CPESB Consultoria Agronômica - Pesquisa - Mapeamento de Solos

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Efficiency of chemical control of weeds in soybean by application of glyphosate allied to different manganese sources

1. INTRODUCTION

Brazil, with an estimated soybean production of 113 milliontons for the 2017/18 harvest, currently ranks second in the ranking world production, with most of its production concentrated in the State of Mato Grosso (CONAB, 2018). The soybean crop found in Brazil favorable environment for its development and, with the help of the genetic improvement that provided the adaptability of the crop todifferent regions of the country, it was possible to leverage their cultivation by reaching high levels of productivity. There are several factors that contribute to the attainment ofsatisfactory yields of soybean production, among which the variables climatic conditions, the use of adapted cultivars, sowing in according to the recommendation, adequate soil preparation, among others. About some of the factors mentioned can not be controlled, for but other parameters can be corrected reduce losses and achieve greater productivity. Weeds compete for water, light, nutrients and space, represent one of the main factors contributing to the decrease in the productivity of crops of economic value, such as soybean(Zimdahl, 1993; Agostinetto et al., 2018). According to Varanasi et al. 2016productivity losses as a function of weeds vary according to the crop, the species of weed and the agricultural practices used. According to Pedroso (2016), losses due to mat-soybean can reach 80%, and infested areas present maturation ununiform and lower grain quality. In addition, weeds also interfere with harvesting operations and can act as pest hosts and phytopathogenic agents (Varanasi et al., 2016). The use of chemical control by the use of herbicides has been themain tool in weed management due to the simplicity inapplication, high efficiency and cost reduction by requiring less time and comparison with other practices (Agostinetto et al., 2018; Varanasi et al.al., 2016).With the advent of glyphosate resistant cultivars, this herbicide started to be used on a large scale, facilitating the maintenance of the area and reducing weed-competition. According to Huber et al. (2007) the use of glyphosate contributes to the development of microorganisms capable of oxidizing manganese (Mn), making this nutrient unavailable to plants. As a result, it became essential to supply manganese by using fertilizers with the base of this nutrient. Manganese acts directly on photosynthesis, aiding in the synthesis of chlorophyll. In addition, this element is linked to the enzyme system and is responsible for triggering several important plant reactions. The Mn also has the function of accelerating germination and maturity, while increases the availability of phosphorus and calcium (POTAFOS, 1998).

Despite the importance of Mn to plants, there are indications that some sources of this nutrient when applied together with glyphosate, can alter herbicide efficiency and reduce plant control weeds. The objective of this study was to evaluate the efficiency of control of weeds with glyphosate applications combined with different Mn sources, as well as to evaluate the productivities obtained with the treatments.2.

MATERIAL AND METHODS

2.1 Description of the area.

The experiment was conducted in the experimental area of CPESB -CONSULTING, RESEARCH AND EXPERIMENTATION LTDA, located in Nova Mutum, Mato Grosso, harvest 2017/2018. Geographic coordinates were obtained with GPS (Global Positioning System), with 13 ° 51'24.66 "S(latitude) and 56 ° 8'52.15 "W (longitude), at 433 m altitude. After performing soil analysis of the area, fertilization and control of diseases and pests were carried out in accordance with technical soybean crop in the central region of Brazil (Embrapa, 2014). The area has been corrected according to need after previous evaluation of the soil analysis. The fertilization was performed with Micro Essentials 09-43-00 + 9% sulfur in the dose of 180 kg ha-1, and 200 kg ha-1 of KCL (00-00-60) in the haul before sowing. Rainfall and temperature data were collected daily in the conduct of the test and are available in Annex 1.The applications of agrochemicals were carried out by means of CO pressure pressurized spray, constant pressure (32 psi) with bar of 3 meters and 6 nozzles Teejet type Cone Empty 8005 with volume of solution of 100 L ha-1.

