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RESEARCH ARTICLE

PILEA MICROPHYLLA CHEMICAL CONTROL IN DESERT ROSE PRODUCTION

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ABSTRACT

The aim was to evaluate the use of oxyfluorfen in *Pilea microphylla* control in desert rose cultivation. The experimental design was completely randomized, with six treatments with six replications, characterized by concentrations of oxyfluorfen (0, 240, 480, 720, 960 and 1200 g a.i. ha^{-1}). The evaluations were performed at 7, 14, 21, 30, 60 and 90 days after application (DAA) of the herbicide to check the fitometrics level on desert rose plants and percentage of control *Pilea microphylla*. The 200 days of culture, was evaluate the fitometrics characteristics: height, number of sprouts, shoots length, diameter caudex, dry mass of stems, leaves and roots. Levels of toxicity symptoms if presented increasing with increasing dose of oxyfluorfen in the evaluations performed at 7 and 14 DAA from the thirtieth day there was no symptoms of phytotoxicity. For evaluations at 30, 60 and 90 DAA there was the 100% control of grease weed at all doses studied. Plant height and dry mass of roots showed decreasing linear effect. However, the number of lateral sprouts and dry matter stems have a quadratic behavior, with minimum point was 371.42 g a.i. ha^{-1} and maximum point was 450 g a.i. ha^{-1}, respectively. The use of oxyfluorfen herbicide is effective in *Pilea microphylla* control in desert rose vases.

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INTRODUCTION

The desert rose (*Adeniumobesum*) has assumed great importance in floriculture for being an exotic plant of peculiar beauty, with dense foliage and base swollen stem, dark green shade of leaves and large flowers of red, white or yellow or pink color, in addition of variegated specimens (Romahn, 2012). Originating from the desert regions of southwestern Africa and the Arabian Peninsula has adapted to hot and dry climate, developing evolutionarily water storage structures, making it a juicy bush (Brown, 2012). Management practices employed in commercial desert rose are not yet well defined, lacking basic information, such as fertilization, disease control and even weed control, thus hindering its cultivation on a commercial scale. Among the weeds considered problems in floriculture, the *Pilea microphylla*, originally from tropical America, has a great importance because it presents perennial cycle, and prostrate herbaceous size, highly branched with 10 to 20 cm length, with seed propagation, which due to its small size can be easily dispersed by wind or handling. Although the *Pilea microphylla* is undemanding in soil conditions, it requires good moisture supply conditions and scattered light (Lorenzi, 2000). It is commonly found in the desert rose vases, causing losses in its development. The control of this and other invasive, production of ornamental pot plants is done, in most cases, by uprooting. However, this technique does not always fully eliminate the weed due to regrowth and high seed production, in addition to being costly (Freitas *et al*., 2007a). Chemical control of *Pilea microphylla* is a tool that can be inserted in the management of ornamental with great efficiency verified by Freitas *et al*. (2004, 2007a, b), the oxyflourfen controlled efficiently plants of *P. microphylla* in bromeliads potted orchids and other ornamental plants without causing phytotoxicity to plants of interest. The oxyfluorfen herbicide is an inhibitor of protoporphyrinogen oxidase (PROTOX) converting protoporphyrinogen IX into protoporphyrin IX. Thus, the protoporphyrinogen IX collects and diffuses out of the multienzyme complex located in the plastid. This undergoes oxidation, forming protoporphyrin IX into the cytosol that interacts with oxygen and light causing lipid peroxidation and consequent destruction of membranes and cell death (Rodrigues and Almeida 2011). It is slightly soluble in water and herbicide strongly adsorbed to soil particles, thus

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hardly leached, is retained in the surface layers of the soil, and present effective control of several weed species (Pereira, 1987). When applied in post-emergence, can cause the closing of the stomata and the deterioration of cell membranes. If applied in pre-emergence acts on the hypocotyl and meristem of plants in an initial growth, without action on the roots tissues. Its half-life in soil is 30 to 40 days, but can cause residual effect until six months ahead, influenced by conditions of high humidity and elevated shading, due the degradation by photolysis (Rodrigues e Almeida, 2011). Therefore, this work aimed evaluate the application of oxufluorfen in *Pilea microphylla* control and the selectivity of desert rose cultivated in vases.

