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Simulated derive of glyphosate in green onion plants (*Allium fistulosum L*.)

D. Riva[1], O. R. Silveira[2] , R. M. Silva[3] , L.S.F. Lima[4]

[1] Eng. Agrônomo, Especialista em Fertilidade do Solo e Nutrição de Plantas, Instituto Federal de Educação, Ciência e Tecnologia do Mato Grosso, Campus Confresa-MT
[2] Mestre em agricultura tropical, Fiscal Agropecuário, Minsteiro da Agricultura, Pecuária e Abastecimento, Cuiabá-MT
[3] Mestre em Agronomia, FEDAF,Fiscal de Defesa Agropecuária e Florestal, Instituto de Defesa Agropecuária do Estado de Mato Grosso, INDEA-MT
[4]Eng. Agrônonomo, Instituto Federal de Educação, Ciência e Tecnologia do Mato Grosso, Campus Confresa-MT

*** Author for correspondence: dhiego42@gmail.com**

Abstract. The effect of simulated glyphosate drift on common chives (*Allium fistulosum L*.) was evaluated. The work was developed in a private garden, in Confresa-MT, from January to February 2016. The experiment consists of 6 treatments with 4 repetitions, arranged in a completely randomized design (DIC). The treatments were formed b 6 sub doses of glyphosate: 0,54,108,162,216 and 270 g.i.a ha^{-1} . At 7 and 14 days after application of the sub doses of the herbicide glyphosate, the plants were subjected to visual analysis of phytointoxication, using notes, on a scale ranging from 0 to 10. At 14 days after application of herbicide, the number total leaves, number of dead leaves, number of tillers, fresh weight of commercial leaf and root length.
Keywords: Herbicide, Application, Sub-doses

Introduction

Brazilian agricultural frontiers are advancing in places that were occupied predominantly by "small farmers". Most of these farmers are rural settlers who carry out various activities, such as growing vegetables.

With the advancement of soybean cultivation around these rural settlement areas, problems related to the application of agricultural pesticides (insecticides, fungicides, herbicides), causing, indirectly, contamination of the environment and people (“blind” drift). Still, herbicides cause direct damage to plants, resulting in losses in productivity or even total crop.

The use of genetically modified soy for resistance to glyphosate resulted in an increased use of this herbicide in the post-emergence phase. The excessive use of glyphosate, both in management and in post-emergence applications, increased the possibility of drift.

Among agricultural practices, the use of phytosanitary products can result in drift, whose effects after application are increasingly evident. On the other hand, aerial spraying is more and more common and new products and formulations act in increasingly smaller doses (COLINA 2012).

The drift is the result of the dragging of small aqueous particles that do not reach the target and are carried by the wind to unwanted areas (MATUO 1990). The drift intensity is related to the application method, the dose and environmental factors, such as temperature and wind speed (CUNHA et al., 2003).

Several studies have evaluated the effect of drift and its toxic potential in cotton, corn, tomato, sorghum, passion fruit and eucalyptus crops, (MAGALHÃES et al., 2001ab; YAMASHITA and GUIMARÃES, 2005; TUFFI SANTOS et al., 2006; LASSITER et al., 2007; FIGUEREDO et al., 2007; WAGNER JUNIOR et al., 2008), respectively. On the other hand, the effect of simulated glyphosate drift on vegetables is scarce. The cultivation of chives is practiced by several producers of Confresa-MT.

Thus, the present study aimed to evaluate the effect of applying different sub-doses of the commercial herbicide Roundup Ready® on *Allium fistulosum L*

Methods

production in the municipality of Confresa-MT. Tiller with three leaves were used, transplanted

to plastic bags with a capacity of 2 kg. For the formation of the substrate for planting chives, soil from the flowerbeds was used to produce vegetables + tanned bovine manure, in a proportion of 50% soil + 50% bovine manure.

The soil used had been cultivated in a cycle with the culture of arugula, lettuce and almond. Before implanting the cultures, an amount of 200 g m-2 of dolomitic limestone, 5 g m-2 of FTE BR 12 and 200 g m^{-2} of the formulated 4-30-10 were applied, being repeated for each cycle of cultures . Irrigations were carried out according to the needs of the crop. The experiment was conducted between December and February 2016, being conducted in a completely randomized design with six treatments and four replications.

