PLANTA DANINHA

SOCIEDADE BRASILEIRA DA CIÊNCIA DAS PLANTAS DANINHAS

<http://www.sbcpd.org>

ISSN 0100-8358 (print)
1806-9681 (online)

Article

Management Programs to Control *Conyza* spp. in Pre-Soybean Sowing Applications

Programas de Manejo para o Controle de ***Conyza*** *spp. em Aplicações Pré-Semeadura da Soja*

ZOBIOLE, L.H.S.[1]*
KRENCHINSKI, F.H.[2]
PEREIRA, G.R.[1]
RAMPAZZO, P.E.[1]
RUBIN, R.S.[1]
LUCIO, F.R.[1]

ABSTRACT - The goal of this study was to compare the efficacy of different weed management through a burndown application followed by sequential applications of herbicides to control *Conyza* spp. Thus, four field experiments were conducted, two in the western region of Paraná state (E1 and E2), one in Jataí, Goiás state (E3) and another one in Ibirubá, Rio Grande do Sul state (E4). *Conyza* spp. in this area had a height ranging between 25 and 60 cm. Treatments were arranged in a randomized block design with four replications. The primary herbicide treatments were 2,4-D + glyphosate + diclosulam, chlorimuron-ethyl + glyphosate + 2,4-D, and four doses of diclosulam + halauxifen-methyl + glyphosate. These treatments were applied singly or in sequential applications, made 10 days before the application of ammonium glufosinate, paraquat or saflufenacil. In all experiments, results showed efficient (90%) control of treatments containing diclosulam + halauxifen-methyl in combination with glyphosate on day 35 DAA, regardless of sequential applications. Applications of 2,4-D + glyphosate + diclosulam or chlorimuron-ethyl + glyphosate + 2,4-D were not effective against *Conyza* spp. at E1 and E2 locations, possibly due to the greater weed size (50 to 60 cm) at these sites. However, the same treatments were effective at E3 and E4 locations, where weeds were smaller. Diclosulam + halauxifen-methyl + glyphosate associated with ammonium glufosinate, paraquat or saflufenacil in sequential applications, proved to be an important tool to manage *Conyza* spp. at different growth stages.

Keywords: horseweed control, herbicide, sequential application, weed.

RESUMO - O objetivo deste estudo foi comparar a eficiência de diferentes sistemas de manejo com aplicações sequenciais de herbicidas no controle de ***Conyza*** *spp. Para isso, foram instalados quatro experimentos em campo, sendo dois na região oeste do Paraná (E1 e E2), um em Goiás (E3) e outro no Rio Grande do Sul (E4). A* ***Conyza*** *spp. presente estava com altura entre entre 25 e 60 cm. Os tratamentos foram dispostos no delineamento em blocos casualizados com quatro repetições. Os tratamentos utilizados na primeira aplicação em dessecação foram o 2,4-D + glyphosate + diclosulam, chlorimuron-ethyl + glyphosate + 2,4-D e (diclosulam + halauxifen-methyl) + glyphosate em quatro doses. Após 10 dias foram realizadas as aplicações sequenciais dentro de cada tratamento, utilizando os seguintes herbicidas: amônio glufosinato, paraquat e saflufenacil, totalizando 18 tratamentos mais uma testemunha sem aplicação herbicida. Os resultados mostraram em todos os experimentos um controle superior a 90% nos tratamentos contendo diclosulam + halauxifen-methyl + glyphosate aos 35 DAA, independentemente do herbicida aplicado na sequência. Os resultados mostraram ainda que os herbicidas 2,4-D + glyphosate + diclosulam e chlorimuron-ethyl +*

*** Corresponding author:**
<LSZobiole@dow.com>

Received: February 25, 2017
Approved: May 29, 2017

Planta Daninha 2018; v36:e018175883

[1] Dow AgroSciences Industrial Ltda. São Paulo-SP, Brasil, [2] Universidade Estadual Paulista " Júlio de Mesquita Filho" Botucatu-SP, Brasil.

