vars. Flower bud injury was easily discernible because injured florets were either black (injured) or white (uninjured) after freezing in the laboratory or freezing injury in the field. This procedure requires more plant material to determine flower bud cold hardiness than the freezing curve method (6), but it requires less expensive laboratory equipment.

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Effects of Application Methods of Controlled-release Fertilizers on Growth and Quality of *Rhododendron obtusum* 'Hinodegiri' Grown in Various Media[1]

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Additional index words. container culture, controlled-release fertilizer, media, ornamental plants

***Abstract. Rhododendron obtusum* (Lindl.) Planch. 'Hinodegiri' responded to the different fertilizer sources and application methods similarly regardless of growing media. Plants top-dressed with Osmocote 18N–3P-10K had a significantly higher growth index, larger stem caliper and increased fresh weight than plants top-dressed with Pro-Grow 24N-3P-10K. Incorporation of either fertilizer source resulted in reduced plant growth and quality. The best fertilization method was a surface application regardless of fertilizer source or media.**

Various studies have demonstrated the necessity for evaluating fertilizer sources (2, 4, 6, 10), levels, and methods of application (1, 2, 5, 11), in container production. However, results may be variable due to different plant species response, fertilizer sources, methods of application and rates, particularly in different types of media (7, 8, 9). Furuta (2) suggested the use of controlled-release fertilizers for production of container-grown ornamentals was the best alternative to other nutritional programs. *Rhododendron* spp. obtained the best growth response when fertilized with controlled-release as compared to liquid fertilizer regardless of application method (6). Gouin (3) reported a surface application of 18N-3P-10K over the propagating medium of 1 peat:1 sand (v/v) resulted in better rooted cuttings of *R. obtusum* (Lindl.) Planch. *japonicum* than when incorporated. Coleman et al. (1) showed similar growth when fertilizer was either incorporated into the medium or surface applied. The objectives of this study were to evaluate growth and quality of *R. obtusum* 'Hinodegiri' as influenced by growing media, sources of controlled-release fertilizers, and methods of application.

A 4 x 4 factorial experiment in a randomized block design was established on May 28, 1979, to test 4 growing media and 4 fertilizer treatments. Treatments were replicated 6 times with 1 plant/pot as an experimental unit. Media treatments were 100% peat, 1 peat:1 pine shavings, 1 peat:1 pine bark, and 1 peat:1 builders sand (by volume). All media treatments were amended with dolomite to adjust the pH to 5.2 and FTE 503 (micronutrient source) added at 1 kg/m^3. Fertilizer treatments were 4.8 kg/m^3 Osmocote 18N-3P-10K incorporated (OSI), 6 g/15 cm diameter pot Osmocote 18N-3P-10K surface applied (OSS), 3.5 kg/m^3 Scott's Pro-Grow 24N-3P-10K incorporated (PGI) and 6 g/15 cm diameter pot Scott's Pro-Grow 24N-3P-10K surface applied (PGS).

Established liners of uniform size were potted 1 per 15 cm diameter pot and grown in the different media and fertilizer treatments. Plants were produced under partial shade (42 klx light maximum) with temperatures of 16°C minimum and 32°C maximum. Indi-

Table 1. Effects of application methods of controlled-release fertilizers on growth and quality of *Rhododendron obtusum* 'Hinodegiri' grown in various media.

Treatment[z]	Growth index[y] (cm)	Stem caliper (mm)	Side shoots (No/plant)	Fresh wt (g)	Foliar[x] color	Plant[w] grade
Peat						
OSS	24.3 a[v]	9.8 a	10.7 a	70.7 a	4.3 a	4.7 a
OSI	20.5 b	8.0 b	9.2 b	58.5 b	4.0 a	4.1 b
PGS	20.2 b	7.6 b	9.3 b	51.3 b	3.3 b	4.0 b
PGI	16.7 c	6.7 c	7.0 c	37.8 c	3.2 b	3.3 c
Peat:shavings						
OSS	22.7 a	8.9 a	8.5 a	56.7 a	4.3 a	4.2 a
OSI	20.0 b	7.8 b	8.4 a	46.2 b	4.1 a	3.9 a
PGS	19.2 b	7.4 b	8.3 a	44.3 b	3.3 b	3.7 a
PGI	16.1 c	6.1 c	7.0 b	24.5 c	2.5 c	2.7 b
Peat:bark						
OSS	22.5 a	8.9 a	9.0 a	56.3 a	4.2 a	4.1 a
OSI	19.6 b	7.5 b	8.2 a	44.3 b	3.9 a	3.9 a
PGS	20.2 b	7.5 b	8.7 a	45.8 b	4.0 a	3.3 b
PGI	18.1 c	6.8 c	7.9 a	38.7 c	3.0 b	3.3 b
Peat:sand						
OSS	21.7 a	7.9 a	8.7 a	49.5 a	3.3 a	4.0 a
OSI	19.1 b	7.0 b	7.9 ab	43.1 b	3.3 a	4.0 a
PGS	18.3 b	6.8 b	7.0 b	37.2 b	3.5 a	3.0 b
PGI	17.7 b	6.5 b	6.7 b	31.0 c	2.8 b	2.8 b

[z]OSS = Osmocote (18N-3P-10K) surface at 6 g/15 cm diameter pot, OSI = Osmocote (18N-3P-10K) incorporated at 4.8 kg/m^3, PGS = Pro-Grow (24N-3P-10K) surface at 6 g/15 cm diameter pot, PGI = Pro-Grow (24N-3P-10K) incorporated at 3.5 kg/m^3.

