EFFICIENCY AND SELECTIVNESS OF HERBICIDE COMBINATIONS IN SUNFLOWER

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Abstract

We studied the respond of sunflower inbred lines and hybrids to herbicide combination. The experiment included six sunflower inbred lines and three hybrids. The herbicide combinations were: trifluralin + fluorochloridone + linuron, pendimenthalin + fluorochloridone + linuron, trifluralin + fluorochloridone + prometryn, alachlor + fluorohloridone + linuron and metolachlor + fluorochloridone. The trial was conducted under field conditions at the experiment fields of the Institute of Field and Vegetable Crops, Novi Sad, The parameters studied were: dry matter content of the above-ground part of seedlings, efficiency and phytotoxicity according to EWRC scale, seed yield, 1000 seed mass and oil content in seed. The father lins were the most sensitive in the first part of growing period. The symptoms of phytototoxicity were slow initial growth and partially necrotic first leaves. The yields of the sunflower lines were different depending on the applied herbicide combination. The combination of trifluralin + fluorochloridone + prometryn negatively influenced the seed yield. The studied herbicide combinations were satisfactory selective for the hybrid sunflower production. The seed yield was at the level of the control variant. The studied herbicide combinations were highly efficient with respect to the existing weeds in the sunflower crop.

Key words: sunflower, weed, herbicide combinations, efficiency, phytotoxicity

Introduction

Application of herbicide in sunflower crop grown for seed is done on the basis of present solutions being introduced in sunflower seed production. There is a justification for the application of herbicides on the basis of solved solutions, to become a regular agrotehnical measure in sunflower seed production for achieving high efficiency in weed control and at the same for escaping all negative consequences.

Sunflower inbred lines have a week competitive ability and they are very susceptible to the presence of weed plants which is not the same with sunflower hybrids. That is why the weed control in sunflower crops grown for seed should be given a special attention.

It is necessary to make a good choice of herbicide depending on the soil type. According to the results of investigations done by Ljubenov (1963), Peer and Atanasev (1963), Kosovac (1963, 1971), Kosovac et al. (1977), Glušac (1989), D'Alessandro and Zora (1992a, 1992b) the success of weed control and increased yield of sunflower seed depends on efficiency of applied herbicide, their quality, selectivity, duration of influence and applied agrotechnical measures.

The aim of this paper was to examine the efficiency of herbicides and their combinations in weed control in the sunflower seed productions and sunflower mercantile production, as well as gaining the knowledge on the reaction of different sunflower genotypes to applied herbicides.

Materials and methods

Six sunflower inbred lines (OCMS-98N, RHA-C-D, OCMS 22, RHA-SNRF-17, OCMS 74, RHA-RFYR 583) and their three hybrids (NS-H-17, NS-H-43 and NS-H-100) were used in this investigations. The investigations were conducted during 1991. and 1992. at location of Rimski Šančevi the Institute of Field and vegetable crops in Novi Sad. The trial was conducted using chernozem soil type, and randomized block design, in three replicates. The planting was done manually with the distance between the rows of 70 cm and the distance inside the row of 30 cm. The incorporation of herbicides was done 10 days prior planting at the depth of 8-10 cm. Pre-emergence herbicides was applied 3 days after sunflower planting. Applied herbicides and their combination are shown in table 1. The analysis of weed sprouting was done a month after the treatment for the first time, and for the second time at the end of sunflower vegetation. The estimation of herbicide efficiency and phytotoxicity was done 20 days after sunflower emergence. Estimation was done according to EWRC method. In order to determine dry matter content, 15 plants at the stage of two leaf pairs were sampled from each treatment and dried at the temperature of 105°C. Dry matter content per one plant was calculated. The seed oil content (%) was determined by using nuclear magnetic resonance analyzer. The analysis of variance was used for dry matter content of the above-ground part of seedlings, seed yield, oil content and 1000 seed mass,.

