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Residual Efficacy of Uniconazole and Daminozide on Potted 'Bright Golden Anne' Chrysanthemum

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Abstract. **Residual activity of a single uniconazole spray (15 mg a.i./liter), uniconazole drench (600 µg a.i./pot), and daminozide spray (5000 mg a.i./liter) were compared to an untreated control using the 'Bright Golden Anne' chrysanthemum *[Dendranthema grandiflorum* (Ramat.) Kitamura]. Based on weekly internode growth, spray and drench treatments with daminozide and uniconazole remained active for 2 to 2.5 and 3 to 3.5 weeks, respectively. Chemical names used: butanedioic acid mono (2,2-dimethylhydrazide) (daminozide); (E)-1-(p-chlorophenyl)-4,4-diemethyl 1-2(1,2,4-triazol-2-yl)-l-penten-3-01 (uniconazole).**

Uniconazole is a relatively new, potent, but as of yet unregistered plant growth regulator (PGR). Davis et al. (1988) noted that triazoles, the class of PGRs to which uniconazole belongs, are more effective at lower concentrations than others, such as daminozide and chlormequat chloride. A single spray of uniconazole at 20 mg a.i./liter applied to diverse species of flowers and a single 6.25 mg a.i./liter spray applied to *Cathranthus roseus* were as effective or more so than two 5000 mg a.i./liter daminozide spray applications (Barrett and Nell, 1986, 1987). Uniconazole at 15 or 20 mg a.i./liter caused a retardation similar to chlormequat chloride at 3500 mg a.i./liter on dwarf potgrown carnation *(Dianthus calyophyllus* L.) (Pobudkiewicz and Goldsberry, 1989). A single uniconazole spray at 20 mg a.i./liter or two sprays at 10 mg a.i./liter provided control equivalent to two daminozide sprays at 2500 mg a.i./liter on potted chrysanthemum cultivars Puritan and Favor (Starman, 1990). Unspecified chrysanthemum cultivars treated with a single spray application of uniconazole at 10 mg a.i./liter were similar in height to plants sprayed three times with daminozide at 2500 mg a.i./liter (Wilfret, 1988). These studies attest to the potency of uniconazole. There is, however, a lack of published information regarding duration of efficacy. Our observations indicate that uniconazole, at concentrations used in this study and proposed on the label for commercial use, not only retards potted chrysanthemum stem elongation initially more strongly than daminozide, but also has longer residual activity. An experiment was established to test these observations.

'Bright Golden Anne' (BGA) chrysanthemum rooted cuttings were planted one per 1.2-liter (14 cm) pot filled with Metro-Mix 350 (Grace/Sierra and Co., Fogelsville, Pa.) on 14 Mar. 1989. Cuttings were triple-irrigated with tap water to ensure good root/growing medium contact, topdressed with Osmocote 19N-2.6P-11.6K (Grace/Sierra and Co.) at 4 g/pot, and placed under intermittent mist with a night time minimum of 21C. Plants were removed from the mist and placed in a glasshouse with a night minimum of 17C on 21 Mar. Throughout the study, plants were maintained under long-day conditions (incandescent light 10:00 PM to 1:00 AM). Single spray or drench PGR treatments were applied when roots reached the sides and bottom of the pot and 2 to 4 cm of new stem growth was evident (30 Mar.). Sprays were applied at 204 ml·m^{-2} of bench area, or ≈3 ml/plant. The drench was applied as 120 ml of solution per 1.2-liter pot. Plant measurements taken initially and weekly thereafter for 5 weeks were height above the pot rim, internode number (counting from the base of the plant to the internode nearest the terminal that was at least 1 cm long), and length of each internode. The length of the four apical internodes was averaged for data analyses and presentation. The study was terminated at' the end of the 5th week because crown buds were visible. There were four treatments: untreated control, daminozide spray at 5000 mg a.i./liter (≈15 mg a.i./plant), uniconazole drench at 600 µg a.i./pot, and uniconazole spray at 15 mg a.i./liter (≈45 µg a.i./plant). Each treatment was replicated three times (i.e., three samples or statistical observations) with six plants (subsamples) per replicate. This yielded a mixed two-factor design-treatment × (time × rep)-with treatment as the "between-measures" factor and time as the "within-measures" or repeated-measures factor. In addition to analysis of variance, omega squared was calculated for the main and interaction effects to provide a measure of the proportion of the total variance attributable to each effect. Finally, LSD values (P = 0.05) based on significant interactions were calculated to allow mean comparisons.

The study was repeated beginning 28 Mar., and again 11 Apr. The results of the second and third trials were the same through week 4 as those obtained in the first trial. Crown bud development became evident at that point so studies were then terminated. Conse-

