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Use of growth regulator in reducing the size of *Sesbania punicea* (Cav.) Benth.

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Abstract: *Sesbania punicea* (Cav.) Benth. is a species with ornamental potential, highlighted by the orange color of the flowers and the formation of inflorescences in racemes. Because it is a native species and few plant breeding information, studies are needed to be used commercially, one of the aspects to be investigated is the reduction of its size for potting. The objective was to evaluate the influence of daminozide in reducing the size of *Sesbania punicea.* The seedlings were grown in 2.8 L pots containing substrate based on pine bark. A completely randomized design was used, with 3 treatments, 1 control, with 4 replications, 5 plants per plot. The treatments consisted of daminozide in doses of 2, 4 and 6 g L^{-1} and control (water + 1 mL L^{-1} adhesive spreader) that were sprayed using a 2 L accumulated pressure sprayer on the plants on the 22nd and 44th days after transplant. At the end of the experiment, height, stem diameter, dry matter of shoot and roots, chlorophyll *a*, *b* and total, number of leaves and internodes were evaluated. There were significant differences for plant height, stem diameter, number of leaves per plant and shoot dry matter. It is concluded that the dose of 5.8 g L^{-1} of daminozide showed superior results for the reduction the size of this species.

Keywords: daminozide, floriculture, native plant, potted flower.

Uso de regulador de crescimento na redução do porte de *Sesbania punicea* (Cav.) Benth

Resumo: *Sesbania punicea* (Cav.) Benth. é uma espécie com potencial ornamental, destacado pela coloração alaranjada das flores e, formação das inflorescências, em racemos. Por ser uma espécie nativa e poucas informações fitotécnicas são necessários estudos para que esta possa ser utilizada comercialmente, um dos aspectos a ser investigado é a redução do porte para uso em vaso. Objetivou-se avaliar a influência de daminozide na redução do porte de *Sesbania punicea*. As mudas foram cultivadas em vasos de 2,8 L contendo substrato a base de casca de pinus. Foi utilizado delineamento inteiramente casualizado, com 3 tratamentos, 1 testemunha, com 4 repetições, 5 plantas por parcela. Os tratamentos foram constituídos por daminozide nas dosagens de 2, 4 e 6 g L^{-1} e testemunha (água + espalhante adesivo 1 mL L^{-1}) que foram pulverizados utilizando pulverizador de pressão acumulada de 2 L nas plantas, ao 22° dia e 44° dia após o transplante. Ao final do experimento foram avaliados: altura, diâmetro do colo do caule, massa da matéria seca da parte aérea e de raízes, clorofila a, b e total, número de folhas e entrenós. Houve diferenças significativas para altura das plantas, diâmetro do colo, número de folhas por planta e massa seca de parte aérea. Conclui-se que a dose de 5,8 g

L^{-1} de daminozide apresentou resultados superiores para a redução de porte dessa espécie.

Palavras-chave: daminozide, floricultura, planta nativa, flor de vaso.

Introduction

Sesbania punicea has ornamental potential, mainly due to the color and formation of its reddish-orange inflorescences in the form of racemes. The alternate leaves are compound with countless folioles; when ripe, the fruits are brown in color, tetrapterous, dehiscent, 4 to 12 cm wide. The plant can be 2 to 4 meters tall (Izaguirre and Beyhaut, 1998; Stumpf et al., 2009). It is commonly called of "fedegoso-da-praia", "cambaí-vermelho" and "acácia-de-flores-vermelhas" (Queiroz, 2020). This species is little known by the Brazilian population; however, it has already been cultivated as an ornamental garden plant in other countries, such as South Africa and the United States (Csurhes and Edwards, 1998; Fischer et al., 2007). *S. punicea* is found from the south of Brazil, coast of Argentina until the Rio de la Plata and Uruguay (Izaguirre and Beyhaut, 1998).

Being a native species still without consolidated cultivation, *S. punicea*, shows itself as an option in an increasingly competitive and eager for new products market, with different colors and formats. Nevertheless, for the use of little-known species, studies are needed in order to provide information that can subsidize their cultivation (Heiden et al., 2006).

