Increasing fertilizer level during production influenced plant width and grade for both cultivars after 6 months indoors, but not plant height, leaf length and width, and foliar color (Table 2). The larger plant width and grade are probably due to carbohydrate reserves accumulated by plants receiving high fertilizer or residual fertilizer present in the containers. Pittosporum species are salt tolerant, thus excess salts due to a high fertilizer level are not a growth deterrent to these plants as it would be to a salt sensitive plant such as Aphelandra (5). The pittosporum cultivars grew equally well under 0.8 and 1.6 klx. Levels of N, P, K and Mg were influenced by production light levels for both cultivars (Table 3). As production light decreased from 90 to 30 klx, there was an increase in N, P and K and a decrease in Mg. Micronutrient averages for both cultivars were about 7, 215, 305, and 255 ppm for Cu, Fe, Mn and Zn, respectively. These averages are similar to those reported for Rhododendron indicum, Viburnum suspensum and Ficus benjamina (6, 8).

Although both green and variegated pittosporum are temperate zone plants, they performed exceptionally well under the interior environments of this experiment. The green form performed somewhat better than the variegated cultivar. At experiment termination, 12 green pittosporums were maintained indoors under 1.6 klx for an additional 4 months and were still initiating new growth at the end of this period. This would indicate that dormancy may not be required for this temperate zone plant and may not be with other temperate zone species. Therefore, other temperate zone evergreen plants should be examined for interior use.

### Table 3. Influence of production light and fertilizer levels on tissue content of nutrients in *Pittosporum tobira* and *F. tobira* 'Variegata' (Thunb.) Ait. grown for 12 months in production area and 6 months in interior environment.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>N (%)</th>
<th>P (%)</th>
<th>K (%)</th>
<th>Ca (%)</th>
<th>Mg (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light (klx)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>0.96a</td>
<td>0.14a</td>
<td>0.90a</td>
<td>1.62a</td>
<td>0.62b</td>
</tr>
<tr>
<td>50</td>
<td>1.59b</td>
<td>0.28a</td>
<td>1.27b</td>
<td>1.82b</td>
<td>0.43a</td>
</tr>
<tr>
<td>30</td>
<td>1.78c</td>
<td>0.34b</td>
<td>2.01c</td>
<td>1.70a</td>
<td>0.43a</td>
</tr>
<tr>
<td>Fertilizer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1.54b</td>
<td>0.27a</td>
<td>1.62b</td>
<td>1.48a</td>
<td>0.38a</td>
</tr>
<tr>
<td>4</td>
<td>1.34a</td>
<td>0.23a</td>
<td>1.17a</td>
<td>1.95b</td>
<td>0.62b</td>
</tr>
<tr>
<td>Fertilizer avg</td>
<td>1.44</td>
<td>0.25</td>
<td>1.39</td>
<td>1.71</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Increasing fertilizer at the end of this period. This would indicate that dormancy may not be required for this temperate zone plant and may not be with other temperate zone species. Therefore, other temperate zone evergreen plants should be examined for interior use.

### Literature Cited


### Deicing Salt Spray Injury in Norway Maple as Influenced by Temperature and Humidity Treatments

**William E. Barrick** and **Harold Davidson**

**Department of Horticulture, Michigan State University, East Lansing, MI 48824**

**Additional index words.** Acer platanoides

**Abstract.** The effect of temperature and humidity conditions on the expression of deicing sprays on sugar maple was investigated using terminal buds and stem sections of Norway maple (*Acer platanoides* L. cv. Emerald Queen). Loss of viability was associated with sodium chloride treatments and appeared in both high (8.3°C) and low (0°C) temperatures. Tissue moisture (%) was significantly lower in low moisture (phosphorous pentoxide) atmospheres and in sodium chloride treatments. Penetration of both Na⁺ and Cl⁻ ions as evidenced by electron microprobe analysis occurred throughout stem tissues. Deicing salt spray injury in Norway maple appears to be related to penetration of phytotoxic ions and not directly associated with moisture loss through osmotic stress.

Reports of deicing salt damage in highway plantings are legion. Deicing salt injury to deciduous trees by contact with above-ground parts has been well documented (4, 6, 10, 20, 22). Support for this injury mechanism is further evidenced by location of symptoms, i.e. injury is observed on sides of plants facing highways and in portions of trees intercepting salt splash, spray, or mist (20, 22). Manifestations of injury are death of terminal buds with concomitant twig dieback, followed by lateral bud break (10, 22). Unlike symptoms of winter injury which occur during the winter, expression of salt damage does not occur until increased temperatures occur in late March and April (10).

Considerable effort has been expended to characterize injury symptoms and rate species according to their sensitivity to deicing salt spray. Unfortunately, knowledge concerning phsy.

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Considerable effort has been expended to characterize injury symptoms and rate species according to their sensitivity to deicing salt spray. Unfortunately, knowledge concerning phys.
Humidity treatments were achieved by placing either distilled H₂O or phosphorous pentoxide (P₂O₅) in the bottom of growth chambers. Humidity treatments were replicated twice within growth chambers maintained at 0°C and 8.3°C. Relative humidities were estimated to be less than 25% in the P₂O₅ treatments and greater than 75% in the water treatments. Phosphorous pentoxide layers were changed daily to insure maintenance of low humidities.

Immediately after cutting from trees, 10 cm sections from 1-year-old wood were placed in 50 ml beakers containing moist quartz sand. Spray treatments applied twice daily for 5 days consisted of an unsprayed control, deionized H₂O or 6.1N (saturated) NaCl spray. Each treatment was replicated 4 times with a single twig serving as a replication.

Percent moisture (g H₂O/g dry wt x 100) was determined by excising terminal buds and recording fresh weight at the termination of each 5 day treatment and dry weight after 72 hr at 75°C. Percent moisture determinations were not made on stem tissues.

