EVALUATION OF PRE-EMERGENCE HERBICIDES AND THEIR COMBINATIONS IN SUNFLOWER

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Abstract

During the 1983/84 growing season it was conducted a field experiment in Guaíba, RS, Brazil, in order to evaluate the efficiency of pre-emergence herbicides and their combinations for weed control in sunflower. The herbicide treatments evaluated were 2-chloro-2',6-diethyl-N-(methoxymethyl) acetanilide (alachlor; 3600 g/ha), 3-amino-2,5-dichlorobenzoic acid (chloramben; 2250 g/ha), 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea (linuron; 750 g/ha), 2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2methoxy-1-methylethyl)-acetamide (metolachlor; 2160 g/ha), and 2,4-bis(isopropylamino)-6-(methylthio)-s-triazine (prometryn; 1920 g/ha) and also the combinations of alachlor or metolachlor with chloramben, linuron or prometryn, when the rates were reduced by 1/3 of those applied individually. The most efficient herbicide treatment, equivalent to the weed-free check, was the combination of metolachlor + prometryn; however, it did not differ from alachlor + prometryn, alachlor + chloramben, and alachlor alone. Linuron, prometryn, and chloramben were the treatments that presented the lowest herbicide efficiency due to their defficient grass weed control.

Introduction

The sunflower crop presents the possibility to be grown as an oil seed crop in the Southern region of Brazil and interest in its cultivation has increased in recent years. In the State of Rio Grande do Sul the tendency of this crop is to expand and occupy certain areas where other crops like corn and dry beans has been traditionally grown at the time sunflower is seeded by the end of winter or beginning of spring. These areas have a history of a broad-spectrum weed infestation, including mono and dicotiledonous species of both cool and warm season annuals. Therefore, information is needed on cultural practices for weed control, including the chemical method, in order to solve the problem.

Many soil applied herbicides are available for weed control in sunflowers; however, for foliage application the chances are restricted to a few products and these include mainly grass control chemicals. So, at the present time, it is difficult to select an efficient post-emergence herbicide whose action would be on broadleaf weeds. Consequently, broad-spectrum weed control depends, at least in part, on soil applied herbicides. Although chemical weed control is used in sunflower fields in important producing areas of the world and research has been conducted concerning herbicide evaluation (Vrânceanu 1977), results not always can be directly applied to new producing areas. Factors like soil type, climatic conditions and other practices can influence herbicide performance(Johnson 1972a and 1972b).

Since information on chemical weed control for sunflower in Brazil, and particularly in Rio Grande do Sul is scarce or only preliminary, it was designed this investigation to determine the effects of pre-emergence herbicides, applied alone or in combination, on weed control, crop tolerance, and agronomic characteristics of sunflowers.

Materials and Methods

The experiment was conducted at the Estação Experimental Agronômica of Universidade Federal do Rio Grande do Sul, in Guaíba, RS, Brazil, during the

1983/84 growing season on a sandy clay loam soil having a 2.0% organic matter content. It was used the 'CONTI-711' cultivar and sunflower was seeded on September 12, 1983. Prior to sunflower seeding were applied 20 kg/ha of N, 60 kg/ha of P_2O_5, and 50 kg/ha of K_2O and disked into the soil. The average sunflower population was 46,300 plants per hectare.

The herbicide treatments were apllied as pre-emergence applications immediately after seeding. The following treatments were tested: alachlor (3600 g/ha), chloramben (2250 g/ha), linuron (750 g/ha), metolachlor (2160 g/ha), prometryn (1920 g/ha), alachlor (2400 g/ha) + chloramben (1500 g/ha), alachlor (2400 g/ha) + linuron (500 g/ha), alachlor (2400 g/ha) + prometryn (1280 g/ha), metolachlor (1440 g/ha) + chloramben (1500 g/ha), metolachlor (1440 g/ha) + linuron (500 g/ha), and metolachlor (1440 g/ha) + prometryn (1280 g/ha). Also were included an untreated check and a weed-free control that was hand hoed. The herbicides were apllied as a spray to the soil surface at a rate of 250 l/ha with a plot sprayer. The treatments were arranged in a randomized block experimental design with four replications. Each plot contained four 6 m rows spaced 75 cm apart.

