

The effect of growth retardants on growth and flowering of dwarf alstroemeria

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Summary

The experiment was conducted to inhibit the growth of dwarf alstroemeria cultivars 'Rosalina' and 'Dorotea' using flurprimidol and daminozide. Additionally, the effect of these retardants on days to anthesis, flowering shoots number, diameter and longevity of florets was evaluated. In vitro propagated plants, grown in 12 cm pots were treated with single sprays of flurprimidol (7.5, 15, 22.5 mg l⁻¹) and daminozide (2500, 3500, 4500 mg l⁻¹) following second pruning, when shoots were 9-12 cm long. Well retarded plants of both dwarf alstroemeria cultivars were obtained when plants were sprayed with flurprimidol at 22.5 mg l⁻¹. Plants treated with daminozide at all tested concentrations were too tall to be grown in 12 cm pots. Flurprimidol significantly reduced the canopy diameter, number of flowering shoots of alstroemeria cultivars 'Rosalina' and 'Dorotea' and floret size of cultivar 'Rosalina'. Daminozide had no effect on the number of days to flower but flurprimidol delayed flowering of tested cultivars only at concentration of 22.5 mg l⁻¹. Intensified green leaf colour was observed on flurprimidol treated plants. The chemical names used: a-(1-methylethyl)-a-[4-(trifluoromethoxy)-phenyl]-5-pyrimidine-methanol (flurprimidol), butanedioic acid mono (2,2-dimethylhydrazide) (daminozide).

Key words: dwarf alstroemeria, pot plants, growth control, growth retardants, flurprimidol, daminozide

INTRODUCTION

Alstroemeria is usually grown as a cut flower but it has also been introduced to the market as a new flowering pot plant. Dwarf alstroemeria is a nice looking plant, easy to grow with low requirements to temperature. It can be propagated either by division of rhizome or in vitro (Podwyszyńska et al., 1997; Podwyszyńska et al., 2000). The height of alstroemeria available for containerised production is excessive for most markets. Although the alstroemeria cultivars 'Mojoinnier' and 'Bird of Paradise' are 50% shorter than cut flower cultivars, the plants are still too tall to be grown in small pots (Healy and Clark, 1993). Even though the clones of dwarf alstroemeria selected in 1990 in the Research Institute of Pomology and Floriculture, Skierniewice (Przybyła, 1992) are naturally dwarf, they have too long generative shoots and an irregular plant habit. To obtain short and well compact potted alstroemeria suitable for application in small pots, growth retardants should be used. When applied in appropriate concentrations growth retardants modify plant architecture of several plant species (Pobudkiewicz and Goldsberry, 1989; Pobudkiewicz and Nowak, 1994a; 1997; 1999; Pobudkiewicz and Podwyszyńska, 1999). Among many growth retardants only flurprimidol and daminozide have been registered for usage in floricultural crops on a Polish market. Daminozide is one of the oldest growth retardants, which has been used for about 40 years to reduce the height of many plants. Flurprimidol is one of the latest growth retardants and unlike daminozide it is active in very low amounts. Growth retardants have not been applied in cultivation of Polish dwarf alstroemeria so far. Therefore this study was undertaken: (1) to improve quality of dwarf alstroemeria cultivars 'Rosalina' and 'Dorotea' using growth retardants, (2) to compare the ability of flurprimidol and daminozide to produce dwarf well compact plants.

MATERIAL AND METHODS

Plants of dwarf alstroemeria cultivars 'Rosalina' [(SKS 2092) - hybrid with white purple flowers having in its pedigree *Alstroemeria pelegriana* and *A. psittacina* (Brazil)] and 'Dorotea' [(SKS 1892) - mutant of sterile hybrid with purple flowers] were planted in the middle of August into 12 cm pots filled with a medium composed of 4 sphagnum peat : 1 perlite (v:v), pH-6.0 and placed directly on the bench. All plants were derived from in vitro propagation and were selected for uniformity prior to the beginning of the experiment. After establishment, the pots were supplied with a nutrient solution (Nowokont – 0.3 ml/l) at every watering. The plants were grown in a greenhouse under a 13 h. photoperiod – 100 $\mu\text{mol m}^{-2} \text{s}^{-1}$ provided by supplementary lighting with 400 W HPS lamps and the ambient temperature was maintained at 15-17°C. Well established dwarf alstroemeria was pruned twice to obtain well branched plants. In the middle of October, following second pruning, when plants were 9-12 cm in height, flurprimidol (Topflor 015 SL) at concentrations of 7.5, 15 and 22.5 mg l^{-1} or daminozide (B-Nine 85 SP) at 2500, 3500 and 4500 mg l^{-1} were applied as single

