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Article

Residual Activity of Diclosulam Applied to Soybean on Cotton Crop in Succession

Atividade Residual de Diclosulam Aplicado na Cultura da Soja sobre o Algodoeiro em Sucessão

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ABSTRACT - The application of alternative herbicides to replace glyphosate can affect the succession cropping due to the persistence in the soil. The aim of this work was to evaluate the residual activity of diclosulam applied to a pre-emergence soybean crop on a cotton plant grown in succession. The present study used a randomized complete block design with five replicates and seven doses of diclosulam (0, 2.19, 4.38, 8.75, 17.5, 35 and 70 g a.i. ha^{-1}). The cotton was sown 112 days after application of the herbicide, with accumulated rainfall of 637 mm during the soybean cycle. Variables related to photosynthetic characteristics, phytointoxication, growth, components of production and productivity were evaluated in both crops. Diclosulam did not affect the soybean cultivar M7739 IPRO. The residual activity of diclosulam (35 g ha^{-1}) on cotton caused phytointoxication at a rate of 5% at 14, 20 and 27 days after sowing (DAS). However, the components of production, productivity and the cotton fiber quality were not affected up to 70 g ha^{-1} of diclosulam.

Keywords: carryover, *Glycine max, Gossypium hirsutum*, herbicide, persistence.

RESUMO - A aplicação de herbicidas alternativos ao glyphosate pode afetar a cultura em sucessão devido à persistência no solo. O objetivo deste trabalho foi avaliar a atividade residual do diclosulam aplicado em pré-emergência na cultura da soja sobre o algodoeiro em sucessão. O delineamento experimental foi em blocos casualizados com cinco repetições, sendo utilizadas sete dosagens (0; 2,19; 4,38; 8,75; 17,5; 35; e 70 g i.a. ha^{-1}) de diclosulam. O algodoeiro foi semeado 112 dias após a aplicação do herbicida, com precipitação pluvial acumulada de 637 mm durante o ciclo da soja. Foram avaliadas variáveis relacionadas a fotossíntese, fitointoxicação, desenvolvimento, componentes de produção e produtividade em ambas as culturas. O diclosulam não afetou o cultivar de soja M7739 IPRO. A atividade residual do diclosulam (35 g ha^{-1}) sobre o algodoeiro acarretou intoxicação de aproximadamente 5% aos 14, 20 e 27 dias após a semeadura (DAS). Contudo, os componentes de produção e produtividade e as variáveis de qualidade de fibra do algodoeiro não foram afetados até a dosagem de 70 g ha^{-1} de diclosulam.

Palavras-chave: *carryover*, *Glycine max*, *Gossypium hirsutum*, herbicida, persistência.

INTRODUCTION

The use of alternative herbicides with different mechanisms of action became of great importance with the emergence of resistant weeds. Therefore, in order to manage or prevent the selection of resistant biotypes, the use of

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residual herbicides allows the control of several emergence flows, besides rotating the mechanisms of action of herbicides (López-Ovejero et al., 2013).

Among the recommended pre-emergence herbicides for soybean crop is diclosulam [N-(2,6-dichlorophenyl)-5-ethoxy-7-fluoro-(1,2,4)triazolo(1,5-c)pyrimidine-2-sulphonamide], belonging to the sulfonanilide triazolopyrimidine group, whose mechanism of action is the inhibition of acetolactate synthase (ALS), a key enzyme in branched chain amino acid biosynthesis of plants (Rodrigues and Almeida, 2011).

Diclosulam has a soil half-life varying from 16 to 87 days, according to the edaphoclimatic conditions (Yoder et al., 2000; Lavorenti et al., 2003). It provides a broad-spectrum control as a latifolicide and may also suppress the development of some grass species (Rodrigues and Almeida, 2011). This herbicide has been one of the main alternatives to control canadian horseweed and sourgrass resistant to glyphosate, mainly during the autumnal management or during the soybean pre-emergence (Melo et al., 2012; Constantin et al., 2013).

The dosage of diclosulam recommended for soybean cultivation may vary from 25 to 35 g ha^{-1}, considered low when compared to other herbicides (Rodrigues and Almeida, 2011). The moisture content and organic matter of the soil are the main factors that influence the adsorption of diclosulam; soil degradation occurs mainly through the microbial route, but photodegradation and volatilization are insignificant (Rodrigues and Almeida, 2011). In soils with water deficit, degradation may be slower (Silva et al., 1999).

The application of diclosulam can promote the reduction of weed interference in the early growth stages, contributing to a more effective shutdown of the soybean (Oliveira Neto et al., 2013). However, one must take care with the residual activity of the herbicide on harvest crops grown in succession.