The sub doses applied were: 0, 54, 108, 162, 216 and 270 g. i. a ha^{-1}, which corresponds to 0, 5, 10, 15 and 25% of the 3 L ha^{-1} recommendation of the original Roundup® commercial product. 30 days after transplantation, sub doses of the herbicide glyphosate were applied using a sprayer with a capacity of 1.5 L and calibrated for a flow of 200 L ha-1.

At 7 and 14 days after application of the sub-doses of the herbicide glyfosate, the plants were submitted to visual analysis of Phytointoxication, through grades, in a scale ranging from 0 to 10 (adapted from Brazilian Society of Weed Science (SBCPD, 1995), where 0 means the absence of any symptoms of phytotoxicity and 10 characterizes the death of the plant (Table 1). At 14 days after herbicide application, the total number of leaves, number of dead leaves, number of tillers, fresh weight of commercial leaf and root length were evaluated.

Table 1. Scale of grades used for visual assessment of phytotoxicity by applying sub-doses of the herbicide glyphosate. Confresa, MT, 2016.

Classification	Score	Observations
Weightless	0-1	Weak or barely evident symptoms. Zero score: there are no changes in the plants
Acceptable	2-3	Pronounced symptoms, however fully tolerated by the plant
Worrisome	3-4	Symptoms greater than in the previous category, but still recoverable, and without expectations of a reduction in economic performance
High	5-7	Irreversible damage, expected to reduce economic performance
Very high	7-10	Very severe irreversible damage, with a forecast of drastic reduction in economic performance. Note 10 for death of the plant

Adapted by SBCPD (1995)

Statistical analysis

The data were analyzed by variance by the F test and the means compared by the Scott & Knott test at 5% probability, with significance for the quantitative factors, regression graphs were made. Statistical analyzes were performed with the aid of the statistical software SISVAR (FERREIRA, 2011).

Results and discussion

The sub-doses of glyphosate caused different levels of phytointoxication, with differences between doses ($p < 0.01$) at 7 and 14 days after application (Table 01). At 7 days after application, only the smallest sub-dose was similar to the Control without application of the herbicide. At 14 days after application, there was a difference between all sub-doses, with a direct effect between intoxication and sub-doses, with symptoms ranging from mild to acceptable. The symptoms were classified as worrying, high and very high.

Phytointoxication scores at 7 and 14 days after application of the herbicide adjusted to a quadratic regression model, with symptoms ranging from mild (dose of 54 g ha^{-1}) to very high (maximum dose of 270 g ha-1; Figure 03 and 04).

Yamashita and Guimarães (2005) evaluated the application of simulated glyphosate drift in cotton (variety ITA 90) with 4 and 7 leaves and observed greater intoxication in younger plants with 144 g ai ha^{-1}, these differences being observed only at 7 and 7 14 days after application. Figueredo et al. (2007) observed that application of glyphosate, starting at 378 g ha^{-1}, affected tomato development, regardless of the stage of development, with the application being carried out with 0, 15, 30, 45, 60, 75 and 90% of the dose of 1,260 g ha^{-1}, at 30, 50 and 70 days after transplanting the culture. In the present study, with the exception of the Control, all doses caused intoxication, but only the doses of 162 g, 216 and 270 g ha^{-1} caused worrying, high and very high intoxication (Figure 02). The potential of glyphosate to cause intoxication is directly related to the stage of development of the plant, species and the applied dose (YAMACHITA and GUIMARÃES, 2006).

Table 2. Phytointoxication evaluation in chives (*Allium fistulosum L*) submitted to simulated glyphosate drift at 7 and 14 days after application. Confresa-MT.

Dosage g.i.a ha^{-1}	Days after aplication	
	7	14
0	0,0 a	0,0 a
54	0,0 a	1,0 b
108	1,0 b	2,0 c
162	2,0 c	4,0 d
216	3,5 d	7,0 e
270	6,2 e	9,2 f
F treatment	118,52**	1257,00**
C.V (%)	20,90	5,27

Averages followed by the same letter in the columns do not differ by the Scott & Knott test at 5% probability **

Figure 01- Phytointoxication score, 7 days after the application of simulated glyphosate drift. From left to right: No damage; Weightless, Acceptable, Worrying, High and Very high

Figure 02- Phytointoxication score, 14 days after the application of simulated glyphosate drift. From left to right: No damage; Weightless, Acceptable, Worrying, High and Very high.

