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EFFECT OF DAMINOZIDE AND FERTILIZER APPLICATION ON THE HEIGHT AND DIAMETER OF POTTED NEW ENGLAND ASTER GROWN IN THE SHORT PHOTOPERIOD CONDITIONS

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SUMMARY

Abundant flowering and habit characteristics make perennials ever more interesting for pot plant production. As the production of most flowering pot plants is inconceivable without growth regulation, research was done (1992–1994) into the effect of daminozide (Alar 85), applied in two concentrations (2000 mgl^{-1}, 4000 mgl^{-1}), and topdressing with liquid mineral fertilizer (Fertina C), in 1.5% concentration, on the height and diameter of potted New England aster - *Aster novae-angliae* cv. 'September Ruby' grown from top and from lateral cuttings under the short photoperiod conditions. Plants were grown in two separate two-factor trials, set up according to the randomized block scheme. Statistical analysis was performed by the standard least squares method for general linear models. Plants grown from top cuttings with the application of 4000 mgl^{-1} daminozide were on average 8.6% (1992) and 9.3% (1993) lower than untreated plants, while there were no significant differences in height in the last trial year. No significant differences in height were recorded in plants grown from lateral cuttings. Daminozide application had no notable influence on plant diameter reduction, with the exception of the last trial year in plants grown from lateral cuttings when the plants from trial combinations without daminozide had 19.5% larger diameters that those treated with 4000 mgl^{-1} of daminozide. A stronger effect on plant diameter was that of topdressing with liquid mineral fertilizer, so the diameter of plants grown from top cuttings was by 6.6% larger in 1993, and by 16% larger in the last trial year compared to unfertilized plants. The results point to the conclusion that daminozide and topdressing have no influence on the height of plants grown from lateral cuttings in the short photoperiod conditions, and that their application for growth regulation is questionable, and in the case of this trial unjustified. Plants of approximately equal height and diameter can be obtained from both cutting types.

Keywords: *Aster novae-angliae*, daminozide, topdressing, short photoperiod

INTRODUCTION

Aster novae - angliae L., New England aster is a perennial grown as a pot plant or for cutting. The plant's ability to respond to different day lengths as well as the abundance of shapes and colors of its flowers make aster an interesting species, available throughout the year, so it is considered a promising species for flower production (N o r d e g r a a f, 1993). Since many cultivars of this species are too high to be grown in containers, reduction of vegetative growth is very important, as it is also for most plant species intended for pot plant production. Growth regulation is especially applied to species that are grown for flowers (A n d e r s e n and A n d e r s e n, 2000). It is possible to reduce plant height by applying growth retardants, at the same time enhancing the intensity of leaf green color and producing plants of uniform spherical shape (W h i p k e r et a l, 1994). Balanced nutrition has an important role in the production of flowering pot plants; however, only orientation values of nutrient requirements are available for the majority of ornamental species (H e r s h e y and P a u l, 1981; F i n c k, 1982; K i n g et a l., 1995). To achieve the desired size, aster is grown in the conditions of 14 to 16 hours of daylight, whereafter flowering is stimulated by shortening the daylight period to the lower limit of 10 hours.

Influence of growth retardants and topdressing upon the height and diameter of New England aster grown in the short photoperiod conditions from two types of cuttings – top and lateral, and the difference in the studied traits between plants grown from top and lateral cuttings were the subject of this research.

MATERIALS AND METHODS

Aster novae - angliae 'September Ruby' is a perennial of erect, ramified growth, up to 1.2 m high, with sharp, lance-shaped leaves covered with fine hairs. Effects of growth retardants and fertilizer application on the growth and flowering of potted New England aster cv. 'September Ruby' in the short photoperiod conditions were investigated in the period from 1992 to 1994 in the experimental garden of the Department of Ornamental Plants and Landscape Architecture in Zagreb. Lateral and top cuttings, 10 cm long, were rooted in cold frames in June of each year. Three weeks after rooting, cuttings were transplanted into a mixture of loamy soil and peat (3:1) in 300 ml plastic pots (one cutting per pot), which were then disposed on an asbestos board.

