Mepiquat chloride and paclobutrazol in size reduction of *Arundina graminifolia*

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ABSTRACT

The objective of this study was to evaluate the effect of mepiquat chloride and paclobutrazol on reducing the size of Arundina graminifolia for commercialization as a flower vase. The experiment was conducted in a greenhouse with 50% of shading. Plants were grown in one-liter black polypropylene vase filled with commercial substrate Plantmax ® and sand in the ratio (1:1). Growth regulators were mepiquat chloride (Pix 50 g L^{-1}), in doses of 1.0; 2.0; 3.0; 4.0 and 5.0 ml L^{-1}, applied via foliar spraying and paclobutrazol (Cultar 250 g L^{-1}), in doses of 1.0; 2.0; 3.0; 4.0 and 5.0 ml L^{-1} applied via substrate irrigation (50 ml per vase), another witness with distilled water. The applications of regulators was held every 15 days, during 5 months, totaling 10 applications. Been evaluated variables number and height of the shoots (cm) with and without flower. The experiment was conducted on a random block with 11 treatments and 10 replications. The paclobutrazol in dose of 2 mg L^{-1} applied via substrate fortnightly, totaling 10 applications is indicated for the reduction of the size of Arundina graminifolia, with doses greater than 3 mg L^{-1} present high number of dead plants. Mepiquat chloride in the doses studied was not effective in reducing the size of Arundina graminifolia. Growth reduction does not change the amount of shoots in the bamboo orchid.

Key words: Growth regulator, bamboo orchid, flower vase, sprouting.

INTRODUCTION

Brazilian flower culture involves around eight thousand producers with properties of 2.5 hectares, on average. In these production units, 81.3% operates with hired labor, generating around eight direct jobs per hectare, resulting in more than 120 thousand jobs around the country, related only to production (Ibraflor 2013).

Production and sales of orchids such as pot flowers are an important segment, being Brazil a seedlings importer. In 2002, orchid seedlings imported from the Netherlands, Thailand and Japan added up to US$ 8.87 million, representing 25.61% of the country's imports, with growth up to 31.47% in the same period of the previous year, being considered material for the final commercial production of plants for consumption (Junqueira and Peetz 2014).

The Orchidaceae family is one of the most numerous among the angiosperms, with more than 850 genes and around 25 thousand species. This number corresponds to 8 to 10% of all species of plants with seeds and, every year, 200 to 500 new species are described (Govaërts 2012). Man has been interested in growing and studying plants from the Orchidaceae family for centuries due to their ornamental value and wide diversity, among other reasons (Hasegawa 2005). Brazil has one of the most diverse orchid types in the American continent and the world, with around 2420 species distributed in 235 genes, 1620 being endemic (Barros et al., 2010).

The *Arundina graminifolia,* also called bamboo orchid, is a terrestrial orchid with thin bamboo-like leaves and stems 2.5 m high or even higher. Flowers are similar to those of the *Cattleya* and are produced successively, with each flower having a life cycle of 2 or 3 days (Suttleworth 1994). The plant flourishes from spring to early autumn, showing rosy-lilac inflorescence, with purple or white labellum, being highly used in contemporary gardens (Patro 2014).

This species is generally used in gardens due to its size and for being a terrestrial orchid. However, for producing flowers all year long under the sun, it becomes a good alternative for cultivation in pots at home; however, a special management for plant size reduction is required.

To meet this need of producers and growers, research on growth regulators has been carried out to produce plants with more adequate aesthetic standard and more compacted for vase planting (Wanderley et al., 2007). The use of growth regulators is effective in flower culture such as the *Epidendrum radicans* (Pateli et al., 2004), since it may produce more compact forms, meeting the needs of the consuming market. (Magnitskiy et al., 2006).

Mepiquat chloride is used to reduce plant height, mainly in cotton culture, but studies on ornamental plants have been carried out with gladiolus (Campos et al., 2010). This product inhibits the endogenous synthesis of giberellins, producing a more compact plant with smaller branches, dark green leaves and that blooms early (Rademacher 2004).

Paclobutrazol, known by the commercial name of Cultar 250 SC, is sold in liquid form and inhibits extension growth in a large number of species (Rademacher 2004). Its active ingredient is much more efficient in reducing plant size than other growth regulators such as clormequat and daminozide (Olsen and Andersen 1995).

The objective of this work was to evaluate the effect of mepiquat chloride and paclobutrazol on the size reduction of the orchid *Arundina graminifolia* for its commercialization as ornamental plant vase.

MATERIALS AND METHODS

The experiment was conducted in a greenhouse with 50% solar retencion, between March 2012 and December 2013, at Universidade Estadual de Londrina –UEL, Londrina, PR, whose coordinates are 23º23' of latitude S, longitude 51º11'W and altitude of 566 meters with average daytime temperature of 26°C and night time 15° C.