Table 1. Investigated herbicides

Herbicides and time of application	Rate (kg a. i. ha^{-1})
A) Trifluralin ** + Fluorochloridone + Linuron*	0.96 + 0.5 + 0.5
B) Pendimethalin ** + Fluorochloridone + Linuron *	1.32 + 0.5 + 0.5
C) Trifluralin ** + Fluorochloridone + Prometryn *	0.96 + 0.5 + 1.5
D) Metolachlor + Fluorochloridone *	1.5 + 0.5
E) Alachlor + Fluorochloridone + Linuron *	1.44 + 0.5 + 0.5
F) Control (hand-weeded)	-

** - pre-sowing, * - pre-emergence

Results

The results of investigation pointed out that there were at the beginning of investigation (in the phase of first and second steady leaf pairs) some phytotoxicity changes on the parent components treated with mentioned herbicide combinations. The changes were manifested by necrosis and plant growth retardation and were more pronounced in father lines (Table 2). There were no phytotoxicity changes in sunflower hybrids. The herbicide combination Trifluralin + Fluorochloridone + Prometryn (0.96 + 0.5 + 1.5 kg/ha) was the most phytotoxic for parent lines manifested by growth retardation and plant drying. RHA-C-D (father of NS-H-17) was the most sensitive to applied herbicides where the phytotoxic symptoms were the most pronounced.

The following weed species were of higher intensity of appearance: *Amaranthus retroflexus, Amaranthus blitoides, Chenopodium album* and *Echinochloa crus-galli*. All examined herbicide combinations efficiently affected the annual weed species (Table 2 and 3). Of perennial weed species the following were present: *Convolvulus arvensis, Sorghum halepense* and *Cirsium arvense.*

Table 2. Efficiency of herbicides in 1991.

Weed	Herbicides				
	A	B	C	D	E
Amaranthus retroflexus	+++	++	+++	++	+++
Amaranthus blitoides	+++	+++	+++	+++	+++
Amaranthus hybridum	+++	+++	+++	+++	+++
Chenopodium hybridum	+++	+++	++	+	+
Chenopodium album	+++	+++	+++	+	+
Convolvulus arvensis	-	-	-	-	-
Solanum nigrum	+++	+++	+++	+++	+++
Echinochloa crus-galli	+++	+++	+++	+++	+++

(+++) efficiency 90-100%, (++) efficiency 80-90 %, (+) efficiency 65-80 %, (-) not efficiency

Table 3. Efficiency of herbicides in 1992.

Weed	Herbicides				
	A	B	C	D	E
Amaranthus retroflexus	+++	++	+++	+	+++
Amaranthus blitoides	+++	+++	++	+++	+++
Amaranthus hybridum	+++	+++	+++	+++	+++
Chenopodium hybridum	+++	+++	+++	+	+
Chenopodium album	+++	+++	+++	+++	+++
Diplotaxis muralis	+++	+++	+++	+++	+++
Sorghum halepense	+++	+++	+++	+++	+++
Convolvulus arvensis	-	-	-	-	-
Solanum nigrum	+++	++	+++	+++	+
Polygonum persicaria	+++	++	+	++	+
Veronica arvensis	+++	+++	+++	+++	+++
Echinochloa crus-galli	+++	+++	+++	+++	+++
Polygonum lapathifolium	+++	+++	+++	+++	++
Cirsium arvense	-	-	-	-	-

(+++) efficiency 90-100%, (++) efficiency 80-90 %, (+) efficiency 65-80 %, (-) not efficiency

Table 4. - Visible phytotoxicity (EWRC)

Lines and hybrids	Herbicides									
	A		B		C		D		E	
	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992
OCMS-98N	2	1	1	1	5	2	1	1	1	1
NS-H-17	1	1	1	1	1	1	1	1	1	1
RHA-C-D	3	3	4	4	5	4	4	4	2	4
OCMS 22	1	1	1	1	5	3	1	1	1	1
NS-H-43	1	1	1	1	1	1	1	1	1	1
RHA-SNRF-17	2	1	1	1	5	2	2	1	2	1
OCMS 74	1	1	1	1	5	2	1	1	1	1
NS-H-100	1	1	1	1	1	1	1	1	1	1
RHA-RFYR 583	1	1	1	1	5	2	1	1	1	1

Of the investigated herbicide combination only the combination Trifluralin + Fluorochloridone + Prometryn in the dosage of 0.96 + 0.5 + 1.5 kg a. i. ha^{-1} had significantly negative influence on the seed yield and dry matter mass of parent lines (Table 5), while there were no significant differences in hybrids in relation to control.

