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Short Communication
Management Control of *Synedrellopsis grisebachii* by Herbicides with Adjuvant

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Abstract

Objective: This study aimed to improve and show an alternative control of Cinderella weed *Synedrellopsis grisebachii* (*S. grisebachii*), because it is a troublesome in a non-till system and in perennial crops in Brazil. **Methodology:** Field trial was conducted in Brazil Midwest, set in a randomized complete block with three replication. The herbicides treatments were the application of Roundup Transorb, DMA and Volcane, also the combination of heat+dash and gramocil+agral. For treatments application, used $C0_2$ backpack, four DG11002 nozzles in 0.5 m spaced apart, with spray volume of 200 L ha^{-1}. Fisher (LSD) test was used for mean comparison with ($p<0.05$). Percentage of control was analyzed by using one-way ANOVA. **Results:** Cinderella weed was affected significantly by all herbicide treatments at 5, 10, 15, 35 and 45 days after application. Heat (70 g a.i. ha^{-1})+dash controlled 100% while Roundup Transorb, DMA and Volcane did not reach 30% at 5 days after application. The DMA showed the best result for controlling 100% at 60 days after application, also heat (70 g a.i. ha^{-1}) +dash and volcane had an effective control for showing low percentage of resprout, 7 and 5%, while Roundup showed the highest resprout 37%. **Conclusion:** Cinderella has a natural resistance to glyphosate and application of DMA is the best herbicide to control.

Key words: Cinderella weed, herbicide, Volcane, DMA, weed control

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Cinderella weed is a native plant to Bolivia, Paraguay and Argentina. It is a perennial weed of pastures and crops, reproduces by seeds and stems also is a troublesome in non-till system and in perennial crops, for requiring low light to grow and the tractor brush cutter does not have an efficient control as well. In addition, it has allelopathic effect in crops and it is a host of nematode *Meloidogyne mayaguensis*.

Since the first herbicide studies of the glyphosate at 1972 in Brazil, this herbicide showed a broad-spectrum control of grasses and broad-leaf weeds. Then, became the most used herbicide in Brazil and worldwide. Weeds started to be tolerant for using glyphosate in field often. Growers sometimes apply four times the same herbicide or the double of the rate indicated at the label. So, weeds as *Conyza bonariensis* and *Digitaria insularis* have become tolerant to glyphosate[1,2]. Some weeds have a natural tolerance as *Commelina benghalensis* and *Synedrellopsis grisebachii* [3,4]. A study at application of glyphosate in tank mixture with other herbicides, split application, sequential application or a better management program were needed.

The soil and herbicide management might influence the seed emergence and growth, because seeds can inherit high tolerance of an herbicide or environment through mother plant. A study conducted in sugar cane crop field showed Cinderella had more nitrogen (^{15}N) assimilation in some sites[5]. Thus, it was essential to use different active ingredient for each crop season, so the mother plant does not produce offspring with high tolerance to herbicides.

This study aimed to develop improved and prolonged *Synedrellopsis grisebachii* control. An experiment was conducted at Midwest of Brazil to investigate the percentage of control and resprout after herbicides application.

MATERIALS AND METHODS

Field trial was conducted in 2015 from June-August at experimental field of Universidade Federal de Goiás, campus Jataí (17°55′ 32″ S, 51°42′ 32″ O). The field has a clay soil, Latossolo Vermelho distroférrico. After soybean harvesting, the weed started to sprout and took over the field, meaning that it was set in older crop season already. In addition, the weed had 90% of density. The trial was set in a randomized complete block design with five replication and each plot had 6×4 m. The herbicide treatments were one application of heat (35 g a.i. ha^{-1})+dash (0.5% v/v), heat (50 g a.i. ha^{-1})+dash (0.5% v/v), heat (70 g a.i. ha^{-1})+dash (0.5% v/v), gramocil (2 L a.i. ha^{-1})+agral (0.2% v/v), Volcane (3 L a.i. ha^{-1}), DMA (1.5 L a.i. ha^{-1}) and Roundup Transorb (3 L a.i. ha^{-1}). For herbicide application used CO_2 backpack, four DG11002 nozzles in 0.5 m spaced apart, with spray volume of 200 L ha^{-1}. During the application, the humidity was around 80% and wind 3 km h^{-1} through the Thermo-Higro-Anemometer Lux-meter device. The percentage of control at 5, 10, 15, 30 and 45 days after application (DAA) and 60 DAA for percentage of resprout was analyzed. For all the analysis used four people, looking at the control treatment, giving the percentage then the average calculated.

Statistical measurement and analysis: Data homogeneity were verified by Levene test using package "car", so only the data from 30 DAA did not show homogeneity, it was log transformed. All the statistical analysis used R software (version 3.3.3). The model $Yhi = \mu+\theta h+\tau i+\varepsilon hi$ was used for percentage of control, in both trials, where Yhi is the random variable representing the response for treatment i observed in block, h and μ are constant, θh is the additive effect of the h block, τ is the additive effect for the i treatment and εhi is the random error for the i treatment in the h block. Percentage of control was analysed by using one-way ANOVA (command for comparison between herbicide treatments). Comparison between herbicide treatments was made by using lm() command and Fisher test contrast ($p<0.05$) by package "agricolae". The percentage of resprout was analysed by SigmaPlot (version 11.0) which was not statistical analyze.