[y]Plant height + maximum plant width ÷ 2.

[x]1 = light green, 3 = medium green and 5 = dark green.

[w]1 = poor, not salable; 3 = good, salable; and 5 = excellent quality.

[v]Mean separation within medium treatment groups in columns by Duncan's multiple range test, 5% level.

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vidual pots were watered with 250 ml/pot as required to accommodate each medium treatment.

On October 21, 1979, data collected were: plant height measured from the soil surface to the apex; plant width across the top of the plant; stem caliper at soil surface; number of side shoots; foliar color (1 = light green, 3 = medium green and 5 = dark green); plant grade (1 = poor, not salable, 3 = good, salable, and 5 = excellent quality) and fresh weight.

Five months after treatment, plant grown in all media had a larger growth index, stem caliper, and fresh weight when Osmocote 18N-3P-10K was surface applied (Table 1). Plants grown in peat, peat:shavings, and peat:sand varied in the number of side shoots/plant depending on the fertilizer source and application method. Plants grown in the peat:bark medium had an equal number of side shoots/plant with both fertilizer sources and application methods. Foliar color of the plants grown in peat or peat:shavings was better when Osmocote was used in comparison to Pro-Grow regardless of application method (Table 1). Incorporation of Pro-Grow in the peat:bark and peat:sand media significantly reduced foliar color in contrast to Osmocote surface applied, Osmocote incorporated, and Pro-Grow surface applied. Plant grade varied depending upon the fertilizer source and application method used; however, in general the best plant grade occurred when Osmocote was top-dressed. The lowest plant grade resulted when Pro-Grow was incorporated into the media. Overall, the best fertilization method was surface application for both sources.

R. obtusum 'Hinodegiri' appears to be a shallow rooted plant requiring maximum fertilizer distribution in the upper portion of the container media. This may explain why top-dressing gave the best results. By applying the fertilizer on the surface all available nutrients are leached into the root zone. The poor growth response of plants fertilized by the incorporation method may be attributed to fewer nutrients available to the shallow root system. Coleman et al. (1) reported that placement of controlled-release fertilizers either within the medium or on the surface did not affect plant growth. Ticknor (9) top-dressed Osmocote on the media of *Rhododendron* spp. and obtained good growth and flower count.

When incorporating fertilizer, the medium should be thoroughly mixed and fertilizer well distributed. However, leaching may reduce the effectiveness of fertilizer located in the bottom portion of the pot, essentially inexcessible to the roots of newly-planted liners. Our results indicated the best fertilizer response was obtained with a surface application regardless of growing media.

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Factors Affecting Predisposition of Flowering Dogwood Trees to Attack by the Dogwood Borer[1]

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Abstract. **Factors affecting natural infestation of flowering dogwoods (*Cornus florida* L.) by the dogwood borer, *Synanthedon scitula* Harris (Lepidoptera: Sesiidae), were studied in an urban cemetery in Louisville, Kentucky. Two tree characteristics, severity of trunk wounding and exposure to sun, were most important in determining the probability of borer attack. Degree of crown dieback or color of bloom did not significantly affect the rate of infestation. There was no correlation between tree diameter and probability of attack, but height of attack sites increased linearly with increasing tree size.**

Flowering dogwoods are among the most widely planted woody ornamentals in the eastern United States. Trees in nurseries and in the urban landscape may be severely injured by the dogwood borer, *Synanthedon scitula* (Harris), a clearwing moth whose larvae tunnel feed in the phloem and cambium in living wood. Infestation by borers may result in lowered tree vitality, dieback of individual branches, structural weakness of major limbs or complete girdling and death of young trees. Trees may be disfigured by unsightly callous formation or large areas of cracked, dead bark around the site of attack. Protected by their galleries, borer larvae are virtually invulnerable to chemical controls and are seldom noticed until they have already inflicted serious injury.

Although native dogwoods in the forest understory are rarely infested (1, 3, 4), trees that are transplanted into the landscape or grown in nurseries are often seriously damaged. Environmental stress factors such as moisture deficiency or sunscald can weaken trees and make them more susceptible to infestation (1). Moreover, injuries inflicted by lawn mowers or other equipment may provide ideal oviposition sites or entry points for young larvae. It is a common phenomenon for certain trees to be severely infested, while neighboring trees are unharmed. The objective of the present research was to determine if certain tree and site characteristics are associated with increased probability of infestation by the dogwood borer.

The study was conducted in Cave Hill Cemetery, Louisville, Kentucky, a 122 ha landscaped area with an extensive collection of woody ornamentals. We selected for study 160 dogwood trees, ranging in diameter from 4–32 cm., from 8 adjoining cemetery sections. These trees had received no insecticide treatments for at least 5 years prior to the investigation, and were selected without regard to previous borer infestation.

Trees were tagged and numbered on May 15, shortly before the expected date of first emergence and oviposition of adult dogwood borers in Kentucky. Trunk diameter was measured at 30–cm. height, and then each tree was characterized with regard to exposure to sun, trunk wounding, crown dieback, and color of bloom. With respect to sun exposure, trees were classed as growing in either full sun, partial shade, or full shade. Trunk

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