Ten days after planting and rooting, plants were decapitated, and another ten days later they were sprayed with a 2000 or 4000 mg/l solution of daminozide (Alar 85). 10 ml of this solution was applied to each plant.

Pre-planting substrate analysis determined a sufficient amount of nutrients, so no fertilizer was added at planting. Topdressing was applied two times with 0.01 l per plant of a 1.5% solution of liquid mineral fertilizer. The first

topdressing was applied 20 days after planting into pots, and the second followed 14 days later. In this way, 39.6 mg N, 59.94 mg P_2O_5, and 79.92 mg K_2O was added per 1 liter substrate.

The combinations were:

H_0G_0 = control;
H_0G_1 = 1.5% solution of liquid mineral fertilizer;
H_1G_0 = solution of 2000 mgl^{-1} daminozide;
H_1G_1 = solution of 2000 mgl^{-1} daminozide +1.5% solution of liquid mineral fertilizer;
H_2G_0 = solution of 4000 mgl^{-1} daminozide;
H_2G_1 = solution of 4000 mgl^{-1} daminozide + 1.5% solution of liquid mineral fertilizer.

In the fourth week after planting, plants started to be exposed to a cycle of 10 daylight hours and 14 hours of darkness throughout five weeks. The total number of light hours from planting to the end of covering was 753 hours.

Plants were grown in two separate two-factor trials, set up according to the randomized block scheme, in five replications, with 6 combinations of 16 plants each. Data obtained by measuring the plant height and diameter was processed by the analysis of variance per trial years. Height was measured from the pot rim to plant top, and the diameter was measured on the most branched part of the plant. Statistical analysis of interactive relations for the studied traits and years was done by the standard least squares method for general linear models, using the GLM procedure (SAS/STAT User Guide, 1990). Since the plants grown from lateral and top cuttings were not randomized within the same trial, they were compared using the t-test between two mean values of their relevant samples.

RESULTS

Growth results are presented first for the height and then for the diameter. Of plant traits, results for top cuttings are given first, and then those for lateral cuttings, starting from 1992 to 1994.

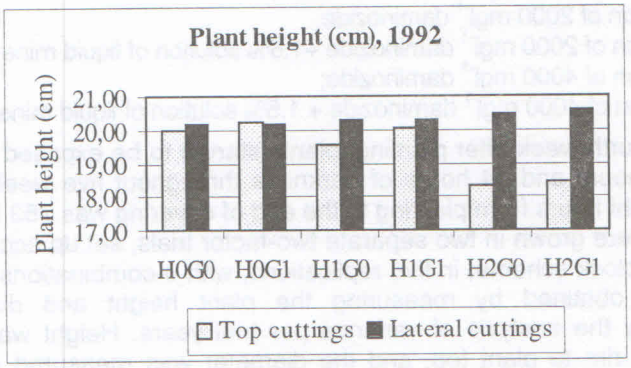
Height of plants grown from top cuttings was significantly influenced by daminozide application. In 1992, the smallest shoot length was recorded in trial variants treated with 4000 mgl^{-1} daminozide, the shoots being 8.6% lower than trial variants without daminozide application, $^{**}P<0.01$. Variants treated with 2000 mgl^{-1} daminozide were shorten than the untreated ones, but the difference was not significant. Similar results were obtained in 1993 – significantly shorter shoots were recorded in variants treated with 4000 mgl^{-1} daminozide than in untreated variants, $^{**}P<0.01$. A difference was also determined between variants treated with 4000 mgl^{-1} and 2000 mgl^{-1} daminozide, $^{*}P<0.05$. There were no significant differences in height in 1994.

Plants grown from lateral cuttings in the same period did not display any significant difference in height. Figure 1 gives the average height values for the plants grown per combinations (Figure 1.)

