HORTSCIENCE 29(8):893–895. 1994.

Application Techniques Alter Uniconazole Efficacy on Chrysanthemums

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Additional index words. Dendranthema ×grandiflorum, growth regulators, daminozide

***Abstract*. Four experiments using container-grown *Dendranthema ×grandiflorum* (Ramat.) Kitamura 'Nob Hill' or 'Tara' were conducted to determine effects of application site and spray volume on uniconazole efficacy. Uniconazole applied only to mature leaves was less effective in controlling stem elongation than were stem applications, whole-plant sprays, or medium drenches. Spray volume altered efficacy more for uniconazole than for daminozide. Also, the effect of uniconazole spray volume was greater when the medium was not covered than when covered to prevent spray solution entering medium. Results from these studies showed the efficacy of uniconazole increased with increased stem coverage andwith amount of chemical reaching the medium, which was achieved with high spray volumes. Chemical names used: (E)-1-(p-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl-1-penten-3-ol) (uniconazole); butanedioic acid mono (2,2-dimethylhydrazide) (daminozide).**

β-[(4-chlorophenyl)methyl]-α-(1,1-dimethylethyl)-1*H*-1,2,4-triazole-1-ethanol (paclobutrazol) and uniconazole are triazoles that control growth of chrysanthemum and other floriculture crops, but uniconazole has greater activity (Barrett and Nell, 1989, 1990). Spray application techniques were shown to have greater influence on efficacy of paclobutrazol than on efficacy of daminozide, which had been most commonly used commercially on chrysanthemums (Barrett and Nell, 1990). When growers began to use paclobutrazol on floriculture crops, many had difficulty obtaining uniform plant size because of its greater efficacy and because of the importance of application procedures (Barrett, 1987). Paclobutrazol was reported to be more effective when applied only to chrysanthemum stems or to medium than when applied to only to leaves (Barrett and Bartuska, 1982). High spray volumes, which would result in more thorough coverage of plant stems and greater solution entering the medium, increased the efficacy of paclobutrazol (Barrett and Nell, 1990). Also, that work found paclobutrazol spray treatments had greater efficacy when the medium was not covered than when covered, indicating the importance of spray solution acting as a medium drench.

Like paclobutrazol, uniconazole moves only in the xylem and does not move out of leaves (Davis et al., 1988). This feature indicates that spray application techniques are important with uniconazole also; however, this potential has not been adequately investigated. Bailey (1989) reported that uniconazole spray volume was not a factor when concentration was varied to give the same active ingredient per plant. Gilbertz (1992) demonstrated that paclobutrazol and uniconazole had greater efficacy if applied soon after pinching, when there would be less leaf coverage of the medium, compared to later applications.

Received for publication 30 Sept. 1993. Accepted for publication 2 Mar. 1994. Florida Agricultural Journal Series no. R-02976. Funding for this research was provided by Valent and Bedding Plants Foundation, and plant material was provided by Yoder Brothers. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

Materials and Methods

We examined the effects of spray volume, timing, and application site on uniconazole efficacy for reducing growth of chrysanthemums. Four experiments were conducted using rooted cuttings planted in Vergro Klay Mix (Verlite Co., Tampa, Fla.). This medium does not contain pine bark, which reduces efficacy of triazole drench treatments (Barrett, 1982). Plants were fertilized at every watering with N at 300 mg·liter^{-1} from a 20N–4.8P–16K soluble fertilizer. Noninductive photoperiods were provided with incandescent lamps from 2200 to 0200 HR. Photoinductive periods were provided by pulling black cloth over plants from 1700 to 0800 HR.

In Expts. 1, 2, and 3, 'Nob Hill' was grown as single-stem, vegetative test plants as described by Barrett and Nell (1990). Data included plant height (from top of pot rim to top of foliage) at time of treatment and 3 to 4 weeks after treatment. Stem elongation was then determined as the difference between initial and final plant height. In Expt. 4, 'Tara' was grown in typical commercial style for flowering potted chrysanthemums, and only final plant heights were determined. All experiments were in a randomized complete-block design with four replications of two or three plants per experimental unit and included nontreated control plants.