Doi: 10.1590/S0100-83582018360100076

glyphosate + 2,4-D foram ineficientes no controle de ***Conyza*** *spp. em E1 e E2, possivelmente pelo tamanho das plantas daninhas (50-60 cm), porém eficientes em E3 e E4 aos 35 DAA, onde as plantas de buva se encontravam menores. O herbicida diclosulam + halauxifen-methyl + glyphosate, associado a amônio-glufosinato, paraquat ou saflufenacil em aplicações sequenciais, mostrou ser uma importante ferramenta para controle de* ***Conyza*** *spp. em diferentes estágios de desenvolvimento.*

Palavras chave: controle de buva, aplicação sequencial, herbicida, planta daninha.

INTRODUCTION

The *Conyza* spp. genus, known by the common name horseweed, hairy fleabane or tall fleabane and belonging to the Asteraceae family, is distributed throughout the world. It is an annual dicotyledonous plant that reproduces by seeds, with an average production of 150 to 200 thousand seeds per plant, which germinate from April to September, ending their cycle in summer; thus, it characterizes itself as a winter and summer weed (Owen et al., 2009). In Brazil, three species (*Conyza bonariensis*, *Conyza canadensis* and *Conyza sumatrensis*) were cataloged; they are distributed in the Southern, Southeastern and Central-Western regions, occupying rural and urban areas. The three species are very similar to each other, and there is still the possibility of hybridization between them; this has hindered their correct identification on site (Santos et al., 2014).

Since they are very frequent species over the crops of Brazil, all three (*Conyza bonariensis*, *C. canadensis* and *C. sumatrensis*) are registered as resistant to glyphosate. *Conyza sumatrensis* is resistant to chlorimuron-ethyl and has a multiple resistance to glyphosate and chlorimuron-ethyl (Heap, 2016). As *Conyza* spp. species present high growth rate and high competitive potential (Moreira et al., 2010a), they have caused damages mainly to soybean crop fields (Silva et al., 2004).

The pre-interference period in soybean varies according to the conditions of the area and the weed stage. For a population of 37 m^{-2} *Conyza* spp. plants established before sowing the crop, this period can reach approximately 24 days (Silva et al., 2014). Thus, pre-sowing burndown with herbicides that present residual effects on the soil provide benefits to the producer, such as a lower weed re-infestation after planting (Ellis et al., 2002), and a reduction in the number of post-emergence operations (Minozzi et al., 2014). It is also a very important tool in the integrated management of weeds, especially glyphosate-resistant (Moreira et al., 2010b).

The most common change adopted by farmers in areas with the presence of resistant weed biotypes is the addition of alternative herbicides, applied alone, in association and also in sequential applications with other products, such as contact herbicides. However, this addition is only feasible if there are alternative herbicides promoting an effective weed control (Peterson, 1999). According to Powles and Holtum (1994), the use of formulated mixtures or sequential applications of herbicides for the management and prevention of resistant biotypes is based on the fact that active ingredients control effectively both biotypes from the same species, that is, the biotype which is resistant to one of the herbicides is controlled by the other active ingredient of the mixture.

Glyphosate-control lacks in RR technology adoption areas have led to the use of other herbicides, such as 2,4-D, one of the mostly used in association with glyphosate, mainly in pre-planting burndown applications (Takano et al., 2013).

As a new alternative to pre-planting burndown, the herbicide halauxifen-methyl is the first molecule of the new chemical group arylpicolinates (Epp et al., 2016), belonging to the action mechanism of auxin mimics; its symptoms are similar to those of 2,4-D, such as epinasty, deformation, necrosis and subsequent death of the species at issue. Halauxifen-methyl interacts with the AFB5 (Auxin F-Box) protein (Bell, 2014). However, other auxinic herbicides (picloram, 2,4-D, fluroxypyr and quinclorac) also interact with the TIR1 (Transport Inhibitor Response 1) protein (Lee et al., 2014). It is absorbed by the leaves and translocated by the xylem and phloem, being accumulated in the meristematic tissue. Some tests show that this herbicide has rapid degradation on soil and straw, and has a broad spectrum, presenting satisfactory control in broadleaf weeds (Efsa, 2015).

