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## Significance to the Nursery Industry

Good quality crotons can be produced with an Osmocote 19N-3P-10K (19-6-12) at a rate of 9.9 g per 12.5 cm (5 in). Higher rates can result in slightly reduced plant height and plant grade as well as significantly higher leachate EC at cooler times of year. Since ground water contamination would be more likely at higher fertilizer rates, the minimum rate which results in good quality crotons should be used.

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# Pruning Responses of Tissue-Cultured Plantlets of Rhododendrons<sup>1</sup>

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## Abstract

Plantlets of *Rhododendron* 'Molly Ann', *R.* 'Paprika Spiced', and *R.* 'Travis L.', recently rooted from tissue culture, were grown in a greenhouse in individual containers. Plants pruned by pinching, top-pruning, or root-pruning were compared to unpruned plants. Growth, as measured by shoot height, shoot dry weight, root dry weight, and stem caliper, was generally reduced by pruning. Top-pruning and pinching induced branching in all cultivars tested and improved stem taper (ratio of basal to upper caliper) in two cultivars, including *R.* 'Travis L.', which is particularly prone to develop weak stems when produced by tissue culture.

**Index words:** branching, caliper, pinching, root pruning, taper, tissue culture, *in vitro* propagation, micropropagation

## Introduction

*Rhododendron* spp. adapt well to multiplication via tissue culture. Methods for culturing explants and for rooting microcuttings produced in tissue culture are well established (1, 8, 11). Cultural and management practices following rooting have not been thoroughly investigated.

Certain cultivars of *Rhododendron* and other genera that have been propagated by tissue culture develop a weak area at the base of the stem (10). This narrow stem area has resulted commercially in the loss of some young plants due to breakage and in the development of top-heavy plants. If simple manipulations, such as early pruning, were found to be effective in overcoming this problem, then more sturdy cultivars could be successfully produced via tissue culture.

Pruning induces branching and compactness (2, 4, 7), and both are desirable habits in these woody shrubs. This experiment was designed to test the effect of pruning on the development and stem taper of *Rhododendron* plantlets rooted from tissue culture.

## Materials and Methods

Plantlets of *Rhododendron* 'Molly Ann', *R.* 'Paprika Spiced', and *R.* 'Travis L.' (heights of 2.8, 4.6, and 5.7 cm, or 1.1, 1.8, and 2.2 in, respectively), rooted from tissue culture and acclimated to greenhouse conditions, were potted individually on May 30 into 6 cm<sup>2</sup> (2.25 in<sup>2</sup>) plastic pots filled with peat, pumice, and sand (12:7:1 by vol), amended with Osmocote 17N-3P-10K (17-7-12) at the manufacturer's recommended rate. Plants were grown in a shaded greenhouse with light intensities of 600 to 1100  $\mu\text{mol}\cdot\text{s}^{-1}\text{m}^{-2}$  (3000 to 5500 ft-c). Temperatures averaged 28°C (82°F) during the day and 14°C (57°F) at night. Plants were watered as needed to keep the medium moist.

After 7 weeks in the greenhouse, the following pruning treatments were performed: no growth removed ('unpruned'), top 1 cm (0.4 in) of the shoot tip removed

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('pinched'), top half of the shoot removed ('top-pruned'), or the outer half of the root mass removed and replaced with potting medium ('root-pruned').

The experimental design was a split-plot, with cultivar as the main effect and pruning treatment as the split. There were three blocks, each with two plants per treatment.

Seven weeks after pruning, plants were harvested. Basal stem caliper was measured 1 cm (0.4 in) above the surface of the growing medium. Upper stem caliper was measured below the top 3 fully expanded leaves on root-pruned and unpruned plants and immediately below the cut on pinched and top-pruned plants. Stem taper (the ratio of basal to upper caliper) was calculated. The number of shoots (terminal and lateral) was counted. Plants were removed from their pots and cut at the surface of the growing medium. Shoot height was measured to the tallest shoot tip. Roots were carefully washed to remove adhering growth medium. Root and shoot dry weights were measured.

## Results and Discussion

Plants pruned by any method usually were shorter, had less root and top weight, and had reduced caliper than plants that were not pruned (Tables 1 and 2). Reduced growth is the universal effect of pruning (3, 7).

Shoot heights and dry weights were significantly lower in plants pruned by any of the 3 methods than in unpruned plants (Table 1). The reduction was greatest in top-pruned plants, despite vigorous axillary shoot growth. Top-pruned plants were only 50 to 70% as tall and had only 25 to 40% as much top dry weight as unpruned plants. Severe pruning may have decreased the growth potential through the loss of photosynthetic capacity. Pinching would not seriously interfere with photosynthetic capacity or carbohydrate assimilation, since little leaf area was removed. In pinched plants, the reduction in height compared to the unpruned plants was probably due to the time required to initiate the growth of axillary buds. Geisler and Ferree (3) showed that

**Table 1. Effect of pruning on height, top weight, root weight, and shoot number of selected cultivars of tissue-cultured rhododendrons.**

