doi: 10.1590/S0100-83582016340400016

AMINOCYCLOPYRACHLOR: NEW OPTION FOR TRUMPET FLOWER CONTROL IN PASTURES[1]

Aminocyclopyrachlor: Nova Opção para o Controle do Amarelinho em Pastagens

REIS, F.C.[2], CASON, J.B.[3], TOLEDO, R.E.B.[2], SOTOMAYOR, J.F.[4], FREITAS, M.M.[5], and VICTÓRIA FILHO, R.[2]

ABSTRACT - The species *Tecoma stans*, introduced to Brazil to be cultivated in urban centers as street trees, in parks and gardens, became important pasture weed. The mechanical control of this species is difficult because the plant presents a large number of sprouts when are mowed. Furthermore, the herbicides usually used in pasture have been shown to be inefficient to control it. This research evaluated the trumpet flower control effectiveness using a new herbicide (aminocyclopyrachlor) applied alone in increasing doses to the cut stump for the control of resprouts and mixed with metsulfuron-methyl in applications to intact plant leaves. The experiment with foliar applications used increasing doses of herbicides (aminocyclopyrachlor + metsulfuron-methyl). Applications of only aminocyclopyrachlor to the cut stump and foliar application of a herbicidal mixture (aminocyclopyrachlor + metsulfuron-methyl) were effective in the control of trumpet flower.

Keywords: exotic species, trumpet flower, susceptibility to herbicides.

*RESUMO - A espécie **Tecoma stans** introduzida no Brasil para ser cultivada nos centros urbanos em arborização de ruas, praças e jardins tornou-se importante planta daninha em pastagens. O controle mecânico dessa espécie é difícil, por apresentar grande número de rebrotas quando as plantas são roçadas. Além disso, os herbicidas normalmente usados em pastagens têm-se mostrado ineficientes no seu controle. Nesta pesquisa foi avaliada a eficiência de controle do amarelinho por um novo herbicida, o aminocyclopyrachlor, aplicado em doses crescentes de forma isolada no toco, visando o controle das rebrotas, e em mistura com o metsulfuron-methyl, em aplicações nas folhas de plantas intactas. No experimento com aplicações foliares foram utilizadas doses crescentes de (aminocyclopyrachlor + metsulfuron-methyl). Aplicações no toco de aminocyclopyrachlor de forma isolada e foliares da mistura de (aminocyclopyrachlor + metsulfuron-methyl) foram eficazes no controle de amarelinho.*

Palavras-chave: espécie exótica, amarelinho, suscetibilidade a herbicidas.

INTRODUCTION

The species *Tecoma stans*, commonly known as yellow trumpet-flower or yellow bells, is an exotic plant introduced to Brazil to be cultivated in urban centers as street trees and as ornamental trees in parks and gardens. Because its seeds are easily dispersed and germinated and because of the invasive behavior of this species (Lorenzi, 2000), it has infested rural areas, highway margins and degraded or abandoned pasturelands.

It is a bush or small tree, 2 to 12 m high, with a round crown and dense foliage, which outcompetes for light with pasture forage plants (Pott et al., 2006). This species produces a large number of seeds, which are quickly

[1] Recebido para publicação em 26.2.2016 e aprovado em 26.4.2016.

[2] Esalq/USP, Piracicaba-SP, Brasil, <fabriciareis@msn.com>; [3] Dupont do Brasil S/A, Paulinia-SP, Brasil; [4] Secretaría de Educación Superior, Ciencia, Tecnología e Innovación, Quito - Ecuador; [5] Universidade Federal de Mato Grosso, Cuiabá-MT, Brasil.

dispersed (Bredow, 2007) and exhibits easy vegetative propagation (Biondi et al., 2008). Furthermore, trumpet-flower species are difficult to control because they produce fast-growing and vigorous sprouts after cutting, which makes mechanical control ineffective (Passini and Kranz, 1997). Thus, herbicide control becomes the only viable choice, even though there is little information in the literature about the chemical control of this species. Passini and Kranz (1997) assessed the control of this plant by using a combination of herbicides (2.4-D + picloram) applied to the cut stump and basal portion of the plant and the application of tebuthiuron to the soil. These authors observed control of plants through tebuthiuron application, however, the product traditionally recommended for the control of weeds in pastures was only marginally effective. Oakes (1970) used a foliar application of 2.4-D + 2,4,5-T herbicides which was also only partially effective.

Still in the experimental stage in Brazil, aminocyclopyrachlor (6-amino-5-chloro-2-cyclopropyl-4-pirimidinecarboylic acid) appears as a new option for the control of harmful pastureland species.