The objective of this work was to evaluate the residual activity of the herbicide diclosulam applied in pre-emergence in a soybean crop on a cotton crop grown in succession.

MATERIALS AND METHODS

The experiment was conducted in the experimental area of the Center for Technology Training and Dissemination of the Cotton Institute of Mato Grosso (IMAmt), Brazil, located in the municipality of Sorriso-MT (12°45’47" S and 55°50’14" W), from November 2015 to July 2016.

Rainfall and the average temperature during the research period are presented in Figure 1. A rainfall accumulation of 637 mm was recorded between the application day and the cotton sowing, and a total of 1,043 mm until harvest.

The experiment was implemented in a typical Distrophic Red-Yellow Latosol (LVAd). On August 15, 2015, a subsoiling operation was carried out, followed by soil correction, with application and incorporation of 2,000 kg ha^{-1} of dolomitic limestone (0.20 m) using a harrow. The basic fertilization of the area was performed on September 15, 2015, and 1,000 kg ha^{-1} of single super phospate was applied in the surface, followed by subsequent incorporation carried out using a levelling harrow. The soil of the experimental units had in the 0.0-0.2 m layer: pH in $CaCl_2$: 4.9; Ca^{+2}: 2.6 $cmol_c$ dm^{-3}; Mg^{+2}: 1.0 $cmol_c$ dm^{-3}; Al^{+3}: 0.0 $cmol_c$ dm^{-3}; H^++Al^{+3}: 5.2 $cmol_c$ dm^{-3}; K^+: 52.0 mg dm^{-3}; P: 14.6 mg dm^{-3}; CTC: 8.8 $cmol_c$ dm^{-3}; MO: 3.7%; and clay texture (sand: 140 g kg^{-1}; silt: 180 g kg^{-1}; clay: 680 g kg^{-1} Cover fertilization was performed 30 days after soybean sowing, with application of 150 kg ha^{-1} of KCl. The herbicide clethodim (100 g ha^{-1}) was applied in the entire area seven days before the experiment, due to the predominance of grasses in the initial post-emergence period.

The soybean cultivar used was the M7739 IPRO, resistant to glyphosate, with semi-determined growth and early-medium cycle. The sowing was mechanically performed on November 6, 2015, using the spacing 0.45 m between rows, adjusting the sowing to obtain a final population of 260,000 plants ha^{-1}. The seeds were treated with the insecticide thiamethoxam at a dose of 100 g 100 kg^{-1} seeds and with the fungicide [carboxin + thiram] (0.6 + 0.6 g kg^{-1} of seed). In addition to seed treatment, inoculation with nitrogen-fixing bacteria (*Bradyrhizobium* $5x10^9$ UFC mL^{-1}) in liquid formulation, at a dose of 100 mL 50 kg^{-1} seeds was performed.