In Brazil, halauxifen-methyl will be sold only through formulated products, such as the herbicide halauxifen-methyl + diclosulam, an association between an auxin herbicide and an acetolactate synthase (ALS) enzyme inhibitor.

The objective of this study was to compare the efficiency of different management systems using burndown applications associated with sequential applications to control *Conyza* spp.

MATERIAL AND METHODS

Four experiments were conducted in different regions of Brazil: two in the western region of Paraná, one in Goiás and another one in Rio Grande do Sul. The experiments named 1 and 2 (E1 and E2) were conducted in the State of Paraná. E1 was conducted in Toledo, at the geographical coordinates: latitude S 24^{o}42'27.16" and longitude W 53^{o}39'41.97"; and E2 in Dez de Maio, at the following geographical coordinates: latitude S 24^{o}42'89.8" and longitude W 53^{o}54'34.27". According to Köppen's climatic classification, the climate in western Paraná is classified as Cfa – humid subtropical mesothermic, with no defined dry season. Experiment 3 (E3) was conducted in the municipality of Jataí - Goiás state (latitude S 17^{o}47'34.5" and longitude W 51^{o}37'01.5"), with its climate classified as Awa - tropical savannah with rainy summer and dry winter, according to the Köppen classification. On the other hand, experiment 4 (E4) was conducted in Ibirubá - Rio Grande do Sul state (latitude S 28^{o}40'54" and longitude W 53^{o}13'33"), whose climate is classified as Cfa – humid subtropical mesothermic, without a defined dry season, according to the Köppen classification.

In all experiments, before the applications, the size of 20 *Conyza* spp. plants was measured in the plot; they presented an average height of 40 to 50 cm in E1, 50 to 60 cm in E2, 60 to 62 cm in E3 and 25 to 40 cm in E4. During this period, the population of *Conyza* spp. plants in the areas was surveyed (plants m^{-2}), using a 0.25 m^2 metal frame, cast randomly twice in each treatment, and resulting in a density of 35, 65, 06 and 35 plants m^{-2} for the experiments E1 , E2, E3 and E4, respectively.

Treatments were arranged in a randomized block design with four replications, consisting in first-application managements in burndown and a sequential application, performed ten days after the first one, totaling 19 treatments (Table 1). Plots were sized 4 x 6 m (24 m^{-2}). As for the usable area, 0.50 m was subtracted from each plot edge, totaling an area of 15 m^{-2}.

First-application treatments were sprayed on October 2nd and 3rd, 2014 for E1 and E2; on September 23rd, 2014 for E3 and on October 22nd, 2014 for E4. The sequential application was performed 10 days after the first application, on October 12nd and 13rd, 2014, respectively for E1 and E2; on October 3rd, 2014 for E3, and on November 1st, 2014 for E4. Applications were performed using a CO_2 propelled backpack sprayer equipped with a bar having six AIXR 110015 flat-fan nozzle type, spaced 0.50 m apart, which, at a constant pressure of 2.46 kgf cm^{-2} and a 1 m s^{-1} speed, provided a spraying volume equivalent to 100 L ha^{-1}. At the time of the first application, temperature and relative air humidity were 25.5 ^{o}C and 57.5%, 27.5 ^{o}C and 55.5%, 26.1 ^{o}C and 56%, and 19.7 ^{o}C and 80.9% for tests E1, E2, E3 and E4, respectively. During the second (sequential) application, temperature and relative air humidity were 28.5 ^{o}C and 49%, 29.5 ^{o}C and 47%, 29 ^{o}C and 54%, and 29.3 ^{o}C and 58%, for tests E1, E2, E3 and E4, respectively.

Although diclosulam + halauxifen-methyl are recommended during burndown and before soybean sowing, this operation was not performed, in order to isolate the mechanical factor in the possible destruction and death of plants. Thus, the efficiency in controlling *Conyza* spp. was evaluated 14, 28 and 35 days after the sequential application of the treatments. For the control evaluation, the SBCPD visual scale (1995) was used, where 0% represents the absence of control and 100% represents the total control of the evaluated plants.

