Nativa, Sinop, v. 12, n. 3, p. 516-523, 2024.
Pesquisas Agrárias e Ambientais
DOI: https://doi.org/10.31413/nativa.v12i3.16878
ISSN: 2318-7670

Management with sequential application of herbicides for the control of hairy fleabane (*Conyza* spp.) in the Cerrado

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Submitted on: 12/19/2023; Accepted on: 08/23/2024; Published on: 09/27/2024.

ABSTRACT: *Conyza* is a genus of weeds that are found in crop areas with high infestation, causing a reduction in productivity. The study was carried out in the field at *De Lollo Agronegócios Rio Verde* Research Station, Goiás, Brazil, in a randomized block experimental design with thirteen treatments and four replications, with sequential application in pre-sowing management in soybean crops. Weed control data were evaluated using the *Scott-Knott* and *Tukey* tests ($P < 0.05$). Management with a sequential application using herbicides showed effective control over Conyza. Treatments T4 (Glyphosate + (S-Metolachlor + Glufosinate); T5 (Glyphosate + Triclopyr-butolitic); T7 (Glyphosate + 2,4-D + (Mesotrione + Atrazine)); T8 (Glyphosate + 2,4-D + Triclopyr-butolitic); T9 (Glyphosate + 2,4 D + (S-Metolachlor + Glufosinate)); T10 (Glyphosate + 2,4-D + Saflufenacil); T11 (Glyphosate + Saflufenacil + Triclopyr-butolitic) applied 20 days before sowing (DAS) and with application of Glyphosate + Clorimuron + Carfentrazone sequentially at 5 DAS and application of T12 treatment (Glyphosate + 2,4-D + Saflufenacil) at 20 DAS and application of the commercial mixture of Diquate + Flumioxazin in sequence at 5 DAS, showed potential for the control of *Conyza* spp..
Keywords: herbicides; glyphosate; *Glycine max*; herbicide resistance; *Conyza* genus.

Manejo com aplicação sequencial de herbicidas sobre o controle de buva (*Conyza* spp.) no Cerrado

RESUMO: *Conyza* é um gênero de plantas daninhas que são encontradas em áreas de cultivos apresentando infestação elevada provocando redução na produtividade. O estudo foi realizado em campo na Estação de Pesquisa De Lollo Agronegócios Rio Verde, Goiás, Brasil, em delineamento experimental em blocos casualizados com treze tratamentos e quatro repetições, com aplicação sequencial no manejo em pré semeadura na cultura de soja. Os dados de controle de plantas daninhas foram avaliados pelos testes de *Scott-Knott* e *Tukey* ($P < 0,05$). O manejo com aplicação sequencial com utilização de herbicidas apresentou controle efetivo sobre *Conyza*. Os tratamentos T4 (Glifosato + (S-Metolacloro + Glufosinato); T5 (Glifosato + Triclopir-butolítico); T7 (Glifosato + 2,4-D + (Mesotriona + Atrazina)); T8 (Glifosato + 2,4-D + Triclopir-butolítico); T9 (Glifosato + 2,4 D + (S-Metolacloro + Glufosinato)); T10 (Glifosato + 2,4-D + Saflufenacil); T11 (Glifosato + Saflufenacil + Triclopir-butolítico) aplicados aos 20 dias antes da semeadura (DAS) e com aplicação de Glifosato + Clorimurom + Carfentrazona de maneira sequencial aos 5 DAS e a aplicação do tratamento T12 (Glifosato + 2,4-D + Saflufenacil) aos 20 DAS e aplicação da mistura comercial de Diquate + Flumioxazin em sequência aos 5 DAS, apresentaram potencial sobre o controle de *Conyza* spp..
Palavras-chave: herbicidas; glifosato; *Glycine max*; resistência a herbicidas; gênero *Conyza*.

1. INTRODUCTION

The correct management of weeds is one of the main concerns for grain production in the world, as these invasive weeds are tolerant to traditional herbicides and are widespread in national and international markets. Popularly known as horseweed (*Conyza* spp.) (Figure 1), it is a genus of weeds belonging to the Asteraceae or Compositae families, the majority of which are native to South America, with around 100 species (URDAMPILLETA et al., 2005). It is described as an autogamous vegetable with an annual or biannual cycle dependent on environmental conditions, which cause major infestation problems in crops around the world, including in Brazil (KISSMANN; GROTH, 1999; MOREIRA; BRAGANÇA, 2010; PALMA-BAUTISTA et al., 2021).

