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Chemical management of *Pilea microphylla* in orchid seedlings[1]

*Manejo químico de **Pilea microphylla** em mudas de orquídeas*

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Abstract - Orchidaceae species are produced on a large scale for commercialization of its flowers. However, because of its slow development, the substrate is subject to weed infestation, such as *brilhantina* (*Pilea microphylla*). Thus, we aimed to evaluate the selectivity of herbicides to the orchid seedlings of genre *Rhynchostylis* ([*Rhynchostylis gigantea* Alba x *Rhynchostylis gigantea*] X *Rhynchostylis gigantea* Semi-Alba) and control of *P. microphylla*. A completely randomized design with four replicates per treatment was adopted. The herbicides studied were oxyfluorfen (0, 120, 240, and 480 g ha^{-1} a.i.), flumioxazin (0, 12.5, 25 and, 40 g ha^{-1} a.i.), nicosulfuron (0, 20, 40, and 80 g ha^{-1} a.i.), and mesotrione (0, 96, 144, and 192 g ha^{-1} a.i.), with a control without application for each molecule. At the time of spraying, the plants of orchid presented four leaves and were 5 cm high, while *P. microphylla* was 10 cm high. Nicosulfuron did not control *P. microphylla*, while oxyfluorfen and flumioxazin showed control levels exceeding 90% on 14 days after application (DAA). The mesotrione showed low ability to control the weed, reaching around 35% efficiency at 49 DAA. All herbicides were selective to the hybrid seedlings *Rhynchostylis*. The oxyfluorfen and flumioxazin molecules were efficient in controlling *P. microphylla* in the tested dose ranges.
Keywords: *Rhynchostylis* spp.; *brilhantina*; herbicide; floriculture; selectivity

Resumo - Espécies da família Orchidaceae são produzidas em larga escala para comercialização de suas flores. Entretanto, devido ao seu lento desenvolvimento, o substrato fica sujeito à infestação de plantas daninhas, como a brilhantina (*Pilea microphylla*). Assim, objetivou-se avaliar a seletividade de herbicidas à mudas de orquídeas do gênero *Rhynchostylis* ([*Rhynchostylis gigantea* Alba x *Rhynchostylis gigantea*] X *Rhynchostylis gigantea* Semi-Alba) e controle de *P. microphylla*. Adotou-se delineamento inteiramente casualizado, com quatro repetições por tratamento. Os herbicidas estudados foram: oxyfluorfen (0, 120, 240 e 480 g ha^{-1} i.a.), flumioxazin (0, 12,5, 25 e 40 g ha^{-1} i.a.), nicosulfuron (0, 20, 40 e 80 g ha^{-1} i.a.) e mesotrione (0, 96, 144 e 192 g ha^{-1} i.a.), com uma testemunha sem aplicação para cada molécula. Na ocasião da pulverização as plantas de orquídea apresentavam quatro folhas e 5 cm de altura, enquanto que a *P. microphylla* possuía 10 cm de altura. O nicosulfuron não controlou *P. microphylla*, enquanto o oxyfluorfen e o flumioxazin apresentaram eficiência de controle superior a 90% a partir dos 14 dias após a aplicação (DAA). A mesotrione demonstrou baixa capacidade de controle da infestante, atingindo em torno de 35% de eficiência aos 49 DAA. Todos os herbicidas foram seletivos às mudas do híbrido de *Rhynchostylis*.

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As moléculas oxyfluorfen e flumioxazin foram eficientes no controle da *P. microphylla* nos intervalos de doses testados.
Palavras-chaves: *Rhynchostylis* spp.; brilhantina; herbicida; floricultura; seletividade

Introduction

Among the ornamental plants marketed, there are the members of the family *Orchideaceae*, with wide acceptance due to the exuberance of its flowers (Freitas et al., 2007a), and considerable adaptive ability to more distinct environments (Paula and Silva, 2006). According to Thomas and Michael (2007), orchids have floral characteristics portrayed through wide range of shapes, sizes and color, and their species or hybrids are highly valued for ornamental trade, either pot or cutting.

Species and hybrids from the genre *Rhynchostylis* show great expertise in the structure and color of its inflorescence, as well as exhibit high longevity from their issue, justifying its high exploitation by florists and acceptance by most consumers (Thomas and Michael, 2007).