In this context, research can contribute with cultivation and management information to be used in these species, aiming the presentation of suitable aspects for commercialization, either as cut flowers, potted flowers or in gardens (Heiden et al., 2006). In addition, information that serves to domesticate native plants contributes to *ex situ* conservation and guarantees the identity of the national genetic heritage (Fior et al., 2004). For each use purpose of the ornamental species different managements are carried out; among them are pruning and using hormones to adapt the characteristics of the species to the needs of the market.

Between the most used cultivation techniques in order to reduce the size of these ornamental species is the usage of growth regulators (Grossi et al., 2009), especially inhibitors of gibberellin biosynthesis. These phytoregulators reduce the internode size, making the plants more compact and with greener foliage (Gruszynski, 2001; Taiz and Zeiger, 2013). This technique is widely used in the cultivation of flowers such as lilies, chrysanthemums and poinsettias (Taiz and Zeiger, 2013).

The regulators action occurs through chemical signaling in regulation of the development and growth of plants, and is characterized by modifying cells and, therefore, tissues and plant organs (Espindula et al., 2010). According to Mateus et al. (2009), the appropriate dose of growth regulator must be tested for each species, in order to obtain the desired result.

Daminozide is a plant growth regulator with effective systemic action in reducing seedling growth, achieving maximum results during warm periods. It must be applied to the aerial part, since it loses its effect when applied to the substrate, considering that this product penetrates the leaf and by its systemic action it is distributed in the rest of the plant (Andrei, 2009; Whipker and Latimer, 2013). Daminozide is highly movable in the plant, travelling quickly

from the application site to the rest of the plant (Whipker and Latimer, 2013).

Another procedure widely used to control the height of ornamental plants is the "pinching", which consists on removing the apical meristem or apical bud from the plant, normally detached manually. Removing the apical bud, the auxin flow which promotes the apical dominance of the plant is interrupted; consequentially stimulating lateral shoots growth, which is very important, especially in ornamental species due to the formation of a more compact aspect of the plants (Hiranaka et al., 2005). Thus, this study aimed to evaluate the influence of daminozide doses application in reducing the size of *Sesbania punicea* for its use as a potted plant.

Material and methods

The experiment was conducted in an agricultural greenhouse without temperature and humidity control, with polyethylene cover and anti-aphid mesh walls. To obtain the seedlings, seeds collected in brown fruits from 20 matrices in the city of Barra do Ribeiro, RS, Brazil (30° 21' 27" S 51° 20' 32" W) were used, with IN185165 exsiccate deposit, being registered at the Herbarium of Botany Faculty, Federal University of Rio Grande do Sul.

The seeds were manually extracted from the fruits and submitted to break dormancy through scarification between sandpapers (80 grit sandpaper) for one minute, and then leaving them in distilled water for two hours.

Sowing was carried out on July 8, 2016, in multicellular trays of 200 cells filled with commercial substrate based on peat, vermiculite and rice husk ash. The pricking out occurred on August 24, 2016 in 2.8-liter pots, with composted pine bark substrate and kept in agricultural greenhouses with micro-sprinkler irrigation. The plants were fertilized weekly with NPK 06-18-32 fertilizer, at a dose of 2 g L^{-1}, with 50 mL per pot.

Before applying the treatments, the "pinching" technique was performed, which consisted of making a ± 2 cm cut from the apical meristem of all plants. The treatments consisted of daminozide (succinic acid-2,2-dimethylhydrate) in doses of 2, 4 and 6 g L^{-1} (85% active ingredient) plus Break Thru® spreader-sticker in the dose of 1 ml L^{-1}. In the control, only water and spreader-sticker were applied. The product application was performed using a 2 L accumulated pressure sprayer up to the drainage point. The applications were made on the 22nd and 44th days after the transplant.

