GRAMINICIDES AND BORON COMPATIBILITY FOR VOLUNTEER CORN CONTROL AND MINERAL NUTRITION IN SUNFLOWER

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Abstract

Low levels of boron (B), characteristic of Brazilian soils, can lead to B deficiency, mainly in sunflower at flowering and maturation. In the savanna area, the crop is sowed after corn and volunteer plants emerge which can compete with sunflower. The experiment was carried out at Barra Bonita farm, Chapadão do Céu County, Goiás State, Brazil, to evaluate the control of volunteer corn with graminicides, alone or in combination with boron fertilizer, as well as the response of sunflower crop to this micronutrient. The experiment was arranged in a split-plot design in a randomized complete block, with five replicates. The treatments were haloxyfop-methyl (0.048 kg a.i./ha) plus mineral oil 0.5% v/v, sethoxydim (0.22 kg a.i./ha) plus mineral oil 0.5% v/v, clethodim (0.12 kg a.i./ha) plus mineral oil 0.5% v/v, fluazifop-p-butyl (0.187 kg a.i./ha) and an unweeded check as the main plots and the absence or presence of boron as the subplots. The treatments were applied alone or in combination with 400 g/ha of two B sources (H3BO3 and Na2B8O13.4H_2O). All herbicides applied alone or in association with two B sources were efficient in volunteer corn control with values of 100%. The boron content increased on sunflower leaves when the nutrient was applied with herbicides. The values were on average of 54 mg/kg in the leaves that did not receive boron and 66 mg/kg when this micronutrient was applied. The application of graminicides with boron is a good strategy for controlling volunteer corn and avoiding B deficiency in the sunflower crop.

Introduction

In Brazilian savannas, sunflower (*Helianthus annuus* L.) is sowed after successive corn and volunteer plants can cause sunflower yield losses. Graminicides are an excellent tool for elimination of volunteer corn. However, in Brazil, only two herbicides are registered for sunflower (alachlor and trifluralin). Some graminicides such as clethodim, haloxyfop-methyl, fluazifop-p-butil and sethoxydim are selectives for sunflower culture, being used in other countries. On the other hand, sunflower, when compared to the other cultivated species, is a plant that requires larger amounts of boron to satisfy its metabolic needs. As the Brazilian soils are usually poor in boron, the deficiency symptoms can appear, mainly in the young leaves (Calle-Manzano, 1985). Death of the apices of the root and sprout can happen causing the emergence of lateral regrowth (Gil Martinez, 1995). Boron deficiencies, in field conditions, usually produce several levels of deformation in sunflower heads and cause them to fall (Castro, 1999). However, to solve those problems, foliar boron application has been used by the farmers, increasing the production costs, soil compaction and breakage of sunflower plants. The objectives of this experiment were to evaluate the control of volunteer corn with graminicides, alone or in combination with boron fertilizer, as well as the response of sunflower crop to this micronutrient.

Materials and Methods

The research was carried out at Barra Bonita Farm, Chapadão do Céu County, Goiás State, Brazil. The experiment was arranged in a split-plot design in a randomized complete block, with five replications. The treatments were haloxyfop-methyl (0.048 kg a.i./ha) plus mineral oil 0.5% v/v, sethoxydim (0.22 kg a.i./ha) plus mineral oil 0.5% v/v, clethodim (0.12 kg a.i./ha) plus mineral oil 0.5% v/v, fluazifop-p-butil (0.187 kg a.i./ha) and an unweeded check as the main plots and the absence or presence of boron as the subplots. The treatments were applied alone or in combination with 400 g ha^{-1} of two B sources (H3BO3 and Na2B8O13.4H2O). Sunflower (M734) was sown on February 15, 2003, in no-till, with 80 cm of row spacing and 50,000 plants per ha. The herbicides were applied on March 15, approximately 23 days after the sunflower emergence, using a sprayer with constant pressure of 276 kPa, maintained by compressed CO2, equipped with a bar of 1.5 m of width and four nozzles (110 03 XR), with a water carrier of 240 L/ ha. Sunflower injury symptoms and volunteer corn control were evaluated at 17 and 31 days after the application (DAA) of the treatments, using a percentile scale, where 0% corresponded to the absence of injury symptoms or any corn control and 100% the death of the crop or total corn control. Sunflower stand, plant height, stem diameter, and 1000- grain weight were evaluated. The leaf boron content was obtained collecting the third or fourth leaf, starting from the top of the stem, at the R4/R5 flowering stage. Oil content, grain boron content and yield were also evaluated. Data were submitted to analysis of variance and means compared by Tukey's test (0.05 probability level).