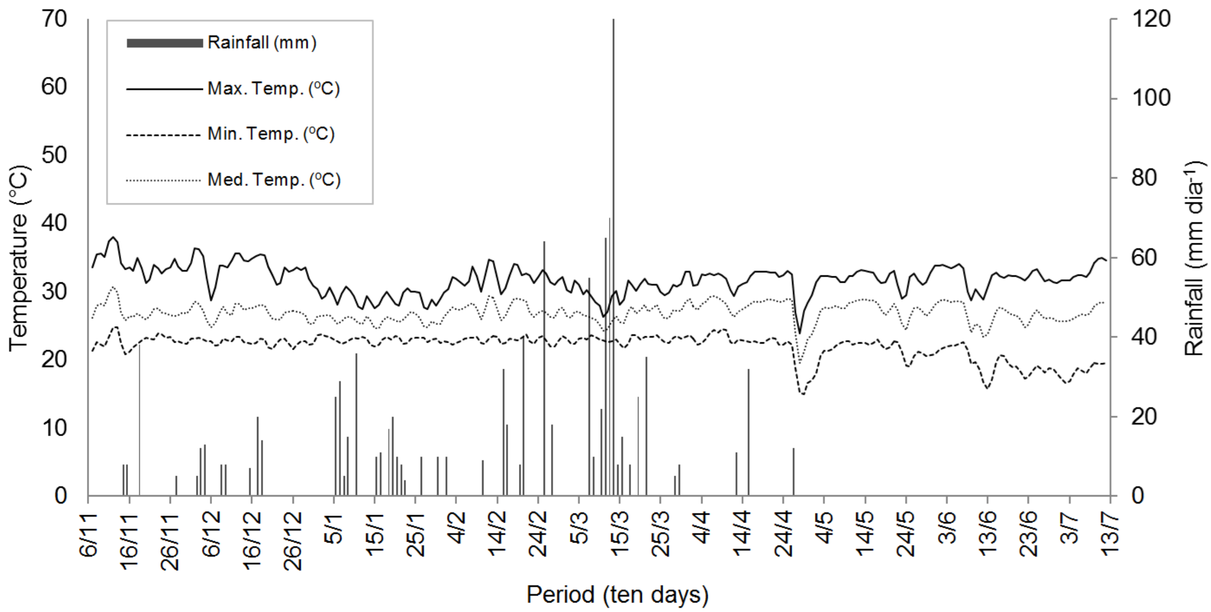

Figure 1 - Climatic conditions recorded in the weather station of the Cotton Institute of the State of Mato Grosso (IMAmt) during the experiment, in a soybean-cotton succession. Maximum, average, minimum tempratures (°C) and annual precipitation (mm day^{-1}). Sorriso-MT. 2016.

The present study used a randomized complete block design with five replicates and seven doses of diclosulam (0; 2.19; 4.38; 8.75; 17.5; 35; and 70 g i.a. ha^{-1}). The plots consisted of eight soybean rows planted 6 m long. Subsequently, after the soybean harvest, four cotton lines were sown in the same plots at a spacing of 0.90 m. The useful plot had 9.0 m² and consisted of four central lines in the soybean crop and two central lines in the cotton crop grown in succession.

The application of the herbicide treatments was carried out during the pre-emergence phase immediately after the soybean sowing, using a XR110.02 costal CO_2 pulverizer, equipped with a fan spray bar with six tips and a 0.5 m space between nozzles, placed at 0.5 m above the soil surface, under a pressure of 2.11 kgf cm², and an spray volume equivalent to 200 L ha^{-1}. The crop treatments were carried out according to the technical recommendations for soybean and cotton crops (Embrapa, 2013; Belot, 2015). During the entire cycle of soybean and cotton cultivations, the plots were manually weeded.

Seven days after the application of the treatments (DAA), the initial soybean evaluation was performed by counting the number of emerged plants per linear meter in the useful plot. At 19, 27 and 34 DAA, the following variables related to photosynthesis were evaluated: internal CO_2 concentration in the substomatal chamber (Ci), photosynthetic rate (A), stomatal conductance (gs) and transpiration rate (E), using a infrared gas analyzer (ADC BioScientific, LCpro-SD) coupled to a 6.25 cm² foliar chamber, equipped with a lighting and cooling system, under artificial saturating light (1,500 μmol photons m^{-2} s^{-1}) and ambient CO_2 concentration. IRGA (gas exchange) readings were performed from 8 am to 10 am, choosing the plant with the most representative vegetative stage of the plot, and the measurements were performed in the medial part of the fully expanded leaflets present in the upper third of the plants.

Soybean intoxication assessments were made on the same dates of the evaluations carried out on photosynthesis-related variables, using visual estimation ranging from 0-100%, where 0 (zero) represented no injuries and 100 (one hundred) the death of plants (Frans and Crowley, 1986).

At 104 DAA pre-harvest soybean plants were evaluated: plant height (soil level to the last pod insertion) and height of insertion of the first pod, evaluating ten plants per experimental unit. The final plant stand (number of plants per linear meter) was also evaluated on that date. At that time, ten plants were collected per plot, for further evaluation of the number of pods per plant and number of grains per pod. Also, at 104 DAA, soybean desiccation occurred with the application of 400 g ha^{-1} of diquat in the total area.

Harvest was performed at 112 DAA. The 100 grain mass and the yield were measured using an accurate analytical balance, correcting moisture to 13%, according to the Rules for Seed Testing (Brazil, 2009). The cotton crop was cultivated in succession to soybean, keeping the same experimental design that was previously applied.

The cotton cultivar used was TMG 42 WS, which presents early-medium cycle, commonly used in the second crop sequence in the middle-northern region of the State of Mato Grosso. The sowing was carried out on February 26, 2016. The basic fertilization was carried out in the sowing furrow, applying 250 kg ha^{-1} of monoammonium phosphate (MAP). The cover fertilization was performed 30 days after sowing, with application of 150 kg ha^{-1} of KCl on the entire surface.

After the emergence of the cotton plant, the initial stand was determined seven days after sowing (DAS), which corresponded to 119 DAA. At 14, 20 and 27 DAS of the cotton crop, the variables related to photosynthesis were evaluated using the IRGA, and the herbicide intoxication was assessed based on a percentage scale, similar to that carried out in the soybean crop.