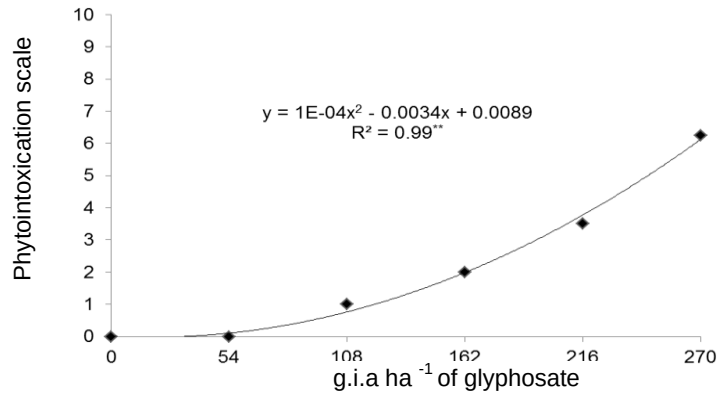

Figure 03- Phytointoxication of green onions 7 days after application of simulated glyphosate drift. Confresa-MT, 2016.

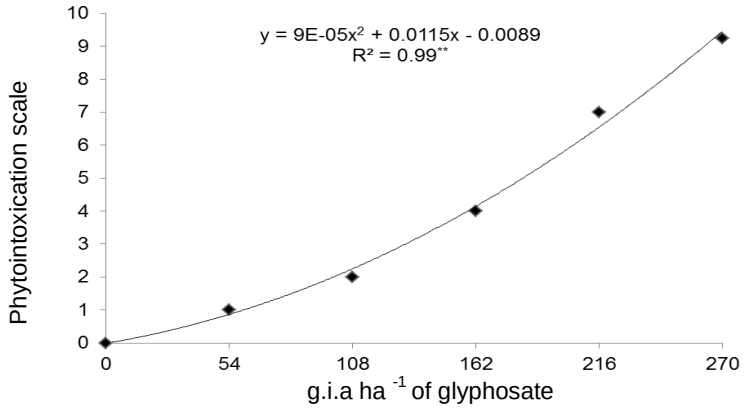

Figure 04- Phytointoxication of green onions 14 days after application of simulated glyphosate drift. Confresa-MT, 2016.

Table 02- Total number of leaves (NL), number of dead leaves (NDL), number of tillers (NT) and cutter mass (CM) of green onions submitted to simulated glyphosate drift. Confresa-MT.

Dosage of herbicida g.i.a ha^{-1}	14 days after aplication				
	NL	NDL	NT	CM	CR
	n	N	n	g plant^{-1}	cm
0	14,00 a	1,00 a	1,50 a	17,98 a	38,75 a
54	12,75 a	2,00 a	1,00 a	14,45 b	20,75 b
108	12,25 a	1,75 a	1,50 a	13,05 b	18,25 b
162	12,00 a	1,25 a	0,50 b	7,55 c	6,00 c
216	8,75 b	3,50 b	0,75 b	2,69 d	3,25 c
270	4,75 c	3,75 b	0,00 c	0,34 d	1,12 c
F treatment	13,17**	11,79**	9,00**	65,17**	79,72**
C.V (%)	17,51	30,47	44,67	18,47	21,77

Averages followed by the same letter in the columns do not differ by the Scott & Knott test at 5% probability.

The number of total leaves and the number of dead leaves were the variables that showed the lowest influence of the doses, being similar (p> 0.05) with the Control up to the dose of 162 g ha^{-1}. With the exception of the total number of leaves and tiller numbers, the highest doses were similar in their results (p> 0.05) (Table 02).

Tiller number, fresh leaf mass and root length were affected with the dose of 270 g ha^{-1}, with no tiller and a reduction of 97.65% and 97.03%, respectively, compared to the Control (Table 02).

The total number of leaves and the number of dead leaves adjusted to a quadratic regression model, with a reduction in the total number of leaves and an increase in the number of dead leaves, reaching a peak in the dose of 270 g ha^{-1} (Figure 05 and 06).