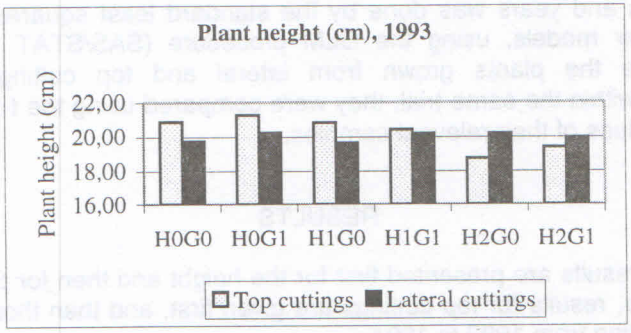
Figure 1. Average heights of Aster novae-angliae *plants per combinations and comparison of average height values between plants grown from top and from lateral cuttings in 1992 (a), 1993 (b), 1994 (c).*

Grafikon 1. Prosječne vrijednosti visine biljaka Aster novae-angliae *po kombinacijama i usporedba prosječnih vrijednosti za visinu između biljaka dobivenih iz vršnih i postranih reznica u 1992. (a), 1993. (b), 1994. (c) godini.*

(a)



(b)



(c)

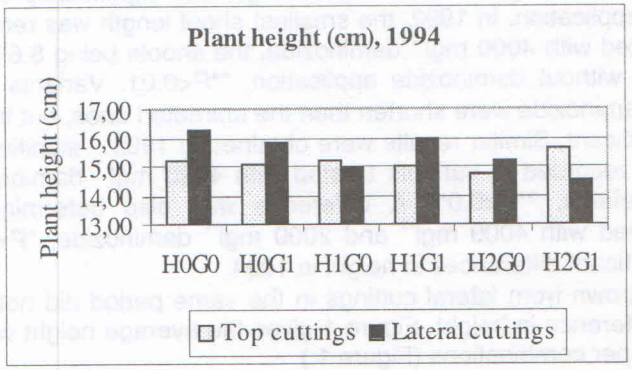
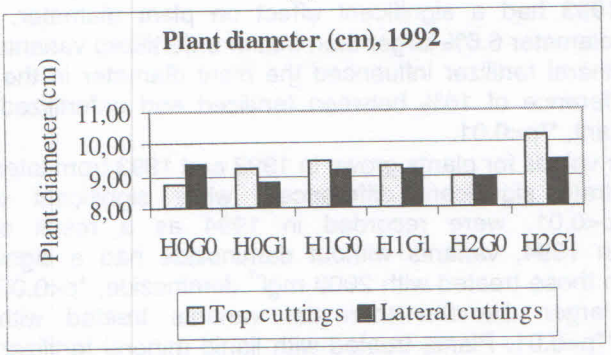


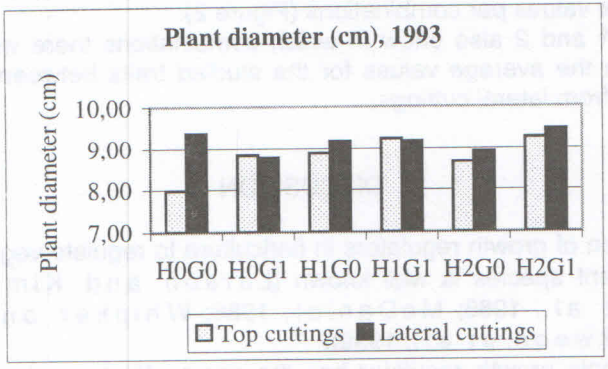
Figure 2. Average diameters of Aster novae-angliae *plants per combinations and comparison of average diameter values between plants grown from top and from lateral cuttings in 1992 (a), 1993 (b), 1994 (c).*

Grafikon 2. Prosječne vrijednosti za promjer biljaka Aster novae-angliae *po kombinacijama i usporedba prosječnih vrijednosti za promjer između biljaka dobivenih iz vršnih i postranih reznica u 1992. (a), 1993. (b), 1994. (c) godini.*

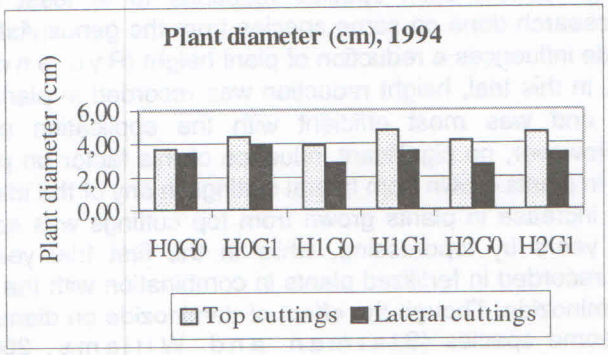
(a)