Conyza spp. it can be found in all regions of Brazil. This genus of invasive plants presents high ecological adaptability and has a high production of viable seeds, whereas some

Conyza species can produce more than 200 thousand seeds per plant with a high germination rate (ALI et al., 2020). The morphology of *Conyza* seeds is small in size and light and has a silky achene that allows them to be dispersed over short and long distances and can be dissipated by the wind or animals (birds, rodents, and mammals) from the mother plant (LEITE et al., 2014). The main species of *Conyza* studied are *C. bonariensis*, *C. sumatrensis*, *C. blakei*, *C. lorentzii,* and *C. canadensis*, being the main infesting species in crop areas in the Americas, Africa, Asia, the Pacific, and Europe, which may present high infestation causing a severe reduction in productivity of more than 18% when compared to the area without infestation (VALENCIA-GREDILLA et al., 2020; CABRERA-PÉREZ et al., 2022). *Conyza* spp. they can also serve as hosts for pests and diseases, thus making management and control in infested areas difficult (GAZZIERO et al., 2010).

Several herbicide molecules have already been created to guarantee weed control and thus maintain grain productivity in small and large crops, thus providing high-quality products. Glyphosate is the main known herbicide, which has been widely disseminated among farmers to guide the control and elimination of weeds since its introduction in 1974. Herbicides have been applied repeatedly for decades or as a mixture in spray tanks to control *Conyza* spp. However, resistance to these products is observed in this genus of plants (ALBRECHT et al., 2020; PERALTA et al., 2022).

Resistance to the main herbicides has been studied on weeds in one or several mechanisms of action. This is due to an evolutionary response of weeds to the selection pressure imposed by repeated and continuous applications of herbicides, which is a concern for the agricultural environment in Brazil and worldwide (BACCIN et al., 2022). Resistance to herbicides by these invasive plants has been observed not only by a single mechanism but by several, which is a major challenge for the control of these weeds where there is a greater expenditure of herbicides, which influences the costs invested in the crop. as there is the use of herbicides presenting different mechanisms of action (MoA) different from the one that selected resistance (AVES et al., 2020; DIEZ DE ULZURRUN et al., 2020).

Therefore, it is necessary to invest in studies that evaluate herbicide molecules together so that they can potentially act on weeds of *Conyza* spp. This will ensure that this group of invasive plants is controlled and that there is low productivity loss, especially in soybean and corn crops in agricultural countries.

Figure 1. Plant of *Conyza* spp.. Arrows (red) show horseweed seeds' wind dispersal (*Conyza* spp.).
Figura 1. Planta de *Conyza* spp.. Setas (vermelha) mostrando a dispersão pelo vento de sementes de buva (*Conyza* spp.).

This study aimed to evaluate different herbicides alone or in conjunction with Glyphosate, presenting different mechanisms of action with permitted use for the control of *Conyza* spp. with sequential application in the management of *Conyza* spp. in pre-sowing soybean (*Glycine max* L.) in the Brazilian *Cerrado*.

2. MATERIAL E METHODS

2.1. Location and experimental design

The experiment was conducted under field conditions at the De Lollo Agronegócios Research Station in Rio Verde, Goiás, Brazil. The installation location's geographic coordinates are (Latitude: 17°46'56.50 S and Longitude: 050°58'18.08 W), with a geographic altitude of 783 m.

The experimental design used was randomized blocks with thirteen treatments and four replications. The experimental unit was composed of a rectangle with a width and length of 3 x 3 m, totaling an area of 9 m² per experimental unit and 468 m² of test area.

2.2. Soil type and cropping history

The soil in the experimental area is classified as Distroferric Red Latosol (Oxisol), typical, clayey texture, *Cerrado* phase (SANTOS et al., 2018). The area used to implement the test has a history of successive cultivation of soybean and corn crops for over five years.

2.3. Soybean cultivar and planting period

The soybean cultivar used in the trial was HO Tererê IPRO, sown on December 22, 2022, and harvested on March 3, 2023.

2.4. Experimental herbicide treatments and spray conditions

For the control of weeds with a focus on *Conyza* spp. management was used with the sequential application of herbicides. The first applications occurred twenty days before soybean sowing, and sequential applications were carried out five days before sowing, as described in (Table 1).

The applications were carried out with a CO_2-pressurized knapsack sprayer equipped with a bar with six ADIA 110.02 type spray tips spaced 0.5 m apart, applying a spray volume equivalent to 150 L ha^{-1}, information on environmental conditions during applications is available and presented in (Table 2). Data on environmental conditions at the time of application were collected using the Kestrel® Ag 5500 thermohygro-anemometer.