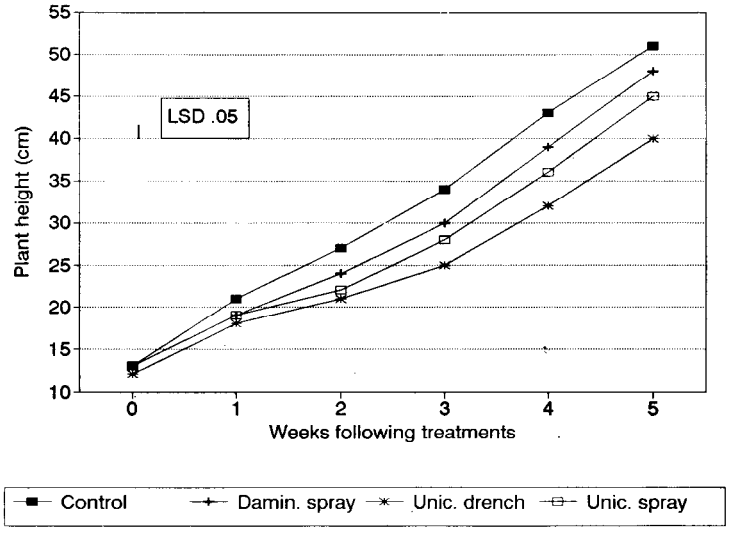

Fig. 1. Change in total plant height of 'Bright Golden Anne' chrysanthemum treated with growth regulators. The F test yielded a significance level for each main effect and the interaction at P = 0.001. Omega squared values (a measure of the proportion of the total variance attributable to the main and interaction effects) for each effect were as follows: treatment = 0.041, time = 0.938, and interaction = 0.015. The $LSD_{0.05}$ value for the interaction is 1.51. Plants were treated week 0.

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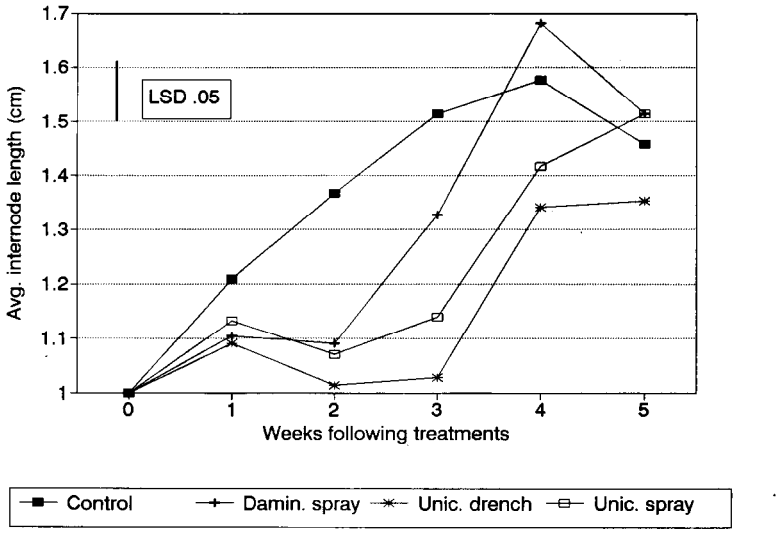

Fig. 2. Average lengths of the four apical internodes [(Internode, + . . . + Internode$_4$)/4] of 'Bright Golden Anne' chrysanthemum treated with growth regulators. The F test yielded a significance level for each main effect and the interaction at $P = 0.001$. Omega squared values for each effect were as follows: treatment = 0.213, time = 0.569, and interaction = 0.117. The $LSD_{0.05}$ value for the interaction is 0.11.

quently, only results from the first trial are presented.

Significant PGR treatment and interaction effects for plant height revealed that single PGR applications effectively, but differentially, retard stem elongation. All plants were essentially the same height at the beginning of the study but elongated at different rates in response to PGR activity. At the conclusion of the study, all PGR-treated plants (Fig. 1) were shorter than control plants, with uniconazole-drenched plants exhibiting the most profound growth retardation (22%), followed by those sprayed with uniconazole (12%) or daminozide (5%).

Plants averaged between four and five new internodes per week. An average length of the four apical internodes, therefore, provided a relative measure of PGR efficacy from week to week. Average internode length among the three PGR treatments remained similar during the first 2 weeks following application (Fig. 2). By the end of the 3rd week, however, they were evident. Terminal internodes of daminozide-treated plants, though shorter than those of control plants, were significantly longer than internodes of daminozide-treated plants of the previous week. Clearly, daminozide lost efficacy in this study between weeks 2 and 3. There was no difference in average internode length between weeks 2 and 3 for either uniconazole treatment, and plants in both were shorter than those treated with daminozide. During week 4, efficacy of uniconazole spray and drench treatments weakened. Terminal internodes of plants from both uniconazole treatments were significantly longer than those of the previous week, although both were shorter than the control. At the end of the final week, none of the PGR treatments differed significantly from the control.

There was a significant difference in the number of internodes among treatments (results not shown). However, this was not interpreted to indicate that PGR treatments reduced the number of nodes produced. Although the treatment effect was significant, it contributed < 1% of the total variance observed in internode number compared to >98% for the time effect. The data reflect a count of internodes that were 1 cm or longer. Internodes at and subtending the stem apices were shorter than 1 cm and therefore were not counted. Rather than reduce the number of internodes, PGR treatments slowed the rate of elongation of the young apical internodes, thereby reducing the number of internodes counted.

In this study, daminozide and uniconazole provided similar initial control of stem elongation. A single daminozide spray at 5000 mg a.i./liter effectively limited internode elongation of BGA chrysanthemum for 2 to 2.5 weeks, and uniconazole spray (15 mg a.i./liter) and drench (600 kg a.i./pot) treatments for 3 to 3.5 weeks. Uniconazole spray and drench treatments do have the potential of providing longer residual activity from a single application than daminozide. Differences in cultivar sensitivity need to be evaluated. Wilfret (1988) reported that chrysanthemum cultivars Circus, Fiesta, and Cirbronze were sensitive to a single application of uniconazole at 10 mg a.i./liter, while 'Stoplight' required 60 mg a.i./liter. It appears that as relative cultivar sensitivity to uniconazole varies, residual efficacy may change.

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