Effects of 2 Slow-Release Fertilizers on the Propagation and Subsequent Growth of 3 Woody Plants[1]

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Abstract

Three woody plants were propagated from cuttings with four levels each of slow-release 27 N-5.2P-0.0K (27-12-0) and 0N-0P-38.2K (0-0-46) fertilizer in factorial combination. Slow-release fertilizer added during propagation had little effect on rooting of cuttings, however, after rooting and before transplanting into larger containers in the spring, the 27-12-0 stimulated both root and top growth of all species. All growth parameters measured for all species grown in 3.8 l (#1) containers were significantly increased after one growing season when treated with a combination of slow-release N and P during propagation or following transplanting.

Index words: *Rhododendron* X Fashion, *Ilex crenata* Thunb. 'Hetzi,' *Pyracantha coccinea* Roem. 'Wyatti,' container grown, propagation

Introduction

Success of propagating plants from cuttings depends upon physiological factors largely uncontrollable by the propagator (3) and environmental factors, such as rooting media, stock plant nutrition and misting.

Leaching of metabolities and nutrients from leaves and other plant tissues under intermittent mist presents a unique problem (1, 2, 11, 13) and may influence subsequent growth (14). Tukey (11) found that potassium and sodium were leached with relative ease from young leaves with 80 to 90 percent of the potassium being leached in 24 hours. Good and Tukey (2) compared levels of N, P, K, Ca, Mg and soluble carbohydrates found in cuttings before and after rooting. Nutrient deficiency symptoms found in the cuttings under mist were attributed to leaching of nutrients and dilution of nutrients in cuttings due to growth. Pridham (7) immersed cuttings in aqueous solutions of sucrose, dextrose, maltose, potassium nitrate, ammonium nitrate, and NAA for a period of 24 hours in an effort to supply cuttings with nutrients lost when the cutting was removed from the parent plant. He concluded that rooting of cuttings and subsequent growth of the young plant depended primarily upon the maturity and treatment of the stock plant, and, that response of cuttings to treatments of growth substances, sugars, and nitrogenous compounds, alone or in combination, are of minor importance.

Kamp and Bluhm (4) studied the effects of nutrient 'dip' containing water-soluble N, P, K for periods of

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one hour and concluded nutrients increased rooting 10 percent. By contrast, Zimmerman (16) concluded a liquid fertilizer soak had no effect on rooting and only a slight effect on shoot growth.

Wott and Tukey (15) compared nutrient mist to water mist and concluded that N, P and K content increased in the cuttings being propagated under nutrient mist, as did the dry weight of most species. The water mist had a higher percentage of rooting even though N, P and K decreased in the plants. Nutrient mist had little or no effect on root initiation but did influence quality and percentage of cuttings which rooted.

Sorenson and Coorts (10) found N, P and K levels rose with increased applications of nutrient mist and decreased under water mist at time of callus and root formation. All species except *Buxus* had a greater number of roots and a higher percent rooting under water mist. Nutrient mist did not increase rooting but did contribute to darker green foliage. On *Ilex* and *Taxus* there was a significant decrease in the number of roots per cuttings as the potassium content increased under the nutrient mist.

McGuire and Bunce (5) studied the effects of incorporating a slow-release fertilizer into the propagation medium. They found that in two species rooting was improved or not affected and in one species rooting was decreased. However, subsequent growth of rooted cuttings was significantly better in all treatments with slow-release Osmocote fertilizer. Likewise, Schulte and Whitcomb (8) found that incorporating Osmocote 18N-2.6P-9.9K (18-6-12) into the propagating medium, resulted in increased root grade and rooting percentage of burford holly, *Ilex cornuta* 'Burford.' Soil tests showed that increased levels of nitrates and potassium paralleled increased rooting. Later, Ward and Whitcome (14) studied the effects of incorporated Osmocote on the propagation and subsequent growth of *Ilex crenata* 'Hetzi.' Plants propagated with Osmocote were much larger and more responsive to subsequent fertilizer sources than those propagated without Osmocote. Fertilizer during propagation was essential for best growth and utilization of subsequent fertilizer in larger containers. The literature suggests that fertilization during propagation can greatly benefit plant growth.

The purpose of this study was to compare 4 levels of 2 fertilizers; 27-12-0 and 0-0-46 in factorial combination on the rooting and subsequent growth of 3 woody ornamentals produced in containers.

Methods and Materials

The treatments were 4 levels of nitrogen and phosphorus from 27-12-0 at 0, 2.4, 4.0 and 5.5 kg/m³ (0, 4.0, 6.7 and 9.3 lbs/cu yd) and 4 levels of potassium from 0-0-46 at 0, 0.9, 1.6, and 2.2 kg/m³ (0, 1.6, 2.6 and 3.7 lbs/cu yd) in factorial combination incorporated into the propagation medium. The N and P source was a plastic, resin-coated, controlled-release fertilizer with N approximately 60 percent ammoniacal and 40 percent nitrate derived from ammonium nitrate and ammonium phosphate.[1] The potassium source was potassium sulfate with the same plastic-resin coating.

