SUNFLOWER TOLERANCE TO PRE-EMERGENCE BROADLEAF WEED HERBICIDES

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Summary

The limited sunflower area compared with major crop areas (soybean, sugarcane and corn) is not an incentive for herbicide companies to develop new products especially for this crop. Only three herbicides are registered for sunflower in Brazil. Two of them provide a narrow spectrum for broadleaf weed control (alachlor and trifluralin) and the third one is specific for grasses (sethoxydim). A field experiment was carried out in Londrina, Paraná State, Brazil, during the 1998 sunflower season, to evaluate the selectivity of acetochlor and oxyfluorfen applied on pre-emergence. The experiment was conducted in a randomized complete block design, with four replications. The herbicides and their doses were acetochlor 0, 1152, 2304, 3456 and 4608 g ha^{-1} and oxyfluorfen 0, 360, 720, 1080 and 1440 g ha^{-1}. A backsprayer was used, at constant pressure, with nozzles of 110-02 DG, delivering 200 L ha^{-1}. The herbicide acetochlor reduces seed oil content and yield of sunflower cv M 742, when applied at the dosage of 2304 g ha^{-1} and/or at dosages higher than this. Oxyfluorfen applied at the dosage of 360 g ha^{-1} is selective to the sunflower crop.

Introduction

The extent of losses caused by weeds on sunflower yield may reach 20% to 50% (Chubb, 1975; Montes de Oca and Pearson, 1987; Trasmontes and Duarte, 1991). The presence of weeds during the first stages of the sunflower crop cycle results in chlorotic and short plants with severe decrease of leaf area, stem diameter and head size (Blamey *et al*., 1997). When yield components are considered, the number of seeds per head is the one with the highest reduction (Bedmar, 1983). Herbicides are an excellent alternative for weeds elimination, however, they might cause damage to the crop, especially if not used properly.

The availability of registered herbicides in Brazil which are selective to the sunflower crop is limited. Only trifluralin, sethoxydim, and alachlor are registered for weed control on this crop, demanding a rigid cultural, mechanical, and chemical control program.

The objective of this experiment was to evaluate the selectivity of herbicides applied on pre-emergence on the sunflower crop in a clay textured soil.

Materials and methods

The experiment was carried out from March 18th to October 1st 1998, at Embrapa Experimental Field, Londrina County, State of Parana, South Brazil, located at 23º 23'South, and 51º 11' WGr.

The climate of the region, according to Köppen's classification, is Cfa, that is sub-tropical climate with rains during all seasons and dry periods during winter. Annual average temperature is around 20.7º C and average annual precipitation is around 1.615 mm (Corrêa *et al*, 1982).

The soil where the experiment was carried out was classified as Distrophic Latosol. Data on physical and chemical analysis are shown on Table 1. Each treatment was replicated four times in a randomized block design. Each block consisted of the treatments acetochlor at the dosages of 0, 1152, 2304, 3456, and 4608 g ha^{-1} and oxyfluorfen at the dosages of 0, 360, 720, 1080, and 1440 g ha^{-1}. The sunflower hybrid M 742 was sown at a 0.90 m interspacing with five seeds per linear meter. Each plot area was 20 m^2 (4 x 5m). Fertilization at sowing time consisted of 350 kg ha^{-1} of a 5-25-25 formulation uniformely distributed on the area. Thirty two kg of nitrogen were applied per ha at 30 days after sowing (DAS). Boron was applied by foliar spray at a dosage of 1.2 kg ha^{-1}. The herbicide applications were performed after sowing under pre-emergence conditions. A backsprayer was used, at constant pressure, with nozzles of 110-02 DG, delivering 200 L ha^{-1}. During application, the air temperature was 23º C and relative humidity was 78%. The soil surface was humid and wind velocity was 4 km h^{-1}. The weeds were removed by hand in order to evaluate solely the effect of the herbicides on the crop. The degree of phytotoxicity was evaluated by visual method (percent scale) at 20 and 40 DAS, with 0% meaning no symptoms and 100% meaning the death of the plant. The maximum level of phytotoxicity admitted in farming conditions was 25%. Oil content was determined by nuclear magnetic resonance, using an Oxford, model 400 UMR device. Yield was evaluated by harvesting two 4 m long rows at the center of the plot (7.2 m^2). Regression models were adjusted to collected data providing phytotoxicity at 20 and 40 DAS, oil content, and yield as response variables and herbicide dosages as explanatory variable.