MATERIALS AND METHODS

The experiment was conducted at the State University of Londrina, in greenhouse Van Der Hoeven model with controlled temperature (26º C ± 3) and 50% of sunlight retention. Desert Rose plants with eight months of age and average height of 13 cm were potted in black polypropylene vases with capacity of 0.415 L. As substrate was used a mixture of decomposed pine bark and medium size particle of sand (proportion 1/1). Every 15 days were realized a plant fertilization, using 50 mL of nutrient solution per vase. The solution consisted in a mixture of : 210 ppm of nitrogen (N), 31 ppm of phosphorus (P), 235 ppm of potassium (K), 200 ppm of calcium (Ca), 48 ppm of magnesium (Mg), 64 ppm of sulphur (S), 0.5 ppm of boron (B) 0.02 ppm, copper (Cu), 1 ppm of iron (Fe), 0.5 ppm of manganese (Mn), 0.05 ppm of zinc (Zn) and 0.01 ppm of molybdenum (Mo), according to Hoagland and Arnon (1950). Irrigation was performed three times a week by microsprinklers. Was applied six mm of water each irrigation period, raising humidity content up to field capacity. The appearance of *Pilea microphylla* occurred in a spontaneously and uniformly way due to large presence of seed in the soil and extremely facilitated dispersion. Was not performed control before the experimental setup. The experimental design was completely randomized, consisting of six treatments with six repetitions. The treatments if characterized by different concentrations of oxyfluorfen (0, 240, 480, 720, 960 and 1200 g a. i ha^{-1}) sprayed in all area. The method application of herbicides in total area is best suited for cases where the leaf area of plants of economic interest, at the time of application, will not endanger the access of sprayed drops to weed, since the cultivated species is tolerant to foliar herbicide application (Freitas *et al*., 2007b). For the application of oxyfluorfen, precision spray was used with a meter bar, containing two nozzles (range XR 110.02) spaced 50 cm, with constant pressure of 30 pounds, maintained through CO_2. The plants were distributed in a square meter and volume of syrup of 200 L ha^{-1} was applied over the plants to a height of 50 cm. At the time of application, the relative humidity was 80%, the temperature of 28° C and wind speed of 3 Km h^{-1}.

The evaluations were realized at 7, 14, 21, 30, 60 and 90 days after application of the herbicide, adopting a criterion for assigning grades to control *Pilea microphylla*, ranging from 0 (no control) to 100% (death of weed) (SBPD, 1995). For the evaluation of phytotoxicity, was used the scale of notes proposed by EWRC (1964) (table 1).

Table 1. Scale of phytotoxicity notes proposed by EWRC (1964)

Notes	Symptoms
1	No symptoms of toxicity
2	Symptoms of very mild toxicity
3	Symptoms of mild toxicity
4	Symptoms of toxicity considered moderate
5	Symptoms classified as doubtful
6	Symptoms that appear to cause severe toxicity
7	Strong toxicity
8	Very strong toxicity
9	Death of plants

The 200 days after application, were assessed: plant height (cm) obtained by measurement, with the help of a ruler, between the neck of the plant and the apex of the main stem; length of sprouts (cm), measuring the distance of the insertion of the bud in the main stem at its zenith; caudex diameter (cm), obtained by measurement, with the aid of digital caliper, in the colo of the plant; number of sprouts and number of flowers per plant, obtained by counting; and dry mass of roots, leaves and stems obtained from the drying of tissues in forced ventilation oven at 55° C, until constant weight. Data were subjected to analysis of variance F test, and when significant were subjected to regression analysis ($p < 0,05$).

RESULTS AND DISCUSSION

It is observed in table 2, that phytotoxity levels were rising up to 480 g dose of active ingredient, and from this the symptoms of toxicity remained constant until the dose of 1200 g active ingredient, in the ratings of seven and 14 days after application (DAA). On the other hand, when active 21 DAA was observed reduce levels of toxicity in plants regard less of oxyfluorfen applied doses; those levels being reduced to zero from the thirtieth DAA.

Table 2. Phytotoxicity levels evaluated in desert rose plants to 7, 14, 21, 30, 60 e 90 days after application (DAA) of oxyfluorfen doses

Concentration (g a.i ha^{-1})	7 DAA	14 DAA	21 DAA	30 DAA	60 DAA	90 DAA
0	1.0*	1.0	1.0	1.0	1.0	1.0
240	2.0	2.0	1.0	1.0	1.0	1.0
480	3.0	3.0	2.0	1.0	1.0	1.0
720	3.0	3.0	2.0	1.0	1.0	1.0
960	3.0	3.0	2.0	1.0	1.0	1.0
1200	3.0	3.0	2.0	1.0	1.0	1.0

* Scalephytotoxicity notes proposed by EWRC (1964).

The results obtained to 30 DAA indicate that the initial effects of toxicity in higher doses are overcome due to the rapid growth rate of the desert rose, followed by the issue of new leaves. For Adam *et al*. (2000), the effects observed for this herbicide are restricted to places of contact between the product and the plant, therefore any evolution of effects with plant growth is observed. Similar results were described by Freitas *et al*. (2004, 2007a), which noted that the oxyfluorfen did not cause toxic effect in plants of bromeliad and orchids (*Epidendrumibaguensis* and *Dendrobium sp*.), respectively.