The composition of the weed infestation was mainly of **Digitaria ciliaris** (Retz.) Koel., but also occurred the species **Echinochloa** spp., **Eleusine indica** (L.) Gaertn., **Amaranthus** spp., **Ambrosia elatior** L., **Bidens pilosa** L., **Polygonum convolvulus** L., and **Richardia brasiliensis** (Moq.) Gomez. The weed control was estimated visually using a scale from 1 to 10, with 1 representing no weed control and 10 representing complete control. Plant height, head size (diameter), achene number per head, and achene weight were measured on a ten plant randomized sample per plot. Plant population and seed yield of sunflower were taken at the central two rows of the plot. All data were statistically analyzed, and the treatment means were compared using the Duncan's Multiple Range Test.

Results

Data for herbicide efficiency (Table 1) showed that, for the first visual rating, high weed control grades were obtained for almost all treatments, except for prometryn and linuron. For latter evaluations, weed control values generally decreased, mainly for the treatments prometryn, linuron, and chloramben. Concerning weed control, the combination metolachlor + prometryn was equivalent to the weed-free check; however, that treatment did not differ from alachlor + prometryn, alachlor + chloramben, and alachlor alone, all showing weed control values always higher than 8.5. Alachlor + linuron, metolachlor + linuron, metolachlor, and metolachlor + chloramben demonstrated intermediate herbicide efficiency; whereas, chloramben, prometryn, and linuron showed poor weed control activity in this investigation when they were applied alone. On the other had, it was not observed visible injury effects of the treatments tested on sunflower plants; therefore, considering the conditions of this experiment, apparently all herbicides demonstrated selectivity to the crop.

Sunflower plant population, plant height, and head size (Table 2) were not affected by the treatments; except, linuron and the untreated check that reduced those characteristics. As far as other agronomic characteristics are concerned (Table 3), the herbicides prometryn and linuron significantly reduced sunflower yield, achene number per head, and the mean achene weight as compared to the handweeded check. For achene weight, prometryn was not statistically different from the other herbicides, except for metolachlor + linuron and alachlor + linuron. The weed infestation present during all season in the untreated check caused reductions of 50.3%, 41.7%, and 17.3%, respectively, on achene yield, number, and weight in relation to the handweeded control.

Table 1. Evaluation of pre-emergence herbicides and their combinations in sunflower, Guaíba, RS, Brazil, 1983/84.

Treatment	Rate (g/ha)	Weed control rating[1/]		
		25 days[2,3/]	40 days	53 days
Handweeded control	-	10.a a	10.0 a	10.0 a
Metolachlor + prometryn	1440 + 1280	9.8 a	9.4 ab	9.4 ab
Alachlor + prometryn	2400 + 1280	9.8 a	9.4 ab	9.0 bc
Alachlor + cloramben	2400 + 1500	9.7 a	9.3 ab	8.8 bc
Alachlor	3600	9.6 a	8.8 bc	8.5 bc
Alachlor + linuron	2400 + 500	9.5 a	8.9 bc	8.2 cd
Metolachlor + linuron	1440 + 500	9.3 ab	8.7 bc	8.1 cd
Metolachlor	2160	8.7 ab	8.1 c	7.2 d
Metolachlor + chloramben	1440 + 1500	8.7 ab	8.0 cd	7.5 d
Chloramben	2250	8.2 b	7.1 d	6.3 e
Prometryn	1920	5.5 c	4.6 e	3.7 f
Linuron	750	3.7 d	2.8 f	2.4 g
Untreated control	-	1.0 e	1.0 g	1.0 h
Mean		8.0	7.4	6.9
Coefficient of variability (%)		10.0	8.9	8.9

1/ Weed control was visually rated using a 1 to 10 scale where 1 = no control, and 10 = complete control.

2/ Evaluations after pre-emergence herbicide applications.

3/ Means followed by the same letter in the column are not significantly different at the 5% level according to Duncan's multiple range test.

Table 2. Evaluation of pre-emergence herbicides and their combinations in sunflower, Guaíba, RS, Brazil, 1983/84.

