EFFICACY OF APPLICATION OF NEW SIMPLE AND COMBINED HERBICIDE TREATMENTS IN CONTROLLING THE ANNUAL WEEDS FROM SUNFLOWER CROPS IN ROMANIA.

Alexandrina Popescu
Research Institute for Cereals and Industrial Crops,
Fundulea, 8264, Călărași (Romania)

Abstract

The study presents the results of the research performed în Romania, in a 3 year period (1993-1995), concerning the selectivity and efficacy of a serie of new herbicides for controlling the annual mono- and dicotyledonous weeds from sunflower crops, grown on two types of soils: brown (< 2.5% humus) and chernozemic (> 2.5% humus).

The new herbicides containing dimethenamid, acetochlor + safener, butylate + dimethenamid (applied ppi and slightly incorporated), or propaquizofop (applied postem) controlled the annual monocotyledonous weeds *Setaria, Echinochloa, Digitaria* in a proportion of 90-95%.

The herbicides containing oxyfluoren (preem), bifenox (postem), controlled the annual dicotyledonous species: *Amarathus, Chenopodium, Hibiscus, Sinapis*, while the herbicide imazamethabenz (postem) achieved a control level of 90-95% of the weeds from *Cruciferae* family.

The new herbicides had a good selectivity for the registered hybrids, similar to that of the standard treatments (alachlor+prometrin, trifluralin+prometrin).

The treatments with bifenox and oxyfluorfen produced slight phytotoxicity symptoms, particularly when applied on brown soils, but did not influence significantly the grain yield.

Introduction

Due to its slow growth in the first vegetation stages (6 weeks) and low plant population, sunflower crop is strongly competed by a diversified range of both annual (*Setaria, Echinochloa, Digitaria, Sinapis, Raphanus, Xanthium, Chenopodium, Amarathus, Abutilon, Solanum)* and perennial (*Cirsium, Convolvulus, Sonchus)* weeds. Chemical control represents the only efficient method to prevent the weed competition in the first growing stages of sunflower plants (Zora and Francesco, 1992).

Till the present time, the herbicides alachlor, metilachlor, butylate, EPTC + antidote, trifluralin, applied alone or combined with the herbicides prometrin or linurox have been largely used in Romania (Pintilie et al., 1986; Şarpe, 1987).
In the last years, research concerning the weed control by using a new serie of both imported (dimethenamid, acetochlor+safener, propaquizofop, oxyfluorfen, imazamethabenz, bifenox) and Romanian (dimethenamid + butylate) herbicides has been performed at Research Institute for Cereals and Industrial Crops-Fundulea (RICIC). This study presents the results concerning the selectivity and efficacy of these new herbicides.

Materials and methods

The experiments were performed during 1993-1995, at RICIC and seven other experimental stations (Teleorman, Caracal, Lovrin, Podu Iloaiei, Albota, Oradea, Kogălniceanu), situated in areas with different conditions of soil and climate. Two types of experiments were organized, according to the herbicide characteristics and incorporation depth: (i) non-volatile herbicides (alachlor, dimethenamid, acetochlor + sefener, dimethenamid + butylate), superficially incorporated at 3-5 cm and (ii) volatile herbicides (trifluralin). Complete randomized block design with four replications was used in each location and year and individual plots consisted of four rows (70 cm between rows) totaling an area of 25 m^2.
Sunflower hybrids Turbo, Select, Fundulea 206, Favorit, Super and the inbred line L.c. 1064 were grown, according to specific climate and soil conditions from each location.
The rates and time of herbicide application are presented in tables 1 and 2 for non-volatile herbicide, and 3 and 4 for volatile herbicides. Three types of treatments were used: ppi (before planting), incorporated at 8 cm (volatile) or 5 cm (non-volatile); preem (immediately after planting), and postem (during the vegetation period, at the 4-8 leaves stage of sunflower plants and early growing stage of the weeds). A solution amount of 440 l/ha was used.
Selectivity of sunflower hybrids (7,14 and 30 days after treatment) and efficacy of the herbicides (14, 21, 60 days after treatments) was scored by using EWRS methodology.
Gravimetric measurements of the non-control weeds and grain yield at 8% moisture were determined in each plot at harvest.

Results and conclusions

The fields from the eight locations where the experiments were carried out had different degrees of weed infestation. Thus, the locations situated on brown soils, with less than 2.5% humus (Oradea, Albota, Kogălniceanu), had an average weed infestation degree of 75-80%. Annual species were predominant (90%). Monocotyledonous (*Setaria, Echinochloa, Digitaria)* and dicotyledonous

Table 1

Selectivity and efficacy of non-volatile herbicides applied for controlling annual weeds in sunflower crops. ROMANIA, 1993-1995.