A completely randomized block design was used, with 4 replications and 5 plants per plot. At the end of the experiment and after four months of cultivation, the following parameters were evaluated: plants height, using measuring tape (cm); diameter of the main plant stem, using a digital caliper (mm); leaves chlorophyll index *a*, *b* and total, assessed through an electronic chlorophyll meter (chlorofiLOG), model CFL1030 from Falker®, which uses the Chlorophyll Falker Index (ICF) as the unit of measurement. Analyses were performed using one leaf per plant, chosen at random from the mature leaves. The number of leaves and internodes per plant was also counted. The dry mass of the aerial part and roots was determined by drying in an oven at 65ºC ± 5ºC until constant mass. Data analysis was performed using analysis of variance (ANOVA) and subsequently the means were submitted to linear and quadratic regression analysis (Sisvar 5.6 Program).

Results and discussion

There was a significant decreasing quadratic response for the plant height variables and a decreasing linear regression for the leaf number, stem diameter and shoot dry mass variables, demonstrating the effect of daminozide applications on *S. punicea* plants (Table 1), while for the other parameters no statistical differences were observed.

Table 1. Analysis of variance of *Sesbania punicea* (Cav.) Benth. under different doses of daminozide.

Analyzed variables	Value-p	Overall Average	CV (%)
Plants heigth (cm)	< 0.001	37.84	10.17
Number of internodes per plant	0.18	27.06	10.85
Number of leaves per plant	0.02	21.35	20.90
Base diameter (mm)	0.001	5.89	7.08
Shoot dry matter (g)	0.005	5.82	16.64
Root dry matter (g)	0.58	3.12	18.41
Chlorophyl *a* (FCI)	0.50	29.09	20.18
Chlorophyl *b* (FCI)	0.50	13.03	18.84
Total Chlorophyl (FCI)	0.72	42.13	16.81

FCI = Falker Chlorophyll Index; CV = coefficient of variation.

According to the results presented in Figure 1A, it is noted that the control had a higher height. In this sense, it was observed that plants sprayed with daminozide showed negative quadratic behavior, with height reduction of 43.17%, 55.72% and 59.56% in the treatment, for 2, 4 and 6 g L^{-1} respectively, with the maximum technical efficiency dose being 5.8 g L^{-1}. Fior and Lattuada (2011) had similar results, using daminozide in *Siphocampylus betulifolius* (Cham.) G. Don, the dosages used by the authors were effective in reducing the development of this species at 133 days of follow-up. In the study by Neves et al. (2009) it was observed that ornamental sunflower plants sprayed with daminozide in dosages of 2, 4 and 6 g L^{-1} presented reduced size compared to the control, in addition to presenting an adequate appearance for commercialization.

Regarding the internodes number per plant there were no differences between the control and the plants treated with daminozide (Figure 1B). This fact also happened in the cultivation of chrysanthemum (*Dendranthema grandiflora* Tzvelev.) cultivar 'Snowdon' and *Zinnia elegans* Jacq., in which there was a decrease in the internodes size of plants using this product (Tolotti et al., 2003; Pinto et al., 2005). This result confirms what is exposed in the literature, which describes the gibberellin biosynthesis inhibition in plants, leading to a reduction in the internodes size (Taiz and Zeiger, 2013).

There was a linear progression in the number of leaves per plant as the dose increased (Figure 1C). A similar result to that obtained in this study was found by Mateus et al. (2009) with sunflower cultivation, in which the application of paclobutrazol (PBZ) up to the dose of 0.75 mg L^{-1}, resulted in increasing the number of leaves. On the other hand, Fior and Lattuada (2011) observed the opposite situation to what occurred in this work: as the doses of

daminozide applied to *Siphocampylus betulifolius* increased, there was a decrease in the amount of leaves per plant. These authors say that the reduction in vegetative growth may have been the cause of reducing the number of flowers and of flowering delay. Therefore, it's clear that for each species, the regulator can cause different behavior concerning its influence on the number of leaves.