2.5. Post-application assessments

Assessments on the control of *Conyza* spp. as a result of the application of herbicide treatments, were carried out on days after application (DAA), at 7 and 14 days after the first application (DAAA), and at 7, 14, and 21 days after the second application (DAAB). The visual scale of the Brazilian Society of Weed Science (SBCPD) of 1995 was used, which describes the control scores, being 0% when there was no control of weeds after applying herbicide treatments and 100% when there was death of the plants. Weeds after application of herbicide treatments.

2.6. Statistical analysis

Weed control data were subjected to the analysis of variance (ANOVA) test, and when significant, the Scott-Knott mean separation test was performed. The productive component data were subjected to the Tukey test with a 5% probability using the statistical software SASM-Agri (CANTERI et al., 2001).

Table 1. Treatments, doses, and time of application in the experimental production agricultural area of *De Lollo Agronegócios*, Rio Verde - GO, Brazil, Harvest 22/23.
Tabela 1. Tratamentos, doses e época de aplicação na área agrícola de produção experimental da De Lollo Agronegócios, Rio Verde - GO, Brasil, Safra 22/23.

Treatments		Active ingredient	Application cod.	Application time	Dose (p.c.) Kg L^{-1} ha^{-1}
T1	Witness	-	A	20 DAS	0.000
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T2	Glyphosate	Glyphosate	A	20 DAS	2.500
	Calaris	Mesotrione + Atrazine	A		1.500
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T3	Glyphosate	Glyphosate	A	20 DAS	2.500
	Paxeo	Diclosulam + Halauxifene	A		0.055
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T4	Glyphosate	Glyphosate	A	20 DAS	2.500
	Cheval	S-Metolachlor + Glufosinate	A		2.000
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T5	Glyphosate	Glyphosate	A	20 DAS	2.500
	Triclopyr	Triclopyr-butolitic	A		1.500
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T6	Glyphosate	Glyphosate	A	20 DAS	2.500
	Xtendicam	Dicamba DGA	A		1.500
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T7	Glyphosate	Glyphosate	A	20 DAS	2.500
	2,4 D	2,4 D	A		1.000
	Calaris	Mesotrione + Atrazine	A		1.000
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T8	Glyphosate	Glyphosate	A	20 DAS	2.500
	2,4 D	2,4 D	A		1.000
	Triclopyr	Triclopyr-butolitic	A		1.500
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T9	Glyphosate	Glyphosate	A	20 DAS	2.500
	2,4 D	2,4 D	A		1.000
	Cheval	S-Metolachlor + Glufosinate	A		1.500
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T10	Glyphosate	Glyphosate	A	20 DAS	2.500
	2,4 D	2,4 D	A		1.000
	Heat	Saflufenacil	A		0.075
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T11	Glyphosate	Glyphosate	A	20 DAS	2.500
	Heat	Saflufenacil	A		0.075
	Triclopyr	Triclopyr-butolitic	A		1.500
	Glyphosate	Glyphosate	B	5 DAS	3.000
	Chlorimuron	Chlorimuron	B		0.080
	Aurora	Carfentrazone	B		0.060
T12	Glyphosate	Glyphosate	A	20 DAS	3.000
	2,4 D	2,4 D	A		0.500
	Heat	Saflufenacil	A		0.060
	Burner	Diquat + Flumioxazin	B	5 DAS	2.000
T13	Control	Absolute Control	-	-	-

Note: c.p – Commercial Product; DAS – Days before sowing. [1]Commercial Product. Tank mixtures were carried out following the addition order proposed by Azevedo (2015).Nota: p.c – Produto Comercial; DAS – Dias antes da semeadura. [1]Produto Comercial. As misturas em tanque foram realizadas seguindo a ordem de adição proposta por Azevedo (2015).

Table 2. Data on environmental conditions collected at the time of application of herbicide treatments in the *De Lollo Agronegócios*, Rio Verde - GO, Harvest 22/23.
Tabela 2. Dados de condições ambientais coletados no momento das aplicações dos tratamentos herbicidas na área da De Lollo Agronegócios, Rio Verde - GO, Safra 22/23.