Site of application (Expt. 1). 'Nob Hill' planted one per 12-cm (1.1-liter) pot were not pinched and were kept vegetative under noninductive photoperiods. Fifteen days after planting, uniconazole was applied by medium drench (0.2 mg/pot in 90 ml of water), whole-plant spray (20 mg·liter^{-1}, spray volume 0.2 liter·m^{-2}), painting the stem (20 mg·liter^{-1}), or painting the fully developed leaves (20 mg·liter^{-1}), as described by Barrett and Bartuska (1982).

Volume of spray (Expt. 2). 'Nob Hill' cuttings were planted and grown as described in Expt. 1. A factorial experiment was established using two chemicals (uniconazole at 20 mg·liter^{-1} vs. daminozide at 5000 mg·liter^{-1}) and four spray volumes (0.1, 0.2, 0.3, or 0.4 liter·m^{-2}).

Importance of drench (Expt. 3). 'Nob Hill' cuttings were planted and grown as in Expt. 1. A 4 × 2 × 2 factorial was set up using four spray volumes (0.1, 0.2, 0.3, or 0.4 liter·m^{-2}), two medium treatments (covered, to prevent spray from entering medium, vs. uncovered), and two drench applications (0 mg vs. 0.015 mg/pot). Before the drench application the medium cover was removed. Plants were treated 18 days after planting, and plant height was recorded 22 days after treatment.

Concentration and volume (Expt. 4). 'Tara'

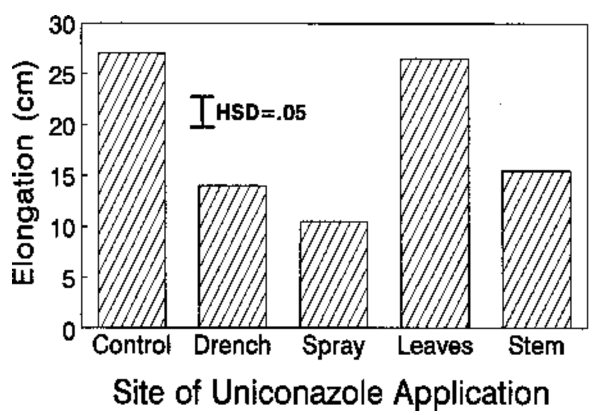

Fig. 1. Comparison of uniconazole efficacy based on site of application on vegetative 'Nob Hill' chrysanthemum. Drench amount was 0.2 mg/pot. Spray, leaf, and stem treatments were made using a 20-mg·liter^{-1} solution.

planted 5 per 15-cm (1.5-liter) pot were placed initially under noninductive photoperiods from 1 until 14 Mar., pinched on 13 Mar., and then placed under photoinductive periods from 14 Mar. to flowering. A 4 × 2 × 2 factorial was established with four spray volumes (0.1, 0.2, 0.3, or 0.4 liter·m^{-2}), two uniconazole spray concentrations (5 vs. 10 mg·liter^{-1}), and two spray times (10 vs. 20 days from time of pinch). Plant height was recorded on 18 Apr.

Results and Discussion

Site of application. Uniconazole applied only to mature leaves did not reduce stem elongation, while all other uniconazole treatments did (Fig. 1). Elongation was slightly less for plants given a whole-plant spray compared to uniconazole applied to stems only. These results are consistent with previous observations on paclobutrazol (Barrett and Bartuska, 1982).

Volume of spray. There was a two-way interaction between chemical and spray volume, indicating that spray volume had more effect on stem elongation with uniconazole than with daminozide (Fig. 2). Daminozide is not active through the medium (personal observation) but is readily translocated from leaves. Once leaves and stems were covered, additional daminozide spray had little additive effect. However, uniconazole is poorly translocated from leaves, and low volumes presumably did not adequately cover stems. Higher spray volumes increased stem coverage and provided more chemical runoff into the medium, resulting in greater uptake by roots.