At 132 DAS, pre-harvest evaluations were carried out, and thus the plant height was determined, as well as the height from the soil to the higher spot of the plant, and the height of the first productive branch, measured from the soil until its insertion, in a sample comprising ten plants to represent the plot. The average mass of buds was estimated by collecting ten buds per plot randomly. Samples of ten buds per plot were also collected to evaluate the fiber quality, determining the yield of feathers (%), mean fiber length, uniformity index, short fiber index, tensile strength, elongation and fiber thickness, reflectance unit, yellowing level, strength and fiber maturity.

The defoliation was performed using a formulated mixture containing 60 g ha^{-1} of thidiazurom + 30 g ha^{-1} of pre-harvest diuron at 132 DAS, when more than 80% of the bolls broke open. Seven days after the application of the defoliant, the cotton was manually collected, in the useful area of the plot; after collection, the feathers were bagged and identified, for obtaining the cotton seed productivity at a later stage.

The data obtained were submitted to analysis of variance by the F test using the statistical software SAS/STAT v.9.1 ($p<0.05$). When significant, the regression analysis and comparison of the models were performed, searching for the one that fits the data behavior best. Thus, the model used was the three-parameter sigmoid function.

$$f = \frac{a}{\left(1 + \exp\left(-\frac{x - x0}{b}\right)\right)}$$

where *f* : response variable; *x*: diclosulam dose; *a*: range or maximum value of *f*; *x*0: *x* value for 50% of the range; *b*: constant of the sigmoid model.

RESULTS AND DISCUSSION

The pre-emergence diclosulam ($p<0.05$) did not affect the variables evaluated in the soybean crop up to the dose of 70 g ha^{-1} (Table 1). Similar results were obtained when applying diclosulam (25, 35 and 40 g ha^{-1}) in a medium-textured soil (430 g kg^{-1} of clay; pH 5.7, MO: 1.4%) in the soybean cultivars BR-36 and FT-abyara (Oliveira Jr. et al., 2002). The same was observed when it was applied (35 g ha^{-1}) in sandy clay and clayey soils (Deuber and Novo, 2006; Gazola et al., 2016) or when glyphosate + diclosulam were combined (1,080 + 25.2 g ha^{-1}) in a clayey soil (680 g kg^{-1} clay) (Neto et al., 2009). Although showing a reduction in the variable “soybean plants height”, Osipe et al. (2014) did not observe significant differences in the productivity of the crop.

The most common mechanism of tolerance to diclosulam is the metabolism of herbicide molecules due to methyl hydroxylation, followed by glucose conjugation (Hodges et al., 1990). Nonetheless, selectivity not only depends on the metabolic pathway, but also on the metabolic rate, preventing lethal levels from reaching the ALS enzyme (Trezzi and Vidal, 2001).

An important factor for the selectivity of diclosulam in soybean crops is also related to soil dynamics, since the herbicide is heavily influenced by moisture content, pH, clay content and

Table 1 **-** Summary of the analysis of variance referring to the variables related to soybean photosynthesis (C_i: internal CO_2 concentration in the substomatal chamber; *E*: transpiration rate; g_s: stomatal conductance; *A*: photosynthetic rate), growth (EI: initial stand; EF: final stand; AP: plant height; AI: height of the insertion of the first pod), components of production (NV: number of pods per plant; NGV: number of grains per pod; M100: 100 grains mass) and productivity (P), analyzed in the soybean crop cv. M7739 IPRO treated with pre-emergence diclosulam. Sorriso-MT, Brazil, 2016

Variable related to photosynthesis	General average	CV (%)	Pr > F	Growth	General average	CV (%)	Pr > F
	19 DAA				EA		
C_i (µmol mol^{-1})	295.51	3.1	0.25^{ns}	EI (plants m^{-1}) - 7 DAA	9.45	10.99	0.58^{ns}
E (mmol H_2O m^{-2} s^{-1})	3.34	4.91	0.07^{ns}	EF (plants m^{-1}) - 104 DAA	9.98	10.68	0.26^{ns}
g_s (mol $m^{-2}s^{-1}$)	1.19	19.18	0.08^{ns}	AP (cm) - 104 DAA	67.42	7.12	0.14^{ns}
A (µmol CO_2 m^{-2} s^{-1})	22.00	8.87	0.12^{ns}	AI (cm) - 104 DAA	13.93	24.47	0.26^{ns}
Variables related to photosynthesis	27 DAA			Components of production	Pre-harvest		
C_i (µmol mol^{-1})	227.34	6.09	0.22^{ns}	NV (pod per plant)	50.43	9.29	0.95^{ns}
E (mmol H_2O m^{-2} s^{-1})	4.94	18.1	0.61^{ns}	NGV (grain pod^{-1})	2.43	6.8	0.44^{ns}
g_s (mol $m^{-2}s^{-1}$)	0.97	33.39	0.15^{ns}	M100 (g)	17.26	4.42	0.93^{ns}
A (µmol CO_2 m^{-2} s^{-1})	16.34	19.31	0.77^{ns}	-	-	-	-
Variables related to photosynthesis	34 DAA			Productivity	Harvest		
C_i (µmol mol^{-1})	252.71	6.94	0.28^{ns}	P (kg ha^{-1})	3187.29	12.53	0.21^{ns}
E (mmol H_2O m^{-2} s^{-1})	6.25	6.82	0.13^{ns}	-	-	-	-
g_s (mol $m^{-2}s^{-1}$)	0.67	26.56	0.05^{ns}	-	-	-	-
A (µmol CO_2 m^{-2} s^{-1})	20.55	12.1	0.40^{ns}	-	-	-	-