sprays. The plants were treated with tested chemicals until the foliage was thoroughly covered but the solution was not allowed to drip off. The control plants were sprayed with tap water at the same time. No wetting agent was added to the growth retardant spray solutions.

The experiment was carried out in a randomized complete block design with three blocks, in 1997 and 1998. Each treatment contained 15 plants. Measurements included the number and length of generative shoots (the length of each shoot was measured from the medium surface to the shoot tip when florets in the cyme were fully developed), the number of days to flowering (from potting plants till the opening of the first floret in the cyme), floret diameter and the longevity of florets. The canopy minimum and maximum diameter was measured for each plant, the average of the two being recorded. The experimental data were subjected to analysis of variance and Duncan's multiple range test was used at the 5% level of significance.

RESULTS AND DISCUSSION

As compared with daminozide, treatment with flurprimidol was more effective in suppressing growth of cultivars 'Rosalina' and 'Dorotea' (Fig. 1). At the time of flowering shoot growth of tested alstroemeria cultivars was significantly inhibited by all doses of flurprimidol. Desirable height of 'Rosalina' and 'Dorotea' was obtained when plants were treated with flurprimidol at concentration of 22.5 mg l⁻¹ and plants were 22.6 and 29.5 cm in generative shoot length, respectively. As compared with flurprimidol, daminozide was less effective growth retardant in reducing alstroemeria shoot length. However 'Rosalina' plants treated with daminozide were slightly shorter than the control ones, the differences were not significant (Fig.1). Cultivar 'Dorotea' appeared to be more sensitive plant to daminozide application than the other tested one and the plants sprayed with this growth retardant at concentrations ranging from 2500 to 4500 mg l⁻¹ were significantly shorter than the untreated plants (Fig.1). The highest daminozide concentration (4500 mg l⁻¹) provided 'Dorotea' plants 38.9 cm in shoot length (Fig.1) but alstroemeria was too high to be grown in 12 cm pots. The data agreed with those of H e a l y and K l i c k (1993) who found, that spray treatments of daminozide were only moderately effective in controlling plant height of potted alstroemeria cultivars 'Mojoennier' or 'Bird of Paradise' and the plant height was still excessive for the market. These authors have also reported that desirable height of these alstroemeria cultivars was obtained using paclobutrazol, which like flurprimidol belongs to very powerful growth retardants of new generation. At the time of flowering the canopies of dwarf alstroemeria cultivars 'Rosalina' (Tab. 1) and 'Dorotea' (Tab. 2) treated with flurprimidol at concentrations of 7.5-22.5 and 15-22.5 mg l⁻¹, respectively were significantly smaller and more compact than the canopies of untreated ones. Plants of both alstroemeria cultivars treated with daminozide did not differ from the control ones in the canopy diameter (Tab. 1 and Tab. 2). The tested dwarf alstroemeria like other species, e.g. *Lilium* (P o b u d k i e w i c z and N o w a k, 1992), *Dianthus caryophyllus* L. (P o b u d k i e w i c z and N o w a k, 1994

a) or *Tulipa* (Pobudkiewicz and Nowak, 1994 b) appears to be a plant with high requirements to flurprimidol. Well retarded with a good habit alstroemeria plants cultivars 'Rosalina' and 'Dorotea' were obtained with flurprimidol applied at concentration of 22.5 mg l⁻¹ but much lower doses of this chemical were used to reduce the height and to improve the compactness of *Dendranthema grandiflora* Twelve cultivar 'Surf' (Pobudkiewicz and Nowak, 1997), *Cuphea ignea* A.DC. (Pobudkiewicz, 2000 a) or *Streptocarpus hybridus* (Pobudkiewicz, 2000 c).