Importance of drench. The two-way interactions between spray volume and medium cover and between spray volume and soil drench were significant (Fig. 3). There was little difference in elongation between plants with and without covered medium at the lowest spray volume (0.1 liter·m^{-2}), when little solution would reach the medium (Fig. 3A). With higher volumes, however, the plants without cover were shorter than those with cover. Also, plants receiving a medium drench had less stem elongation than those not receiving a drench, but the effect of the drench was greater at lower spray volumes (Fig. 3B). These results indicate that uniconazole reaching the medium in spray applications, even at the volume (0.2 liter·m^{-2}) commonly recommended for commercial applications and used in trials to establish optimum concentrations, produces an effect on plant growth.

Concentration and volume. The only significant interaction was between uniconazole spray volume and concentration on these flowering plants (Fig. 4). As with the trials on vegetative plants, higher spray volumes resulted in shorter plants. However, there was little difference in final height of plants given either 5 or 10 mg·liter^{-1} at the lowest spray volume, and the difference between concentrations increased with higher volumes.

Time of application was not significant in this study, which is in contrast to findings on chrysanthemums by Gilbertz (1992) and on petunias (*Petunia hybrida* Vilm.) by Edstrom

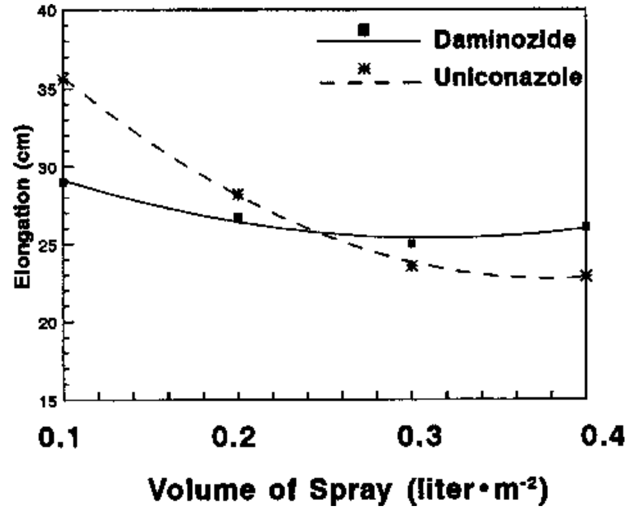

Fig. 2. Interaction of spray volume and growth retardant chemical on vegetative 'Nob Hill' chrysanthemum stem elongation. Points are means of 12 plants at each level. n = 48. The spray volume × chemical interaction was significant at $P = 0.0001$. Equations for the response curves are daminozide: 33.48 – 52.00(v) + 83.33(v^2), $r^2 = 0.15$; and uniconazole: 46.62 – 125.7(v) + 165.4(v^2), $r^2 = 0.71$.

