	+17,11	xxx
a_3b_4	26,25	278,07	+16,81	xxx
a_4b_4	25,88	274,15	+16,36	xxx
a_2b_3	25,76	272,88	+16,32	xxx
a_3b_3	24,41	258,58	+14,97	xxx
a_2b_2	24,02	254,45	+14,58	xxx
a_4b_2	23,85	252,65	+14,41	xxx
a_4b_3	23,76	251,69	+14,32	xxx
a_3b_2	23,26	246,40	+13,82	xxx
a_1b_4	17,45	184,85	+8,01	xxx
a_1b_3	15,02	159,11	+5,58	xx
a_2b_1	14,92	158,05	+5,48	xx
a_4b_1	12,22	129,45	+2,78	x
a_3b_1	11,37	120,44	+1,93	-
a_1b_2	9,44	100,00	Mt	-
a_1b_1	6,33	42,85	-11,11	000

LSD 5%= 2,05q/ha; LSD 1%= 3,46 q/ha; LSD 0,1%= 5,63 q/ha

In year 2012, after applying preemergent herbicides compared to unherbicided variant, production increases were achieved between 6.39 q/ha (a_4- Dual S 960 2 l/ha + Lexone 0,3 kg/ha) and 8,00 q/ha (Stomp 330 EC 5 l/ha + Lexone 0,3 kg/ha), statistically assured as very positive significant differences (Table 5).

Postemergent herbicides and mechanical hoeing bring production increases ranging from5,50 q/ha (2 mechanical hoeing) şi 10,64 q/ha (2 mechanical hoeing + Basagran 3 l/ha), as can be seen from table 6.

Table 5

Unilateral analysis of factor a (pre-emergent herbicides) soybean in 2012

Variant	Production (q/ha)	Difference (q/ha)	Significance
a_2-a_1	17,90-9,90	+8,00	xxx
a_3 -a_1	16,32-9,90	+6,42	xxx
a_4- a_1	16,29-9,90	+6,39	xxx
a_3- a_2	16,32-17,90	-1,58	00
a_4- a_2	16,29-17,90	-1,61	00
a_4- a_3	16,29-16,32	-0,03	-

LSD 5% = 0,74 q/ha LSD 1% = 1,11 q/ha LSD 0,1%= 1,79 q/ha

Table 6

Unilateral analysis of factor b
(maintenance work + postemergent herbicides) soybean in 2012

Variant	Production (q/ha)	Difference (q/ha)	Significance
b_2-b_1	14,48-8,96	+5,50	xxx
b_3-b_1	17,37-8,96	+8,41	xxx
b_4-b_1	19,60-8,96	+10,64	xxx
b_3-b_2	17,37-14,48	+2,89	x
b_4-b_2	19,60-14,48	+5,12	xxx
b_4-b_3	19,60-17,37	+2,23	x

LSD 5% = 2,13 q/ha LSD 1% = 3,65 q/ha LSD 0,1%= 4,17 q/ha

The combined action of the two experimental factors directly reflects on soybean production by yield increases they bring (Table 7).

Table 7

Combined analysis of the two experimental factors regarding soybean production in 2012

Factor *a* preemergent herbicides	Factor ***b***: maintenance work + postemergent herbicides				Media factorului ***a***		Yield differ. (q/ha)	Signific
	b_1 unhoed unherbicided postem.	**b_2** 2 mech. hoeing	**b_3** 2 mech. hoeing + Agil (1 l/ha).	**b_4** 2 mech. hoeing + Basagran (3 l/ha)	Mean of production (q/ha)	Relative production (%)		
a_1 – unherbicided preem	4,80	7,52	13,48	13,80	9,90	100,0	Mt	-
a_2 – Stomp 330 EC (5 l/ha) +Lexone (0,3 kg/ha)	11,24	17,79	20,10	22,45	17,90	180,8	+8,00	xxx
a_3 Relay (2 l/ha) + Lexone (0,3 kg/ha)	9,03	15,46	19,38	21,40	16,32	164,84	+6,42	xxx
a_4 - Dual S 960 2 l/ha + Lexone (0,3 kg/ha)	10,75	17,15	16,52	20,75	16,29	164,5	+6,39	xxx

LSD 5% = 0,74 q/ha; LSD 1% = 1,11 q/ha; LSD 0,1% = 1,79 q/ha

Mean factor ***b***: maintenance work + postemergent herbicides

Average production (q/ha)	8,96	14,48	17,37	19,60
Relative production (%)	61,88	100,00	119,96	135,60
Yield differences (q/ha)	-5,52	Mt	+2,89	+5,12
Significance	000	-	xxx	xxx

LSD5% = 1,05 q/ha; LSD 1% = 1,40 q/ha; LSD 0,1% = 1,85 q/ha.

Pre-emergent herbicides compared to preemergent unherbicided variant bring increases of production up to 80,80% (Stomp 330 EC 5 l/ha +

Lexone 0,3 kg/ha), 64,84% (Relay 2,0 l/ha + Lexone 0,3 kg/ha), respectively 64,54% (Dual S 960 2,0l/ha + Lexone 0,3 kg/ha).

Postemergent herbicides associated with two mechanical hoeing compared to the control (two mechanical hoeing), achieved production increases of 19,96% (2 mechanical hoeing + Agil 1 l/ha), respectively 35,60% (2 mechanical hoeing + Basagran 3 l/ha).

