Broad leaved weeds control in safflower (*Carthamus tinctoris L.)* with herbicides in South-east Bulgaria

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Abstract:

Field trial aiming at establishment of herbicide's influence on the broad leaved weeds in safflower crop (*Carthamus tinctorius L.)* has been conducted on the experimental field of the Institute of agriculture – Karnobat in 2004 – 2007.

It has been ascertained that in South-East Bulgaria most common is the mixes type of weed plants in safflower with predominance of broad leaved once. Highest herbicide activity in treatment after sawing and pre-emergence has Linureks 45 SC, Stomp 330 EC and Raft 400 SC. Application of Linureks 45 SC and Stomp 330 EC leads to increase with 21-23 % of the yield. Usage of Linureks 45 SC, Goal 2 E and Basagran 600 SL is related to phytotoxicity to the crop. Safflower plants recover completely on the 28th day after Linureks 45 SC and Goal 2 E application, but Basagran 600 SL vanish many plants. During vegetation best results have been found in usage of Stomp 330 EC – an average for the period increase in yield by 20%.

Key words: weeds, herbicides, safflower, yield.

Introduction

The safflower is annual herbaceous plant distributed mainly in the Middle East, North America, Australia, USA, South Russia, and South Europe (5). In the recent years it has been cultivated for the vegetable oil extracted from its seeds and their flowers which are used fro coloring and flavoring foods and making dyes. In Bulgaria this crop win recognition first id South East and South regions where the climate (high temperatures and insufficient rainfall) strongly limits the wide spread of sunflower. Later (after 1960) its cultivation has been abandoned because of the high yielding sunflower cultivars. In the recent years the safflower oil is considered as good and profitable resource for the intensively developed world bio diesel industry (1).

Weeds can cause serious problems and significant reduction of yield. The slow development in the first stages of safflower - from the emergence to the rosette formation, is precondition for weed infestation of the crop. Plants are with very low competitive power and the rosette period seems to be the most critical for weed infestation (6). Minimizing the risk could be facilitated by following some precautions as use of clean and safe seeds and cultivation on fields, free of weeds. Agricultural practices aiming at diminishing the weed's influence are also the appropriate crop rotation, soil cultivation and others (7).

Areas, known as broad leaved weeds infected are not good place for safflower growing. Kochia, Russian thistle and wild mustard are the most difficult weeds to control. Perennials such as Canada thistle and perennial sow thistle can provoke serious problems. Safflower should not be cultivated on fields with heavy infestations of perennial weeds. (3).

Problematic broad leaved weeds as mustard can be controlled by herbicides control. The crop shows good tolerance to treatment with imazamethabenz-methil and desmedipham (4).

Cereal weed infestation is recommendable controlled by herbicides with active ingredients metolachlor and trifluralin (8, 9). Trifluralin and EPTC are effective of early season weeds, after which competition by the safflower itself reduces or eliminates further weed germination and growth (8).

In Bulgaria till now there are no similar researches on safflower.

The aim of the investigation is establishment of the influence of some herbicides for broad leaved weeds control in safflower, cultivated in South East Bulgaria.

Material and methds

The research was conducted on the experimental field of The Institute of Agriculture, Karnobat, Bulgaria, in soil type – Leaked smolnitza (Pellic vertisol by FAO), during the period 2004-2007. It has been used complete block design with four repetitions and plot size - 25 m^2.

The trial includes 11 variants:

1. K_1 – weedy check
2. K_2 – untreated and without weeds
3. Stomp 330 EC (330 g/l pendimetalin) – 4.0 l/ha
4. Raft 400 SC (800 g/kg oxadiargyl) – 0.8 l/ha
5. Linureks 45 SC (450 g/l linuron) – 2.0 l/ha
6. Dual Gold 960 EC (960 g/l s-metolachlor) – 1.5 l/ha
7. Stomp 330 EC (330 g/l pendimetalin) – 4.0 l/ha
8. Raft 400 SC (800 g/kg oxadiargyl) – 0.8 l/ha
9. Linureks 45 SC (450 g/l linuron) – 2.0 l/ha
10. Goal 2 E (240 g/l oxyfluorfen) – 0.8 l/ha
11. Basagran 600 SL (600 g/l bentazone) – 2 l/ha

Variants 3 – 6 have been treated after sowing and pre-emergence, variants 7-10 – during the vegetation, in rosette period for the safflower and 2-4 leaves of the weeds.

The species composition and density are accounted by quantity – weight method in 0.25m^2 in four replicates on each variant.

The following parameters have been recorded: herbicides selectivity (by *EWRS-European Weed Research Society* scale – note 1 – no injuries, note 9 – cultivar was completely exterminated). Herbicides effectiveness - quantity – weight method, grain yield.

The statistical significance of the differences in weed density and grain yield between variants has been determined by Dospehov (1985).

The climate conditions are presented on figure 1. It is clear that the rainfalls are unevenly distributed in months in all three years. Dry periods are observed in April and June 2004, April 2005, and March – May 2007. The water deficit has negative effect on the crop development and soil herbicides efficacy.