Spray date	02/10/2022	17/10/2022
Start of application (h)	7:43 AM	11:11 AM
Application end (h)	8:21 AM	11:25 AM
Minimum temperature (°C)	20.0	25.60
Average temperature (°C)	21.2	26.6
Maximum temperature (°C)	23.3	27.7
Wind speed (km h)	5.20	5.80
Relative humidity (%)	81.6	67.0

3. RESULTS

Table 3 presents control data on fleabane plants after the application of herbicide treatments at 7 and 14 days after application A (DAAA), which was carried out 20 days before sowing and at 7, 14, and 21 days after application B (DAAB), which was carried out 5 days before soybean sowing.

In Figure 1 and Table 3, at 7 and 14 days after application, A (DAAA), treatments T9, T10, T11, and T12 presented higher means of control over horseweed in the two evaluation periods. They were statistically equal to each other and superior to the other treatments according to the mean separation test by Scott-Knott with a 5% probability. The treatments mentioned showed an average of horseweed control greater than 86% at 14 DAAA.

The second application shows that at 7 DAAB treatments, T4, T9, T10, T11, and T12 presented the best average values for horseweed control and did not show any statistical difference between them, being statistically superior to the other treatments applied.

At 14 DAAB, treatments T2, T5, T9, T10, T11, and T12 presented higher average values than the horseweed control and were statistically superior to the other treatments applied. In Figure 1 and the evaluation of 21 DAAB in Table 3, the treatments that promoted the highest average values of horseweed control presented control rates above 90%. Therefore, treatments T4, T5, T7, T8, T9, T10, T11, and T12 did not differ statistically and were superior to the other treatments evaluated.

Table 3. Control of *Conyza* spp. after applications of herbicide treatments in the experimental area of De Lollo Agronegócios, Rio Verde - GO, Harvest 22/23.
Tabela 3. Controle de Conyza spp. após aplicações dos tratamentos herbicidas na área experimental da De Lollo Agronegócios, Rio Verde - GO, Safra 22/23.

	7 DAAA	14 DAAA	7 DAAB	14 DAAB	21 DAAB
T 1	0.0 0d	0.00 d	0.00 d	6.25 d	12.50 d
T 2	20.00 c	62.50 b	78.75 b	91.25 a	82.50 b
T 3	12.50 c	35.00 c	48.75 c	71.25 c	65.00 c
T 4	35.00 b	70.00 b	82.50 a	87.50 b	92.50 a
T 5	18.75 c	47.50 c	76.25 b	91.25 a	100.00 a
T 6	13.75 c	38.75 c	67.50 b	81.25 b	82.50 b
T 7	13.75 c	57.50 b	75.00 b	85.00 b	93.75 a
T 8	13.75 c	43.75 c	72.50 b	87.50 b	100.00 a
T 9	53.75 a	86.25 a	90.00 a	95.00 a	100.00 a
T 10	60.00 a	91.25 a	97.50 a	100.00 a	100.00 a
T 11	63.75 a	95.00 a	98.75 a	100.00 a	100.00 a
T 12	63.75 a	93.75 a	95.00 a	98.75 a	100.00 a
T 13	0.00 d	0.00 d	0.00 d	0.00 d	0.00 d
CV (%)	30.19	23.66	12.62	10.87	14.71