Data were analyzed by analysis of variance (ANOVA); when the F test was significant, the Tukey's test (p≤0.05) was used to compare the means.

Table 1 - First-application and sequential application treatments to control *Conyza bonarienses*. Toledo - Paraná state, Dez de Maio – Paraná state, Jataí-Goiás state and Cruz Alta-Rio Grande do Sul state

Treatment	First application	Dose (g a.i. or a.e. ha^{-1})	Sequential Application	Doses (g a.i. or a.e. ha^{-1})
1	2,4-D + glyphosate + diclosulam	1000 + 960 + 25.2	[2] Ammonium glufosinate	366
2			[3] Paraquat	400
3			[3] Saflufenacil	35
4	[1] 2,4-D + glyphosate + chlorimuron-ethyl	1000 + 960 + 20	Ammonium glufosinate	366
5			Paraquat	400
6			Saflufenacil	35
7	[4]* (diclosulam + halauxifen-methyl) + glyphosate	15.3 + 960	Ammonium glufosinate	366
8			Paraquat	400
9			Saflufenacil	35
10	(diclosulam + halauxifen-methyl) + glyphosate	23 + 960	Ammonium glufosinate	366
11			Paraquat	400
12			Saflufenacil	35
13	(diclosulam + halauxifen-methyl) + glyphosate	30.6 + 960	Ammonium glufosinate	366
14			Paraquat	400
15			Saflufenacil	35
16	(diclosulam + halauxifen-methyl) + glyphosate	38.2 + 960	Ammonium glufosinate	366
17			Paraquat	400
18			Saflufenacil	35
19	Control Sample	---	No Application	---

[1] The adjuvant Joint Mineral Oil was used at the dose of 0.5% v/v. [2] The adjuvant Aureus was used at the dose of 0.1% v/v, for all treatments containing ammonium glufosinate. [3] The adjuvant Agral was used at the dose of 0.1% v/v, for all treatments containing paraquat and saflufenacil. [4] The adjuvant Methyl Ester was used at the dose of 1.0 L ha^{-1}, for all treatments containing diclosulam + halauxifen-methyl. * Pre-formulated commercial mixture. Obs .: g = gram; a.i. = active ingredient; a.e. = acid equivalent.

RESULTS AND DISCUSSION

Considering the results presented by the four experiments, it is possible to observe that each one of them presented different characteristics to control *Conyza* spp. The results observed in experiment E1 showed that treatments containing halauxifen + diclosulam provided control above 90% when used at doses of 23, 30.6 and 38.2 g a.i. ha^{-1} in the different application programs, at 35 DAA (Table 2). Moreover, observing the results from experiment E1, comparing auxin inhibitors, it is possible to observe that treatments with (diclosulam + halauxifen-methyl) at doses of 23, 30.6 and 38.2 (T10 to T18) showed control above 90% in relation to those applied with 2,4-D (T1 to T6) (Table 2). In the T1, T2 and T3 treatments with 2,4-D + glyphosate + diclosulam, the average control difference was 26%; on the other hand, for treatments with 2.4-D + glyphosate + chlorimuron-ethyl, this difference was 49% less effective in controlling *Conyza* spp. plants.

The results on *Conyza* spp. control that were found in experiment E2 (Table 3) diverged from E1, since only treatment 18 presented control above 90%; however, treatments from T13 to T17 showed control above 80% at 35 DAA. Different results about herbicide control effectiveness may be related to plant size and environmental conditions. According to Koger et al. (2004), the development stage of *Conyza* spp. plants is one of the most control-interfering factors, whose E2 results can be explained by the greater plant height in relation to E1, as highlighted by other authors in controlling *Conyza* spp. (Vangessel et al., 2009; Moreira et al., 2010b; Oliveira Neto et al., 2010; Bressanin et al., 2014).

