Influence of Bottom Heat and Mulch on Rooting of Evergreen Cuttings©

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During greenhouse winter propagation, stem cuttings of arborvitae (*Thuja occidentalis*), Hetz juniper (*Juniperus virginiana* 'Hetzii'), Hick's yew (*Taxus* ×*media* 'Hicksii'), Ramlosa juniper (*Juniperus chinensis* 'Ramlosa'), Savin juniper (*Juniperus sabina*), and Tamarix juniper (*Juniperus sabina* 'Tamariscifolia') were rooted with low (12 ± 2 °C) or high (21± 2 °C) bottom heat in a 1 perlite : 1 sand (v/v) medium. The medium was left uncovered or mulched with clear polyethylene (poly), white poly, Microfoam, or aluminum foil. In terms of percent rooting, Hick's yew, Hetz juniper, Savin juniper, and Ramlosa juniper rooted better with low bottom heat, and Tamarix juniper and arborvitae with high bottom heat. Compared with the uncovered medium, Tamarix juniper rooted better under clear poly but less under white poly; Ramlosa juniper rooted better under clear poly, white poly, and aluminum mulches. Rooting of the other taxa was unresponsive to mulch. For each taxa, an inverse relationship was observed between percent rooting and percent of callused (unrooted) cutting.

INTRODUCTION

The use of bottom heat to promote rooting is a widespread practice. Base temperatures typically range between 20 and 24 °C. During the 1970s energy crisis researchers reported successful propagation in unheated or more-energy conserving low temperature regimes (Van Hof, 1978; van de Giessen, 1979; Tinus, 1984; Hull, 1975). Freeman and Van de Wetering (1976) demonstrated that seed flats covered with white poly under greenhouse conditions had less fluctuating temperatures than those covered with clear poly or no poly, thus providing better temperature control for germinating seeds.

This study investigated the rooting of evergreen cuttings with two different base temperatures in medium uncovered or covered with various types of mulches during greenhouse winter propagation.

MATERIALS AND METHODS

In a SDP-16 glazed greenhouse compartment, two benches, supplied with Root Zone bottom heat (Vary Industries Ltd., Ontario), were subdivided into 0.8 m × 0.8 m × 13 cm-deep sections partitioned by 1.5-cm thick styrofoam. Each section was filled with a medium of 1 perlite : 1 sand (v/v) and was left uncovered or covered (mulched) with clear poly (6 mil thick), white poly (4 mil), Microfoam (6.5 mm), or aluminum foil (four × 0.015-mm thick layers). The mulch edges were held in place by furring strips. Slits (rows), 0.6 m in length and 3 cm apart, were made in each mulch to accommodate the cuttings. Thermostats at the 5-cm depth in the uncovered medium regulated base temperatures of 12±2 °C (low bottom heat) in one bench and 21±2 °C (high bottom heat) in the other. The temperatures under each mulch were monitored at the same depth. The greenhouse set points were 10 ºC for ambient day/night air temperature and 14 ºC for venting.

In mid-December, stem cuttings of arborvitae (*Thuja occidentalis*), Hetz juniper (*Juniperus virginiana* 'Hetzii'), Hick's yew (*Taxus* ×*media* 'Hicksii'), Ramlosa juniper (*J. chinensis* 'Ramlosa'), Savin juniper (*J. sabina*), and Tamarix juniper (*J. sabina* 'Tamariscifolia') were treated at the bases with Seradix No. 3 rooting powder (0.8% indole-3-butyric acid), and inserted 25 per row (2.5 cm within row). Periodically, water was manually applied to the uncovered medium surface or through the slits of mulched treatments. Between March and April, the percentages of cuttings that developed roots, those that callused without roots, and those that died were recorded. Data were analyzed as a split plot design with mulches as main plots and species as subplots, using the two base temperatures as blocks. Transformations of the data were considered but were unnecessary.

Table 1. Response (rooting %) of stem cuttings from six evergreen taxa to low and high bottom heat.

	Bottom heat		
Taxa	Low	High	Difference[z]
Hick's yew	81	31	+50
Hetz juniper	75	55	+20
Savin juniper	90	73	+17
Ramlosa juniper	58	50	+8
Tamarix juniper	40	45	-5
Arborvitae	65	75	-10
Mean	68	55	

[z] Low over high.