DAA: days after application; EA: evaluation period according to the response-variable; ^{ns}: non significant.

organic matter. As observed in the experiment, there was no water restriction during the soybean cycle, a fact that might have favored the degradation through microbial activity and herbicide leaching. It was also noticed that the soil had a higher pH than the pKa of the herbicide (pH $CaCl_2$: 4.9 > pKa: 4.09), and this means that more than 50% of the diclosulam molecules were present in a dissociated form (less sorped in the soil) and, consequently, more molecules were available for leaching and degradation (Oliveira and Brighenti, 2011).

The residual activity of pre-emergence diclosulam applied in the soybean crop significantly affected the variable “intoxication” (14, 20 and 27 DAS). However, the other variables were not affected (Table 2).

Thus, the herbicide persistence was observed for more than 112 DAA, a period between the application of the treatments and the sowing of the cotton crop. This result is in consonance with those obtained by Dan et al. (2011), who found that the residual activity of diclosulam (35 g ha^{-1}) caused injury to the millet at 120 days after the pre-emergence application in soybean in the clayey Dystroferric Red Latosol (510 g kg^{-1} clay, 50 g kg^{-1} silt e 440 g kg^{-1} sand).

The residual activity of the application of 35 g ha^{-1} of pre-emergence diclosulam in soybean caused visual intoxication on the cotton plant in all the evaluation days (Figure 2). The estimated quantities of diclosulam required to result in 5 and 10% of poisoning cotton crops grown in succession are shown in Table 3. According to the results, at 14 DAS of the cotton crop, 35 g ha^{-1} of diclosulam was responsible for 5% of poisoning. The evaluations at 20 and 27 DAS revealed that the doses of 37 and 35.8 g ha^{-1}, respectively, caused the same level of intoxication. It has been estimated that 40.1 g ha^{-1} of diclosulam may cause intoxication in cotton up to 10% at 27 DAS.

During the early stages of cotton growth, there was no water restriction, and precipitation was sufficient. Diclosulam may lead to a higher toxicity in sensitive crops in soils with higher moisture content (Monquero et al., 2013). The authors found that pre-emergence diclosulam (35 g ha^{-1}) in a clayey Dystroferric Red Latosol (560 g kg^{-1} clay; 240 g kg^{-1} silt; 200 g kg^{-1} sand; pH ($CaCl_2$) 6.2; 3,6% MO), presented a phytotoxic effect for a longer period when the soil maintained a moisture level of 100% at field capacity. In such moisture conditions, persistence of diclosulam was verified up to 90 DAA, using corn and sunflower as bioindicators (Monquero et al., 2013).

The residual activity of diclosulam did not affect the productivity and quality of the cotton fiber at the doses applied. This result may be related to herbicide degradation and/or leaching in

Table 2 - Summary of the analysis of variance referring to the variables related to cotton photosynthesis (C_i: internal CO_2 concentration in the substomatal chamber; *E*: transpiration rate; g_s: stomatal conductance; *A*: photosynthetic rate), growth (EI: initial stand; EF: final stand; AP 132 DAS: plant height; ARP 132 DAS: height of the insertion of the first productive branch), components of production and productivity (NC: number of buds per plant; MMC: average mass of buds; RP: yield of feathers; PC: cotton seeds productivity) and fiber quality (TR: leaves; A: area of impurity; UHM: fiber length; UI: uniformity index; SFC: short fiber index; STR: tensile strength; ELONG: elongation; MIC: fiber thickness; RD: reflectance unit; +B: yellowing level; SCI: amount of pounds-force to break a 120 jd-length and 1.5 jd-circumference skein; MAT: maturity), assessed in the cotton plant cv. TMG 42 WS grown in succession to soybean cv. M7739 IPRO treated with pre-emergence diclosulam. Sorriso-MT, Brazil, 2016