Note: Application A at 20 DAS: T1 – no application; T2 – Glyphosate + (Mesotrione + Atrazine) [2.50 + 1.50 kg/L ha^{-1}]; T3 – Glyphosate + (Diclosulam + Halauxifene) [2.50 + 0.055 kg/L ha^{-1}]; T4 – Glyphosate + (S-Metolachlor + Glufosinate) [2.50 + 2.00 kg/L ha^{-1}]; T5 – Glyphosate + Triclopyr-butolitic [2.50 + 1.50 kg/L ha^{-1}]; T6 – Glyphosate + Dicamba [2.50 + 1.50 kg/L ha^{-1}]; T7 – Glyphosate + 2.4 D + (Mesotrione + Atrazine) [2.50 + 1.00 + 1.00 kg/L ha^{-1}]; T8 – Glyphosate + 2.4 D + Triclopyr-butolitic [2.50 + 1.00 + 1.00 kg/L ha^{-1}]; T9 – Glyphosate + 2.4 D + (S-Metolachlor + Glufosinate) [2.50 + 1.00 + 1.50 kg/L ha^{-1}]; T10 – Glyphosate + 2.4 D + Saflufenacil [2.50 + 1.00 + 0.075 kg/L ha^{-1}]; T11 – Glyphosate + Saflufenacil + Triclopyr-butolitic [2.50 + 0.075 + 1.50 kg/L ha^{-1}]; T12 – Glyphosate + 2.4 D + Saflufenacil [3.00 + 0.50 + 0.06 kg/L ha^{-1}]; T13 – Absolute control (no application occurred). Application B at 5 DAS was the same in treatments from T 1 to T 11 using Glyphosate + Chlorimuron + Carfentrazone [3.00 + 0.08 + 0.06 kg/L ha^{-1}] and in T 12 used (Diquate + Flumioxazin) [2.00 kg/L ha^{-1}]. DAAA - Days after application A; DAAB - Days after application B; CV – Coefficient of variation. Means followed by the same letter in the column do not differ using the *Scott-Knott* test at 5% probability.
Nota: Aplicação A aos 20 DAS: T1 – sem aplicação; T2 – Glifosato + (Mesotriona + Atrazina) [2,50 + 1,50 kg/L ha^{-1}]; T3 – Glifosato + (Diclosulam + Halauxifeno) [2,50 + 0,055 kg/L ha^{-1}]; T4 – Glifosato + (S-Metolacloro + Glufosinato) [2,50 + 2,00 kg/L ha^{-1}]; T5 – Glifosato + Triclopir-butolítico [2,50 + 1,50 kg/L ha^{-1}]; T6 – Glifosato + Dicamba [2,50 + 1,50 kg/L ha^{-1}]; T7 – Glifosato + 2,4 D + (Mesotriona + Atrazina) [2,50 + 1,00 + 1,00 kg/L ha^{-1}]; T8 – Glifosato + 2,4 D + Triclopir-butolítico [2,50 + 1,00 + 1,00 kg/L ha^{-1}]; T9 – Glifosato + 2,4 D + (S-Metolacloro + Glufosinato) [2,50 + 1,00 + 1,50 kg/L ha^{-1}]; T10 – Glifosato + 2,4 D + Saflufenacil [2,50 + 1,00 + 0,075 kg/L ha^{-1}]; T11 – Glifosato + Saflufenacil + Triclopir-butolítico [2,50 + 0,075 + 1,50 kg/L ha^{-1}]; T12 – Glifosato + 2,4 D + Saflufenacil [3,00 + 0,50 + 0,06 kg/L ha^{-1}]; T13 – Controle absoluto (não ocorreu nenhuma aplicação). Aplicação B aos 5 DAS foi a mesma nos tratamentos de T 1 a T 11 utilizando Glifosato + Clorimurom + Carfentrazona [3,00 + 0,08 + 0,06 kg/L ha^{-1}] e no T 12 utilizou (Diquate + Flumioxazin) [2,00 kg/L ha^{-1}]. DAAA - Dias após aplicação A; DAAB - Dias após aplicação B; CV – Coeficiente de variação. Médias seguidas pela mesma letra na coluna não diferem entre si pelo teste de *Scott-Knott* a 5% de probabilidade.

Table 3 presents weed control averages in general, including all species mentioned above. At 7 and 14 days after application A (DAAA) and at 7 DAAB, treatments T9, T10, T11, and T12 presented potential with higher averages for weed control in the two evaluation periods and were therefore statistically equal to each other and superior to the other treatments using the *Scott-Knott* mean separation test at 5% probability.

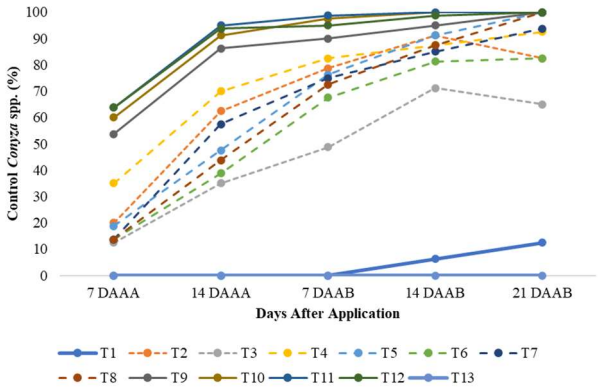

Figure 1. Evolution of *Conyza* spp. control depending on the applications of herbicide treatments. From De Lollo Agronegócios, Rio Verde - GO, Harvest 22/23. Note: Identification of applications and treatments identical to Note in Table 3.

Figura 1. Evolução do controle de *Conyza* spp. em função das aplicações dos tratamentos herbicidas. De Lollo Agronegócios, Rio Verde - GO, Safra 22/23. Nota: Aplicação A aos 20 DAS; Identificação das aplicações e dos tratamentos idêntica à Nota da Tabela 3.

At 14 DAAB, treatments T5, T9, T10, T11, and T12 were statistically superior to the other treatments and showed no difference between them according to the *Scott-Knott* test with 5% probability, with higher average values for weed control in this evaluation period (Table 3 and Figure 2).