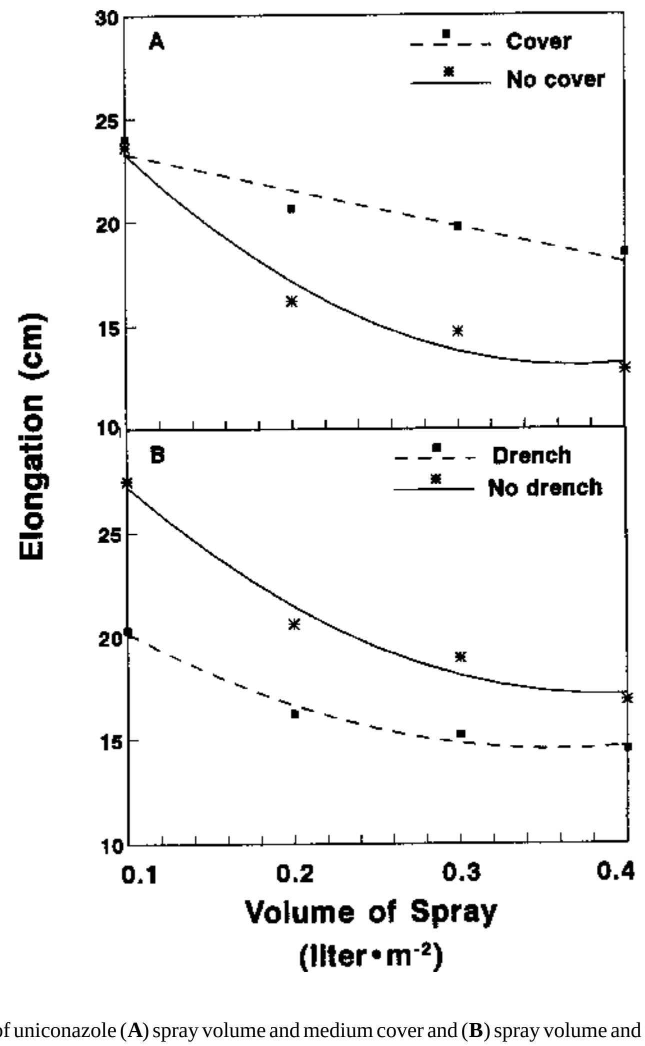

Fig. 3. Effect of uniconazole (**A**) spray volume and medium cover and (**B**) spray volume and medium drench on vegetative 'Nob Hill' chrysanthemum stem elongation. Points are means of 24 plants at each level. n = 96. The spray volume × medium cover × medium drench interaction and the medium cover × medium drench interaction were nonsignificant at $P = 0.05$. The spray volume × medium cover interaction and spray volume × medium drench interaction were significant at $P = 0.0002$ and $P = 0.0016$, respectively. Equations for the response curves are (**A**) cover: 25.125 – 17.854(v), $r^2 = 0.22$; no cover: 32.235 – 103.47(v) + 139.5(v^2), $r^2 = 0.53$; (**B**) drench: 25.391 – 60.62(v) + 84.55(v^2), $r^2 = 0.34$; no drench: 35.379 – 93.76(v) + 120.5(v^2), $r^2 = 0.48$.

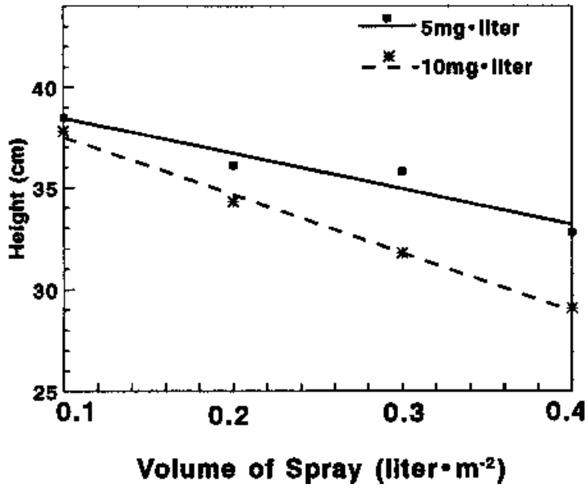

Fig. 4. Effect of uniconazole spray volume and concentration on the height of flowering 'Tara' chrysanthemum. Points are means of 16 plants at each level. n = 64. The time × concentration × spray volume interaction was nonsignificant at $P = 0.05$. The concentration × spray volume interaction was significant at $P = 0.0037$. Equations for the response lines are 5 mg: 40.20 – 17.51(v), $r^2 = 0.48$; 10 mg: 40.34 – 28.47(v), $r^2 = 0.69$.

et al. (1993). The previous reports indicated that as plants become larger, more spray is intercepted by leaves and efficacy is reduced. Wilfret (1991, 1992) observed that uniconazole had less efficacy on chrysanthemum cultivars with more dense foliage.

Results of our studies reveal that uniconazole is similar to paclobutrazol with regard to spray volume (Barrett and Bartuska, 1982) and medium cover (Barrett and Nell, 1990) in that these factors alter the efficacy of spray applications. Uniconazole efficacy increased as the amount of chemical reaching the stem, medium, or both was increased. This finding agrees with Davis et al.'s (1988) contention that uniconazole is translocated acropetally through the xylem and does not translocate from leaves. The amount of uniconazole reaching stems, medium, or both is increased with high spray volumes.

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