Results and discussion

The degree of phytotoxicity on sunflower plants significantly increased as dosages of acetochlor were also increased (Figure 1 A). This herbicide affected mainly the height of sunflower plants. The application of 2304 g ha^{-1}, the dosage recommended for other crops, caused damages to the shoots. Phytotoxicity symptoms reached 18% at 20 DAS, being increased up to 40 DAS for the two highest dosages of the product. The average oil content value was 36.2% when 2304 g ha^{-1} were applied, and 37.4% in the control plots (Figure 2 A). Laboratory studies had shown that sunflower plants tolerated acetochlor in dosages varying from 1500-2000 g ha^{-1} (Prado *et al*., 1993). Regarding the yield, the average value observed was 1394 kg ha^{-1} when 2304 g ha^{-1} of acetochlor were applied. On the control plots, the yield was 1675 kg ha^{-1} (Figure 3 A).

The herbicide oxyfluorfen is recommended at dosages varying from 240 to 1440 g ha^{-1} for several other crops such as rice, cotton, coffee, and eucalyptus (Rodrigues and Almeida, 1995). This product caused increases in the percent values of phytotoxicity as dosages applied were increased (Figure 1 B), causing tissue necrosis on sunflower leaves. Values around 20% of phytotoxicity were obtained with the 360 g ha^{-1} dosage at 20 DAS and 22% at 40 DAS. The average figures for oil content and yield decreased with the increasing dosages of the product (Figures 2B and 3B). However, the application of 360 g ha^{-1} resulted in average figures of 37% and 1616 kg ha^{-1} for oil content and yield while these values were 37.4% and 1675 kg ha^{-1} for the control plots, respectively. Studies performed with this chemical at a dosage of 480 g ha^{-1} revealed no reduction on sunflower yield (Pinzariu *et al.*, 1996). Both herbicides used are adsorbable by soil colloids from the clay as well as from the organic matter (Rodrigues and Almeida, 1995). Thus, in sandy soils and/or in soils with low organic matter content, the phytotoxicity effect will probably be higher.

Conclusion

The herbicide acetochlor reduces seed oil content and yield of sunflower cv M 742, when applied at the dosage of 2304 g ha^{-1} and/or dosages higher than this.
Oxyfluorfen applied at the dosage of 360 g ha^{-1} was selective to the sunflower crop.

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Table 1- Physical and chemical soil parameters for the 0 – 20 cm soil layer at the Embrapa Soybean experimental field. Embrapa National Soybean Research Center, Londrina, PR, 1998[1].

clay	silt	sand	organic matter	P	pH $CaCl_2$	Al^{+3}	K	Ca	Mg	$H^{+}+Al^{+3}$	CEL
----------% ----------				mg/dm^3		----------$cm ol_c/dm^3$----------					
76,2	15,4	8,4	2,89	20,5	5,01	0,05	0,40	4,65	1,60	5,71	12,36

1-analysis performed by the soil analysis laboratory of Embrapa National Soybean Research Center

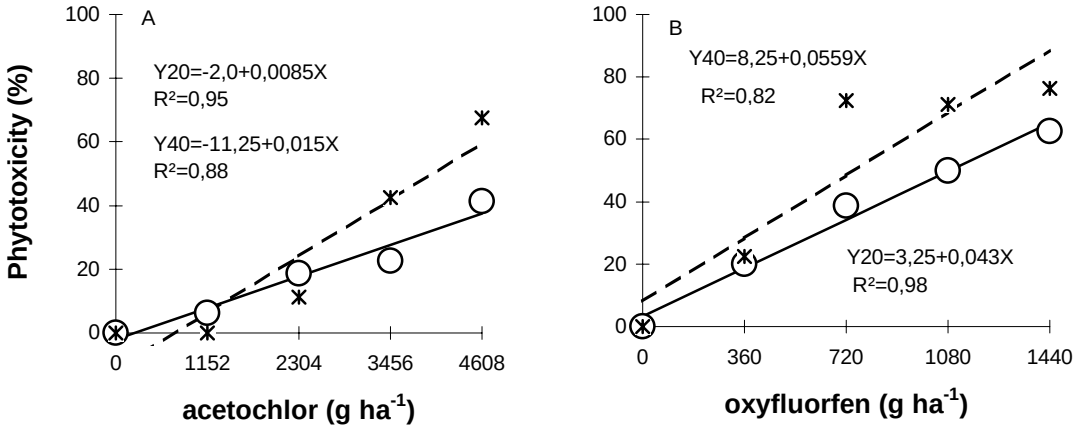

Figure 1. Phytotoxicity on sunflower plants as a function of dosages of acetochlor (A) and oxyfluorfen (B) at 20 (—— ^{0}) and 40 (-----*) days after sowing . Embrapa National Soybean Research Center, Londrina, PR, 1998.