In Table 3 and Figure 2 at 21 DAAB it can be seen that treatments T4, T5, T7, T8, T9, T10, T11, and T12 presented the highest averages between treatments, with control of Conyza plants greater than 97%, being statistically superior to the other treatments and showing no difference between them according to the *Scott-Knott* test with ($P < 0.05$).

Table 4 presents the productive components corrected for 13% humidity. For thousand grain weight (PMG) the T5 treatment with application of Glyphosate + Triclopyr-butolitic [2.50 + 1.50 kg/L ha^{-1}] 20 days before sowing (DAS) and application of Glyphosate + Clorimurom + Carfentrazone [3.00 + 0.08 + 0.06 kg/L ha^{-1}] at 5 DAS provided the highest average for this variable with 208.75 g, this treatment was statistically equal to the T4 treatment with application of Glyphosate + (S-Metolachlor + Glufosinate) [2.50 + 2.00 kg/L ha^{-1}] at 20 DAS and superior to the other treatments by Tukey's test at 5% probability. Treatments T8, T9, and T10 (presented productivity averages above 80 bags per hectare, which were the highest among the treatments; however, these treatments did not differ statistically from the treatments that adopted the management of sequential application, with the application at 20 DAS and 5 DAS using the Tukey test ($P < 0.05$).

The application carried out only at 5 DAS in the T1 treatment with Glyphosate + Clorimurom + Carfentrazone [3.00 + 0.08 + 0.06 kg/L ha^{-1}] promoted productivity of 20, 71 bags per hectare more than the T 13 treatment, where no herbicide application was made (Table 5).

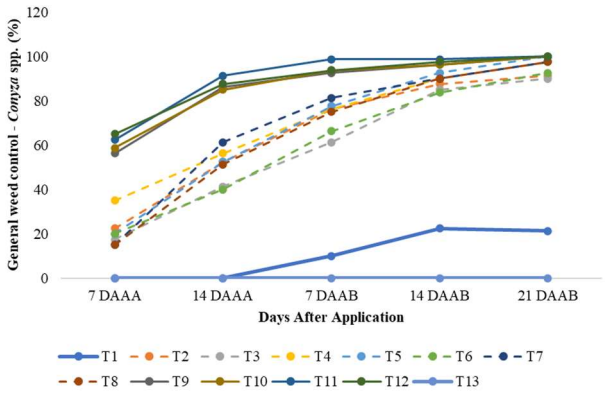

Figure 2. Evolution of general weed control depending on the applications of herbicide treatments. De Lollo Agronegócios, Rio Verde - GO, Harvest 22/23. Note: Identification of applications and treatments identical to Note in Table 3.

Figura 2. Evolução do controle geral de plantas daninhas em função das aplicações dos tratamentos herbicidas. De Lollo Agronegócios, Rio Verde - GO, Safra 22/23. Nota: Identificação das aplicações e dos tratamentos idêntica à Nota da Tabela 3.

Table 4. Control of general weeds present in the trial after applications of herbicide treatments. In *De Lollo Agronegócios*, Rio Verde - GO, Harvest 22/23.

Tabela 4. Controle de plantas daninhas gerais presentes no ensaio após aplicações dos tratamentos herbicidas. Em De Lollo Agronegócios, Rio Verde - GO, Safra 22/23.

	7 DAAA	14 DAAA	7 DAAB	14 DAAB	21 DAAB
T 1	0.00 d	0.00 c	10.00 d	22.50 c	21.25 c
T 2	22.50 c	52.50 b	76.25 b	87.50 b	91.25 b
T 3	17.50 c	41.25 b	61.25 c	85.00 b	90.00 b
T 4	35.00 b	56.25 b	76.25 b	90.00 b	97.50 a
T 5	20.00 c	52.50 b	77.50 b	92.50 a	100.00 a
T 6	20.00 c	40.00 b	66.25 c	83.75 b	92.50 b
T 7	15.00 c	61.25 b	81.25 b	90.00 b	97.50 a
T 8	15.00 c	51.25 b	75.00 b	90.00 b	97.50 a
T 9	56.25 a	86.25 a	92.50 a	96.25 a	100.00 a
T 10	58.75 a	85.00 a	93.75 a	96.25 a	100.00 a
T 11	62.50 a	91.25 a	98.75 a	98.75 a	100.00 a
T 12	65.00 a	87.50 a	93.75 a	97.50 a	100.00 a
T 13	0.00 d	0.00 a	0.00 e	0.00 d	0.00 d
CV (%)	27.93	22.83	9.34	6.86	5.52

Note: Identification of applications and treatments identical to Note in Table 3; DAAA - Days after application A; DAAB - Days after application B; CV – Coefficient of variation. Means followed by the same letter in the column do not differ using the *Scott-Knott* test at 5% probability.