This herbicide belongs to the pyridinecarboxylic acid chemical group, which act as auxins mimic herbicides. It is effective in controlling broadleaf weeds, annual and perennial plants, including bushes and trees, when used alone (Minogue et al., 2011; Reed and Mccullongh, 2012) and also in combination with metsulfuron-methyl (Turner and Colbet, 2011).

This research examined the efficiency of aminocyclopyrachlor applied alone to the cut stump and in combination with metsulfuron-methyl in foliar application to control trumpet flower species.

MATERIAL AND METHODS

The research was conducted in pastureland grown with signal grass (*Braquiaria decumbens*) infested with yellow trumpet-flower established in a Eutroferric Red Nitosol. Two modes of applications were tested, one at the top of the plants (foliar applications) and the other directly to the stumps, immediately after cutting.

Seven treatments of the herbicides were assessed in the cut-stump application, as follows: five aminocyclopyrachlor doses (120, 180, 240, 480 and 960 g in 100 L^{-1} of water), equivalent to 0.5, 0.75, 1.0, 2.0 and 4.0% v/v of the formulate product DPX MAT28 SL, to which Assist adjuvant was added at 2% v/v, 720 g 100 L^{-1} of picloram, equivalent to 3% of the commercial product Padron, and one control without herbicide. Randomized block experimental design was used with four replications and two plants per replicate. Before cutting, the plants were selected and identified with stakes at the plant base. The selected plants were approximately 2.0 m high, and the main stem was between 4 and 6 cm in diameter. Cutting was made 10 cm above the ground using a sickle.

Immediately after cutting, the herbicides were applied using a CO_2-pressurized backpack sprayer at 2.0 kgf cm^{-2} constant pressure and a Guarany® universal liquids doser. When applications were performed the temperature was 37.3 °C, relative air humidity was 34%, and wind speed was 1.7 km h^{-1}. Spraying was applied at the rate of 15 mL of the product solution for every 2 cm wide stem diameter.

To evaluate the plant control, no sprouting, we adopted the visual scale described by the Asociación Latinoamericana de Malezas (Alam, 1974), which considers the range of 91-100% as excellent control of weeds; 81-90% as very good control; 71-80% as good control; 61-70% as sufficient control; 41-60% as moderate control; and 0-40% as no control. Control effectiveness was assessed 37 and 386 DAA, and the number of sprouts per plant were determined 386 DAA. Descriptive graphical statistics were used for interpretation of the data.

The DPX – Q2K13 WG formulate, which contains 395 + 126 g kg^{-1} of aminocyclopyrachlor and metsulfuron-methyl, respectively was used to assess the efficacy of the herbicide mixtures (aminocyclopyrachlor + metsulfuron-methyl). The following dosages were assessed: (40 + 13), (59 + 19), (79 + 25), and (119 + 38), which were dissolved in 100 L^{-1} of water, corresponding to 0.1, 0.15, 0.2 and 0.3% v/v of the DPX – Q2K13 WG formulated

product. Agral adjuvant was added to all experiments at 0.5% v/v. The spray solutions were applied in the following conditions: temperature 35 °C, relative air humidity 48% and wind speed 5.2 km h^{-1}. Assessments of defoliation efficiency of yellow trumpet-flower plants and the species and control were carried out 41, 119 and 216 days after application (DAA).

The experimental design was randomized blocks with four replications, and two plants per experimental parcel. The plants selected for re-sprouts had mean height of 1.5 m and the main stems were 2-4 cm in diameter. The treatment applications were made directly to the plant, by spraying 125 mL of the herbicide solution to each plant. A CO_2-pressurized backpack sprayer with 2.0 kgf cm^{-2} and a Guarany® universal doser were used.

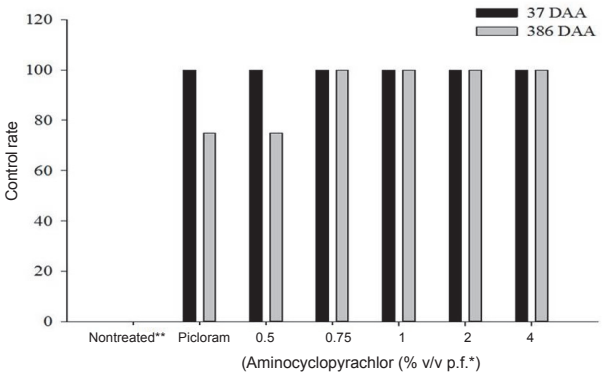
Assessments of defoliation rates were made visually, according to ALAM's scale (1974), which ranges from 0% to 100%, where 0% equals no loss of plant leaves and 100% equals total loss of plant leaves. In addition, the percentage of controlled plants (no sprouting) was determined, using the same scale. The results were interpreted using descriptive statistical graphs.