Variable related to photosynthesis	General average	CV (%)	Pr > F	Components of production and productivity	General average	CV (%)	Pr > F
	14 DAS				Pre-harvest		
C_i (µmol mol^{-1})	230.34	6.01	0.12^{ns}	NC	4.08	33.87	0.37^{ns}
E (mmol H_2O m^{-2} s^{-1})	5.14	17.40	0.69^{ns}	MMC (g)	2.91	13.62	0.96^{ns}
g_s (mol m^{-2}s^{-1})	0.29	31.15	0.71^{ns}	RP (%)	42.46	2.01	0.26^{ns}
A (µmol CO_2 m^{-2} s^{-1})	16.54	19.08	0.69^{ns}	PC (kg ha^{-1})	738.22	31.26	0.65^{ns}
Variables related to photosynthesis	20 DAS			Fiber quality	After harvest		
C_i (µmol mol^{-1})	216.28	8.27	0.58^{ns}	TR	2.88	51.51	0.85^{ns}
E (mmol H_2O m^{-2} s^{-1})	8.19	7.56	0.10^{ns}	A (%)	0.37	70.60	0.86^{ns}
g_s (mol m^{-2}s^{-1})	0.50	19.73	0.17^{ns}	UHM (in)	1.13	2.94	0.92^{ns}
A (µmol CO_2 m^{-2} s^{-1})	22.98	11.06	0.76^{ns}	UI (%)	81.92	1.64	0.99^{ns}
Variables related to photosynthesis	27 DAS			SFC (%)	9.37	5.38	10.28^{ns}
C_i (µmol mol^{-1})	259.57	9.95	0.42^{ns}	STR (gf tex^{-1})	28.79	4.78	0.90^{ns}
E (mmol H_2O m^{-2} s^{-1})	4.80	18.68	0.80^{ns}	ELONG (%)	6.38	4.59	0.40^{ns}
g_s (mol m^{-2}s^{-1})	0.67	47.11	0.95^{ns}	MIC (µg in^{-1})	3.82	3.73	0.90^{ns}
A (µmol CO_2 m^{-2} s^{-1})	18.65	37.98	0.69^{ns}	RD (%)	83.55	1.25	0.85^{ns}
Growth	EA			+B	8.01	3.89	7.81^{ns}
EI (plants m^{-1})	7.56	10.99	0.65^{ns}	SCI (lbf)	134.34	7.55	0.99^{ns}
EF (plants m^{-1})	8.90	12.45	0.96^{ns}	MAT (%)	85.02	0.62	0.56^{ns}
AP (cm) - 132 DAS	47.65	14.70	0.40^{ns}	-	-	-	-
ARP (cm) - 132 DAS	21.79	6.66	0.10^{ns}	-	-	-	-

DAS: Days after sowing; EA: Assessment period according to the response-variable; ^{ns}: non significant.

the soil during the soybean cycle. The speed of degradation of diclosulam is directly related to the microbial activity in the soil, as this is the most common form of degradation of this herbicide (Rodrigues and Almeida, 2011). Therefore, if the soil has favorable moisture and organic matter contents, a decline in the persistence of the herbicide in the soil is favored. When applying 35 g ha^{-1} of diclosulam in a medium-textured clayey Dystroferric Red Latosol (445 g kg^{-1} clay; 200 g kg^{-1} silt; 355 g kg^{-1} sand; MO: 1.9%; pH (CaCl2): 5.0) under a no-tillage system, the increased microbial activity caused by the system accelerated the herbicide dissipation in the soil (Lavorenti et al., 2003).

Diclosulam is a water-soluble herbicide (Christoffoleti et al., 2008), which facilitates its dispersion. Herbicides with high solubility rates are easily dissipated in the environment through the water flow and have relatively low sorption coefficients (Oliveira and Brighenti, 2011). The properties of the soil evaluated in the present work (68% clay; MO: 3.7%; soil pH > diclosulam pKa) and the 637 mm precipitation observed in the period between the application of diclosulam and the cotton sowing formed an adequate scenario for the dissipation of the herbicide in the soil.

It is worth noting that this result was obtained when sowing the cotton at 112 DAA and that, if an earlier soybean cultivar with a 100 day cycle is used, for example, the herbicide degradation period will be shorter and the result may be different. Besides, one must pay attention to the precipitations that occurred during the tolerant crop cycle. All these factors may reduce or prolong the persistence of diclosulam in the soil.