Nota: Aplicação A aos 20 DAS; Identificação das aplicações e dos tratamentos idêntica à Nota da Tabela 3; DAAA - Dias após aplicação A; DAAB - Dias após aplicação B; CV – Coeficiente de variação. Médias seguidas pela mesma letra na coluna não diferem entre si pelo teste de *Scott-Knott* a 5% de probabilidade.

Table 5. Productive components about the weed management adopted. De Lollo Agronegócios, Rio Verde - GO, Harvest 22/23.
Tabela 5. Componentes produtivos em relação ao manejo de plantas daninhas adotado. De Lollo Agronegócios, Rio Verde - GO, Safra 22/23.

Treatments	WTG	kg ha^{-1}	Bags ha^{-1}	More bags than 13 treatments without herbicide application
T1	191.58 g	3818.53 b	63.64 b	20.71
T2	201.83 cd	4508.82 ab	75.15 ab	32.22
T3	202.50 c	4338.70 ab	72.31 ab	29.38
T4	206.87 ab	4518.56 ab	75.31 ab	32.38
T5	208.73 a	4478.71 ab	74.64 ab	31.71
T6	198.97 de	4694.77 ab	78.25 ab	35.32
T7	198.98 de	4761.41 ab	79.36 ab	36.43
T8	203.70 bc	4823.56 ab	80.40 a	37.46
T9	201.60 cd	4814.57 a	80.24 a	37.31
T10	198.46 de	5038.40 a	83.97 a	41.04
T11	196.05 ef	4734.13 a	78.90 ab	35.97
T12	194.39 fg	4618.90 ab	76.98 ab	34.05
T13	194.03 fg	2575.84 c	42.93 c	-
CV (%)	0.70	8.50	8.50	-

Note: Note: Identification of applicações and treatments identical to Note in Table 3; PMG (*WTG*) – weight of one thousand grains; CV% – Coefficient of variation; The production component data is corrected for 13% humidity. Means followed by the same letter in the column do not differ from each other using the Tukey test at 5% probability.
Nota: Identificação das aplicações e dos tratamentos idêntica à Nota da Tabela 3; PMG (*WTG*) – peso de mil grãos; CV – Coeficiente de variação; Os dados de componente produtivo estão corrigidos para umidade de 13%. Médias seguidas pela mesma letra na coluna não diferem entre si pelo teste de Tukey a 5% de probabilidade.

4. DISCUSSION

Despite efforts to control *Conyza* spp. with several herbicide molecules, this is proving to be a difficult fight to win regarding the tolerance and resistance of this invader in crops worldwide. Several studies show a synergistic effect of the combination of herbicides on the control of *Conyza*; Dalazen et al. (2015) found that the herbicides Glyphosate and Saflufenacil on Glyphosate-resistant horseweed plants found that the mixture of these herbicides was positive for the *Conyza bonariensis* biotype evaluated. Still, in this study, the researchers found that dosages of 540 g ha^{-1} of Glyphosate and 35 g ha^{-1} of Saflufenacil prevented the regrowth and dispersion of new viable horseweed seeds, which did not occur in plants treated only with Saflufenacil.

Still corroborating our findings, Moreira et al. (2010) reported that in horseweed plants at the ten-leaf stage, the herbicidal potential was observed with the application together with Glyphosate + Bromacil + Diuron at doses (1,440 + 1,200 + 1,200 g ha^{-1}, Glyphosate + Atrazine (1,440 + 1,500 g ha^{-1} and Glyphosate + Diuron (1,440 + 1,500 g ha^{-1}), for the pre-flowering stage of *Conyza* spp., the application of the herbicide Ammonium-Glufosinate 400 g ha^{-1}, alone or associated with MSMA, Bromacil + Diuron, Metsulfuron, Carfentrazone and Paraquat was the control alternatives for *C. bonariensis* and *C. canadensis*.