Synthesis of production results (Table 8) shows a wide range of soybean production values ranging between 4.80 q / ha and 22.45 q / ha.

Table 8

Synthesis of experimental results on soybean production in 2012

Variant	Absolute production (q/ha)	Relative production (%)	Difference in production (q/ha)	Significance
a_2b_4	22,45	299,33	+14,93	xxx
a_3b_4	21,40	284,57	+13,88	xxx
a_4b_4	20,75	275,93	+13,23	xxx
a_2b_3	20,10	267,29	+12,58	xxx
a_3b_3	19,38	257,71	+11,86	xxx
a_2b_2	17,79	236,60	+10,27	xxx
a_4b_2	17,15	228,06	+9,63	xxx
a_4b_3	16,52	219,68	+9,00	xxx
a_3b_2	15,46	205,59	+7,94	xxx
a_1b_4	13,80	183,51	+6,28	xxx
a_1b_3	13,48	179,25	+5,96	xxx
a_2b_1	11,24	149,48	+3,72	xx
a_4b_1	10,75	142,95	+3,23	x
a_3b_1	9,03	120,08	+1,51	-
a_1b_2	7,52	100,00	Mt	-
a_1b_1	4,80	63,83	-2,72	0

LSD 5%= 2,46 q/ha; LSD 1%= 3,29 q/ha; LSD 0,1%= 4,33 q/ha

This year too, the best harvest results were recorded in variants : a_2b_4-Stomp 330 EC 5 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha (22,45 q/ha), a_3b_4-Relay 2 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha (21,40 q/ha), a_4b_4 -Dual S 960 - 2 l /ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha (20,75 q/ha) and a_2b_3 -Stomp 330 EC 5 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing +Agil 1 l/ha (20,10 q/ha). Production increases achieved in comparison to the control (a_1b_2) were: 14,93 q/ha, 13,88 q/ha, 13,23 q/ha respectively 12,58 q/ha, statistically assured as very positive significant differences.

CONCLUSIONS

Researches conducted during the two experimental years, in the field of Agrotechnical discipline have led to the following conclusions:

- Soy is known as a very sensitive crop to the presence of weeds, due initially slow growth rate and long growing season, which requires the use of a set of measures that contribute to reducing the weed, with direct implications on production.
- In 2011, due to drought conditions, weed growth was relatively low, 159 weeds/m^2 the most common species being: *Setaria glauca, Echinochloa crus-galli, Amaranthus retroflexus* and *Hibiscus trionum.* The following year, due to abundant rainfall, weed infestation of soybean crop was more pronounced, 214 weeds/m^2, predominantly the same species.
- The best results for harvest in 2011 occurred in the variants: a_2b_4-Stomp 330 EC 5 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha (26,55 q/ha), a_3b_4-Relay 2 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha (26,25 q/ha).
- Next year, the best productions were recorded in the same experimental variants: a_2b_4-Stomp 330 EC 5 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha (22,45 q/ha), a_3b_4-Relay 2 l/ha + Lexone 0,3 kg/ha - 2 mechanical hoeing + Basagran 3 l/ha (21,40 q/ha).
- Soybean yields obtained were correlated with the effectiveness of herbicides and agro-technical measures applied but also with the climatic conditions of the two experimental years, considered less favorable for this crop.

REFERENCES

1. Berca M., 2004, Managementul integrat al buruienilor, Ed. Ceres, Bucureşti
2. Chirilă C., 1989, Cartarea buruienilor din culturile agricole, Ministerul Agriculturii, Bucureşti
3. Chirila S., Chirila P., 2008, Research regarding soybean crop critical period to weed harmfulness, Lucrari Stiintifice-Universitatae de stiinte Agro. Bucuresti. Seria A, Agronomie 51: 507-512
4. El-Gizawy N.Kh.B., FaLSDallah A.M., Hassanein A.M., Soliman I.E., 2012, Estimation of the critical period for weed control in soybean (Glycine max L) as influenced by plant density, J. Plant Production, Mansoura Univ., vol. 3(9) 2375-2394.
5. Lăzureanu A., D. Manea, Gh. Cârciu, S. Alda, 2006, Agrotehnică aplicată, Ed. Eurobit, Timişoara
6. Mohammadi G.R., Amiri F., 2011, Critical period of weed control in soybean (*Glycine max*) as influenced by starter fertilizer, AJCS 5(11):1350-1355
7. Pîrşan P., 2006, Fitotehnie - cereale şi leguminoase pentru boabe, Editura Eurobit, Timişoara
8. Popa A., 2008, Studies concerning the impact of fertilisation on protein and oil content in a soy cultivar assortment, Research Journal of Agricultural Science, Vol. 40 (1):169-172
9. Slonovschi V., M. Niță, A. Nechita, 2001, Prezent şi viitor în combaterea buruienilor, Editura Ion Ionescu de la Brad, Iaşi
10. Sylvestre Habimana, K.N. Kalyana Murthy, B.C. Shankaralingappa, M.T. Sanjay, C. Ramachandra, 2013, Efficiency and economics of weed control with pre and post-emergence herbicides in soybean (*Glycine Max* L.), Asian Journal of Plant Science and Research, 2013, 3(4):18-20
11. * * *, 2011, Codexul produselor de protecția plantelor omologate pentru utilizare în România. Ed. Carmel Print. Arad