RESULTS AND DISCUSSION

Control effectiveness for *Tecoma stans*, or yellow trumpet-flower, by aminocyclopyrachlor when applied to the plant cut stump is shown in Figures 1, 2 and 3. To assess the control effectiveness, we adopted the scale proposed by the Asociación Latinoamericana de Malezas (Alam, 1974). Based on this scale, we can conclude that aminocyclopyrachlor applications in doses equal to or over 0.75% v/v of the DPX MAT28 SL formulation ensured high plant control effectiveness. Figures 2 and 3 show the number of re-sprouts per stump and the height of re-sprouts 386 days after the application of the herbicide. In all stumps not sprayed with herbicides, several re-sprouts were observed, resulting in a quick re-infestation of the parcel by *Tecoma stans*. These shoots reached an average height of 2.0 m 386 days after cutting the shrubs. This shows that the mechanical method for the control of the plant is ineffective. Passini and Kranz (1997) also found that the mechanical control of trumpet-flower is not effective, because the plant has a rapid and vigorous regrowth after cutting.

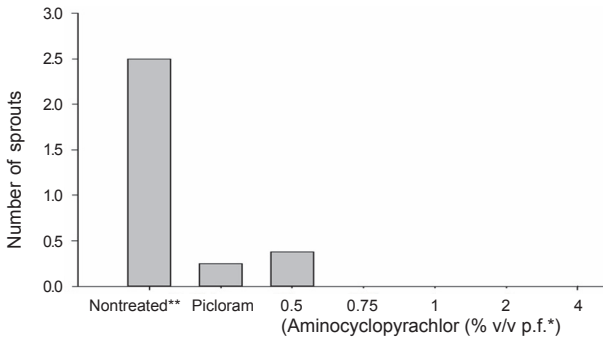
However, in the treatments with the lowest dosage of aminocyclopyrachlor (0.5% v/v) and the standard herbicide picloram, the control was 75% of the plants at 386 DAA. According to ALAM (1974), control efficiency in the range of 71-80% is considered good, but this value is below the accepted level in practice. Farmers accept as control only when over the 90% level. Therefore, the control effectiveness of trumpet flower in the range of 80-89% was considered moderate. In a study that assessed the effectiveness of aminocyclopyrachlor in the control of *Elaeagnus angustifolia*, Edwards (2011) observed a 92% control rate when aminocyclopyrachlor was applied at a dose of 2% during fall and 100% after application in summer and a rate of 100% was observed when a 5% dose was applied during fall.

In the case of trumpet flower control effectiveness by applying the formulated mixture of aminocyclopyrachlor + metsulfuron-methyl (DPX – Q2K13 WG) to the leaves (Figures 4 and 5) show that foliar applications of this herbicidal mixture in doses equal to or higher than 40 g + 13 g in 100 L^{-1} of water caused defoliation and optimum control of the plant. This species has the characteristic of being resistant to chemical control, as



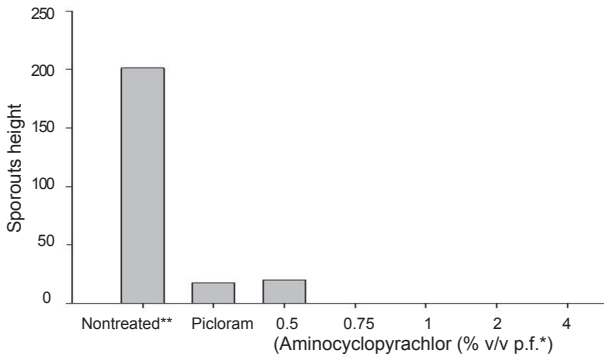
pf*- DPX MAT28 SL. **Nontreated herbicide control.

Figure 1 - Control rate (% of regrowth inhibition) of yellow trumpet-flower plants 37 and 386 days after application of different doses of aminocyclopyrachlor herbicides to the plant cut stump and the recommended dose of picloram.