Treatment	Rate (g/ha)	Stem diameter[1,2] (cm)	Plant height (cm)	Plant population (10m²)
Handweeded control	-	18.7 a	162 a	45.5 a
Alachlor	3600	18.3 a	162 a	46.0 a
Chloramben	2250	18.4 a	160 a	47.0 a
Metolachlor	2160	18.0 a	158 a	47.0 a
Prometryn	1920	17.6 a	156 a	44.5 a
Alachlor + chloramben	2400 + 1500	18.1 a	159 a	47.5 a
Alachlor + linuron	2400 + 500	18.5 a	161 a	44.5 a
Alachlor + prometyn	2400 + 1280	18.7 a	159 a	45.2 a
Metolachlor + chloramben	1440 + 1500	18.3 a	156 a	47.5 a
Metolachlor + linuron	1440 + 500	18.3 a	163 a	46.8 a
Metolachlor + prometryn	1440 + 1280	18.4 a	162 a	47.2 a
Linuron	750	15.6 b	146 b	46.5 a
Untreated control	-	14.3 b	139 c	46.8 a
Mean		17.8	157	46.3
Coefficient of variability (%)		6.6	2.6	6.2

1/ Determinations taken 75 days after sunflower emergence (anthesis complete).

2/ Means followed by the same letter in the column are not significantly different at the 5% level according to Duncan's multiple range test.

Table 3. Evaluation of pre-emergence herbicides and their combinations in sunflower, Guaíba, RS, Brazil, 1983/84.

Treatment	Rate (g/ha)	Grain yield 1,2/ (kg/ha)	Achenes per head (number)	Weight of 1,000 achenes (g)
Handweeded control	-	2,923 a	727 a	88.6 a
Metolachlor + linuron	1440 + 500	2,841 a	699 a	87.2 ab
Alachlor + linuron	2400 + 500	2,650 a	688 a	86.7 ab
Alachlor	3600	2,946 a	744 a	86.4 abc
Alachlor + chloramben	2400 + 1500	2,788 a	691 a	84.9 abc
Metolachlor + prometryn	1440 + 1280	2,778 a	692 a	84.9 abc
Metolachlor + chloramben	1440 + 1500	2,749 a	672 a	86.1 abc
Alachlor + prometryn	2400 + 1280	2,612 a	681 a	84.6 abc
Metolachlor	2160	2,713 a	684 a	84.6 abc
Chloramben	2250	2,652 a	676 a	83.5 bc
Prometryn	1920	2,182 b	596 b	82.5 cd
Linuron	750	1,975 b	531 b	79.8 d
Untreated control	-	1,453 c	424 c	73.3 e
Mean		2,559	654	84.1
Coefficient of variability (%)		9.1	7.4	2.9

1/ Grains at 13% moisture.

2/ Means followed by the same letter in the column are not significantly different at the 5% level according to Duncan's multiple range test.

Discussion

Since linuron and prometryn activity tends to be higher on annual broadleaf weeds than of grasses and that alachlor and metolachlor show better efficiency on annual grasses and less so on broadleaf species (Weed Science Society of America 1983), results of this research showed these same trends when these herbicides were applied alone. Chlorambem, however, showed an intermediate performance on those weed classes. Therefore, the low visual ratings for linuron and prometryn could be expected, since the area was infested mainly by **Digitatia ciliaris**, an annual grass weed that was poorly controlled by these two chemicals. The combinations of alachlor or metolachlor with prometryn and of alachlor plus chloramben provided the highest weed control values. Other researchers also found that the combination of alachlor with prometryn satisfactorily controlled both grasses and broadleaf weeds in sunflower (Johnson 1972a and 1972b). It was also reported by the researcher that cloramben did not control efficiently grasses (Johnson 1972b).

As a result of poor **Digitaria** control with linuron and prometryn, the competition exerted by this species resulted in decreased sunflower yield and also produced negative effects on the agronomic characteristics evaluated.

In conclusion, sunflower showed tolerance to the herbicides tested in this experiment, while the chemicals adequately controlled the weeds, particularly **Digitaria ciliaris**. Linuron and prometryn, however, when applied alone, controlled satisfactorily broadleaf weeds but did not show efficiency against **Digitaria**. So, soil applied herbicides as pre-emergence treatments seemed to be an appropriate technology for weed control under similar growing conditions of Southern Brazil.

References

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