RESULTS

Bottom Heat. Four of the six taxa rooted better with low than with high bottom heat (Table 1). Hick's yew benefited the most (+50% rooting in low vs. high bottom heat), followed by Hetz juniper (+20%), Savin juniper (+17%), Ramlosa juniper (+8%), Tamarix juniper (-5%), and arborvitae (-10%). Similarly, Lamb (1977) reported better rooting in some woody species when base temperature in mist or under plastic was reduced from 21 to 24 ºC to 16 to 18 ºC, although other species preferred the higher temperature regime. He obtained same or better rooting in 15 out of 19 species when basal electric heat was cut off for 12 h daily than when it was available for 24 h. Van Hof (1978) also described successful yew propagation without bottom heat. With spruce cuttings, bottom heat was both beneficial and detrimental to rooting depending on the species (Girouard, 1977). Whalley and Loach (1977) reported increased rotting and decreased rooting of rhododendrons when basal temperatures increased from 15 to 25 ºC. In the present study, the high bottom heat caused more death of cuttings due to rotting (14%, mean over mulches and taxa) than the low bottom heat (4%).

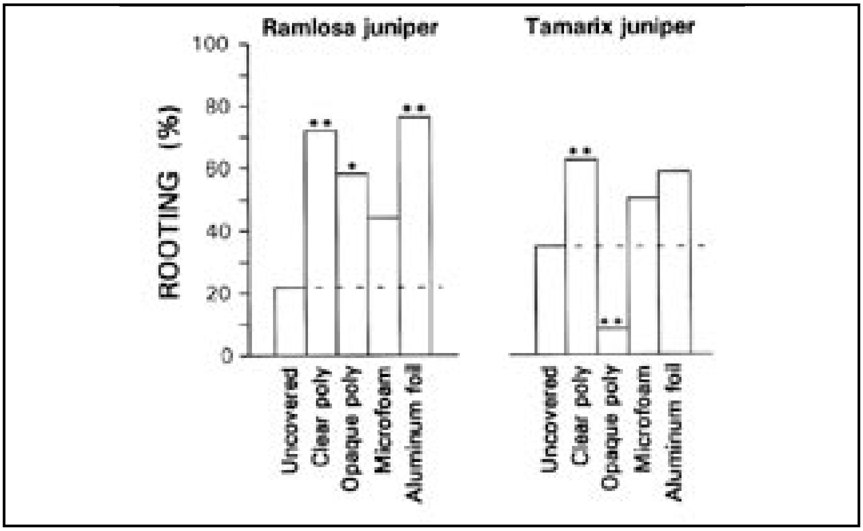

Figure 1. Rooting response of Ramlosa and Tamarix junipers to various mulches (mean over low and high bottom heat). The horizontal broken line represents response in the uncovered medium. The asterisks indicate significant differences (* P <0.05; ** P <0.01) from the uncovered treatment.