Due to heavy commercial appeal, it is of great importance for the development support of flowering with commercial purpose, which use quality substrate (Assis et al., 2010). However, due to the slow development of orchids (Suzuki et al., 2010), the substrate is exposed for long periods to infestation by weeds, such as *Pilea microphylla* (*brilhantina*), interfering with the development of the seedlings, raising costs of production, and reducing its commercial value (Freitas et al., 2007b).

Also considered ornamental depending on the application, *P. microphylla* shows rapid growth and competitiveness in shaded conditions and high humidity, being opportunistic and commonly seen next to potted plants used in landscape design and decoration (Rodrigues et al., 2007). The brilhantina control in ornamental crops is usually performed by manual pull-off and may regrow if it is not fully eliminated, since it easily regrow in regions of girth. In addition, the large seed production and barochory dispersal stimulated by handling during cultural practices promote fast reinfestation (Freitas et al., 2007b; Lorenzi and Souza, 2008).

Entrepreneurs and producers of ornamental branch report that *P. microphylla* is frequently occurring and high-density infestation in seedling nurseries, by using the manual control as the primary measure of combat. However, this handling method is of high monetary cost and time due to the need for constant uprooting, in addition to the damage caused to shoot and roots of flowering, resulting in reducing the aesthetic beauty of the pot, reflected directly in market value of the final product (Gardeners personal communication).

Accordingly, the chemical control may become an important alternative for the management of *P. microphylla* in commercial nurseries, as it makes possible considerable savings in optimizing the hand labor and operating time (Maciel et al., 2005). However, there is no record of herbicides in Brazil for use in orchids, while are few published works that report studies on the chemical control of *P. microphylla* (Freitas et al., 2007a,b).

Soon, it becomes necessary to obtain adequate information about chemicals for weed management and rotation of active ingredients to work with the control practices of *P. microphylla*, being action molecules pre or post-emergence related to weeds without harming the development of orchids.

Therefore, the aim of this study was to evaluate the selectivity of inhibiting herbicides of Protox, ALS and carotene synthesis to hybrid seedlings of orchids of the genus *Rhynchostylis* ([*Rhynchostylis gigantea* Alba x *Rhynchostylis gigantea*] X *Rhynchostylis gigantea* Semi-Alba), and their effectiveness in controlling *P. microphylla*.

Material and Methods

The experiment was conducted under shadow protection roofing, 75% shading. A completely randomized design with four replications was adopted.

The test consisted of four chemical compounds studied in 16 treatments, with four concentrations for each product: oxyfluorfen (0, 120, 240, and 480 g ha^{-1} a.i.), flumioxazin (0, 12.5, 25, and 40 g ha^{-1} a.i.), nicosulfuron (0, 20, 40, and 80 g ha^{-1} a.i.), and mesotrione (0, 96, 144 and 192 g ha^{-1} a.i.), having control without application for all the studied molecules.

Each plot corresponded to a pot, filled with 0.4 kg of substrate containing a seedling of hybrid orchid *Rhynchostylis* ([*Rhynchostylis gigantea* Alba x *Rhynchostylis gigantea*] X *Rhynchostylis gigantea* Semi-Alba) 5 cm high, infested with *P. microphylla* around 10 cm high. The seedlings of *Rhynchostylis* were obtained from Orchid Splendor in Marechal Cândido Rondon-PR.

At intervals of five days orchids were sprayed with the aid of manual spray, 20 mL per pot of nutrient solution containing 8,00, 20,00, 12,00, 1,00, 0,30, 3,00, 0,07, 0,02, 0,04, and 0,03% of N, P, K, Ca, Mg, S, Fe, Mn, B and Zn, respectively.

The spraying of syrup prepared with the herbicide was made in total plot area by spraying aid, maintained at a constant pressure by CO_2, equipped with four corners Magno 11002 ADGA, spaced at 0.5 m, at 40 kgf cm^{-2} pressure providing a spray volume of 200 L ha^{-1}. At the time of application, the temperature was 24 °C and relative humidity 67%, with wind speed at 4 km h^{-1}.

The intoxication symptoms assessments of seedlings of *Rhynchostylis* and control of *P. microphylla* at 4, 7, 14, 21, 28, 35, 42 and 49 days after application (DAA) began. The evaluations were made through percentage scale of visual notes, where 0 (zero) corresponds to no injury demonstrated by the plant and one hundred (100) to the death of plants, as proposed by SBCPD (1995).

Data were subjected to analysis of variance ($p < 0.05$), with subsequent adjustment to the multiple regression models, and the equations chosen based on significant models with biological logic and high R^2.