Included in all propagation treatments was Micromax micronutrients at 0.6 kg/m³ (1 lb/yd³). All treatments were incorporated into a 1:1 (v:v) ratio of peat moss to coarse perlite. A randomized complete block design was used with 10 replications and 4 subsamples per replication. Propagation containers were 5.7 cm³ (2.25 in³).

Propagation containers were placed on an expanded metal bench in an unshaded greenhouse. Cuttings were misted for 3 seconds every 4 minutes during daylight hours. Bottom heat was provided by a gas-fired furnace and a polytube distribution system beneath the benches. Air temperatures were maintained at a minimum of 20°C (68°F) and a maximum of 35°C (95°F).

Terminal stem cuttings of Fashion hybrid azalea (*Rhododendron* X 'Fashion'), Hetzi Japanese holly (*Ilex crenata* 'Hetzi'), and Wyatti Pyracantha (*Pyracantha coccinea* 'Wyatti') were taken November 8, 15, and 16, 1979 respectively, from stock plants grown under uniform nutritional and cultural conditions. All cuttings were treated with 8,000 ppm IBA in talc.

On February 7, 1980 the cuttings were evaluated for root visual grade, number of bud breaks and height, then returned to the propagation container. On April 9 (22 weeks after the treatments began) a second evaluation of the holly liners was made for overall visual grade, number of branches and height of each liner. Liners were potted into 3.8 l (#1) white-on-black poly bags. A medium consisting of 3:1:1 (v:v:v) ratio of ground pine bark, peat and sand was used with Osmocote 17N-3.0P-9.9K (17-7-12), gypsum, dolomite, triple-superphosphate 0N-19.8P-0K (0-46-0) and Micromax micronutrients at 6.36, 0.92, 2.72, 0.68 and 0.68 kg/m³ (14, 2, 6, 1.5 and 1.5 lbs/yd³) respectively. Holly and azalea liners were grown under 30 percent saran shade. Water was supplied through overhead sprinklers, as needed, and all plants were pruned twice to stimulate branching. Weeds were controlled by oxadiazon (Ronstar) 2 G at 6.7 kg/ha (6 lbs aia). A third and final evaluation was made on September 16, 1980. The ten-month old plants were evaluated for branch number, overall visual grade, and fresh top and root weight.

Results and Discussion

After 12 weeks, cuttings had rooted but few significant differences among treatments were detected (Tables 1, 2 and 3). This is in agreement with several researchers who found that nutrient applications, either through the mist or incorporation into the rooting medium, had little effect on rooting or early stages of growth of the cuttings (10, 15).

However, after 22 weeks, just prior to planting, visual grade, number of branches, and height of Japanese holly increased as the level of 27-12-0 fertilizer applied during propagation increased (Table 2). Azalea and pyracantha responded similarly (data not presented). After 10 months, visual grade, number of branches, height, and visual root grade of azalea significantly increased as the level of Osmocote 27-12-0 increased in the propagating medium (Table 1 and Fig. 1). Number of branches, visual grade, and top and root weight of Japanese holly and top and root weight, visual grade, height and stem caliper of pyracantha also significantly increased as Osmocote 27-12-0 increased (Tables 2 and 3). Tissue N, P and K increased significantly with each increased level in the rooting medium.

[1]Sierra Chemical Co., 1001 Yosemite Drive, Milpitas, CA 95035.

Potassium added during propagation had no significant effect on rooting of cuttings, or subsequent plant growth (data not presented). No visually detectable signs of nutrient deficiencies were detected throughout the experiment and plants differed only in size and quality. Those receiving only coated potassium or no nutrients during propagation closely resembled the plants from the best treatments in leaf and stem color. This can be attributed to the fact that the 27-12-0 and potassium were varied only during the propagation phase of the experiment. After transplanting, all plants received the same levels of all nutrients. Although each plant had an equal opportunity to absorb and utilize these nutrients during propagation it is apparent that the Osmocote 27-12-0 during propagation stimulated growth and development. This stimulation was prob-

Table 1. Effects of Osmocote 27-12-0 applied during propagation on the growth and development of Fashion Azalea.

Osmocote Rate		Root Visual	Top Weight[x]	Top Visual	Number	Height[x]	Visual Root
kg/m³	lb/yd³	Grade[y,w]	(gm)	Grade[x,w]	Branches[x]	(cm)	Grade[x,w]
0.0	0.0	5.3a[z]	41.0a	5.0a	13.4a	27.0a	5.8a
2.4	4.0	4.4b	61.0b	5.8b	17.3b	31.1b	7.1b
4.0	6.7	53.a	71.3c	6.7c	20.0c	33.1b	8.0c
5.5	9.3	5.1ab	85.1d	7.5d	25.3d	35.9c	8.8d

[z]Mean separation within columns followed by the same letter or letters are not significantly different at the 5% level using Duncan's Multiple Range Test.

[y]Rated 10 weeks after the initiation of treatments.

[x]Rated 10 months after the initiation of treatments.

[w]Scale: 1 = poor; 10 = excellent.