(b)



(c)



Analysis of variance determined a statistically significant difference in the interaction of the growth retardant and fertilizer application factors for 1992, *P<0.05. The largest diameter in plants grown from top cuttings was achieved when plants were treated with 4000 mgl^{-1} daminozide in combination with fertilizer application, and similar diameter values were recorded in plants treated with 2000 mgl^{-1} daminozide without fertilizer. Topdressing with liquid mineral fertilizer in 1993 had a significant effect on plant diameter, *P<0.05, and resulted in a diameter 6.6% larger than that of unfertilized variants. Topdressing with liquid mineral fertilizer influenced the plant diameter in the last trial year when the difference of 16% between fertilized and unfertilized variants was highly significant, **p<0.01.

Diameter values for plants grown in 1992 and 1993 from lateral cuttings did not demonstrate significant differences, while significant differences in diameter, **p<0.01, were recorded in 1994 as a result of daminozide application. In 1994, variants without daminozide had a significantly larger diameter than those treated with 2000 mgl^{-1} daminozide, *p<0.05, and a highly significantly larger diameter than the variants treated with 4000 mgl^{-1} daminozide, **p<0.01. Plants treated with liquid mineral fertilizer had a 21.3% larger diameter than unfertilized plants, **p<0.01. Figure 2 gives the average plant diameter values per combinations (Figure 2).

Figures 1 and 2 also show in which combinations there were significant differences in the average values for the studied traits between plants grown from top and from lateral cuttings.

DISCUSSION

Application of growth regulators in floriculture to regulate vegetative growth of various plant species is well known (Larson and Kimmins, 1972; Barrett et al., 1986; McDaniel, 1986; Whipker and Dasoju, 1998; Yongkweon et al., 1999).

Not a single growth regulator has the same effect on plant height in all species, though almost each species responds to at least one chemical substance. Research done on some species from the genus *Aster* has proven that daminozide influences a reduction of plant height (Ryu and Lee, 1993) and diameter. In this trial, height reduction was recorded in plants grown from top cuttings, and was most efficient with the application of 4000 mgl^{-1} daminozide. However, no significant influence of this factor on plant reduction was recorded in plants grown from lateral cuttings in any of the trial years.

Diameter increase in plants grown from top cuttings was achieved in the last two trial years by topdressing, while in the first trial year the largest diameter was recorded in fertilized plants in combination with the application of 4000 mgl^{-1} daminozide. Though the effect of daminozide on diameter reduction is known in some species (Starman and Wiliams, 2000), including

those from the genus *Aster* (Whipker et al, 1995), no influence of this factor on the diameter trait was recorded in plants grown from lateral cuttings in the first two trial years, while a significant diameter reduction resulting from daminozide application was established only in 1994. The mentioned diameter reduction was not desired in the last trial year because of the unfavorable height to width ratio that affects the esthetic appearance of plants. The height to width ratio of plants was 1:3.6 in 1994 for plants grown from top cuttings and 1:4.8 for those grown from lateral cuttings. Diameter increase resulting from topdressing was also recorded in the same year, which can be regarded as a desirable effect.

Application of daminozide and/or fertilizer influenced both of the studied traits of plants grown from top cuttings in 1992 and 1993, and the diameter in the last trial year. Neither of the factors influenced the studied traits of the plants grown from lateral cuttings in the first two trial years. Comparison of the effects of daminozide and topdressing on the studied traits in plants grown from top and from lateral cuttings revealed that the influence of the studied factors was less expressed in plants grown from lateral cuttings, which particularly holds for plant height. The obtained results allow the conclusion that the use of daminozide and topdressing have no influence on the height of plants grown from lateral cuttings in the short photoperiod conditions, and that their application for growth regulation is questionable, and in the case of this trial unjustified.