Results and Discussion

The seedling of *Rhynchostylis* did not show visible symptoms of intoxication (Figure 1) after applications of herbicides during the trial period (data not presented). It was found that all molecules assessed in this study owned selectivity for hybrid plants. Corroborating this study, Maciel et al. (2005), found wide selectivity to *Euphorbia splendens* (Euphorbia milii) when applying nicosulfuron (60 g ha^{-1}), do not damaging the visual quality of plants in the growing season, and preventing further damage to the inflorescences *E. splendens*.

Mudge and Haller (2009) achieved results with different flumioxazin selectivity levels according to the species in question, working with ornamental such as Snapdragon (*Antirrhinum majus*), impatiens (*Impatiens wallerana*) and begonia (*Begonia semperflorens-cultorum*), noting that the impatiens and begonia suffer the great effects of flumioxazin at doses of 5 g ha^{-1} a.i., while the Snapdragon supports higher doses of the product, exceeding 40 g ha^{-1} a.i.

Thus, it is evident that the occasional symptoms of poisoning are very dependent on the species in question, the product dose and form of application, and the results of this study to other species of Orchideaceas or other ornamental species cannot be extrapolated.

Figure 2 shows the control data of *P. microphylla* in seedlings of *Rhynchostylis* after herbicide application. It was verified that oxyfluorfen (Figure 2A) and flumioxazin (Figure 2B) quickly demonstrate its effectiveness in controlling *P. microphylla*, being greater than 90% at all three doses studied from 14 DAA. At 49 DAA these products had satisfactory efficacy, playing full control of the weed population. As for mesotrione (Figure

2D), intermediate control was obtained at the end of the 49 DAA in doses higher than 144 g ha^{-1} a.i.

It was noted also that oxyfluorfen and flumioxazin inhibit issuance of new shoots and young seedlings germination of *P. microphylla* during the 49 days of study conduct (Figure 1A and 1B respectively), while the other molecules have not provided this effect. Both herbicides (oxyfluorfen and flumioxazin) molecules are absorbed by leaves and the roots, and have great persistence in soil, increasing and prolonging its effect (Jursík et al., 2011; Jung, 2011), justifying the results observed in this test.

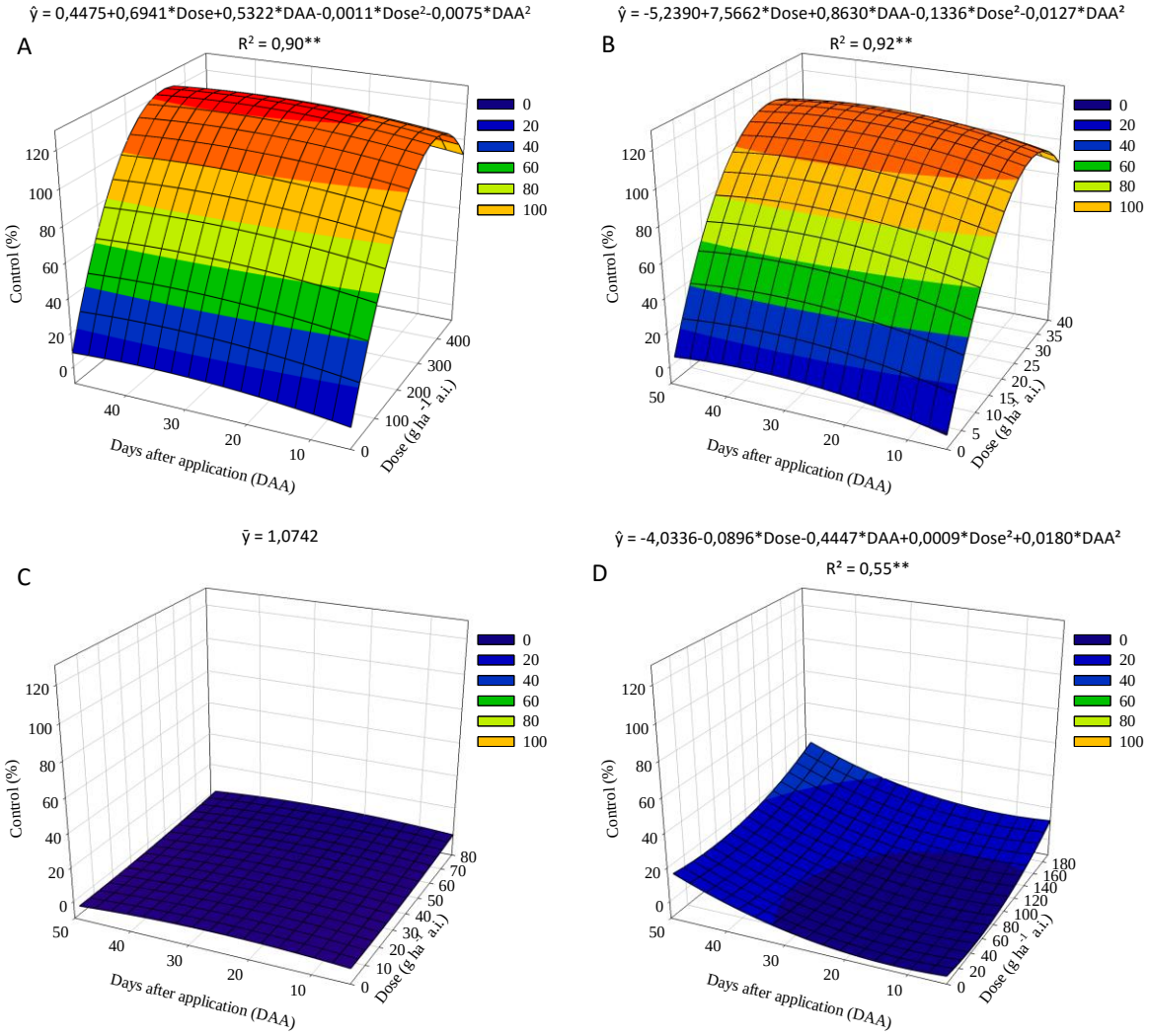
Figure 1. Aspects of seedlings of *Rhynchostylis* ([*Rhynchostylis gigantea* Alba x *Rhynchostylis gigantea*] X *Rhynchostylis gigantea* Semi-Alba) and control of *P. microphylla* at 49 days after application of herbicides (A) oxyfluorfen, (B) flumioxazin, (C) nicosulfuron, and (D) mesotrione.