The climate in early spring of 2006 was reason for a late sawing which resulted in very low density of the crop. In this year the plots were severely attacked by *Chloridea obsoleta F.* and the trial was discarded.

Results and discussion

The experimental field has mixed type of natural weeds where predominance of annual dicotyledonous - *Polygonum convolvulus L., Sinapis arvensis L, Chenopodium album L., Euphorbia helianthi L., Anagalis arvensis,* and annual monocotyledonous as *Avena sp.*The total weed number during the experimental period reach 232/m^2 with prevalence of Polygonum convolvulus (128 n/m^2).

The vegetation treatment with Linureks 45 SC, Goal 2 E and Basagran 600 SL provoked phyto-toxicity in safllower plants, expressed in different leaves size. The crop recovers after 14 days of Linureks 45 SC and Goal 2 E use, and on the 28th day it completely overcomes the toxicity. Significant injuries as burnings, deformation and death of entire plants are observed after application of Basagran 600 SL

Herbicides effectiveness data are presented on table 1. The average for the period total weed number in the control plots is 232 *n/m^2*. The fresh weight of weeds is significant and reaches 876.20 *g/m^2.*

Good herbicide effect in treatment after sawing and pre-emergence have Linureks 45 SC, Stomp 330 EC and Raft 400 SC. Very low effectiveness show Dual Gold 960 EC. It is useful only against monocotyledonous and few dicotyledonous weeds. We do not recommend this herbicide for usage in such type of weeds.

Stomp 330 EC and Raft 400 SC implicated after the crop emergency have significantly lower effectiveness. Linureks 45 SC and Goal 2 E are effective but toxic for the crop. Using Basagran 600 SL retain high weed density as result of safflower necrosis and secondary development of weeds.

The grain yield data indicates its strong correlation with weed infestation, herbicides effectiveness and climate conditions (table 3). Highest yield - 1.81 до 3.46 t/ha is obtained in none treated, weeding control. The variation is due primary to climate condition changes. The rainfall in 2004 is uneven distributed – only 2.8mm in April. The water supply in March – April 2007 is 60 % less then the average multiyear's data and the critical for safflower rosette stage was in dry conditions. Relatively favorable was the climate in 2005 and the grain yield are significantly higher.

In the control variant (K1) the average yield is 30 % less then the weeding variant (K2). Treatment after sawing before emergence with Linureks 45 SC causes 23 % of yield increase, Stomp 330 EC – 21%, and with Dual Gold 960 EC – only 13 %.

Best results in vegetation treatment of safflower have been obtained using Stomp 330 EC. It provokes average of 20% augmentation of the yield. Linureks 45 SC and Goal 2 E leaved the crop free of weeds, but express some toxicity over the plants. Slower development of the crop has been recorded in the first two weeks after chemical treatment.

The yield in Basagran 600 SL variant has not been recorded because of the low plants density in the plot and secondary heavy weed growth, which additionally suppressed the crop development.

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Conclusions

- In South East Bulgaria most common is mixed type of weed infestation in safflower fields with predominance of broad leaved weeds.
- Highest herbicide effectiveness in treatment after sawing and pre-emergence have Linureks 45 SC, Stomp 330 EC and Raft 400 SC. Higher (21 -23%) yields has been obtained in variant treated with Linureks 45 SC and Stomp 330 EC.
- Vegetation application of Linureks 45 SC, Goal 2 E and Basagran 600 SL provoke phyto toxicity over the plants. The crop recovers completely on the 28th day after Linureks 45 SC and Goal 2 E use. Basagran 600 SL leads to full necrosis of some plants.
- Best results in herbicides vegetation treatment are recorded for Stomp 330 EC – average of 20 % increase of the yield.

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Figura 1. Climatogramm for the period of study