Generally speaking, the results of the experiments in the western region of Paraná (E1 and E2) to control *Conyza* spp. (40-60 cm) at 28 and 35 DAA, highlight that treatments 2,4-D + glyphosate + diclosulam (T1, T2 and T3), 2,4-D + glyphosate + chlorimuron-ethyl (T4, T5, and T6) and

Table 2 - Control percentage of *Conyza bonarienses* after the application of the treatments in experiment E1. Toledo – Paraná state. 2014-15 season

Treatment	% control on day 14 DAA	% control on day 28 DAA	% control on day 35 DAA
1	64.00 abc	80.00 abc	81.00 ab
2	67.00 ab	84.00 abc	74.00 abc
3	44.00 bcd	51.00 de	51.00 bc
4	56.00 abc	65.00 bcde	65.00 abc
5	70.00 ab	64.00 bcde	58.00 bc
6	25.00 d	26.00 f	15.00 d
7	55.00 abc	57.00 cde	54.00 bc
8	56.00 abc	57.00 cde	46.00 c
9	36.00 cd	41.00 ef	19.00 d
10	52.00 abc	89.00 ab	98.00 a
11	70.00 ab	98.00 a	100.00 a
12	60.00 abc	88.00 ab	89.00 a
13	54.00 abc	92.00 ab	97.00 a
14	62.00 abc	92.00 ab	98.00 a
15	57.00 abc	85.00 ab	93.00 a
16	61.00 abc	91.00 ab	96.00 a
17	79.00 a	93.00 ab	98.00 a
18	45.00 bcd	76.00 abcd	89.00 a
19	0.00 e	0.00 g	0.00 d
MSD	16.56	18.13	22.37
VC%	21.87	17.85	22.02

Equal lowercase letters in the column do not differ by Tukey's test ($p \leq 0.05$). Average = treatment average control; MSD = minimum significant difference; VC = variation coefficient.

Table 3 - Control percentage of *Conyza bonarienses* after the single and sequential application in experiment E2. Dez de Maio – Paraná state. 2014-15 season

Treatment	% control at 14 DAA	% control at 28 DAA	% control at 35 DAA
1	75.00 ab	68.00 abc	64.00 abcd
2	78.00 ab	72.00 abc	64.00 abcd
3	67.00 ab	56.00 bc	50.00 cd
4	67.00 ab	61.00 abc	64.00 abcd
5	69.00 ab	58.00 bc	51.00 cd
6	64.00 b	52.00 c	38.00 d
7	77.00 ab	71.00 abc	68.00 abcd
8	77.00 ab	72.00 abc	75.00 abc
9	69.00 ab	62.00 abc	54.00 bcd
10	78.00 ab	76.00 ab	69.00 abcd
11	78.00 ab	76.00 ab	77.00 abc
12	75.00 ab	73.00 abc	79.00 abc
13	81.00 a	80.00 a	88.00 ab
14	79.00 ab	77.00 ab	80.00 abc
15	75.00 ab	77.00 ab	84.00 abc
16	77.00 ab	76.00 ab	88.00 ab
17	82.00 a	81.00 a	89.00 ab
18	74.00 ab	77.00 ab	93.00 a
19	0.00 c	0.00 d	0.00 e
Average	71.00	67.00	67.00
MSD	16.10	22.00	35.58
VC%	8.71	12.61	20.28

Equal lowercase letters in the column do not differ by Tukey's test ($p \leq 0.05$). Average = treatment average control; MSD = minimum significant difference; VC = variation coefficient.

(diclosulam + halauxifen-methyl) + glyphosate at the lowest dose (15.3 g a.i. ha^{-1}) (T7, T8 and T9), did not present effective control in the different sequential application programs (Tables 2 and 3). According to Bressanin et al. (2014), the plant stage at the time of application is essential for its control, since, by evaluating resistant *Conyza* spp. biotypes at stages of 9 and 10 to 13 leaves with glyphosate + chlorimuron-ethyl, they observed that plants with 9 leaves presented 100% control, whereas plants with 10 to 13 leaves showed only a 66% control; the same fact was observed by Rorato et al. (2013), where 0 to 20 cm *Conyza* spp. plants were efficiently controlled with chlorimuron-ethyl. On the other hand, Oliveira Neto et al. (2010) evaluated the control of *C. bonariensis* with sequential applications; the first one was glyphosate + 2,4-D, shortly after the season of off-season maize (1,080 + 1,005 g a.e. ha^{-1}), and the second one 16 days before soybean planting, with glyphosate + 2,4-D + diclosulam (1,080 + 1,005 + 25.2 g a.e. or a.i. ha^{-1}). This management provided 98% control for this weed, and high control was achieved by hitting weeds at early development stages, especially in the first application.