The study selected 110 with one-year old plants of *Arundina graminifolia*, 30 cm high on average and with 2 stems, purchased from Holambra-SP producers. Plants were grown in a 15.0cm high and 12.5 cm wide black polypropylene pot, filled with the Plantmax® commercial substrate mix (average composition - 60% of pine husk, 15% of "fine" granulometry vermiculite, 15% of "superfine "granulometry and 10% of humus) and sand in the proportion (1:1).

Fertilization occurred quarterly through fertigation, with NPK formulation (10-30-20), on the dosage of 1 g L^{-1}. (Faria et al., 2010). Irrigation was conducted by aspersion with was done with a 6 mm slide of water, fulfilled during the morning for five minutes. During the winter, irrigation frequency was every three days and in the summer plants were irrigated daily.

Growth regulators were applied with mepiquat chloride (Pix 250 g L^{-1}), via spraying (50 ml per vase), at dosages of 0.0; 1.0; 2.0; 3.0; 4.0 and 5.0 ml L^{-1} and with paclobutrazol (Cultar 250 g L^{-1}) at dosages of 0.0; 1.0; 2.0; 3.0; 4.0 and 5.0 ml L^{-1}, via substrate irrigation (50 ml per vase). Applications occurred twice a month (every 15 days), for 5 months, a total of 10 applications. The variables number of shoots and height of shoots (cm) with and without flowers were evaluated 30 days after the last treatments application.

The experiment was carried out in a randomized block design with 11 treatments and 10 replications. Data were submitted to an analysis of variance at 5% of probability and a regression study. Statistical analysis used the "SISVAR" program, version 5.1 (Ferreira 2003).

RESULTS AND DISCUSSION

Both for treatments with paclobutrazol and with mepiquat chloride, the analysis of variance (Table 1) showed significance for shoots height with and without flowers but no significance for the variable number of shoots, when these products were used as size reducing agent.

Table 1. Analysis of variance for number of shoots, shoot height with flower and height of non-flower shoots of Arundina graminifolia plants submitted to doses of mepiquat chloride (CLM) and paclobutrazol (PBZ). Londrina 2014.

Treatment		SQ	QM	F	CV %
CLM	Shoot height with flower	0.4569	0.9138	12.74**	9.29
	Shoot height without Flower	0.3701	0.0740	21.45**	16.27
	Number of shoots	4.6833	0.9367	1.321^{ns}	15.27
PBZ	Shoot height with flower	6.1674	1.2335	537.16**	13.08
	Shoot height without Flower	1.4385	0.2877	240.83**	20.19
	Number of shoots	4.3333	0.8667	1.00^{ns}	16.79

**Significant at 1%; ^{ns}Non-significant by the F test ($p < 0.05$).

These results agree with Pateli et al. (2004), in a study with *Epidendrum radicans*, are not found significance for number of shoots in plants using paclobutrazol or mepiquat chloride. However, are not disagree with the results obtained by Wanderley et al. (2014), who found significant difference in number of buds for the *Epidendrum radicans* orchid, according to the dosage used by the growth regulators applied. As for the *Arundina graminifolia*, there was a reduction in number of new shoots and the occurrence of shoots death depending on the dosages of the products. On the other hand, Pinto et al. (2006), in a work realized with the Siam tulip did not observe any significant difference in number of shoots per pot for plants treated with paclobutrazol at any of the dosages used.

The regression analysis showed that there is a quadratic and descending behavior for shoots height with and without flowers submitted to treatments with mepiquat chloride and paclobutrazol (Figure 1). The use of the latter as vegetal growth regulator at these concentrations caused a significant reduction in *Arundina graminifolia* shoots height (Figure 2).

Studies with *Cordyline terminalis*, Hagiladi and Watad (1992) concluded that increasing concentrations of paclobutrazol reduced plants height. As for *Clerodendros sp*. Delaune (2005) found that dosages between 5 and 15 mg per vase of paclobutrazol caused plant's height reduction. Pateli et al. (2004), in a study carried out with the Epidendrum radicans orchid observed that an increase in paclobutrazol dosages reduced main stem lengths progressively.