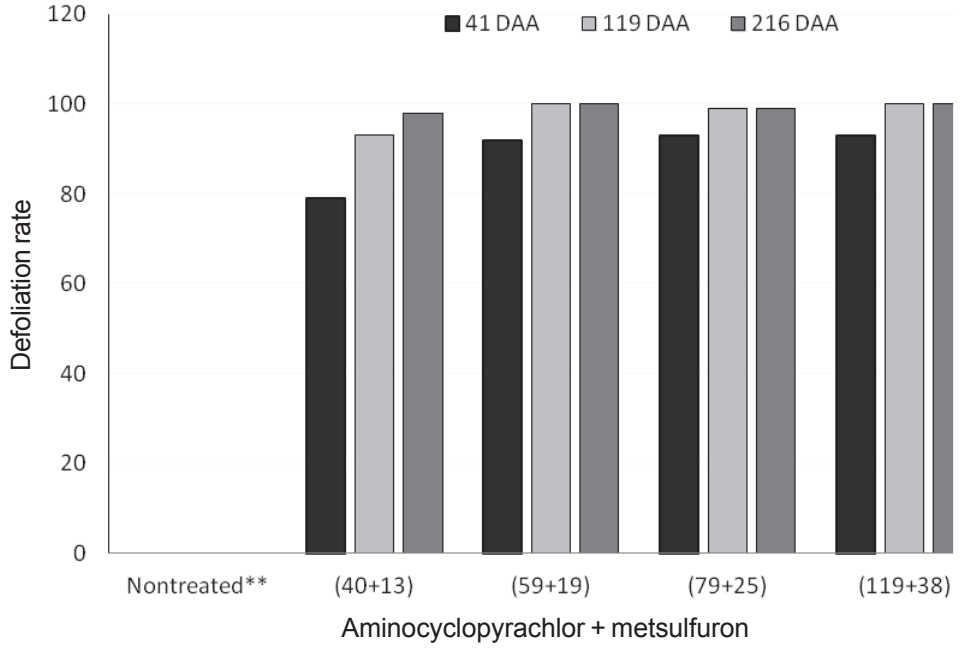
pf*- DPX MAT28 SL. **Nontreated herbicide control.

Figure 2 - Number of yellow trumpet-flower sprouts at 386 days after application of different doses of aminocyclopyrachlor herbicides to the plant cut stump (in 5% v/v of commercial formulate and standard treatment [picloram]).



pf*- DPX MAT28 SL. **Nontreated herbicide control.

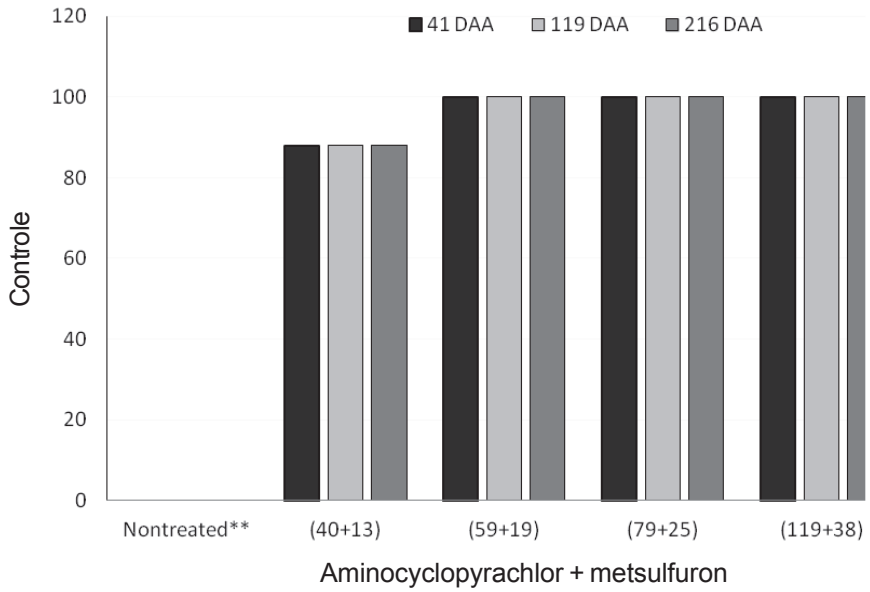
Figure 3 - Sprouts height of yellow trumpet-flower at 386 days after application of different doses of aminocyclopyrachlor herbicides to the plant cut stump (in 5% v/v of commercial formulate and standard treatment [picloram]).