In experiment E2 (Table 3), the 23 g a.i. ha^{-1} dose (T10, 11 and 12) of (diclosulam + halauxifen-methyl) also showed no control above 80%, even after the sequential application of ammonium glufosinate, paraquat and saflufenacil. However, in E1, this dose was efficient (Table 2), since *Conyza* spp. plants had an average height of 40 to 50 cm and, in E2, they had an average height of 50-60 cm. Often, a control around 80.00% for *Conyza* spp. plants may not be enough, as this weed presents high regrowth potential, which results in negative interferences on the following crop (Oliveira Neto et al., 2013). Nonetheless, in E1 and E2 (Tables 2 and 3), the 30.6 and 38.2 g a.i. ha^{-1} doses (T13, 14, 15, 16, 17 and 18) of the herbicide (diclosulam + halauxifen-methyl) associated with the herbicide glyphosate with a sequential application of ammonium-glufosinate, paraquat and saflufenacil to control *Conyza* spp. showed that, at 28 and 35 DAA, these treatments presented control between 80.00 and 98.00%, which is higher than the other treatments. Field observations demonstrate that (diclosulam + halauxifen-methyl) act on the plant for a long period of time, even reaching days after the application, which guarantees greater product efficiency in relation to the control of *Conyza* spp., avoiding their regrowth. In addition to post-emergence control, the association of residual herbicides and systemic herbicides in the burndown of *C. bonariensis* also reduces the initial competition of weeds and crop (Constantin et al., 2007).

Unlike the results found in experiments E1 and E2, in experiment E3, at 14 DAA, all the evaluated treatments provided control above 90.00%; there were no differences between the products used in the sequential application, with the exception of the treatment with diclosulam + halauxifen-methyl + glyphosate, when used at the 15.3 g a.i. ha^{-1} dose, where the most effective control was reached with the sequential application of ammonium glufosinate (T7 and T13), compared to the herbicide saflufenacil (Table 4). As for E4, all treatments were effective at 14 DAA (Table 5), reaching control above 95%, with no difference between treatments. At 28 and 35 DAA, in E3 and E4, all treatments were efficient in controlling *Conyza* spp., providing control above 94.5%, with no significant difference between the herbicides used in the second application.

The results involving 2,4-D + glyphosate + chlorimuron-ethyl treatments with the sequential application of ammonium-glufosinate, paraquat and saflufenacil, in experiments E1 and E2, did not present control for *Conyza* spp. plants; in turn, for experiments E3 and E4, these treatments were efficient (> 90%) and did not differ from the others. In the western part of Paraná (region of experiments 1 and 2), there were cases of control deficiency when associating chlorimuron-ethyl and glyphosate, and this may be related to the presence of glyphosate and chlorimuron-ethyl resistant biotypes of *Conyza sumatrensis* (Santos et al., 2015).

Table 4 - Control percentage of *Conyza bonarienses* after the single and sequential application in experiment E3. Jataí – Goiás state. 2014-15 season

Treatment	% control at 14 DAA	% control at 28 DAA	% control at 35 DAA
1	97.00 a	100.00 a	100.00 a
2	98.00 a	100.00 a	100.00 a
3	97.00 a	99.00 a	99.00 a
4	98.00 a	99.00 a	100.00 a
5	97.00 a	99.00 a	100.00 a
6	98.00 a	99.00 a	100.00 a
7	98.00 a	99.00 a	96.00 a
8	95.00 ab	95.00 a	95.00 a
9	80.00 b	97.00 a	96.00 a
10	96.00 ab	98.00 a	98.00 a
11	95.00 ab	99.00 a	100.00 a
12	96.00 ab	99.00 a	95.00 a
13	99.00 a	99.00 a	98.00 a
14	96.00 ab	96.00 a	97.00 a
15	93.00 ab	98.00 a	97.00 a
16	98.00 a	99.00 a	97.00 a
17	99.00 a	99.00 a	99.00 a
18	93.00 ab	96.00 a	96.00 a
19	0.00 c	0.00 b	0.00 b
Average	96.00	98.00	98.00
MSD	16.00	16.24	12.48
VC%	7.72	7.35	4.90