Evaluating the selectivity of herbicides, including oxyfluofen, on seedlings of *Myracrodruon urundeuva*, Duarte *et al*. (2006) verified, to 14 DAA, mild symptoms of intoxication, however after the 28 DAA, there was no intoxication in plants treated with the lower dose. Gonçalves *et al*. (2009) also observed characteristic symptoms of in toxication by oxyfluorfen in *Jatrophacurcas*, being these more intense in the first evaluation (7 DAA), however, from that period there was no progression of symptoms and the new leaves had normal aspects. For all other evaluations, it was noted by the F test ($p < 0,05$) effect on the *Pilea microphylla* controland as well as the height, number of sprouts, dry mass of stems and root dry mass of desert rose plants. In evaluations carried out at 30, 60 and 90 DAA showed 100% control of *Pilea microphylla* for all doses studied. For this reason, were represented graphically in figure 1, only there views that occurred at seven, 14 and 21 DAA. It was verified that the 30 DAA, all treatments have reached 100% control, independent of the concentration applied. This may have occurred in function of oxyfluorfenbetrans location through phloemandxylem, the smaller doses are absorbed through the leaf, are not sufficient to promote the control of *Pilea microphylla*. During the days the absorption via substrate associated with the translocation by xylem promotes the increase of concentration in the cells to promote the death of this weed.

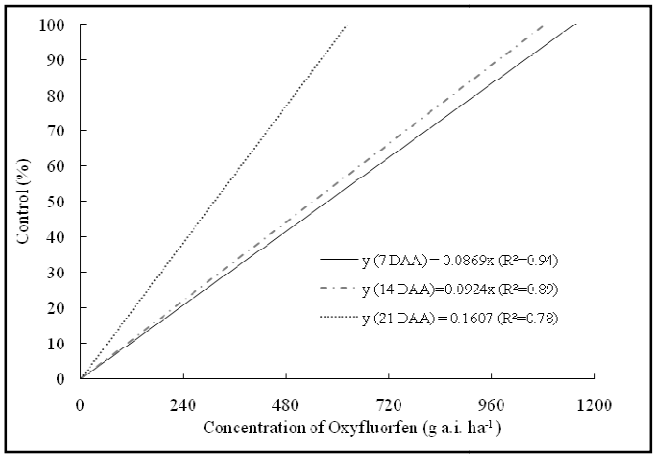

Figure 1. Concentration of oxyfluorfen in control of *Pilea microphylla* in vases of desert rose to 7, 14, 21 daysafteraplication (DAA)

Freitas *et al*. (2007b) verified control of *Pilea microphylla* higher than 90%, with the use of oxyfluorfen, at 30 and 60 DAA for crops of *Zantedeschiaaethiopica*, *Strelitziareginae* and *Archontophoenixtake* cultivated in vases. Similarly, Freitas *et al*. (2007a) obtained results studying the control of *Pilea microphylla* in two species of orchids grown in vases, in which the use ofoxyfluorfen also control more than 90% from the dose of 250 g ha^{-1}, at 30 and 60 DAA. In the present study, the dose of 720 g ha^{-1} presented 100% control of *Pilea microphylla* to 21 DAA, to previous reviews was not observed a total control of this weed even at the highest dose of oxyfluorfen (1200 g ha^{-1}). For phytometric characteristics evaluated in desert rose plants (Figure 2), the height and root dry mass (Figure 2a and 2b) showed linear descending behavior in relation to concentrations of oxyfluorfen, who promoted phytointoxication on the observed evaluations at 7, 14 and 21 DAA.