Table 1

Effect of single application of flurprimidol and daminozide on the canopy diameter, the number of flowering shoots, the number of days to flowering, the floret diameter and the floret longevity of dwarf alstroemeria 'Rosalina'

Growth retardant Treatments	Number of days to flowering	Number of flowering shoots per plant	Canopy diameter (cm)	Floret diameter (cm)	Floret longevity (days)
Control	132.2 ab	7.3 c	32.7 c	5.0 b	11.2 c
Daminozide					
2500 mg l ⁻¹	128.6 a	7.1 c	30.1 c	4.7 a	11.1 c
3500 mg l ⁻¹	132.3 ab	6.8 bc	32.0 c	4.4 a	11.2 c
4500 mg l ⁻¹	132.2 ab	7.5 c	30.5 c	4.6 a	10.3 abc
Flurprimidol					
7.5 mg l ⁻¹	129.2 a	5.0 ab	25.0 b	4.6 a	10.8 bc
15 mg l ⁻¹	138.3 bc	4.5 a	24.2 b	4.6 a	9.8 a
22.5 mg l ⁻¹	141.7 c	4.0 a	21.1 a	4.3 a	10.1 ab

Values followed by the same letter are not different at 5% level of significance

The effect of growth retardants on floret size depended on dwarf alstroemeria cultivar being tested. Alstroemeria 'Dorotea' receiving applications of daminozide or flurprimidol did not differ in floret size from the control (Tab. 2) but the florets of the other tested cultivar (Tab. 1) were significantly smaller when plants were treated with both chemicals at all tested concentrations. Studies conducted on the other species have also shown that flower size might be effected by flurprimidol application. There were noted significant effects of flurprimidol on the tepal length of *Lilium* (Pobudkiewicz and Nowak, 1992), the bract length of *Euphorbia pulcherrima* Willd (Pobudkiewicz et al., 1995) and the calyx-tube size of *Cuphea ignea* A.DC. (Pobudkiewicz, 2000 a).

In this research project neither floret longevity nor number of flowering shoots were effected by daminozide application. Floret longevity of both alstroemeria cultivars was significantly shorter, when flurprimidol was applied to 'Rosalina' (Tab. 1) and 'Dorotea' plants (Tab. 2) at concentrations of 15-22.5 mg l⁻¹ and 22.5 mg l⁻¹, respectively. Flurprimidol significantly decreased the number of flowering shoots of dwarf alstroemeria cultivars 'Rosalina' (Tab. 1) and 'Dorotea' (Tab. 2) when used at rates of 7.5-22.5 mg l⁻¹ and 15-22.5 mg l⁻¹, respectively. In report of Healy and Klicik (1993) the number of generative shoots of potted alstroemeria cultivars 'Mojoinnier' and 'Bird of Paradise' was not effected by the growth retardant treatments.

Table 2

Effect of single application of flurprimidol and daminozide on the canopy diameter, the number of flowering shoots, the number of days to flowering, the floret diameter and the floret longevity of dwarf alstroemeria 'Dorotea'

Growth retardant Treatments	Number of days to flowering	Number of flowering shoots per plant	Canopy diameter (cm)	Floret diameter (cm)	Floret longevity (days)
Control	145.3 ab	7.0 b	26.3 c	3.8 ab	14.3 b
Daminozide					
2500 mg l ⁻¹	148.1 a-c	6.4 ab	24.3 bc	3.8 ab	14.1 b
3500 mg l ⁻¹	153.7 a-c	7.0 b	23.2 bc	3.7 ab	14.0 b
4500 mg l ⁻¹	155.3 bc	6.9 b	22.7 a-c	3.7 ab	13.5 b
Flurprimidol					
7.5 mg l ⁻¹	152.2 abc	6.0 ab	23.2 bc	3.9 b	14.9 b
15 mg l ⁻¹	151.2 abc	4.9 a	19.7 a	3.8 ab	14.4 b
22.5 mg l ⁻¹	157.1 c	5.1 a	21.6 ab	3.7 a	10.6 a