Equal lowercase letters in the column do not differ by Tukey's test ($p \leq 0.05$). Average = treatment average control; MSD = minimum significant difference; VC = variation coefficient.

Table 5 - Control percentage of *Conyza bonarienses* after the single and sequential application in experiment E4. Cruz Alta – Rio Grande do Sul state. 2014-15 season

Treatment	% control at 14 DAA	% control at 28 DAA	% control at 35 DAA
1	99.50 a	100.00 a	100.00 a
2	99.00 a	100.00 a	100.00 a
3	99.00 a	100.00 a	100.00 a
4	95.00 a	97.00 a	94.00 b
5	97.00 a	97.00 a	96.00 ab
6	98.00 a	98.00 a	96.00 ab
7	99.00 a	100.00 a	100.00 a
8	98.00 a	99.00 a	99.00 ab
9	99.00 a	99.00 a	98.00 ab
10	98.00 a	100.00 a	100.00 a
11	98.00 a	100.00 a	100.00 a
12	99.00 a	99.00 a	99.00 ab
13	99.00 a	100.00 a	100.00 a
14	98.00 a	99.00 a	99.00 ab
15	99.00 a	100.00 a	100.00 a
16	98.00 a	100.00 a	100.00 a
17	98.00 a	100.00 a	100.00 a
18	99.00 a	100.00 a	100.00 a
19	0.00 b	0.00 b	0.00 c
Average	93.00	94.00	94.00
MSD	5.61	3.17	5.07
VC%	2.3	1.29	2.07

Equal lowercase letters in the column do not differ by Tukey's test ($p \leq 0.05$). Average = treatment average control; MSD = minimum significant difference; VC = variation coefficient.

The different control observed in the experiments E1 and E2, in relation to E3 and E4, are probably related to the sensitivity of the biotypes or populations of *Conyza* spp. from the various states to the used herbicides and not in relation to the plant. Trezzi et al. (2011), while evaluating *Conyza* spp. biotypes collected in different municipalities in the State of Paraná, observed that they were controlled differently by the herbicide glyphosate; some biotypes had higher sensitivity and others lower sensitivity to the herbicide. In the same context, Santos et al. (2015) evaluated the control of *Conyza sumatrensis* when subjected to the action of chlorimuron-ethyl and glyphosate, and control results also showed variability.

The results of these experiments showed that halauxifen-methyl associated with diclosulam, in the different sequential application programs, is able to promote control above 90% for *Conyza* spp., especially when applied at doses of 30.6 and 38.2 g a.i. ha^{-1} for experiments E1 and E2 and, at the other doses, for experiments E3 and E4. Thus, new herbicides, such as halauxifen-methyl, are important tools to weed management in Brazil.

REFERENCES

Bell J.L. et al. **Arylex™ mode and site of action characterization**. Weed Science Society of America and Canadian Weed Science Society/Société Canadienne de Malherbologie; 2014. [acessado em: 09 de mar. 2017]. Disponível em: <http://wssaabstracts.com/public/22/abstract-389.html>.

Bressanin F.N. et al. Controle de biótipos resistentes de Conyza bonariensis com glyphosate+ clorimuron-etílico em função do estádio de desenvolvimento. **Rev Bras Herb.** 2014;13:68-72.

Constantin J. et al. Estimativa do período que antecede a interferência de plantas daninhas na cultura da soja, var. Coodetec 202, por meio de testemunhas duplas. **Planta Daninha**. 2007;25:231-7.