Comparison of the average values of the studied traits between plants grown from top and from lateral cuttings indicates that the differences in height and diameter were not significant in most combinations. To be more precise, there were no significant differences in plant diameter and height in the first two trial years in any combination, except for H_2G_0 in 1992, while in the last trial year there were differences in average heights in 2 combinations (H_0G_1 and H_1G_1) and in diameter in 3 combinations (H_1G_0, H_1G_1 and H_2G_0). Comparison of the average values of the studied traits between plants grown from top and from lateral cuttings points to the conclusion that plants of approximately equal height and diameter, that is, growth compactness, can be grown from both types of cuttings – top and lateral.

CONCLUSION

Height of plants grown from top cuttings was most efficiently reduced by the application of 4000 mgl^{-1} solution of daminozide, whereas no significant influence of either factor on height reduction was recorded in plants grown from lateral cuttings.

Diameter increase in plants grown from top cuttings in the last two trial years was a result of topdressing, and in the first trial year of the combination of 4000 mgl^{-1} daminozide and fertilizer. No influence of the factors on plant

diameter was recorded in plants grown from lateral cuttings in the first two years, while a significant diameter decrease was induced by daminozide application and a diameter increase by topdressing in 1994.

As the effects of daminozide and topdressing upon plant height and diameter were less expressed in plants grown from lateral cuttings and had no influence on the height of plants grown from lateral cuttings in the short photoperiod conditions, their application for height and diameter reduction does not serve the set purpose.

No differences in plant height and diameter between plants grown from top and from lateral cuttings were recorded in most combinations.

UTJECAJ DAMINOZIDA I GNOJIDBE NA VISINU I PROMJER ULONČENOG OŠTROLISNOG ZVJEZDANA U UVJETIMA SKRAĆENOG FOTOPERIODA

SAŽETAK

Bogatstvo cvatnje i habitualnih značajki čini trajnice sve više interesantnim u uzgoju lončanica. Kako je proizvodnja većine cvatućih lončanica nezamisliva bez regulacije rasta, u razdoblju 1992.-1994., provedena su istraživanja utjecaja daminozida (Alar 85) primijenjenog u dvije koncentracije (2000 mgl^{-1}, 4000 mgl^{-1}) i prihrane s tekućim mineralnim gnojivom (Fertina C) u koncentraciji 1,5% na svojstva visine i promjera ulončenog oštrolisnog zvjezdana *Aster novae-angliae* 'September Ruby' uzgojenog iz vršnih i postranih reznica u uvjetima skraćenog fotoperioda. Biljke su uzgajane u dva odvojena dvofaktorijelna pokusa postavljena po slučajnom bloknom rasporedu. Statistička analiza provedena je standardnom metodom koja se temelji na procjeni najmanjeg kvadrata za uopćene linearne modele. Biljke uzgojene iz vršnih reznica uz primjenu 4000 mgl^{-1} daminozida bile su 1992. godine u prosjeku 8,6%, a 1993. godine 9,3% niže od netretiranih biljaka, dok u zadnjoj godini nije bilo signifikantnih razlika u visini. Primjena daminozida ne utječe znatno na smanjenje promjera biljaka, sa izuzetkom zadnje godine pokusa kod biljaka uzgojenih iz postranih reznica kada su kombinacije bez primjene daminozida imale promjer 19,5% veći od tretiranih sa 4000 mgl^{-1} daminozida. Veći utjecaj na svojstvo promjera ima prihrana tekućim mineralnim gnojivom pa je promjer biljaka dobivenih iz vršnih reznica u 1993. godini bio 6,6% veći, a u zadnjoj godini 16% veći nego kod negnojenih biljaka. Temeljem dobivenih rezultata može se reći da uporaba daminozida i prihranjivanja nema utjecaja na visinu iz postranih reznica uzgojenih biljaka u uvjetima skraćenog fotoperioda,

te da je njihova uporaba u svrhu reguliranja rasta upitna, a u slučaju ovog pokusa neopravdana. Biljke podjednake visine i promjera mogu se dobiti iz oba tipa reznica.

Ključne riječi: *Aster novae-angliae,* daminozid, prihranjivanje, skraćeni fotoperiod

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