Viability was determined using a separate set of twigs at the end of each 5 day treatment period. Twig sections were cut and placed in a greenhouse mist bench for 7 days at 22°C to encourage terminal bud break and/or injury symptom expression. Terminal buds were rated viable if bud break occurred without signs of browning; stem tissue was considered viable if no browning of vascular tissues occurred.

Relative Na⁺ and Cl⁻ levels in terminal twig samples were determined using an electron microprobe X-ray analyzer (Model EMX-SM, Applied Research Laboratories) at an acceleration voltage of 15 kV and 0.200μA sample current. Freeze-dried samples were sectioned longitudinally to prevent Na⁺ and Cl⁻ redistribution and coated with carbon prior to analysis. Distribution patterns following penetration of Na⁺ and Cl⁻ ions were observed by a point scan through transverse stem sections.

Percent moisture in terminal buds was significantly lower in the low humidity (P₂O₅) treatment (Table 1). This reduction in bud moisture was attributed to the efficient dessicating properties of P₂O₅ (5). Yet viability of terminal buds did not differ as a result of reduced humidities (Table 1). Terminal buds sprayed with 6.1N NaCl had about 25% less moisture than either control or deionized H₂O treated buds (Table 2). Viability of terminal buds and stem tissues was lower in NaCl treatments (<10%) when compared with check sprays (>95%). There was a non-significant interaction between humidity and salt treatment in viability of terminal buds.

Bowers and Hesterburg (1) hypothesized that deicing salt may act as nonsselective contact herbicides. Their proposal states that salt coatings on needles of Pinus strobus alter water diffusion gradients, resulting in cell plasmolysis and ultimate injury. If viability of terminal buds and stem tissue of Norway maple were solely dependent on % moisture, then reductions from P₂O₅ atmospheres should have yielded reductions in viability. It could be argued that a threshold moisture level causing injury might not have been reached in this experiment, yet P₂O₅, although not in intimate contact with tissues, is clearly a more efficient dessicant than NaCl (5).

Significantly greater % moisture occurred at 8.3°C than at 0°C (Table 1). Early work by Johnston (8) demonstrated that moisture in peach buds increased as mean daily temperatures exceeded 6.1°C. Although increases in bud moisture were observed at higher temperatures, no differences in viability were observed. A non-significant interaction in tissue viability occurred between spray treatment and temperature treatments.

Microprobe analysis clearly demonstrated penetration of Na⁺ and Cl⁻ ions into twigs. Penetration of Cl⁻ into foliar tissues has been demonstrated by numerous authors (2, 3, 24, 25). Penetration of herbicides into young stem tissue is well documented (12, 13, 14, 17, 18). Humidity and temperature treatments seem to have had no effect on penetration patterns of Na⁺ and Cl⁻. In general, high humidities (9, 15, 16) and temperatures (7, 12, 17, 19) tend to favor the penetration of foliarly applied compounds. Although not presented in Fig. 1., penetration patterns for Na⁺ were quite similar to those of Cl⁻. Levels of Cl⁻ in salt-treated tissues were well above H₂O-treated tissue or background. Chloride ions were more concentrated in bark and vascular tissue, but were relatively high in pith layers.

Based on microprobe analysis, it appears that injury in dormant tissue is more closely related to penetration of phytotoxic ions than to osmotic stress. Reduction in moisture as a result of salt spray deposition might be a secondary parameter of injury, occurring simultaneously with or after injury.

**Literature Cited**


**CULTIVAR & GERMPLASM RELEASES**


**RSM K1 and RSM K5 Rose Germplasm**

H. H. Marshall

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*Additional index words.* Rosa sp., ornamentals breeding

The improvement of winter hardiness of tender tetraploid hybrid tea, grandiflora and floribunda roses has been difficult because of interspecific crossing barriers between these and hardy northern species.

In the rose breeding program at Morden, the hardy tetraploid *R. arkansana* Porter has been crossed with the floribunda ‘Donald Prior’ and a few fertile F₁ hybrids have been produced. These have served in breeding a new series of roses at Morden (1). Other hardy species such as *R. rugosa* Thunb. are diploid and produce mostly sterile triploids when crossed with tetraploid garden roses.

This paper reports a new hybrid from hardy roses which has shown cross compatibility with a wide range of roses.

**Origin**

Two seedlings, RSM K1 and RSM K5 (Research Station, Morden plus a code number), were found among 111 seedlings in one progeny of *R. rugosa* ‘Alba’ having [(‘J. W. Fargo’ × ‘Donald Prior’ × *R. arkansana*)] × mixed R. *arkansana* hybrids as a pollen parent. Since ‘J. W. Fargo’ is double form of *R. arkansana* the pollen parent carries and exhibits many characters of this species plus a slight infusion of floribunda characters. The progeny from which RSM K1 and RSM K5 were selected was vigorous and the growth habit and dark red-purple flowers of the pollen parent were predominant.

The 2 similar and fertile RSM K1 and RSM K5 seedlings exhibited the rough foliage of *R. rugosa* to a greater degree than their sterile, probably triploid sisters. Pollen and stomata of the fertile seedlings were of the size found in tetraploid roses; cytological examination at meiosis confirmed a tetraploid count of 28 chromosomes in RSM K1. This strongly suggests they arose from ovules with the 2n complement of *R. rugosa*.

Since the 2 seedlings are similar except for petal number, only RSM K1 is described.

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**1** Received for publication March 5, 1979. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper must therefore be hereby marked advertisement solely to indicate this fact.

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**Fig. 1-3. Flowers and foliage of *R. rugosa* ‘Alba’, hybrid RSM K1, and complex *R. arkansana* hybrid parent, respectively.**