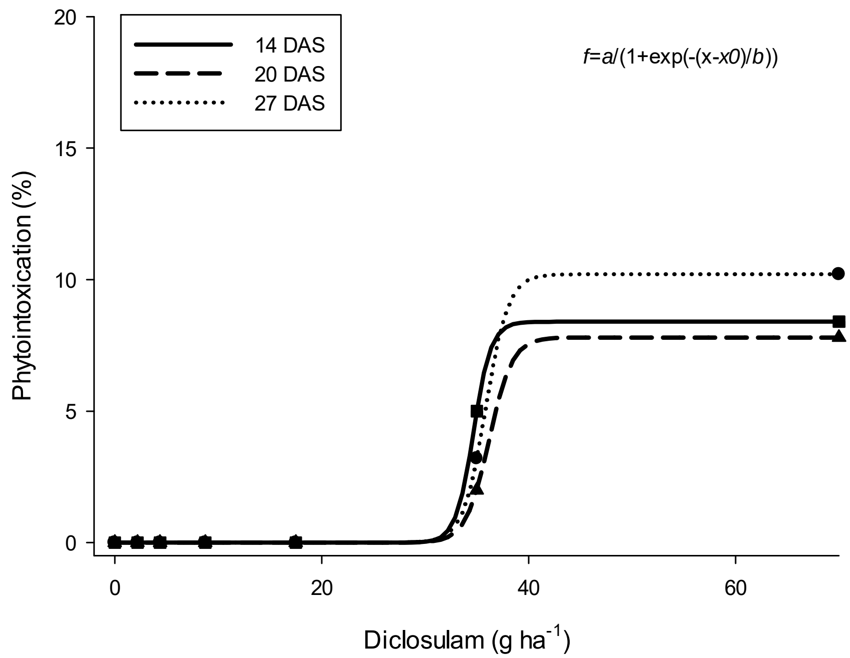

Figure 2 - Percentage of intoxication in cotton plant cv. TMG 42 WS at 14 (a: 8,4; b: 0,8598; x0: 34,67), 20 (a: 7,8; b: 1,1166; x0: 36,19) and 27 DAS (a:10,2; b:1,0853; x0: 35,85), grown in succession to soybean cv. M7732 IPRO subjected to the application of pre-emergence diclosulam. Sorriso-MT, 2016.

Table 3 - Dose of diclosulam (g ha^{-1}) required to cause an intoxication rate of 5 and 10% [D_5 and D_{10}] in cotton plant cv. TMG 42 WS grown in succession to soybean. The regression parameters were calculated using the equation of the sigmoid model (*f*=*a*/(1+exp(-(*x*-*x0*)/*b*))). Sorriso-MT, Brazil, 2016

Variable	Parameter			R^2	D_5	D10
	a	*b*	*x0*			
Phytointoxication 14 DAS	8.40	0.8598	34.67	0.99	35.00	-
Phytointoxication 20 DAS	7.80	1.1166	36.19	0.99	37.00	-
Phytointoxication 27 DAS	10.20	1.0853	35.85	0.99	35.80	40.1

DAS: days after sowing; R^2: coefficient of determination; *f*: response-variable; *x*: diclosulam dose; *a*: range or maximum value of the response-variable; *b*: constant of the sigmoid model; *x0*: doses of diclosulam for a 50% range.

In view of the results obtained, it was concluded that the pre-emergence diclosulam did not negatively affect the soybean cultivar M7739 IPRO up to twice the recommended dose (70 g ha^{-1}) and despite the fact that the residual activity of diclosulam (35 g ha^{-1}) on the cotton crop led to a phytointoxication of approximately 5% up to 27 DAS, no significant effect was observed ($p<0.05$) on the components of production, cotton seed productivity and variables related to cotton fiber quality in the quantities applied.

REFERENCES

Belot JL. Manual de boas práticas de manejo do algodoeiro em Mato Grosso. Cuiabá: IMAmt; 2015. 337p.

Brasil. Ministério da Agricultura, Pecuária e Abastecimento. Regras para análise de sementes. Brasília, DF: 2009.

Christoffoleti PJ. López-Ovejero RF, Damin V, Carvalho SJP, Nicolai M. Interações dos fatores ambientais com os herbicidas aplicados ao solo e as consequências agronômicas. Piracicaba: Basf; 2008. Cap. 2, Comportamento dos herbicidas aplicados ao solo na cultura da cana-de-açúcar; p.33-60.

Constantin J, Oliveira Jr RS, Oliveira Neto AM, Blainski E, Guerra N. Manejo da buva na entressafra. In: Constantin J, Oliveira Jr RS, Oliveira Neto AM. Buva: fundamentos e recomendações para manejo. Curitiba: Omnipax; 2013. p.41-61.