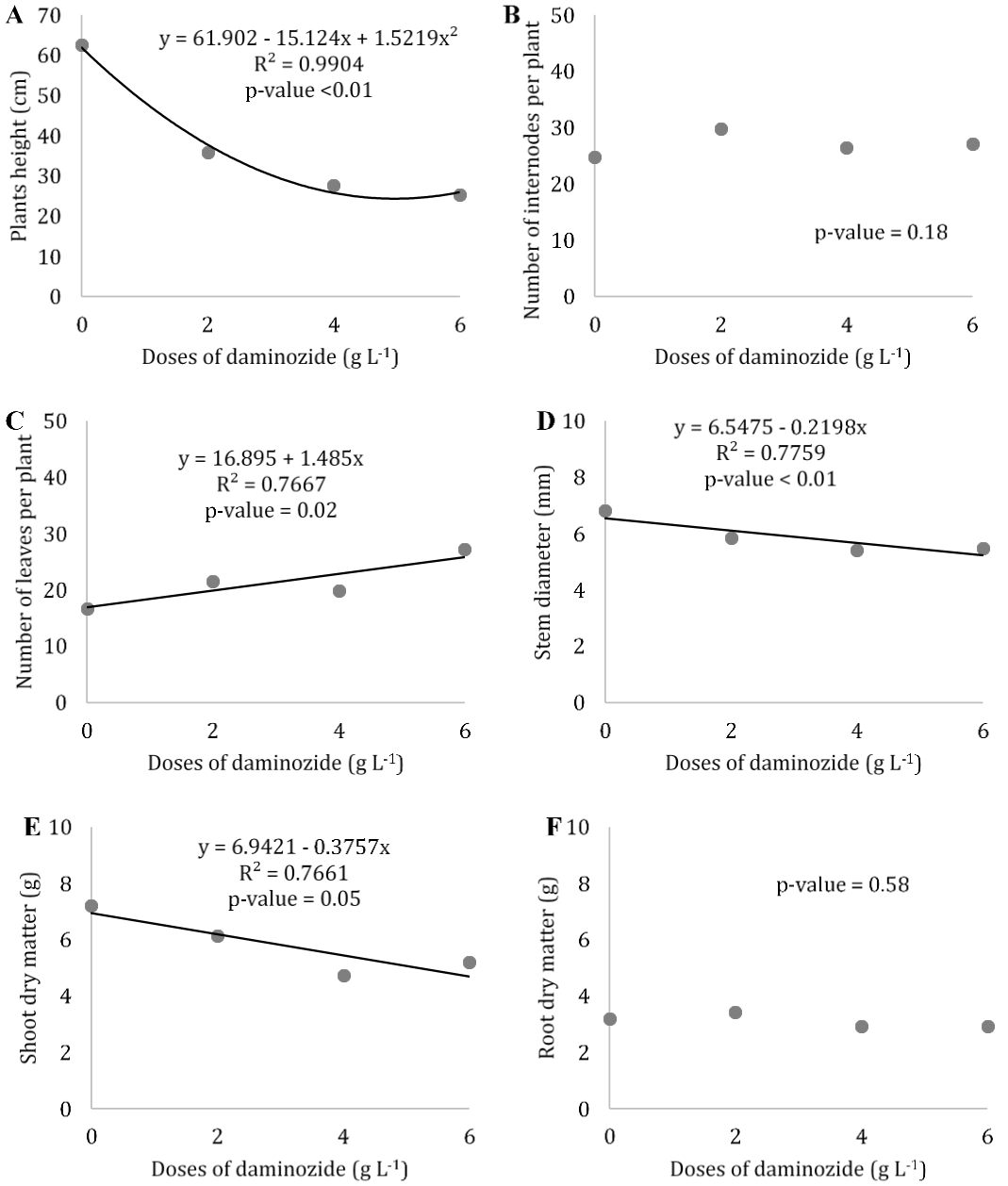

Figure 1. Plants height (A), number of internodes per plant (B), number of leaves per plant (C), stem diameter (D), shoot dry matter (E) and root dry matter (F) in plants of *Sesbania punicea* (Cav.) Benth. subjected to doses of daminozide.

It's possible to observe a linear decrease in the diameter of plants stem with the increasing of daminozide doses (1D). In sugarcane, gibberellin sprinkling increases the production of sugar, as internode elongation is stimulated (Taiz

and Zeiger, 2013). The use of this regulator is responsible for inhibiting the gibberellin biosynthesis, interfering in the reduction of stem cells of *S. punicea* plants and consequently decreasing their diameter.