Results and Discussion

No visual injury symptom was observed in sunflower plants when herbicides were applied alone or in association with B sources at 17 DAA (Table 1). However, at 31 DAA phytotoxicity degrees were observed from 0.4% to 1.4%. Sunflower injury symptoms observed in this period were transient and did not affect yield. All treatments applied, alone and in association with the two boron sources, were effective in eliminating volunteer corn, and obtaining 100% control. The leaf boron content increased when the herbicides were applied with two B sources. Those values were statistically superior to those obtained when the herbicides were applied without B. The average of leaf boron content was 54 mg/kg in the leaves that did not receive boron and 66 mg/kg when this micronutrient was applied. The treatments with haloxyfop-methyl and clethodim, in association with each of the two boron sources, presented a higher content of that micronutrient in the grain. No differences among treatments were found for stand, plant height, stem diameter, 1000-grain weight, oil content and yield.

Table 1. Sunflower injury and volunteer corn control percentage at 17 and 31 days after treatment application (DAA), stand (plants/ha), plant height (cm), stem diameter (mm), 1000-grain weight (g), leaf and seed boron content (mg/g), oil content (%) and sunflower yield (kg/ha), as a function of the treatments. Embrapa Soybean, 2003.

Treatments	Boron sources	Phytotoxicity 17 DAA	Phytotoxicity 31 DAA	Volunteer Corn Control 17 DAA	Volunteer Corn Control 31 DAA	Stand (plants ha)	Height (cm)	Stem Diameter (mm)	1000 Grain Weight (g)	Leaf Boron content ($mg\ kg^{-1}$)	Grain Boron Content ($mg\ kg^{-1}$)	Oil Content (%)	Yield ($kg\ ha^{-1}$)
Haloxyfop-methyl	-	0	0,0	100	100	50.625 A[1]	202,7 A	25,0 A	60,0 A	56,6 C	17,7 B	40,6 A	2.259,6 A
	H_3BO_3	0	1,0	100	100	46.875 A	202,0 A	26,5 A	59,2 A	63,1 B	19,1 AB	40,8 A	2.042,0 A
	$Na_2B_8O_{13}.4H_2O$	0	0,0	100	100	50.000 A	200,7 A	25,4 A	57,4 A	66,9 A	20,7 A	40,4 A	2.243,7 A
Sethoxydim	-	0	0,6	100	100	47.708 A	200,1 A	25,3 A	60,5 A	49,1 C	19,9 A	40,1 A	2.171,2 A
	H_3BO_3	0	0,6	100	100	48.958 A	199,3 A	25,1 A	60,2 A	64,2 A	14,5 B	40,5 A	2.148,2 A
	$Na_2B_8O_{13}.4H_2O$	0	0,6	100	100	50.208 A	196,3 A	24,9 A	58,1 A	57,8 B	16,2 B	40,6 A	2.098,9 A
Clethodim	-	0	0,0	100	100	51.458 A	202,8 A	25,2 A	60,0 A	51,7 C	15,3 B	40,6 A	2.283,5 A
	H_3BO_3	0	1,4	100	100	50.000 A	202,0 A	25,6 A	58,2 A	61,8 B	17,0 AB	40,8 A	2.259,5 A
	$Na_2B_8O_{13}.4H_2O$	0	0,0	100	100	49.791 A	201,3 A	25,6 A	60,4 A	66,5 A	18,5 A	41,0 A	2.207,8 A
Fluazifop-p-butil	-	0	0,0	100	100	49.583 A	201,4 A	25,5 A	58,7 A	56,6 B	16,4 A	40,6 A	2.276,1 A
	H_3BO_3	0	0,6	100	100	48.750 A	202,7 A	25,8 A	57,1 A	71,4 A	14,8 A	40,6 A	2.188,7 A
	$Na_2B_8O_{13}.4H_2O$	0	0,4	100	100	50.208 A	203,0 A	26,8 A	58,0 A	68,3 A	15,2 A	40,4 A	2.301,7 A
Unweeded check	-	0	0,0	100	100	49.583 A	197,8 A	24,9 A	56,8 A	58,4 B	14,7 A	41,0 A	2.159,5 A
	H_3BO_3	0	0,0	100	100	49.791 A	199,3 A	25,0 A	59,2 A	71,4 A	15,7 A	40,9 A	2.130,9 A
	$Na_2B_8O_{13}.4H_2O$	0	0,0	100	100	50.208 A	199,1 A	24,7 A	59,5 A	69,3 A	15,6 A	40,4 A	2.238,0 A
C.V. (%)	-	-	-	-	-	6,6	2,3	3,9	4,3	3,6	7,5	1,7	6,8

[1] In each column and treatment, means followed by the same letter do not differ significantly, according to Tukey's test ($P \leq 0.05$).

Conclusions

All herbicides applied alone or in association with each of two B sources were efficient on volunteer corn control. The boron content increased in sunflower leaves when the nutrient was applied with herbicides. The application of graminicides with boron is a good strategy for controlling volunteer corn and avoiding B deficiency in the sunflower crop.

References

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