Dan HA, Dan LGM, Barroso ALL, Procópio SO, Oliveira Jr RS, Assis RL et al. Atividade residual de herbicidas pré-emergentes aplicados na cultura da soja sobre o milheto cultivado em sucessão. Planta Daninha. 2011;29(2):437-45.

Deuber R, Novo MCSS. Nodulação e desenvolvimento de planta de soja IAC-19 com aplicação dos herbicidas diclosulam e flumetsulam. Rev Bras Herb. 2006;5(2):57-63.

Empresa Brasileira de Pesquisa Agropecuária – Embrapa. Tecnologias de produção de soja – Região Central do Brasil 2014. Londrina: Embrapa Soja; 2013. 265p. (Embrapa Soja. Sistemas de Produção, 16).

Frans R, Crowley H. Experimental design and techniques for measuring and analyzing plant responses to weed control practices. In: Southern Weed Science Society. Res Meth Weed Sci. 1986;3:29-45.

Gazola T, Dias MF, Belapart D, Castro EB, Bianchi L. Efeitos do diclosulam na soja cultivada em solos de diferentes classes texturais. Rev Bras Herb. 2016;15(4):353-61.

Hodges CC, De Boer GJ, Avalos J. Uptake and metabolism as mechanism of selective herbicidae activity of the 1, 2, 4 - Triazolo [1, 5 - a] pyrimidines. Pest Sci. 1990:29(3):365-78.

Lavorenti A, Rocha AA, Prata F, Regitano JB, Tornisielo VL, Pinto OB. Comportamento do diclosulam em amostras de um latossolo vermelho distroférrico sob plantio direto e convencional. Rev Bras Cienc Solo. 2003;27:183-90.

López-Ovejero RF, Soares DJ, Oliveira WS, Fonseca LB, Berger GU, Soteres JK, Christoffoleti PJ. Residual herbicides in weed management for glyphosate resistant soybean in Brazil. Planta Daninha. 2013;31(4):947-59.

Melo MSC, Rosa LE, Brunharo CACG, Nicolai M, Christoffoleti PJ. Alternativas para o controle químico de capim-amargoso (*Digitaria insularis*) resistente ao glyphosate. Rev Bras Herb. 2012;11(2):195-203.

Monquero PA, Munhoz WS, Hirata ACS. Persistência de imazaquim e diclosulam em função da umidade do solo. Rev Agroamb. 2013;7(3):331-7.

Neto MEF, Pitelli RA, Basile EAG, Timossi PC. Seletividade de herbicidas pós-emergentes aplicados na soja geneticamente modificada. Planta Daninha. 2009; 27(2):345-352.

Oliveira Jr RS, Maciel CDG. Controle de plantas daninhas e seletividade de diclosulam aplicado em pré-emergência na cultura da soja. Rev Bras Herb. 2002;3:69-74.

Oliveira MF, Brighenti AM. Comportamento dos herbicidas no ambiente In: Oliveira Jr RS, Constantin J, Inoue MH. Biologia e manejo de plantas daninhas. Curitiba: Omnipax; 2011. p.263-304.

Oliveira Neto AM, Constantin J, Oliveira Jr RS, Guerra N, Braz GBP, Vilela LMS et al. Sistemas de dessecaçã o em áreas de trigo no inverno e atividade residual de herbicidas na soja. Rev Bras Herb. 2013;12:14-22.

Osipe JB, Oliveira Jr RS, Constantin J, Biffe DF, Rios FA, Franchini LHM et al. Seletividade de aplicações combinadas de herbicidas em pré e pós-emergência para a soja tolerante ao glyphosate. Biosci J. 2014;30(3):623-31.

Rodrigues BN, Almeida FS. Guia de herbicidas. 6ª.ed. Londrina: Grafmarke; 2011.

Silva AA, Oliveira Jr RS, Costa ER, Ferreira LR, Constantin J, Apoloni DKM *et al.* Persistência de herbicidas do grupo das imidazolinonas e efeitos sobre as culturas sucessoras de milho e sorgo. Acta Sci. 1999;21(3):459-65.

Trezzi MM, Vidal RA. Herbicidas inibidores da ALS. In: Vidal RA, Merotto Jr A. Herbicidologia. Porto Alegre: 2001. 152p. Cap. 4

Yoder RN, Huskin MA, Kennard LM, Zabik JM Aerobic metabolism of diclosulam on U.S. and South American soils. J Agric Food Chem. 2000; 48:4335-40.