Table 5. Effect of herbicides on dry matter mass, seed yield, 1000 seed mass and oil content in seed

Herbicides	Inbred lines and hybrids								
	OCMS-98N	NS-H-17	RHA-C-D	OCMS 22	NS-H-43	RHA-SNRF-17	OCMS 74	NS-H-100	RHA-RFYR 583
Dry matter mass (g)									
A	0.42	0.54	0.26	0.25	0.44	0.27	0.32	0.56	0.23
B	0.43	0.46	0.22	0.27	0.46	0.30	0.37	0.61	0.23
C	0.38	0.56	0.19*	0.21	0.55	0.22	0.31	0.61	0.21
D	0.44	0.58	0.25	0.28	0.55	0.30	0.33	0.60	0.26
E	0.40	0.59	0.23	0.26	0.47	0.27	0.33	0.59	0.23
F	0.39	0.57	0.26	0.23	0.49	0.28	0.34	0.60	0.24
LSD (0.05)	0.06	0.14	0.06	0.08	0.12	0.09	0.06	0.08	0.06
(0.01)	0.08	0.20	0.08	0.12	0.16	0.13	0.08	0.12	0.08
Seed yield (kg ha^{-1})									
A	1180	3372	494	1285	4017	438	1435	3450	430
B	1211	3415	520	1236*	3966*	440	1458	3423	428
C	829**	3346	396**	1121**	3969*	298**	1141**	3634	359**
D	1112	3409	491	1338	4019	468	1483	3551	433
E	1147	3394	506	1307	3968*	469	1477	3309	437
F	1203	3457	514	1318	4082	491	1509	3373	440
LSD (0.05)	106	115	55	74	92	60	81	261	16
(0.01)	147	164	73	89	130	78	115	370	21
1000 seed mass (g)									
A	55.2	56.6	30.1	47.8	61.3	35.6	54.1	67.2	37.7
B	55.3	56.5	31.3	49.3	63.3	34.1	53.6	62.2	35.9
C	55.4	60.2	30.8	49.6	62.5	34.3	52.5	64.2	38.4
D	56.6	61.9	30.2	49.3	62.6	35.5	54.5	67.8	37.7
E	55.5	64.2	32.3	45.5	62.7	34.8	53.7	69.2	38.2
F	55.3	62.9	30.0	46.5	62.8	36.6	51.8	68.4	37.9
LSD (0.05)	4.9	6.8	1.6	3.8	3.9	3.5	5.1	6.9	3.0
(0.01)	6.9	9.7	2.3	5.4	5.6	5.0	7.3	9.8	4.3
Oil content in seed (%)									
A	46.6	49.8	45.1	43.8	45.7	45.8	39.6	41.3	45.7
B	47.7	51.3	46.1	44.6	47.1	48.4	39.8	43.1	46.0
C	49.4	50.1	46.3	45.2	47.2	48.9	41.8	43.7	47.1
D	48.6	50.5	46.4	45.1	47.0	47.3	41.8	42.2	46.3
E	47.1	49.6	45.2	44.3	47.4	47.8	40.3	41.3	45.9
F	48.1	49.9	44.7	44.7	46.7	47.2	39.9	41.9	45.6
LSD (0.05)	1.6	1.3	1.4	1.4	1.1	1.0	1.3	1.1	1.0
(0.01)	2.1	1.9	2.0	2.0	1.5	1.3	1.9	1.6	1.4

*,**; significant difference at 0,05 and 0,01 levels in compared to control, respectively

Herbicides had no influence on the change of oil content in seed and 1000 seed mass in relation to control variant. On the basis of the achieved results one can conclude that prometryn in the dosage of 1.5 kg a.i.ha^{-1}, alone or in the combination with other herbicides, should not be applied for the production of sunflower inbred lines.

Conclusion

It can be concluded from the results as follows:
-There exists a significant susceptibility of different sunflower genotypes to the applied herbicide combinations;
-Selectivity of the applied herbicides depended on active matter, genotype and environment conditions;
-The line RHA-C-D was most sensitive;
-The lowest selectivity was achieved with the combination Trifluralin + Fluorochloridone + Prometryn (0.96 + 0.5 + 1.5 kg/ha), which is evident through significantly lower yields of inbred sunflower lines.
- All examined herbicide combinations efficiently affected the annual weed species.

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