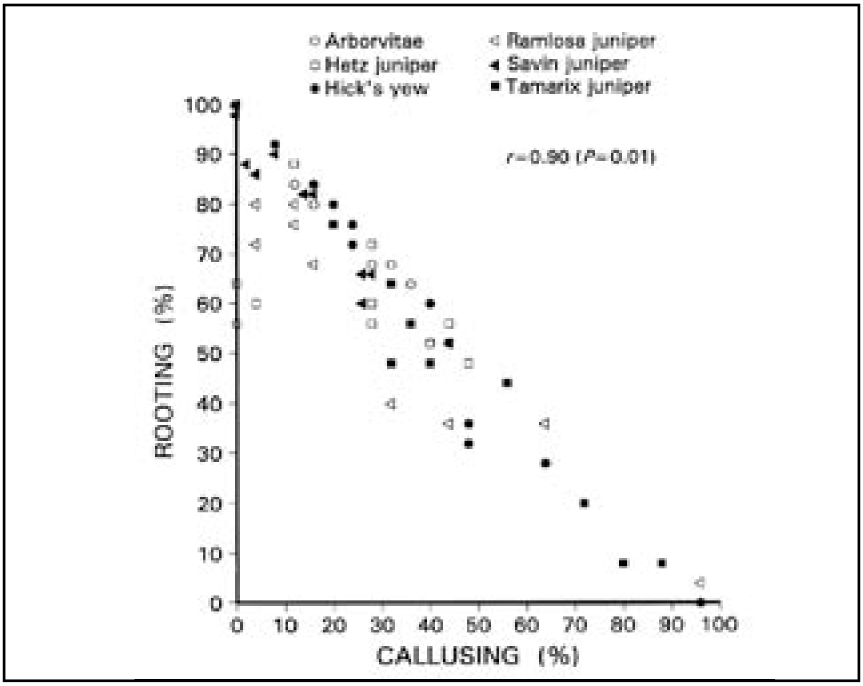

Figure 2. Relationship between percent rooting and percent callusing of cuttings of six evergreen taxa.

Table 2. Base temperature variations under mulches over a 24-h period[z].

	Uncovered	Clear poly	White poly	Microfoam	Aluminum foil
		High bottom heat			
Maximum	23.8	24.8	25.1	25.9	28.7
Minimum	18.7	20.5	20.0	20.9	23.9
Mean	21.3	22.7	22.6	23.4	26.3
		(+1.4)[y]	(+1.3)	(+2.1)	(+5.0)
		Low bottom heat			
Maximum	16.9	16.4	13.4	16.8	17.2
Minimum	11.1	12.1	10.3	12.0	12.6
Mean	14.0	14.3	12.9	14.4	14.9
		(+0.3)[y]	(-1.1)	(+0.4)	(+0.9)

[z]Clear sunny day in January with ambient maximum and minimum greenhouse air temperatures of 13.6 and 9.9 °C.

[y]Mean temperature of mulched over uncovered treatment.

Mulch. Base temperatures recorded hourly over a typical 24-h period in January are summarized in Table 2. Under high bottom heat, the mean temperatures were higher under the mulches (aluminum, +5.0 °C; Microfoam; +2.1 °C; clear poly, +1.4 °C; and white poly, +1.3 °C) than in the uncovered medium. Except for white poly which was cooler (-1.1 °C) than the uncovered medium, the above trend was similar under low bottom heat but the temperature differences were smaller (+0.3 to +0.9 °C).

Compared with the uncovered medium: (A) Tamarix juniper rooted better under clear poly (+28%) but less under white poly (-26%); and (B) Ramlosa juniper rooted better under clear poly (+50%), opaque poly (+36%), and aluminum foil (+54%) (Fig. 1). The other four taxa were unresponsive to mulch. Interestingly, unlike these taxa, both Ramlosa and Tamarix junipers rooted poorly in the uncovered medium.

According to Miller and Green (2003), mulches can affect level and quality of light reflected into the plant canopy, and could perhaps induce other subtle physiological differences in the proximity of the cuttings either below or above the mulches. Under aluminum, some arborvitae cuttings developed roots along the upper surface of the rooting medium just under the mulch. Temperatures at the surface of the rooting medium should exhibit significantly more diurnal fluctuations than at rooting level, but these were not measured.

Effect of Callusing. Despite variable rooting response of the six taxa to basal temperatures and mulches, closer examination of the data showed a clear and consistent inverse relationship between percent rooting and percent of callused (unrooted) cuttings for each taxa, irrespective of differences in bottom heat and mulches (Fig. 2). The mean correlation over all taxa was r = -90**, P<0.01.

Gislerod (1983) reported that callusing on poinsettia cuttings increased with temperature and that conditions which induce large callus formation inhibited rooting. Ellyard and Ollerenshaw (1984) indicated that callusing was often associated with stem dieback of *Grevillea* cuttings. This evidence suggests that to achieve better rooting of evergreen cuttings we should be considering more closely and try to understand those factors which reduce or eliminate callusing.

CONCLUSION

Low bottom heat was preferable to high bottom heat for rooting four of the six taxa (Hick's yew, Hetz juniper, Savin juniper, and Ramlosa juniper) with Hick's yew benefitting the most. The mulches influenced rooting of two taxa (Ramlosa and Tamarix junipers) although the responses were variable. Callusing had a negative effect on rooting and was the single most important and consistent factor influencing rooting of the evergreen cuttings.

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