The daminozide doses also influenced the shoot dry matter, since there was a linear decrease in the values of this variable as the concentrations of this product increased (Figure 1E). Similarly to what happened in this study, it was also observed with sunflower under different doses of paclobutrazol that as the doses increased, there was a decrease in the leaves dry mass and capitullum (Wanderley et al., 2014).

For the root dry matter, there were no statistical differences between the control and the different dosages of daminozide (Figure 1F). In *Arabidopsis* plants, the GA20-ox gene is expressed especially in apical buds and young leaves, proving to be the main gibberellins synthesis sites. The synthesized gibberellins in the aerial part can be moved to the rest of the plant through phloem. The early stages of gibberellin biosynthesis can occur in one tissue and the metabolism to make it active in another (Taiz and Zeiger, 2013).

It is assumed that in this study there were no statistical differences in the root dry mass because the synthesis of gibberellins occurs in the aerial part of the plants, as well as their inactivation with the use of regulators, not interfering in the root mass.

In *S. punicea* there were no significant differences between treatments to the chlorophyll *a, b* and total variables with the use of daminozide (Figure 2). Differently from what was found in the poinsettia cultivation (*Euphorbia pulcherrima* Willd. ex Klotzsch) where the interaction of daminozide and chlormequat chloride significantly affected the increase in chlorophyll *a* and *b*, especially in the lower dosages associated with chlormequat chloride (Lodeta et al., 2010). Thakur et al. (2006) suggested that the intensification in chlorophyll content in leaves of lily seedlings (*Lilium longiflorum*, var. Pollyanna) treated with paclobutrazol (PBZ) and ancymidol is due to the decrease in cells and, therefore, the chlorophyll content is more concentrated in a smaller cell volume. Probably the cells decrease was not so pronounced in this study with daminozide doses.

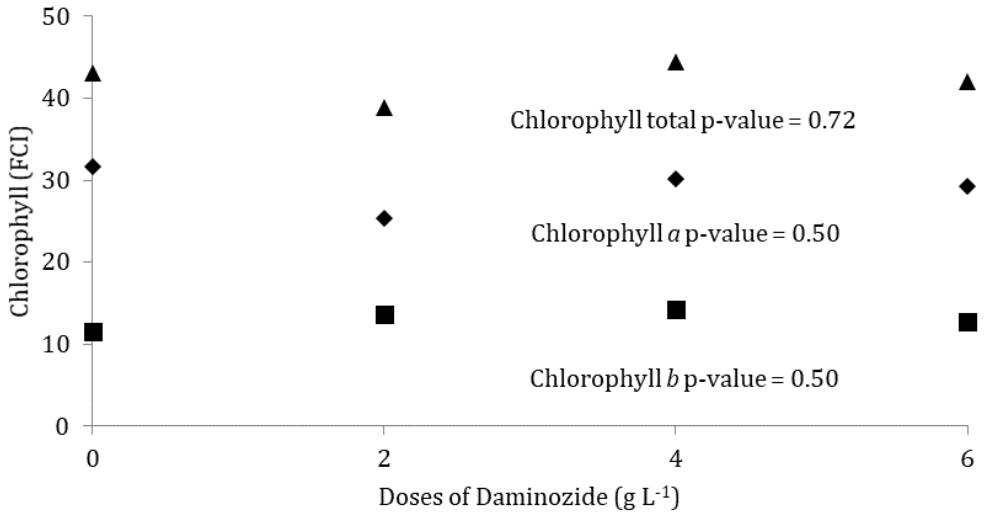

Figure 2. Chlorophyll *a*, *b* and total in plants of *Sesbania punicea* (Cav.) Benth. subjected to doses of daminozide.

In this context, this work presents initial information about the effect of daminozide on plants of *S. punicea*, therefore, is emphasized the possibility of using this product as a way to reduce the size of the species and consequently obtaining more compact plants for commercialization.

Conclusion

It was concluded that the dosage of 5.8 g L^{-1} of the daminozide regulator was effective in reducing the size of *S. punicea*.

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