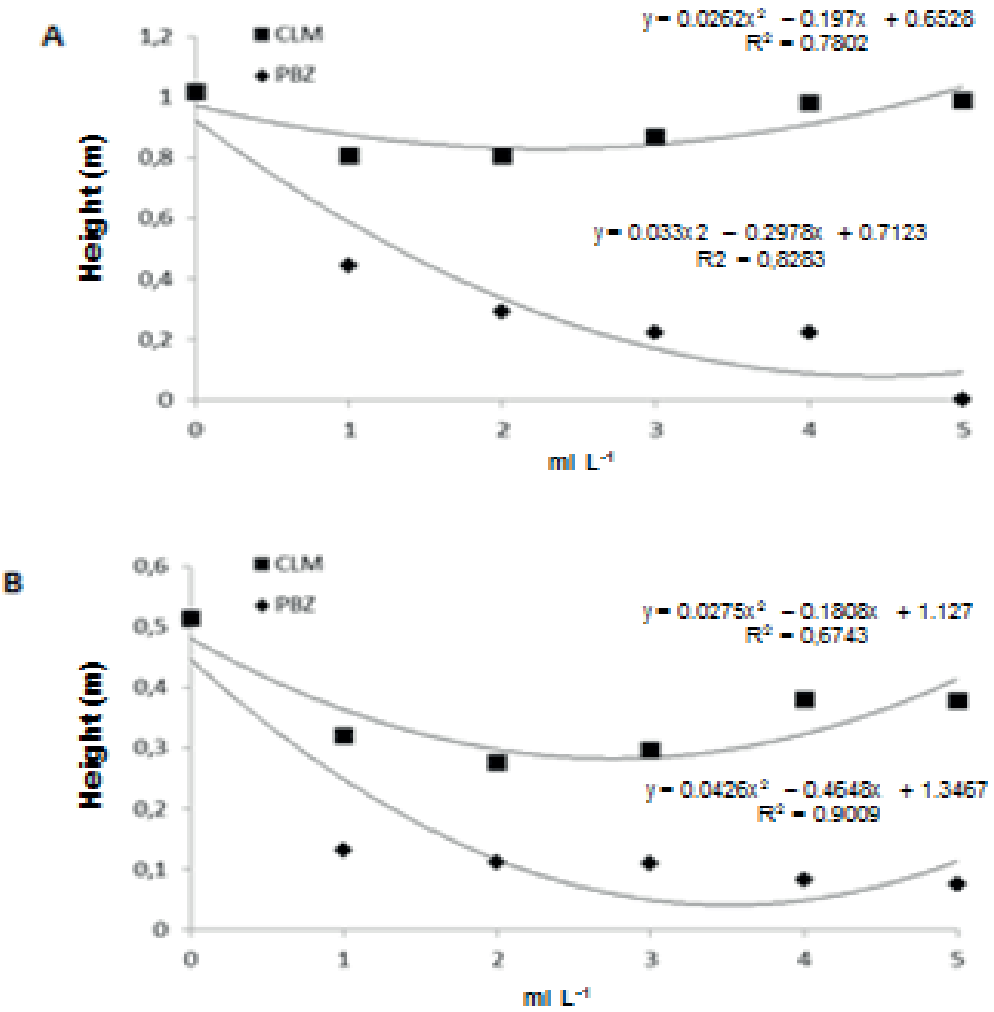

Figure 1. Height of shoots with flower (A) and height of shoots without flower (B) of *Arundina graminifolia* plants submitted to dosages of mepiquat chloride (CLM) and paclobutrazol (PBZ). Londrina, PR. 2014.

Figure 2. Plant A (control treatment without product application). Plant B (treated with 3 ml L^{-1} de Paclobutrazol).

The use of mepiquat chloride as a vegetal growth regulator at these concentrations reduced Arundina graminifolia orchid shoots height with and without flowers of orchid; however, height reduction percentage was not inferior to paclobutrazol (Figure 1). Similarly Campos et al. (2010), studying plants of Gladiolus communis with the application of mepiquat chloride showed no size reduction, considering that its plants continued to grow like the control.

Plants was showed signs phytotoxicity with dosages over 2 mg L^{-1} of paclobutrazol, presenting deformed nodes and leaves, 20% of dead leaves at the concentration of 3 mg L^{-1}, 30% of mortality at the concentration of 4 mg L^{-1} and, finally, 60% of mortality in the concentration of 5 mg L^{-1}. Cox and Keever (1988) studied height reduction in *Zinnia elegans* (zinnia) and *Pelargonium hortorum* (geranium) and verified that highest dosages of paclobutrazol generated deformed plants.

In regards to flower size, treatments that received mepiquat chloride as well as paclobutrazol dosages showed no difference in relation to the control. Leaves and internodes were shortened during the application of growth regulators, as shown in this work. The use of regulators delays cell division and restricts gibberellins biosynthesis (GB), interfering in internodes growth, producing more compact forms (Magnitskiy et al., 2006).

CONCLUSIONS

Ten fortnightly applications of paclobutrazol (2 mg L^{-1}) via substrate irrigation (50 ml per vase) are recommended for reducing the size of *Arundina graminifolia*. Doses over 3 mg L^{-1} show high number of dead plants.

Mepiquat chloride in the dosages studied was inefficient in reducing the size of *Arundina graminifolia* orchid.

Growth regulators do not alter the number of shoots in bamboo orchid.

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