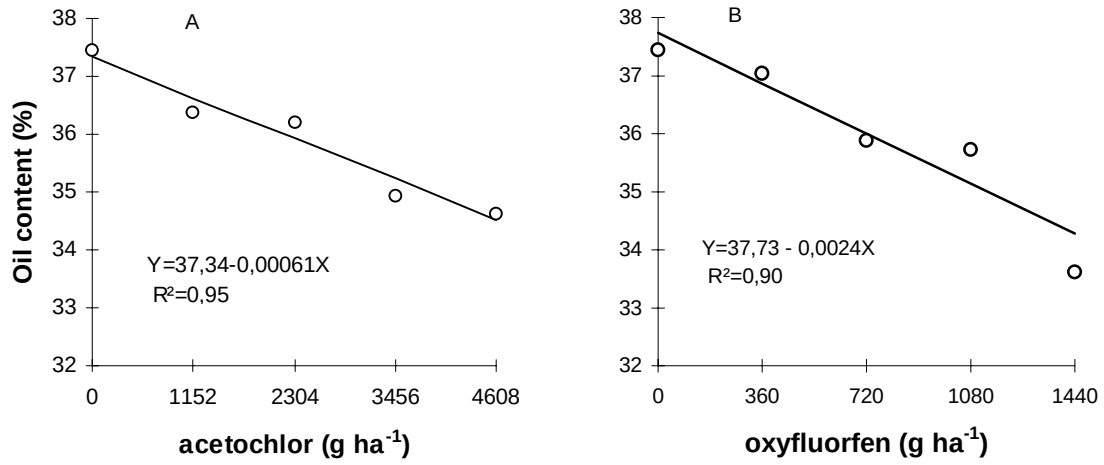

Figure 2. Oil content of sunflower cv M 742 as a function of herbicide doses : acetochlor (A) and oxyfluorfen (B). Embrapa National Soybean Research Center, Londrina, PR, 1998.

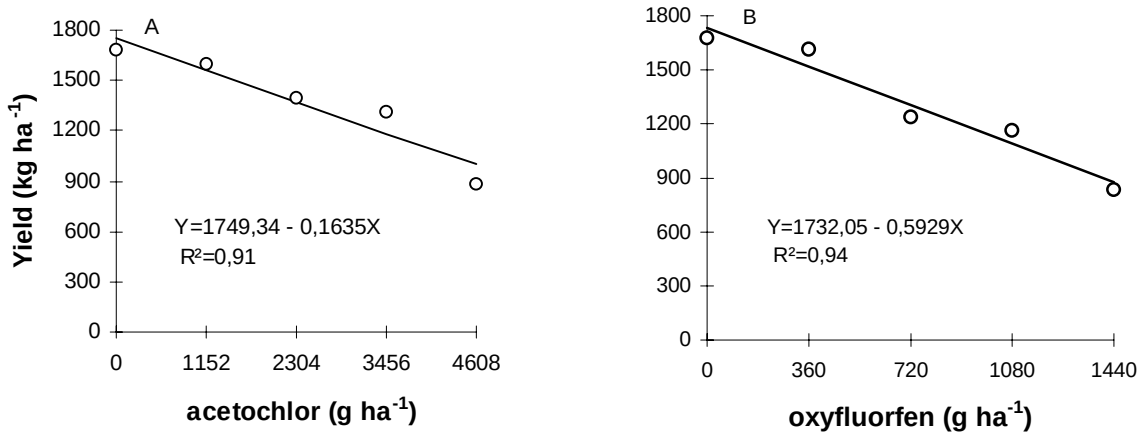

Figure 3. Yield of sunflower cv M 742 as function of herbicide doses: acetochlor (A) and oxyfluorfen (B). Embrapa National Soybean Research Center, Londrina, PR, 1998.