	Treatment	Cultivar		
		'Molly Ann'	'Paprika Spiced'	'Travis L.'
Height (cm)	Unpruned	15.0	13.5	18.9
	Pinched **	11.4	13.1	17.5
	Top-pruned **	7.7	9.4	10.9
	Root-pruned *	12.8	12.9	17.1
Top dry wt. (g)	Unpruned	2.02	3.11	2.02
	Pinched **	1.41	2.40	1.64
	Top-pruned **	0.51	1.29	0.67
	Root-pruned *	1.84	2.51	1.92
Root dry wt. (g)	Unpruned	1.01	0.95	0.26
	Pinched *	0.36	0.94	0.16
	Top-pruned **	0.26	0.57	0.11
	Root-pruned	0.80	0.91	0.20
Shoot number	Unpruned	2.3	1.0	1.0
	Pinched **	3.5	2.5	2.5
	Top-pruned **	4.0	2.7	2.8
	Root-pruned	2.3	1.0	1.0

\*, \*\*Pruning treatment was significantly different from unpruned at the 5% or 1% level, respectively. Treatment by cultivar interactions were not significant.

**Table 2. Effect of pruning on stem caliper of selected cultivars of tissue-cultured rhododendrons.**

	Treatment	Cultivar		
		'Molly Ann'	'Paprika Spiced'	'Travis L.'
Basal Caliper (mm)	Unpruned	3.76	5.09	2.45
	Pinched	3.04 *	4.69	2.68
	Top-pruned	2.40 **	4.13 **	2.20
	Root-pruned	3.87	4.70	2.67
Upper Caliper (mm)	Unpruned	4.37	6.12	6.09
	Pinched	3.82	4.71 **	4.55 **
	Top-pruned	2.61 **	4.42 **	3.17 **
	Root-pruned	4.81	5.13 **	5.66
Taper (basal caliper/upper caliper)	Unpruned	0.86	0.83	0.40
	Pinched	0.80	1.00 **	0.59 **
	Top-pruned	0.92	0.93 *	0.69 **
	Root-pruned	0.80	0.92	0.47

\*, \*\*Pruning treatment significantly different from unpruned at 5% or 1% level, respectively. Treatment by cultivar interactions were significant (P < 5%), so cultivars were analyzed separately.

root pruning results in water stress and a decreased rate of photosynthesis in the shoot tips, which temporarily reduces the rate of shoot growth in length and diameter.

Root dry weight was significantly lower in pinched and top-pruned plants than in unpruned plants (Table 1). This response has been seen in other crops as well (4). Root dry weight in root-pruned plants was not significantly lower than in unpruned plants. Other researchers have also noted no effect on root growth after root-pruning (3, 5); root pruning stimulates the growth of secondary roots and tends to reduce shoot growth more than root growth (9).

Removal of the shoot apex by pinching or top-pruning increased shoot number in the 3 cultivars tested (Table 1). Root-pruning did not induce branching. Other studies on branching show these same responses (4, 7). In unpruned plants, no branching was seen in 'Paprika Spiced' or 'Travis L.': lateral budbreak only occurred in 'Molly Ann'.

Stem caliper of the plants was generally reduced by pruning, and the response was more pronounced in the upper than in the basal caliper (Table 2). Noting the response of caliper and taper (the ratio of basal to upper caliper) is particularly important in monitoring the extent of the weak area at the base of the stem of tissue-cultured plants (10). The overall strength of the stem is influenced by taper (6). Stems with greater taper should be stronger; numbers smaller than one indicate reverse taper. Unpruned plants of all the cultivars tested exhibited reverse taper (Table 2). Root-pruning did not affect taper. Pinching and top-pruning decreased the amount of reverse taper in 'Paprika Spiced' and in 'Travis L.', but not in 'Molly Ann'.

Of the *Rhododendron* cultivars tested in this experiment, 'Travis L.' was the tallest, but its root weight was about 75% smaller than that of the others (Table 1). The problem of reverse taper was most severe in 'Travis L.' (Table 2). Pinching or top-pruning of this cultivar was an effective method of improving stem taper, but this cultivar remained relatively weak and spindly. The stem of this cultivar can be narrow at the base, even when plants are 3 years old (10). The cause of the poorly developed root system and of the narrow stem zone are unclear.

### Significance to the Nursery Industry

Pinching may be an effective tool for managing the growth of tissue-cultured rhododendron plantlets, especially of those

prone to weak stems. Pinching increased branching and compactness in all three cultivars tested and improved stem taper in two cultivars, thus resulting in more desirable plants. These benefits came at the expense of overall plant growth, which was somewhat reduced. Top-pruning also stimulated branching, reduced height, and increased taper, but the reduction in growth was more severe than in pinched plants. Root-pruning had little effect other than a slight decrease in plant size. While pinching and top-pruning enhanced the strength of rhododendron cultivars prone to weak stems, these manipulations did not completely overcome the problem. Screening of cultivars for stem strength may be necessary.

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