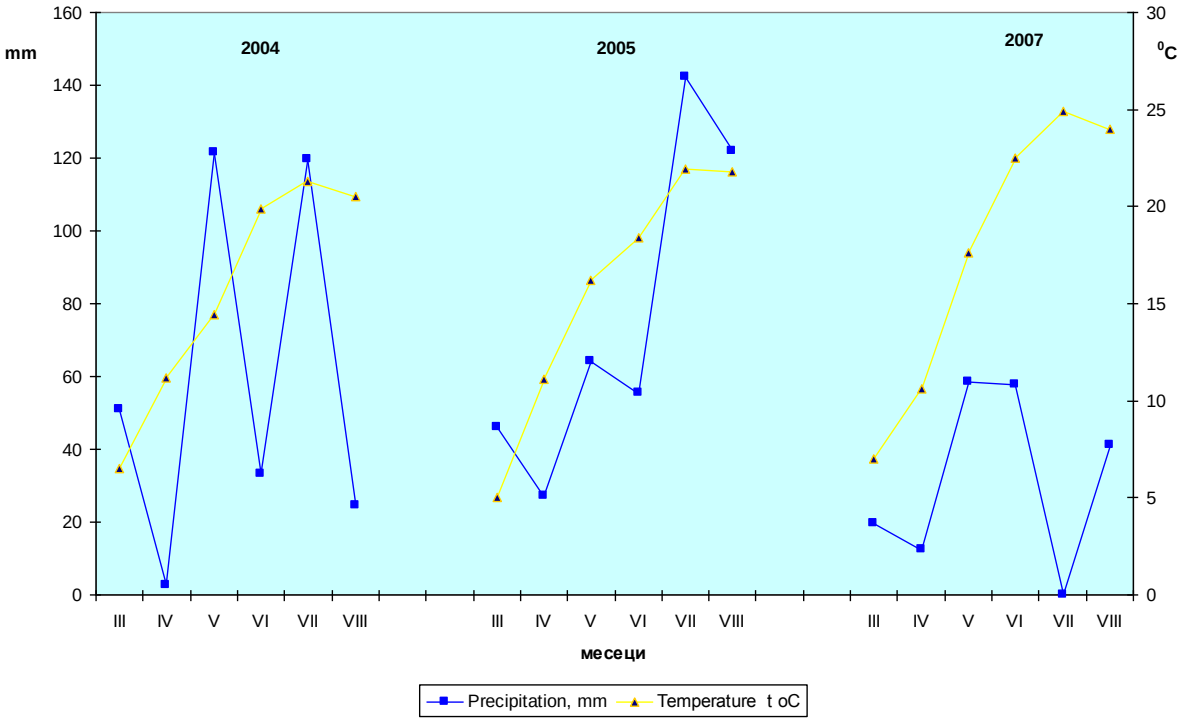

Table 1. **Efficiency and selectivity of herbicides in safflower**

Variants	Rate l,kg/ ha	Weed species after treatment						Selecti-vity by EWRS
		Annual dycotyledouns		Annual monocotyledouns		Total		
		number/ m^2	g/m^2	number/ m^2	g/m^2	number/ m^2	g/m^2	
K_1 – weedy check		220	613.80	12	262.40	232	876.20	1
K_2 – untreated and without weeds		0	0	0	0	0	0	1
Stomp 330 EC (330 g/l pendimetalin) – ASPE*	4.0	17	16.00	4	15.10	21	31.64	1
Raft 400 SC (800 g/kg oxadiargyl) - ASPE	0.8	25	35.92	1	8.30	26	44.22	1
Linureks 45 SC (450 g/l linuron) - ASPE	2.0	10	50.00	0.5	2.45	10.5	52.45	1
Dual Gold 960 EC (960 g/l s-metolachlor) - ASPE	1.5	98	437.00	4	22.47	102	459.47	1
Stomp 330 EC (330 g/l pendimetalin) -AS	4.0	44	150.0	1	5.10	45	155.10	1
Raft 400 SC (800 g/kg oxadiargyl) - AS	0.8	87	288.3	5	127.7	92	416.0	1
Linureks 45 SC (450 g/l linuron) - AS	2.0	12	7.08	2	10.40	14	17.48	3
Goal 2 E (240 g/l oxyfluorfen) - AS	0.8	3	5.12	3	10.98	6	16.10	4
Basagran 600 SL (600 g/l bentazone) - AS	2.0	55	369.0	6	108.00	61	477.00	7

*ASPE – After sowing and pre-emergence
*AS - After sprung

Table 2. **Influence of herbicides on safflower grain yield (2004-2007)**

Variants	Rate l,kg/ ha	Yield, t/ha			Average for period	
		2004	2005	2007	t/ha	%
K_1 – weedy check	-	1.49	2.60	1.43	1.84	100
K_2 – untreated and without weeds	-	1.82***	3.46***	1.81***	2.36	128
Stomp 330 EC (330 g/l pendimetalin) – ASPE*	4.0	1.69	3.21***	1.78	2.22	121
Raft 400 SC (800 g/kg oxadiargyl) - ASPE	0.8	1.83***	2.88***	1.78***	2.16	117
Linureks 45 SC (450 g/l linuron) - ASPE	2.0	1.77**	3.40***	1.63*	2.26	123
Dual Gold 960 EC (960 g/l s-metolachlor) - ASPE	1.5	1.81***	2.82***	1.64*	2.09	113
Stomp 330 EC (330 g/l pendimetalin) -AS	4.0	1.78**	3.08***	1.73**	2.20	120
Raft 400 SC (800 g/kg oxadiargyl) - AS	0.8	1.63	3.00***	1.60	2.07	112
Linureks 45 SC (450 g/l linuron) - AS	2.0	1.87***	2.83***	1.62*	2.11	115
Goal 2 E (240 g/l oxyfluorfen) - AS	0.8	1.71*	2.88***	1.79***	2.13	116
GD (1 %) **(0.1 %)** **(0.5 %)**		0.171 0.231 0.308	0.133 0.183 0.233	0.134 0.181 0.242		

*ASPE – After sowing and pre-emergence

*AS - After sprung