European Food Safety Authority – EFSA. Conclusion on the peer review of the pesticide risk assessment of the active substance halauxifen-methyl (XDE-729 methyl), 2015. [acessado em: 09 de mar. 2017]. Disponível em: <http://www.efsa.europa.eu/sites/default/files/scientificoutput/files/main documents/3913.pdf>.

Ellis J.M. et al. Benefits of soil-applied herbicides in glyphosate-resistant soybean (*Glycine max*). **Weed Technol.** 2002;16:541-7.

Epp J.B. et al. The discovery of ArylexTM active and RinskorTM active: Two novel auxin herbicides. **Bioorg Med Chem.** 2016;24:362-71.

Heap I. The international survey of herbicide resistant weeds. [acessado em: 09 de mar. 2017]. Disponível em: http://www.weedscience .org/in.asp.

Koger C.H. et al. Glyphosate-resistant horseweed (*Conyza canadensis*) in Mississippi. **Weed Technol.** 2004;18:820-5.

Lee S. et al. Defining binding efficiency and specificity of auxins for SCFTIR1/AFBAux/IAA co-receptor complex formation. **ACS Chem Biol.** 2014;9:673-82.

Minozzi G.B. et al. Eficácia de diferentes manejos das plantas daninhas na cultura da soja transgênica. **Rev Bras Ci Agr.** 2014;9:406-12

Moreira M.S. et al. Crescimento diferencial de biótipos de Conyza spp. resistente e suscetível ao herbicida glifosato. **Bragantia**. 2010a;69:591-8.

Moreira M.S. et al. Herbicidas alternativos para o controle de biótipos de *Conyza bonariensis* e *C. canadensis* resistentes ao herbicida glyphosate. **Planta Daninha**. 2010b;28:167-75.

Oliveira Neto A.M. et al. Estratégias de manejo de inverno e verão visando ao controle de *Conyza bonariensis* e *Bidens pilosa*. **Planta Daninha**. 2010;28:1107-16.

Oliveira Neto A.M. et al. Sistemas de dessecação de manejo com atividade residual no solo para áreas de pousio de inverno infestadas com buva. **Comun Sci.** 2013;4:120-8.

Owen L.N. et al. Evaluation of spring and fall burndown application timings on control of glyphosate-resistant horseweed (*Conyza canadensis*) in no-till cotton. **Weed Technol.** 2009;23:335-9.

Peterson, D. E. The impact of herbicide-resistant weeds on Kansas agriculture. **Weed Technol**. 1999;13:632-35.

Powles S.B., Holtum J.A.M. **Herbicide resistance in plants:** biology and biochemistry. Boca Raton: Lewis, 1994.

Rorato D.N. et al. Eficiência do herbicida saflufenacil, no controle de *conyza* spp. em dessecação pré-plantio da soja. **Campo Digital: Rev Ci Exatas Terra Ci Agr.** 2013;8:1-8.

Santos G. et al. Multiple resistance of *Conyza sumatrensis* to Chlorimuronethyl and to Glyphosate. **Planta Daninha**. 2014a;32:409-16.

Santos F.M. et al. Herbicidas alternativos para o controle de *Conyza sumatrensis* (Retz.) E. H. Walker resistentes aos inibidores da ALS e EPSPs. **Rev Ceres**. 2015;62:531-8.

Silva D.R.O. et al. Glyphosate-resistant hairy fleabane competition in RR® soybean. **Bragantia**. 2014;73:451-7.

Sociedade Brasileira de Ciências das Plantas Daninhas – SBCPD. **Procedimentos para instalação, avaliação e análise de experimentos com herbicidas**. Londrina: 1995. 42p.

Takano H.K. et al. Efeito da adição do 2,4-D ao glyphosate para o controle de espécies de plantas daninhas de difícil controle. **Rev Bras Herb.** 2013;12:1-13.

Trezzi M.M. et al. Resistência ao glyphosate em biótipos de buva (Conyza spp.) das regiões oeste e sudoeste do Paraná. **Planta Daninha**. 2011;29:649-54.

Vangessel M.J. et al. Influence of glyphosate-resistant horseweed (*Conyza canadensis*) growth stage on response to glyphosate applications. **Weed Technol.** 2009;23:49-53.