Table 2. Effects of Osmocote 27-12-0 applied during propagation on the growth and development of Hetzi Japanese Holly.

Osmocote Rate		Visual Root	Top Visual	Number	Height[x]	Number	Top Visual	Top Weight[w]	Root
kg/m³	lb/yd³	Grade[y,v]	Grade[x,v]	Branches[x]	(cm)	Branches[x]	Grade[w,v]	(gm)	Weight[w] (gm)
0.0	0.0	6.8ab[z]	3.7a	4.5a	13.3a	18.1a	4.7a	56.0a	26.9a
2.4	4.0	7.5a	7.5b	8.3b	18.5b	27.9b	7.1b	94.6b	46.7b
4.0	6.7	6.1b	8.4c	9.5c	19.2b	30.2b	7.5b	101.8b	49.3b
5.5	9.3	6.4ab	8.6c	9.6c	19.3b	33.8c	8.1c	116.3c	56.5c

[z]Mean separation within columns followed by the same letter or letters are not significantly different at the 5% level using Duncan's Multiple Range Test.

[y]Rated 12 weeks after the initiation of treatments.

[x]Rated 22 weeks after the initiation of treatments.

[w]Rated 10 months after the initiation of treatments.

[v]Scale: 1 = poor; 10 = excellent.

Table 3. Effects of Osmocote 27-12-0 applied during propagation on the growth and development of Wyatti Pyracantha.

Osmocote Rate		Visual Root	Top	Root	Top Visual	Height[x]	Stem
kg/m³	lb/yd³	Grade[y,w]	Weight[x] (gm)	Weight[x] (gm)	Grade[x,w]	(cm)	Caliper[x] (cm)
0.0	0.0	8.6a[z]	194.4a	80.9a	5.3a	79.3a	1.0a
2.4	4.0	8.4a	291.6b	135.7b	7.0b	90.9b	1.2b
4.0	6.7	9.2a	304.9b	140.8b	7.7c	92.9b	1.3c
5.5	9.3	9.1a	335.1c	159.3c	8.0c	95.1b	1.3c

[z]Mean separation within columns followed by the same letter or letters are not significantly different at the 5% level using Duncan's Multiple Range Test.

[y]Rated 10 weeks after the initiation of treatments.

[x]Rated 10 months after the initiation of treatments.

[w]Scale: 1 = poor; 10 = excellent.

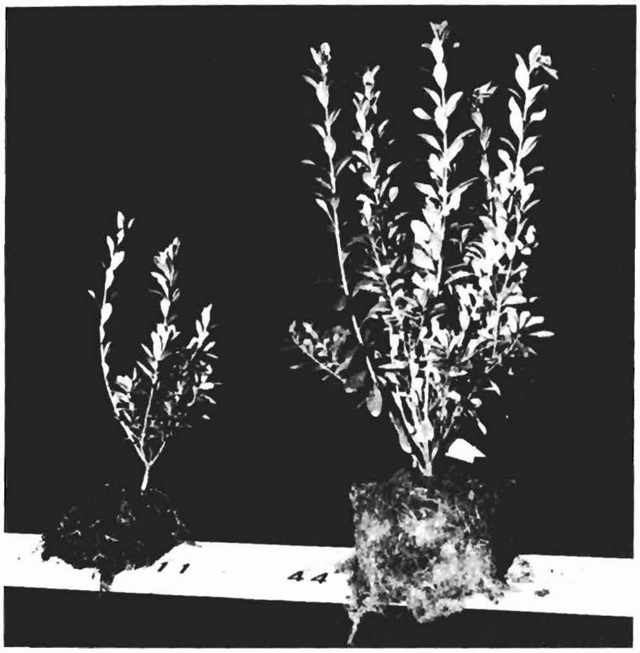

Fig. 1. **Without N and P during propagation the growth of Fashion azalea (left) was much less than when N and P were incorporated at the highest level (right). This growth response is the result of N and P added during propagation, as all nutrient levels in the 3.1 l (#1) container were the same throughout the growing season. Root growth increased as dramatically as shoot growth.**

ably due to the increased root system and rate of root development into the medium following transplanting. These data emphasize the importance of adding N and P during propagation in order to stimulate subsequent plant growth. However, the fact that K levels in the tissue increased with K in the propagation medium but had no effect on plant growth suggests that the K lost by misting may not be as important as previously believed. Further studies to separate the effect of N and P are needed as soon as slow release forms of these individual elements become available.

In general, few differences were apparent during the early stages of growth of the cuttings. However, at 22 weeks and again at 10 months, there was a significant increase in growth with each increase in the level of Osmocote 27-12-0. These increases are directly attributable to the 27-12-0 provided to the cuttings during propagation.

Significance to the Nursery Industry

This study shows that slow release nitrogen and phosphorus applied to the propagation medium may not enhance rooting but can stimulate the subsequent growth of nursery stock. Coated 27-12-0 can be incorporated into the propagation medium with substantial growth benefits. Potassium does not appear to play an active part in the nutrition of cuttings during propagation.

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