Values followed by the same letter are not different at 5% level of significance

Flowering time of dwarf alstroemeria 'Rosalina' and 'Dorotea' was not accelerated nor delayed by daminozide treatments but time from potting plants to their anthesis was significantly longer [on average 10 and 12 days of 'Rosalina' (Tab.1) and 'Dorotea' (Tab. 2), respectively] when plants were treated with flurprimidol at the highest concentration - 22.5 mg l⁻¹. The data achieved with flurprimidol treatment verify those obtained by Healy and Klink (1993) who demonstrated that the number of days to flower of potted alstroemeria was increased by up to 5 days by application of paclobutrazol at 10 or 20 mg l⁻¹. Studies conducted on the other species have shown that flurprimidol significantly delayed flowering of *Lilium* (Pobudkiewicz and Nowak, 1992) when applied at the highest concentrations, promoted flowering of seed propagated geranium *Pelargonium x hortorum* L.H. Bailey (Pobudkiewicz, 2000 b) but had no significant effect on days to flowering when applied to *Dianthus caryophyllus* L. (Pobudkiewicz and Nowak, 1994 a), *Globba winitii* (Siam) (Pobudkiewicz and Podwyszyńska, 1999), *Pelargonium x hortorum* L.H. Bailey cultivars 'Ina' and 'Bargpalais' (Pobudkiewicz and Nowak, 1999) or *Cuphea ignea* A.DC. (Pobudkiewicz, 2000 a).

The green colour of the foliage of dwarf alstroemeria cultivars 'Rosalina' and 'Dorotea' treated with flurprimidol was darker comparing with the untreated plants. Intensified green leaf pigmentation of flurprimidol treated pot plants was also observed on many plant species including *Lilium* (Pobudkiewicz and Nowak, 1992), *Dianthus caryophyllus* L. (Pobudkiewicz and Nowak, 1994 a), *Tulipa* (Pobudkiewicz and Nowak, 1994 b), *Dendranthema grandiflora* Tzwelev (Pobudkiewicz and Nowak, 1997), *Globba winitii* (Siam) (Pobudkiewicz and Podwyszyńska, 1999), *Cuphea ignea* A.DC. (Pobudkiewicz, 2000 a), *Pelargonium x hortorum* L.H. Bailey (Pobudkiewicz, 2000 b), *Streptocarpus*

hybridus (Pobudkiewicz, 2000 c) and a wide variety of other floricultural crops. There was no detectable injury or chlorosis to the foliage in dwarf alstroemeria from any of the treatments. The rhizomes of flurprimidol treated plants were smaller than those of untreated ones.

Consultations:

1. Single foliar application of flurprimidol reduces effectively the size of dwarf alstroemeria cultivars 'Rosalina' and 'Dorotea'.
2. Application of flurprimidol at 22.5 mg l⁻¹, when shoots are 9-12 cm long following second pruning is sufficient to obtain short and well compact plants of dwarf alstroemeria cultivars 'Rosalina' and 'Dorotea'.
3. Dwarf alstroemeria plants treated with daminozide at concentrations ranging from 2500 to 4500 mg l⁻¹ are to high to be grown in 12 cm pots.
4. Flurprimidol treatment at 22.5 mg l⁻¹ delays flowering time of dwarf alstroemeria 'Rosalina' and 'Dorotea' by 10 and 12 days, respectively.