Takano et al. (2010) also found that *Conyza*, *Commelina benghalensis*, *Richardia brasiliensis*, *Euphorbia heterophylla*, *Spermacoce latifolia*, *Ipomoea grandifolia* plants treated with herbicides in additional doses of Glyphosate and 2,4-D were decisive for the control of these weeds. *Conyza* is a group of weeds that are difficult to control, as observed, and that is why several other authors, in addition to our study, are testing combinations so that we can obtain control over these invasive plants. Among many studies, we mention Silva et al. (2023), who analyzed the combination of herbicides on *Conyza* in soybean crops and found that high percentages were obtained in the control using Saflufenacil + Glyphosate or Diquat. Glufosinate provided satisfactory control 7 days after application of treatments, however, with regrowth throughout the evaluations, except when applied with Diclosulam. Pre-emergent herbicides decreased the emergence of *Conyza* spp. resulting in 0.25 plants m^{-2}, with the application of Flumioxazin + Imazethapyr at 28 DAT. Furthermore, regardless of the treatment, the researchers did not detect significant phytotoxicity in the soybean crop. In this study, the management of *Conyza* spp. Positioning herbicides simultaneously proved more efficient when performed sequentially with Diquat and/or Saflufenacil + Glyphosate and Flumioxazin + Imazethapyr in pre-emergence.

In another study, Dalazen et al. (2015) analyzed several herbicides against *Conyza* and their selectivity over white oat and ryegrass, where they found that the herbicide Imazethapyr was not selective when compared to the independent herbicides 2,4-D amine, Metsulfuron-Methyl, Chlorimuron-Ethyl, Diclosulam, Saflufenacil and Flumoxyoxazin. of the doses applied. Both in soybeans and in other crops, the verification of different dosages of one or more herbicides with different formulations must be verified for their selectivity. These researchers also corroborate the theory that in some treatments in certain evaluations where they presented the highest average control values over *Conyza* spp. in the latest evaluations, they may show a decrease in the effective control of these weeds. This is due to the regrowth capacity these weeds can promote if management cannot achieve total control. Still, in conjugated dosages, Cesco et al. (2019) conducted a field experiment applying 2,4-D + Glyphosate (1035 + 703.5 g ha^{-1}) to Conyza spp., where they obtained 65% control and 100% regrowth.

Our results, among other results, reinforce the fact that in *Conyza* spp. with plants at a more advanced stage of development, the application of 2,4-D + Glyphosate is no longer sufficient to promote control, with the consequent

massive production of seeds and new germination flows. Silva et al. (2021) also obtained similar data, stating that when applying 2,4-D + Glyphosate (975 + 1025 g ha^{-1}) to control *Conyza* spp. with plants over 20 cm tall, they obtained a maximum control of 55%.

5. CONCLUSIONS

The application of herbicides is necessary to manage weeds. Management with sequential application using herbicide molecules with different mechanisms of action is a tool that should be disseminated in the management of rural properties as it can promote effective control of the weed community, including difficult-to-control weeds such as *Conyza* plants. Treatments with Glyphosate + S-Metolachlor + Glufosinate; Glyphosate + Triclopyr-butolitic; Glyphosate + 2,4 D + Mesotrione + Atrazine; Glyphosate + 2,4-D + Triclopyr-butolitic; Glyphosate + 2,4-D + S-Metolachlor + Glufosinate; Glyphosate + 2,4-D + Saflufenacil; Glyphosate + Saflufenacil + Triclopyr-butolitic applied 20 days before sowing and with application of Glyphosate + Clorimurom + Carfentrazone sequentially at 5 days and application of treatment with Glyphosate + 2,4-D + Saflufenacil at 20 days and application of a commercial mixture of Diquate + Flumioxazin in sequence after 5 days showed significant effects on the control of *Conyza* spp.

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Acknowledgments: The De Lollo Agricultural Research; to the Hydraulics and Irrigation and Technological Chemistry Laboratory of IF Goiano, Goiás, Brazil; the Goiás State Research Support Foundation for the Doctoral Scholarship for the second author.

Authors contribution: A.N.J.: conceptualization, methodology, and writing an original draft; A.C.P.M.F.: methodology, investigation or data collection, statistical analysis, and writing review and editing; P.S.: translation and writing review and editing; M.V.A.V.: statistical analysis and writing an original draft; f.r.c.: acquisition of financing and administration; E.M.B.: administration or supervision, validation, and writing of original draft; F.C.B.: validation, writing original draft, and writing review and editing; K.A.D.L.: acquisition of financing and administration or supervision.

Data availability: Study data can be e-mail from the corresponding author or the second author upon request.

Conflicts of Interest: The authors declare no conflict of interest. Supporting entities had no role in the study's design, data collection, analysis, or interpretation, manuscript writing, or decision to publish the results.