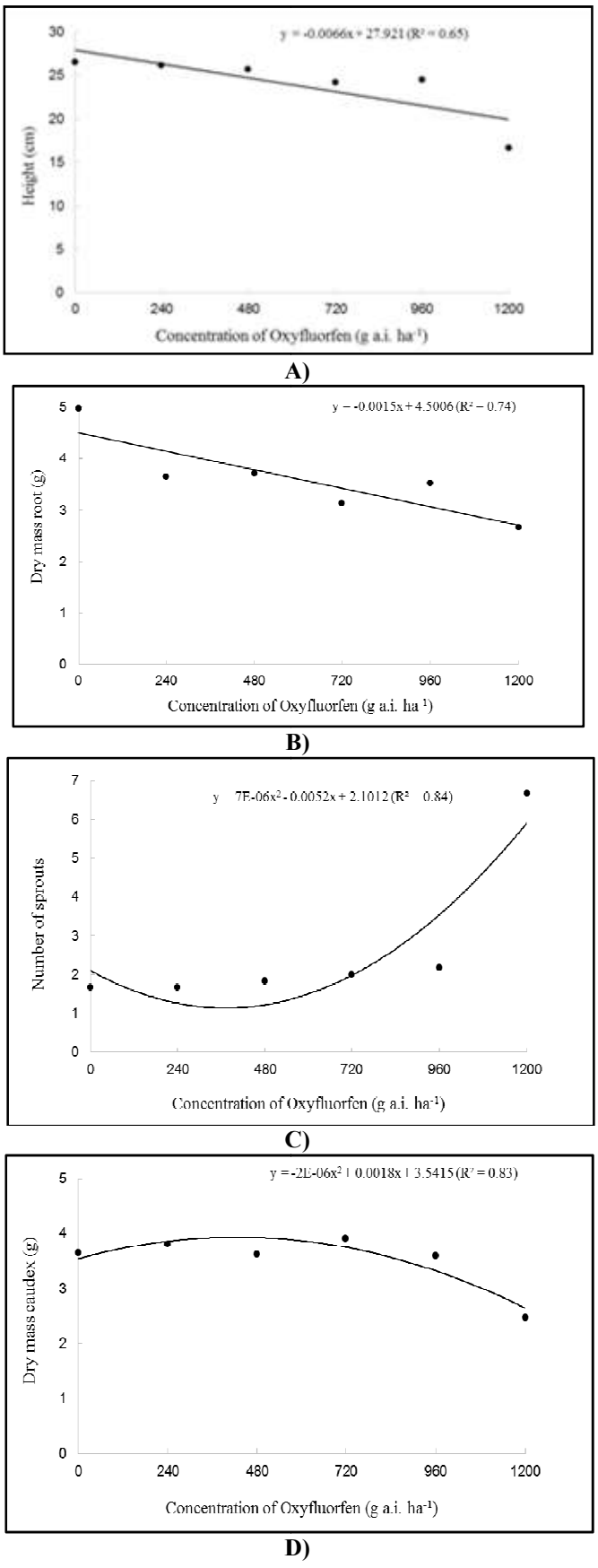

Figure 2. Height (A), dry mass root (B), number of sprouts (C) and dry mass caudex (D) of desert rose plants in 200 days after application (DAA) of oxyfluorfen

Rocha *et al*. (2010), also observed the reduction plant height in study of selectivity of oxyfluorfen under *Jatrophacurcas*, at 720 ha^{-1}. Queiroz (2011) observed linear decrease in response to the increase in doses of oxyfluorfen for root dry mass of *Tageteserecta*. This reduction in plant development can be related to indirect effects of the degradation of cell membranes by oxidation promoted by the herbicide. Also, the inhibition of the enzyme proto porphyrinogen oxidase (PROTOX), which leads the formation of reactive oxygen species metabolism (ROS) and lipid peroxidation of membranes, inducing the development of oxidative stress (Lorenzi, 2000). The characteristic number of sprouts (Figure 2 c) showed quadratic behavior, with minimum point at 371.42 g ha^{-1}, which highlights the decreased of apical dominance due to phytotoxitivity in growing points (apical meristem) as the doses increased. With this, there is an increase in the number of side sprouts, which is interesting when you think about the marketing of plants, since the largest number of sprouts is indicative of greater number of inflorescences. In relation to the stem dry mass (Figure 2d) quadratic behavior was observed with maximum point at 450 g ha^{-1}, possibly due to the translocation of caudex to the sides sprouts. Santos *et al*. (2001) studying *Commelina benghalensis* and *Commelinadiffuse* damage were observed after application of glyphosate in plants and stimulating sprouting. The 180 DAA was again observed the germination of seeds of *Pilea microphylla*, thus corroborating with Rao and Almeida (2005), which noted that the residual effect of oxyfluorfen can be upto six months. The appearance of this weed occurred homogeneously in all the vases that received herbicide, it is not possible to observe the difference between the concentrations. In summary, the tolerance of the desert rose plants to oxyfluorfen is related to serosity present in the leaves (Romahn, 2012). The cuticular waxed position take splace over the days which promotes the thickening of this layer. This thickening promotes lower penetration of the product through the plant leaf, due to less wetting. The translocation of the product absorbed by roots occurs via xylem until this reaches the meristematic points, causing phytotoxicity in tender tissue (Oliveira Júnior, 2011).

Conclusion

The oxyfluorfen performed as an efficient tool for the control of *Pilea microphylla* in desert rose, even the smallest concentrations applied. The lower doses have not altered the characteristic sof growth and development and phytotoxity symptoms observed were mild and disappeared after 21 days

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