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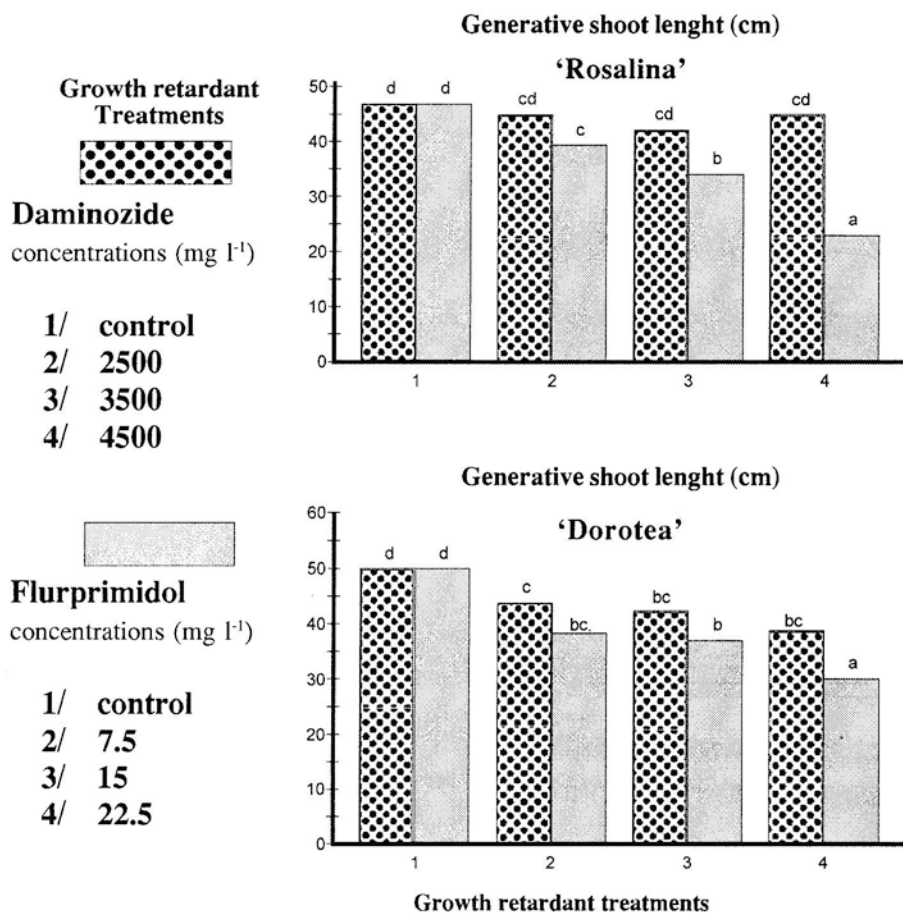
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Wpływ retardantów wzrostu na wzrost i kwitnienie alstremerii karłowej

Streszczenie

Doświadczenie prowadzono w celu zahamowania wzrostu alstremerii karłowej odmian 'Rosalina' i 'Dorotea' przy użyciu flurprimidolu i daminozydu. Dodatkowo badano wpływ tych retardantów na liczbę dni do kwitnienia, liczbę pędów generatywnych oraz średnicę i trwałość kwiatu. Alstremerię rozmnożoną in vitro uprawiano w doniczkach o średnicy 12 cm i traktowano flurprimidolem (7,5, 15 i 22,5 mg · l⁻¹) oraz daminozydem (2500, 3500 i 4500 mg · l⁻¹) dolistnie jednokrotnie po drugim przycinaniu roślin, gdy pędy miały 9-12 cm długości. Dobrze skarłone rośliny alstremerii karłowej 'Rosalina' i 'Dorotea' uzyskano stosując flurprimidol w stężeniu 22,5 mg · l⁻¹. Rośliny traktowane daminozydem we wszystkich badanych stężeniach były za wysokie do uprawy w doniczkach o średnicy 12 cm. Średnica roślin oraz liczba kwitnących pędów roślin alstremerii 'Rosalina' i 'Dorotea' oraz średnica kwiatu roślin odmiany 'Rosalina' były istotnie mniejsze niż roślin kontrolnych. Daminozyd nie wpływał istotnie na liczbę dni do kwitnienia, ale flurprimidol w stężeniu 22,5 mg · l⁻¹ opóźniał istotnie kwitnienie badanych odmian alstremerii. Rośliny opryskiwane flurprimidolem miały intensywniejszy kolor liści niż rośliny nie traktowane retardantem.



Means followed by the same letter do not differ significantly at 5% level.

Fig. 1. Effect of single application of flurprimidol and daminozide on the generative shoot length of dwarf alstroemeria cultivars ‘Rosalina’ and ‘Dorotea’