Herbicides	Rate kg a.i./ha	Time of application	EWRS scores (average over years and locations) Selectivity[1] Soil type <2.5% humus (3)*	Selectivity[1] Soil type >2.5% humus (5)*	Efficacy[2] Soil type <2.5% humus (3)*	Efficacy[2] Soil type >2.5% humus (5)*
Control I-3 times cultivated	-	-	1	1	1	1
Control II - non cultivated	-	-	1	1	8.5	9
Alachlor + Prometrin (Standard)	2.88 + 3.00	preem	1.3	1	1.4	2.3
Alachlor + Oxyfluorfen	2.88 + 0.24	"	1.8	1.1	1.5	2.4
Oxyfluorfen	0.24	"	1.7	1.1	2.5	3.5
Dimethenamid + imazamethabenz	1.17 + 0.25	ppi 5 cm + postem	1	1	2.2	2.5
Acetochlor / safener + bifenox	1.68 + 0.48	ppi 5 cm + postem	1.2	1.1	1.5	2
(Dimethenamid +butylate +bifenox)	(1.2 + 2.0 + 0.48)	ppi 5 cm + postem	1.2	1.1	1.5	2

1) Selectivity
1 = no phytotoxic symptoms
9 = 85 - 100% damaged plants

2) Efficacy
1 = 90 - 100% controlled weeds
9 = 85 - 100% non controlled weeds

*) number of locations

Table 2

Grain yield (t/ha) obtained in the experiments with non-volatile herbicide treatments for controlling the annual weeds in sunflower crops. ROMANIA, 1993-1995.

Herbicides	Rate kg a.i./ha	Time of application	Soil type <2.5 % humus (3*) t/ha	<2.5 % humus (3*) %	>2.5 % humus (5*) t/ha	>2.5 % humus (5*) %
Control I-3 times cultivated	-	-	2.47	100	3.15	100
Control II - non cultivated	-	-	1.17	48***	1.58	50***
Alachlor + Prometrin (Standard)	2.88 + 3.00	preem	2.34	95	2.90	92
Alachlor + Oxyfluorfen	2.88 + 0.24	"	2.29	93	2.80	89*
Oxyfluorfen	0.24	"	2.13	86**	2.46	78***
Dimethenamid + imazamethabenz	1.17 + 0.25	ppi 5 cm + postem	2.24	91	2.72	86**
Acetochlor / safener + bifenox	1.68 + 0.48	ppi 5 cm + postem	2.36	95	2.95	94
(Dimethenamid +butylate +bifenox)	(1.2 - 2.0 + 0.48)	ppi 5 cm + postem	2.33	94	2.93	93
		LSD for	P < 0.05	11		9
			P < 0.01	14		13
			P < 0.001	20		17

*) number of locations

Selectivity and efficacy of volatile herbicides applied for controlling the annual weeds in sunflower crops.
ROMANIA, 1993-1995.

Herbicides	Rate kg a.i./ha	Time of application	EWRS scores (average over years and locations)			
			Selectivity[1)]		Efficacy[2)]	
			Soil type			
			<2.5% humus (3)*	>2.5% humus (5)*	<2.5% humus (3)*	>2.5% humus (5)*
Control I-3 times cultivated	-	-	1	1	1	1
Control II - non cultivated	-	-	1	1	8.5	9
Trifluralin + prometrin (Standard)	0.96 + 3.00	ppi 8 cm preem	1.3	1	1.7	2
Trifluralin + oxyfluorfen	0.96 + 0.24	ppi 8 cm preem	1.5	1.1	1.9	2.4
Trifluralin + bifenox	0.96 + 0.48	ppi 8 cm postem	1.2	1.1	1.5	2.4
Trifluralin + imazamethabenz	0.96 + 0.25	ppi 8 cm postem	1	1	1.5	2.7
Propaquizafop + imazamethabenz	0.08 + 0.25	postem	1	1	1.7	2.9

1) Selectivity
1 = no phytotoxic symptoms
9 = 85 - 100% damaged plants

2) Efficacy
1 = 90 - 100% controlled weeds
9 = 85 - 100% non controlled weeds

*) number of locations

Table 4.

Grain yield (t/ha) obtained in the experiments with volatile herbicide treatments for controlling the annual weeds in sunflower crops.
ROMANIA, 1993-1995.