The number of tillers and the commercial fresh weight of leaves adjusted to a linear regression model, with maximum reduction with a dose of 270 g ha^{-1} (Figures 07 and 08).

Root length was the variable that had the greatest change with the application of different doses, adjusting to a quadratic regression model, with a greater reduction in the dose of 270 g ha^{-1} (Figure 09).

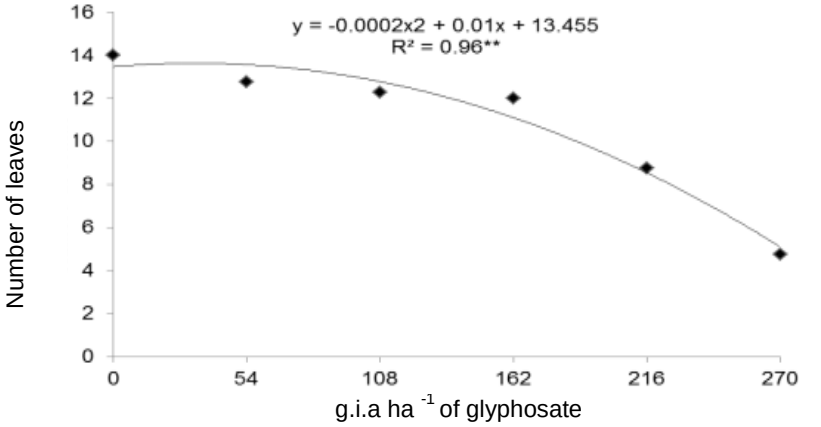

Figure 05- Number of green chive leaves 14 days after application of simulated glyphosate drift. Confresa-MT, 2016.

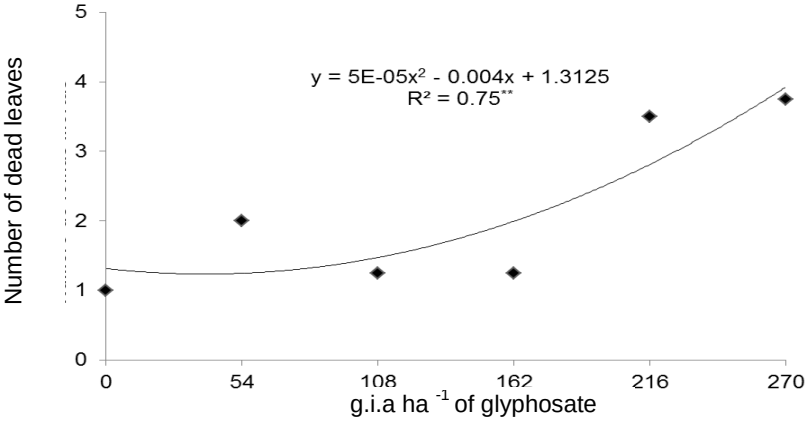

Figure 06- Number of dead green chive leaves, 14 days after application of simulated glyphosate drift. Confresa-MT, 2016.

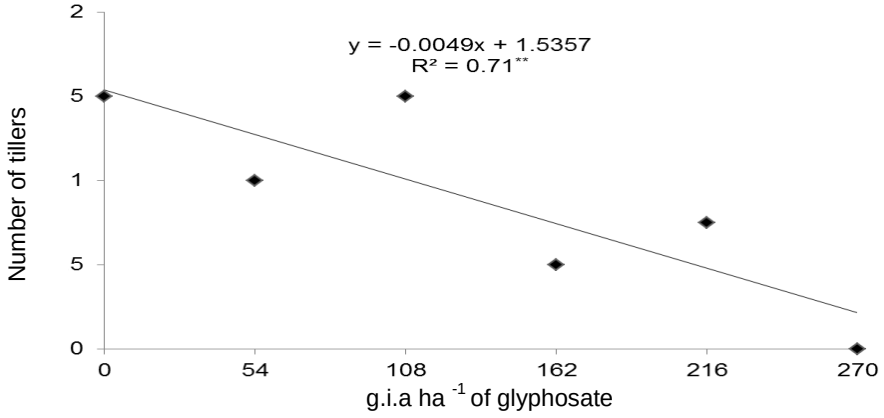

Figure 07- Number of green chive tillers, 14 days after application of simulated glyphosate drift. Confresa-MT 2016