2.2. Experimental design and treatments.

The trial was installed on December 1 with the sowing of the cultivar TMG 1180 RR of semi-determined growth habit and group of relative maturation of 8.0. The experimental design was randomized blocks with eight treatments, including the control with glyphosate without sources of manganese in four replicates.

The assay was conducted as described in the Table 1. Each experimental plot was composed of 12 lines of 10 meters, with 15 plants per linear meter, and line spacing of 0.5 m. At evaluations were carried out in the useful area of the plot, discounting 1 meter of border of each side.

Table 1. Description of treatments: products, doses and times of application,2017/2018 crop. CPESB, Nova Mutum - MT.

Treatment	Product	Rate	Moment
T1	Roundup Transorb	2,5 L ha^{-1}	V5
T2	Roundup Transorb Metalosate Big 5	2,5 L ha^{-1} 0,5 L ha^{-1}	V5
T3	Roundup Transorb Metalosate Big 5	2,5 L ha^{-1} 1,0 L ha^{-1}	V5
T4	Roundup Transorb Metalosate Big 5	2,5 L ha^{-1} 2,0 L ha^{-1}	V5
T5	Roundup Transorb Broadacre Mn	2,5 L ha^{-1} 0,5 L ha^{-1}	V5
T6	Roundup Transorb Kellus Manganese	2,5 L ha^{-1} 0,5 kg ha^{-1}	V5
T7	Roundup Transorb Sulfato de Manganês	2,5 L ha^{-1} 0,5 kg ha^{-1}	V5
T8	Roundup Transorb Starter Manganês	2,5 L ha^{-1} 0,5 kg ha^{-1}	V5

2.2 Statistical evaluation and analysis

Weed numbers were evaluated prior to application of the treatments and at 7, 14 and 21 days after application of the treatments (DAA). For this, a 1 m2 point was sampled within each experimental plot, where we counted the number of weeds. The efficiency of control was calculated based on the initial number of weeds present in the sampled area of each plot, according to Abbott's formula(1925).

For the evaluation of productivity 4 lines of 4 meters of length within the useful area of each experimental plot. After harvest of the repetitions followed the treading, obtaining the weight and correction of moisture content to 13%, the average production was extrapolated to hectare. The mass of one thousand grains (MMG) was obtained by counting one sample of 1000 grains removed from each replicate totaling 4000 grains per treatment, with moisture corrected to 13%. The data were submitted to the Shapiro Wilk normality test and the Analysis of variance by the F test and when significant was Scott Knott's average comparison test at the 5% probability level error message.

3 RESULTS AND DISCUSSION

In the evaluation prior to the application of the treatments, three weed species present in the sampled area, the sorghum of alepo (Sorghum halepense), grass of Santa Luzia (Euphorbia hirta) and milkman(Euphorbia heterophylla). There was no difference between treatments in number of weeds in this initial evaluation (Table 2).Table 2. Previous evaluation of the number of weeds in each treatment, harvest 2017/2018. CPESB, Nova Mutum – MT

Tratamento	*Sorghum halepense*	*Euphorbia hirta*	*Euphorbia heterophylla*
T1	12,0 a	3,5 a	1,3 a
T2	12,3 a	3,8 a	2,3 a
T3	11,8 a	3,3 a	1,8 a
T4	11,8 a	5,0 a	3,3 a
T5	11,5 a	3,8 a	1,8 a
T6	11,3 a	4,5 a	2,8 a
T7	11,8 a	5,0 a	2,0 a
T8	12,0 a	4,8 a	2,3 a
CV (%)	**6,5**	**13,7**	**22,7**

Médias originais transformadas por $\sqrt{Y + 0{,}5}$ seguidas da mesma letra na coluna não diferem entre si pelo teste de Scott Knott ao nível de 5% de probabilidade de erro.

At seven days after application there was difference between treatments on the number of weeds of the species Sorghum halepense and Euphorbia hirta, for both species treatment 7 presented lower control (Figure 1). There was no difference between the treatments in this evaluation in relation to the amount of Euphorbia heterophylla (Table 3).

