Uniconazole Retards Growth and Increases Flowering of Young Macadamia Trees

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Abstract. Uniconazole (0.2 g a.i. per cm trunk diameter) was applied as a soil drench to 2-year-old potted macadamia (*Macadamia integrifolia* Maiden & Betcher) trees, and reapplied yearly for 4 additional years. Uniconazole significantly reduced tree height and trunk diameter 1 year after initial treatment, and suppressed shoot extension for the duration of the study. It significantly increased flowering the second year after initial treatment, the first year that both the control and treated trees flowered. Subsequently, no differences in flowering were observed until the fifth year, when flowering was significantly less in treated trees, probably due to reduced shoot and trunk growth and tip dieback. Chemical name used: E-1-(p-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazole-1-penten-3-ol) (uniconazole).

Strategies to control size and increase precocity of trees are critical in the production of orchard crops such as macadamia. No dwarfing rootstocks for macadamia are available, and little pruning is practiced to control tree size, except to develop a vertical central leader and thin out branches that interfere with movement of machinery in the orchard.

Macadamia trees usually begin bearing at 4 years after transplanting, but economic yields are not realized until 6 to 7 years (Keeler and Fukunaga, 1968), and full production may not be attained until 11 years (Nagao and Hiraie, 1992). Racemes are produced predominantly during the spring on 2-year-old branches that developed from previous spring and fall flushes (Nagao et al., 1994). Fruits mature at 30 weeks after anthesis when they abscise and are harvested from the orchard floor (Sakai and Nagao, 1985).

Triazoles, in particular, paclobutrazol [(2RS, 3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)pentan-3-ol] and uniconazole, retard shoot elongation and reduce shoot length in many orchard crops, and can hasten and/or increase flowering (Davis and Curry, 1991; Davis et al., 1988; Facticeau and Chestnut, 1991; Miller, 1988; Wilkinson and Richards, 1991; Zimmerman and Steffens, 1995). The objective of this study was to

evaluate the effects of uniconazole drenches on the growth and flowering of young potted macadamia trees.

Two-year-old grafted 'Kau' macadamia trees were planted in 37-cm-diameter (49-L) plastic pots containing 2 perlite : 1 Fisons Sunshine Mix (Vancouver, B.C.) (by volume). The medium was drenched with uniconazole to provide 0.2 g a.i. per cm trunk diameter. A solution of uniconazole (2.0 L) was applied to each tree in July 1990, Aug. 1991, Aug. 1992,

Sept. 1993, and Sept. 1994. Flowering, tree height, and trunk growth were monitored for 5 years. Tree height was measured from the surface of the medium and trunk diameter taken at 13.0 cm above the medium. At initial treatment, the mean trunk diameter was 2.9 ± 0.3 cm, and mean tree height was 159.1 ± 16.1 cm. Trees were repotted into fresh medium in 50-cm (75-L) plastic pots in July 1993, kept in the open in Hilo, Hawaii, for the duration of the study, and irrigated and fertilized as necessary. Experimental units consisted of five single-tree replicates arranged in a randomized complete-block design. Data were analyzed by analysis of variance, and the *t* test was used to compare means (SAS Institute, Cary, N.C.).

A reduction in shoot elongation was observed in flushes emerging at 6 months after treatment. Height and trunk diameter of the treated trees were significantly reduced by uniconazole 1 year after initial treatment (Fig. 1 A and B). Shoot extension was almost totally suppressed for the duration of the study; dieback of some shoot tips was observed in the treated trees in 1995. Cupping of the leaf lamina was observed on flushes affected by uniconazole and was consistent with observations reported on plants treated with high rates of paclobutrazol (Davis et al., 1988).

Uniconazole treatment significantly increased flowering in 1992, the first year that both the control and treated trees flowered (Fig. 2). Flowering occurred from January to May, which is typical of the flowering season for macadamia in Hawaii. No differences in flowering were observed between treated and control trees in 1993 and 1994; however, in

Fig. 1. Effects of uniconazole drenches on (A) macadamia tree height and (B) trunk diameter. Mean separation within dates by *t* test ($P < 0.05$).

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Fig. 2. Effect of uniconazole drenches on flowering of young macadamia trees. Mean separation within years by *t* test ($P < 0.05$).

1995 flowering was significantly less than in control trees, probably due to reduced shoot and trunk growth and tip dieback.

Uniconazole drenches reduced tree height, and initially increased flowering of young trees. The concentration used in this study reduced trunk growth, paralleling its effects on apple trees (Zimmerman and Steffens, 1995), and produced trees with an extremely compact appearance. In the absence of dwarf-

ing rootstocks, triazoles may have potential for controlling macadamia tree growth. An added benefit may be earlier bearing in orchards. Triazoles are known to inhibit gibberellin synthesis (Davis et al., 1988), and application of GA_3 to macadamia trees near the onset of flowering inhibited flowering (Nagao and Sakai, 1990). However, whether endogenous GA is involved in macadamia flowering has not been determined.

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