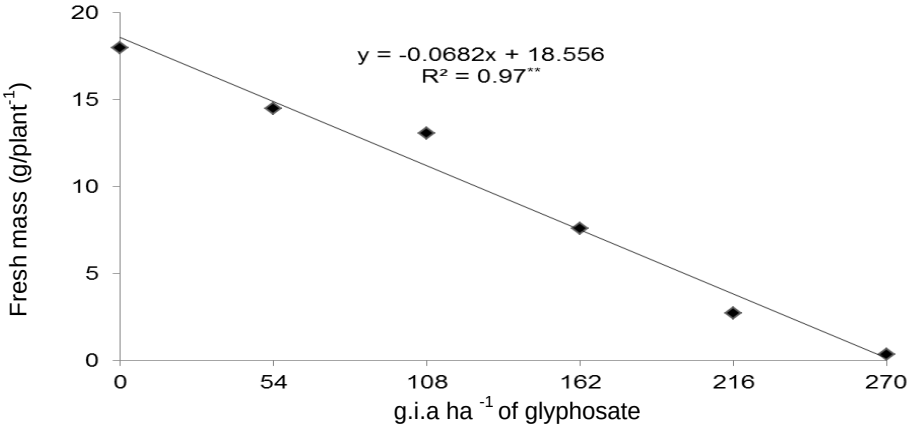

Figure 08- Fresh mass of green chives leaves 14 days after application of simulated glyphosate drift. Confresa-MT, 2016.

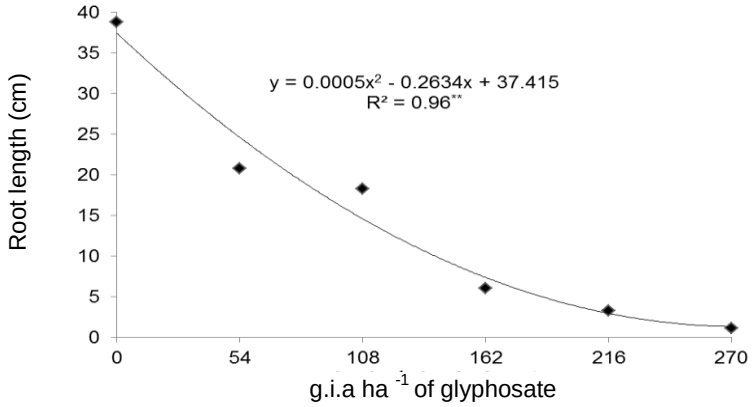

Figure 09- Green chives root length 14 days after application of simulated glyphosate drift. Confresa-MT, 2016.

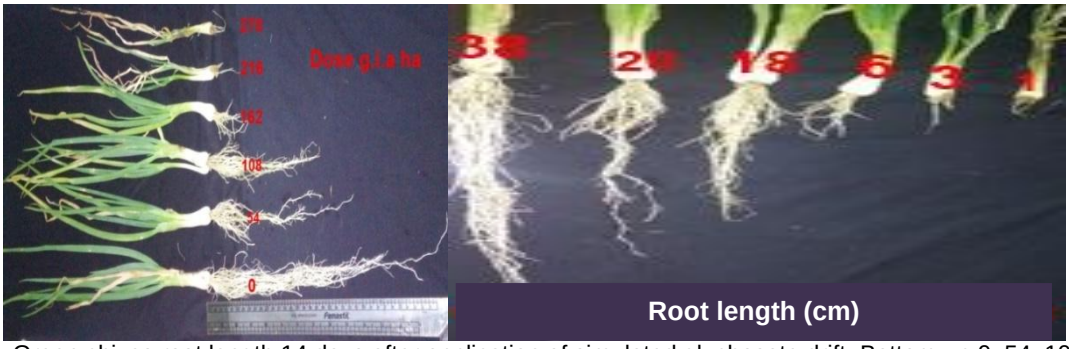

Figure 10- Green chives root length 14 days after application of simulated glyphosate drift. Bottom-up 0, 54, 108, 162, 216 and 270 g.i.a of glyphosate ha $^{-1}$. Confresa-MT, 2016.

Conclusion

We concluded that there was a statistical and visual difference, as the glyphosate dose increased, there was an effect on the phenological development of *Allium fistulosum L.*

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