Although all treatments had superior to the first evaluation at 7 DAA (Figure 1).treatment had a lower control and differed from the other treatments into the number of weeds at 14 DAA, with the highest average. At 21 days after the application of the treatments, there was difference between treatments in relation to the number of weeds in the E. heterophylla species (Table 3).

However, treatment 7 was higher than other treatments regarding the number of weeds of the species S.Halepense and E. hirta (Table 3).Regarding the control percentage, treatment 7 alone did not obtained 100% control of S. halepense until the last evaluation at 21 DAA (Figure 1). None of the treatments obtained 100% control over E. hirtaat 21 days, except for treatment 1.

Still, the other treatments with except for T7, had a high percentage of control over the species, ranging from 79% to 94% (Figure 1). Treatments 1, 2 and 5 had 100% control on E. heterophylla, with treatment 7 being lower than the others, with 56% control (Figure 1).

The treatments 2, 3, 4 and 5 were superior to the other treatments productivity (Table 4). The same treatments also showed productivity increases in relation to T1 (without addition of Mn sources), the largest increments were verified for T5 and T4 with2.5 and 2.0 bags ha-1, respectively (Table 4).

Table 3. Number of weeds at 7, 14 and 21 days post-weaning the application of treatments, harvest 2017/2018. CPESB, Nova Mutum - MT.

	7 DAA		
Tratamento	***Sorghum halepense***	***Euphorbia hirta***	***Euphorbia heterophylla***
T1	2,8 b	2,5 b	1,0 a
T2	3,0 b	2,3 b	1,5 a
T3	3,0 b	2,8 b	1,5 a
T4	3,3 b	3,3 b	2,5 a
T5	2,8 b	3,0 b	1,5 a
T6	3,3 b	2,8 b	2,0 a
T7	6,3 a	4,3 a	2,0 a
T8	3,8 b	4,0 a	1,5 a
CV (%)	**7,7**	**10,6**	**22,1**
	14 DAA		
T1	0,0 b	0,3 b	0,0 b
T2	0,0 b	0,5 b	0,5 b
T3	0,0 b	0,5 b	0,3 b
T4	0,3 b	0,8 b	0,5 b
T5	0,0 b	0,3 b	0,3 b
T6	0,0 b	0,5 b	0,3 b
T7	2,8 a	3,0 a	1,5 a
T8	0,5 b	1,3 b	0,5 b
CV (%)	**16,3**	**25,0**	**28,2**
	21 DAA		
T1	0,0 b	0,0 b	0,0 a
T2	0,0 b	0,3 b	0,0 a
T3	0,0 b	0,5 b	0,3 a
T4	0,3 b	0,5 b	0,3 a
T5	0,0 b	0,3 b	0,0 a
T6	0,0 b	0,5 b	0,3 a
T7	2,5 a	2,3 a	0,8 a
T8	0,0 b	0,5 b	0,3 a
CV (%)	**7,1**	**27,0**	**24,5**

Médias originais transformadas por $\sqrt{Y + 0{,}5}$ seguidas da mesma letra na coluna não diferem entre si pelo teste de Scott Knott ao nível de 5% de probabilidade de erro.