Freitas et al. (2007a), found selectivity of oxyfluorfen molecule for orchids *Epidendrum ibaguensis* and *Dendrobium* sp., providing effective control (above 90%) of *P. microphylla* at 30 DAA, for doses 62.4g ha^{-1} a.i. and/or superior. Battistus et al. (2014) also found the same result in *Cattleya* orchid's seedlings (*Cattleyatenebrosa* x *Cattleya leopoldy*), being selective to the seedlings of floriferous and performing control of *P. microphylla* (above 90%) in 14 DAA for doses equal and/or superior to 120 g ha^{-1} a.i.

In another study, Freitas et al. (2007b), observed that oxyfluorfen provided 90% of control eficiency with doses of 300, 320, and 400 g ha^{-1} a.i. at 30 DAA on a population of *P. microphylla*, on crops of ornamental plants of *Zantedeschia aethiopica* (Calla lily), *Strelitzia reginae* (Strelitzia) and *Archontophoenix cunninghamiana* (King palm), respectively. There was also the occurrence of symptoms of

intoxication, mild and low incidence in seedlings of ornamental, but more evident in plants *A. cunninghamiana*.

Overall, the results obtained indicate that the appropriate use of herbicides molecules in orchid nurseries can reduce infestation levels *P. microphylla*, making it easy to apply and manage work force, as well as preserve the aesthetic quality of ornamental, keeping their commercial value.



**significant at 1% of probability by the test "F".

Figure 2. Control level of *Pilea microphylla* in seedlings of *Rhynchostylis* ([*Rhynchostylis gigantea* Alba x *Rhynchostylis gigantea*] X *Rhynchostylis gigantea* Semi-Alba) after apllying herbicides (A) oxyfluorfen, (B) flumioxazin, (C) nicosulfuron, and (D) mesotrione.

Conclusions

The doses tested of oxyfluorfen, flumioxazin, mesotrione and nicosulfuron are selective to hybrid seedlings of *Rhynchostylis* ([*Rhynchostylis gigantea* Alba x *Rhynchostylis gigantea*] X *Rhynchostylis gigantea* Semi-Alba).

Oxyfluorfen and flumioxazin herbicides have potential for commercial use, making them efficient in controling *P. microphylla* in the tested dose ranges.

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