RESULTS AND DISCUSSION

The combination of herbicide (Table 1), heat+dash control 100% with 70 g a. i. ha^{-1} of Cinderella while Roundup Tansorb, DMA and Volcane did not reach 30%. All the combination of heat and dash at 10 DAA had a control above 98% and the treatments with low control at 5 DAA increased the control although did not reach at least 30%. Same situation at 15 DAA for the treatments with low control and all the treatments with heat+dash had a little decrease. Studying the effect of burning down herbicides in soybean crop[6], glyphosate applied 10 days before sowing+(paraquat+diuron) at the sowing, controlled 88% of Cinderella, differently of glyphosate applied at sowing, 1 day before sowing and 5 days before sowing that had the lowest control, lower than 10%. Thus, Cinderella shows a natural tolerance to glyphosate. The efficiency of Heat is due to the susceptibility of Cinderella for inhibiting protoporphyrin IX a metabolic precursor for hemes, cytochrome and chlorophyll[6].

Heat (30 g a.i. ha^{-1})+dash had a significant decrease at 30 DAA almost 10%, so the plant showed a faster metabolism

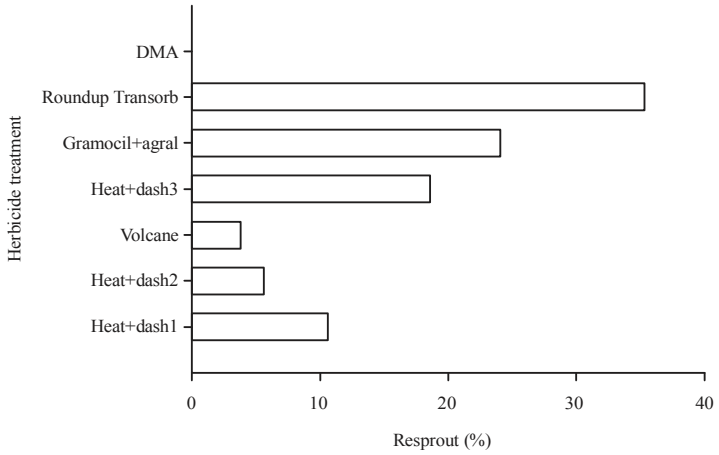

Fig. 1: Percentage of resprout at 60 DAA of *Synedrellopsis grisebachii*, 1: Heat (35 g a.i. h^{-1}), 2: Heat (50 g a.i. h^{-1}) and 3: Heat (70 g a.i. h^{-1})

Table 1: Probability of block and herbicides (trade names) treatment, Coefficient of Variation (CV), least significant difference (LSD) and the percentage of control days after application (DAA) from *Synedrellopsis grisebachii*

Variables	5 DAA	10 DAA	15 DAA	30 DAA	45 DAA
Block	0.120	0.495	0.185	0.358	0.414
Treatment	<2e-16	<2e-16	<2e-16	<2e-16	<2e-16
LSD	2.04	3.33	3.20	0.066	7.55
Heat+dash2	98.80^{a}	99.40^{a}	98.60^{a}	94.00^{ab}	89.80^{b}
Heat+dash3	100.00^{a}	100.00^{a}	98.40^{a}	97.00^{a}	94.80^{ab}
Volcane	27.00^{c}	27.00^{c}	26.00^{c}	71.00^{d}	93.40^{ab}
Heat+dash1	99.40^{a}	100.00^{a}	97.80^{a}	87.60^{abc}	81.60^{c}
Gramocil+agral	86.60^{b}	88.00^{b}	88.00^{b}	82.60^{bc}	77.60^{c}
Roundup Transorb	11.00^{e}	13.60^{e}	15.60^{e}	22.00^{e}	24.00^{d}
DMA	17.00^{d}	18.00^{d}	19.00^{d}	81.80^{cd}	99.60^{a}
Control	0.00^{f}	0.00^{f}	0.00^{f}	0.00^{f}	0.00^{e}
CV (%)	3.67	4.61	4.46	10.86	8.31

Means followed by the same letter are not different by fisher test at ($p<0.05$). Heat: Saflufenacil, Dash: Adjuvant, Agral: Adjuvant, Volcane: Sodium hydrogen methylarsonate, Gramocil: (Paraquat, Diuron), DMA: (2,4-D, Dimethylamine salt), Roundup Transorb: Glyphosate

of herbicide, probably due to the concentration within the plant. Contrasting situation had Volcane and DMA almost increased 63%, perhaps the herbicide mobility within the plant was low and concentration as well before 30 DAA. The herbicide DMA inhibits synthetic auxins a hormone responsible for growth and development, so the plants might be susceptible due the molecule 2, 4-D or to the dimethylamine salt contained at the DMA formulation. In addition, the mechanism of resistance as reduced translocation, detoxification and anatomy of vascular systems are not efficient as grasses against DMA[7]. The control at 45 DAA shows a low control with gramocil+agral and Roundup 77 and 24%. Surprisingly, the treatments DMA and Volcane had a percentage of control over 93% similar to heat (70 g a.i. ha^{-1})+dash. The percentage of resprout (Fig. 1) at 60 DAA shows no resprout for DMA, 5% for Volcane and 7% for heat+dash at the highest rate of heat. In addition, Roundup Transorb showed the highest resprout over 35%. Thus, Volcane had a similar activity as DMA for not having a fast control, meaning that the activity was systemic but it cannot be applied in post emergence at citrus crops unless is an application on the target. Abbas *et al.*[8] showed an effective control on all biotypes of *Xanthium strumarium* L. by sodium hydrogen methylarsonate.

CONCLUSION

These results indicated that there is a natural resistance to glyphosate for *Synedrellopsis grisebachii* as *Commelina benghalensis*. Thus, for growers that have both plants on the field the best management will be using Roundup+DMA tank mixture.

SIGNIFICANCE STATEMENTS

This study discovered the natural tolerance of *Synedrellopsis grisebachii* to glyphosate and how to manage it. Thus it can be beneficial for farmers and researchers. This

study will help the researcher to uncover the critical areas of weed science and weed technology that many researchers were not able to explore. Therefore, a new theory on *Synedrellopsis grisebachii* natural resistance may be arrived at.

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