Herbicides	Rate kg a.i./ha	Time of application	Soil type			
			<2.5 % humus (3*)		>2.5 % humus (5*)	
			t/ha	%	t/ha	%
Control I-3 times cultivated	-	-	2.64	100	3.42	100
Control II - non cultivated	-	-	1.52	58***	1.37	40***
Trifluralin + prometrin (Standard)	0.96 + 3.00	ppi 8 cm preem	2.48	94	3.11	91
Trifluralin + oxyfluorfen	0.96 + 0.24	"	2.40	91	3.01	88*
Trifluralin + bifenox	0.96 + 0.48	ppi 8 cm postem	2.51	95	3.07	90*
Trifluralin + imazamethabenz	0.96 + 0.25	"	2.56	97	2.98	87**
Propaquizafop + imazamethabenz	0.08 + 0.25	postem	2.40	91	2.95	86**
		LSD for	P < 0.05	11		10
			P < 0.01	15		13
			P < 0.001	19		17

*) number of locations

(Raphanus, Chenopodium, Solanum, Amarathus, Polygonum, Cirsiumn Convolvulus) species contributed equally to the weed infestation.

A higher weed infestation (80-85%) was recorded in the locations situated on chernozemic soils, with a humus content larger than 2.5% (Fundulea, Teleorman, Caracal, Lovrin, Podu Iloaiei), the predominant weeds (60%) being the species *Setaria, Echinochloa, Digitaria.* Dicotyledonous species *Sinapis, Amaranthus, Xanthium, Chenopodium, Solanum, Abutilon, Hibiscus, Gallium, Cirsium, Convolvulus, Sonchus* had a lower frequency (40%). Perennial species represented 20-25% in these conditions.

Selectivity (tables 1 and 3). Higher phytotoxic effects were registered on brown soils at the herbicides oxifluorfen (score 1.7 - 1.8), bifenox (score 1.2) and prometrin (score 1.3) than those found on chernozemic soils (maximum score 1.1). The treatments with the new herbicides dimethenamid, acetochlor+safener, dimethenamid+butylate, applied at planting and with imazamethabenz alone or *tank mix* with propaquizafop, applied during the vegetation, manifested a very good selectivity for the hybrids grown in the experiments.

Efficacy (tables 1 and 3). In the conditions of weed infestation mentioned above, the treatments with herbicides, particularly those applied preem had a good efficacy (90-95% controlled weds) on the brown soils, due to the higher rainfall (60.3 mm on the average) and to the low frequency of perennial species *Cirsium, Convolvulus, Sonchus.*

On the chernozemic soils, the level of weed control was only 80-90%, due mainly to the heavier infestation with perennial species (20-25%) and to low rainfall (particularly at the stations located in the Southern Romania - Fundulea and Teleorman - less than 10 mm).

A good level of weed control (both mono- and dicotyledonous species) was obtained by using a treatment *tank mix* between alachlor and oxyfluorfen, applied preem or by applying two treatments: the first at planting with a graminicide (dimethenamid, acetochlor+safener, the combination between dimethenamid and butylate) followed by a treatment with bifenox or imazamethabenz (particularly when a high infestation with *Cruciferae* was present).

The treatment *tank mix* with propaquizatop and imazamethabenz, applied during the vegetation was less efficient (control degree of 80%) on this type of soils than on brown soils (control degree of 90%), due to a longer emergence period of the weeds in the specific drought conditions of the chernozemic soil area, that caused the overpassing of the treatment optimum stage for some groups of weeds, and to the high frequency of the perennial species.

Grain yield (tables 2 and 4) was highly correlated with the degree of weed control. Treatments with non-volatile herbicides, on the brown soils, produced grain yields similar to that obtained at control I (3 times cultivated) (91-95 %), excepting the oxyfluorfen treatment, that yielded significantly less than control I. Because of a less efficient weed control (particularly *Xanthium, Solanum, Abutilon, Cirsium, Convolvulus, Sonchus*), on the chernozemic soils, the yields obtained at the treatments with alachlor + oxyfluorfen, oxyfluorfen and

dimethenamid + imazamethabenz were significantly lower, as compared to control I. The grain yield obtained at the standard treatment (alachlor + prometrin), as well as, at the combined treatments (acetochlor + safener)+bifenox, and (dimethenamid + butylate) + bifenox did not differ significantly from control I. The grain yields obtained at the treatments with volatile herbicides (table 4), on brown soils, were similar that obtained at control I, due to the high weed control degree of such herbicides on this type of soils. The treatments with oxyfluorfen (preem), imazamethabenz and bifenox (postem) were less efficient in controlling species *Xanthium, Solanum, Abutilon, Cirsium, Convolvulus*, and consequently the grain yields obtained at these treatments were significantly lower than control I.

Taking into account the results obtained in this study, the optimum system of chemical weed control, by using the herbicides described herein, might be established according to the type of soils, the degree of weed infestation and the frequency of different species of weeds.

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