** Nontreated herbicide control.

Figure 4 - Defoliation rate (%) of yellow trumpet-flower 41, 119 and 216 days after foliar application of different doses of formulated mixture of aminocyclopyrachlor + metsulfuron-methyl (DPX – Q2K13 WG).

reported by Oakes (1970). This author found that trumpet flower plants exhibited a 50-90% defoliation rate one month after foliar application of the 2.4-D and 2,4,5-T applied alone or in formulated combination. However, when these herbicides were applied sequentially, the defoliation rate was 95%. Other information in the literature about the efficacy of aminocyclopyrachlor + metsulfuron-methyl in the control of weed plants was reported by Reed et al. (2013), West et al. (2011), Ferrel et al. (2012) and Kyser and DiTomaso (2013). These authors found that this product was effective in the control of *Diodia virginiana, Lantana camara*, *Cayratia japonica* and *Linaria dalmatica.*



** Nontreated herbicide control.

Figure 5 - Control rate (%) of yellow trumpet-flower 41, 119 and 216 days after foliar application of different doses of the formulated mixture of aminocyclopyrachlor + metsulfuron-methyl (DPX – Q2K13 WG) herbicides.

Based on the results of this study, we conclude that aminocyclopyrachlor herbicide for application to the cut stump alone or in association with metsulfuron-methyl in application to the leaves is effective to control *Tecoma stans*. The conclusion is that aminocyclopyrachlor has a high potential to be used as a herbicide in pastures, and further studies about the control effectiveness of other species should be carried out, as well as its behavior in the environment, which is still unknown.

ACKNOWLEDGMENTS

The authors are deeply grateful to Dupont Crop Protection for providing herbicides for this study. We thank the National Council for Scientific and Technological Development of Brazil (CNPq) for a Master's Scholarship awarded to Fabricia Cristina dos Reis.

REFERENCES

Asociación Latinoamericana de Malezas. Recomendaciones sobre unificación de los sistemas de evaluación en ensayos de control de malezas. **ALAM**. 1974;1:35-8.

Biondi D, Bredow E.A., Leal L. Influência do diâmetro de estacas no enraizamento de *Tecoma stans* (L.) Juss. ex Kunt. **Semina: Ci. Agr.** 2008;29:277-82.

Bredow E.A. **Atributos do solo em áreas de ocorrência de *Tecoma stans* (L.) Juss. Ex. Kunt (Bignoniaceae) no estado do Paraná** [dissertação]. Curitiba: Universidade Federal do Paraná, 2007.

Edwards R.J. **Control and dispersal of Russian olive (*Eleagnus angustifolia* L.)** [thesis] Fort Collins: Colorado State University; 2011.

Ferrel J., Sellers B., Jennings E. Herbicidal control of largeleaf lantana (*Lantana camara*). **Weed Technol.** 2012;26:554-8.

Kyser G.B., Di-Tomaso J.M. Effect of timing on chemical control of dalmatian toadflax (*Linaria dalmatica*) in California. **Invas Plant Sci Manage.** 2013. In-Press.

Lorenzi, H. **Plantas ornamentais do Brasil: arbustivas, herbáceas e trepadeiras**. 2. ed. Nova Odessa: Instituto Plantarum, 2000. 1088-p.

Minogue P.J. et al. Comparison of aminocyclopyrachlor to common herbicides for Kudzu (*Pueraria Montana*) management. **Invas Plant Sci Manage.** 2011;4:419-26.

Oakes A.J. Herbicidal control of *Tecoma stans* (L.) Juss. ex HBK. **Turrialba**. 1970;20:415-8.

Passini T., Kranz W.M. Eficácia de herbicidas no controle de amarelinho (*Tecoma stans*) em pastagem. **Planta Daninha**. 1997;15:190-7.

Pott A. et al. **Plantas daninhas de pastagem na região de Cerrados**. Campo Grande: Embrapa, 2006. 336p.

Reed T.V. et al. Aminocyclopyrachlor Efficacy for Controlling Virginia Buttonweed (*Diodia virginiana* L.) and Smooth Crabgrass (*Digitaria ischaemum* Schreb.) in Tall Fescue. **Weed Technol.** 2013;27:488-91.

Reed T.V., Mccullough P.E. Aplicattion timing of aminocyclopyrachlor, fluroxypyr, and tryclopyr influence swinecress control in tall fescue. **HortScience**. 2012;47:1548-9.

Turner R.G., Colbert S.F. Aminocyclopyrachlor herbicide mixtures for the western US vegetation management market. In: Proceedings of the 64ªAnnual Meeting of the Western Society of Weed Science; 2011; Spokane. Las Cruces: WSWS, 2011. p.71.

West A.M. et al. Bushkiller (*Cayratia japonica*) response to selected herbicides. **Invas Plant Sci Manage.** 2011:4:73-7.