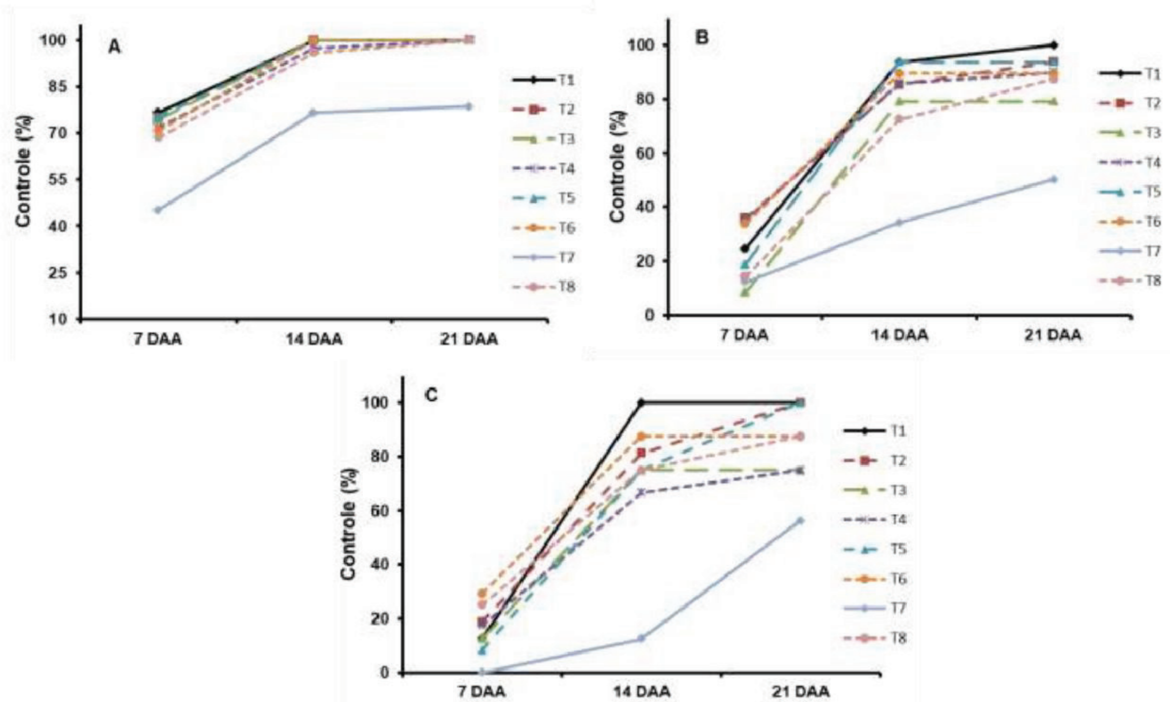

Figure 1. Percentage of control of: A) Sorghum halepense; B) Euphorbiahirta; C) Euphorbia heterophylla, harvest 2017/2018. CPESB, Nova Mutum - MT.

Table 4. Thousand grain mass (MMG) in grams, productivity and increment in sacks ha-1, harvest 2017/2018. CPESB, Nova Mutum - MT.

Treatment	MMG	Yield	% of increase
T1	163,3 a	52,1 b	-
T2	164,4 a	53,5 a	1,4
T3	157,4 b	53,9 a	1,8
T4	159,5 b	54,1 a	2,0
T5	156,8 b	54,6 a	2,5
T6	168,2 a	52,1 b	-
T7	166,5 b	52,1 b	-
T8	150,8 b	50,8 b	-
CV (%)	**3,8**	**2,9**	**-**

Médias seguidas da mesma letra na coluna não diferem entre si pelo teste de Scott Knott ao nível de 5% de probabilidade de erro.

It is important to emphasize that all the treatments that presented increases in productivity have possibly had this only by the reduction of the weed-competition that can be verified by the proximity of the control percentage of the treatments with Mn sources and T1 (without Mn sources), but also because the culture was responsive to different sources of Mn. Treatment 7 was lower than the others, not only in the control of weeds, but also in the this treatment was similar to treatments 1 (without of Mn), 6 and 8. These treatments, except for T8, had an MMG higher than the other treatments, however, the plants possibly had a lower number of pods and grains, which caused these treatments reduced production compared to other treatments present higher productivity than treatment 1.4.

FINAL CONSIDERATIONS

Under the conditions under which this assay was conducted, treatment 7 was lower than the other treatments in the percentage of weed control and did not differ from treatment 1 in yield. The treatments 4 and 5 reached the highest yields, with 54.1 and 54.6 bags ha-1, respectively.

Literature

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Annex 1. Daily data of Temperature (oC) and Precipitation (mm) collected in the Meteorological station located in the experimental area of CPESB in Nova Mutum-MT.