

Table 1. Effect of soil fertilization on mycorrhizal development and growth of Juniperus chinensis var. sargentii.

<table>
<thead>
<tr>
<th>Mycorrhizal treatment</th>
<th>Fertilization level (µg/g mix)</th>
<th>Total fresh wt (g)</th>
<th>Crown spread (cm)</th>
<th>Root colonization (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noninoculated</td>
<td>10N–4.4P–8.3K</td>
<td>58.8 ± d</td>
<td>26.1 d</td>
<td>3.9 d</td>
</tr>
<tr>
<td></td>
<td>110</td>
<td>99.1 cd</td>
<td>35.9 c</td>
<td>18.5bcd</td>
</tr>
<tr>
<td></td>
<td>220</td>
<td>119.8 cd</td>
<td>34.6 c</td>
<td>7.1 cd</td>
</tr>
<tr>
<td>Inoculated</td>
<td>0</td>
<td>59.7 bc</td>
<td>40.3 bc</td>
<td>39.2 a</td>
</tr>
<tr>
<td></td>
<td>110</td>
<td>209.6 ab</td>
<td>45.8 ab</td>
<td>24.4abc</td>
</tr>
<tr>
<td></td>
<td>220</td>
<td>276.4 a</td>
<td>52.7 a</td>
<td>36.4 ab</td>
</tr>
</tbody>
</table>

*Avg of maximum length x width measurements.
*Mean separation by Duncan’s multiple range test.

Fertilization levels, within the range used in this study, did not significantly affect the percentage of root colonization by the mycorrhizal fungi (Table 1). A greater concentration of P, exceeding the high rate of 45 µg/g of mix, is probably required to suppress mycorrhizal development. Rates of 50–150 µg Pi/kg of soil did not markedly reduce root infection of cotton by the isolate of G. margarita used in our study (11). The inability of 110 and 220 µg/g of mix fertilization rates to reduce mycorrhizal root colonization and the increased growth of mycorrhizal plants at the highest fertilization level suggests that these rates are suboptimum for juniper growth. Some mycorrhizal development was present in the noninoculated plants, particularly on roots near the bottom of the microplot; therefore, colonization probably occurred late in the study and may have influenced their development. In spite of this, significant growth differences occurred between the inoculated and noninoculated plants and one could surmise that the degree of benefit may have been greater in the absence of contamination.

Species of VA mycorrhizal fungi vary in symbiotic effectiveness and plants hosts may differ in mycorrhizal dependency (4); therefore, growth responses by closely related plant species cannot be assumed to be uniform. For example, Maronek et al. (9) reported no growth stimulation or inhibition with ‘Bar Harbor’ juniper (Juniperus horizontalis Moench.) inoculated with G. fasciculatum, even though roots were extensively infected with the endophyte. In our study, a mixed spore suspension of different species of VA mycorrhizal fungi, including G. fasciculatum, was used to inoculate J. chinensis var. sargentii plants with a resulting increase in plant growth. It is evident that with many species of ornamental plants, screening tests will have to be conducted to determine the host’s potential to respond to VA mycorrhizae. The use of an inoculum mixture of numerous different VA mycorrhizal fungi should ensure a quicker and surer way to make an initial evaluation. However, investigation of specific fungal species and factors, such as fertility and growth medium, should be carried out to improve mycorrhizal benefits if results of the initial test are positive.

Literature Cited


HortScience 16(9):918–919. 1982.

Evapotranspiration and Transpiration for Four Foliage Plants

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Abstract. Evapotranspiration and transpiration were determined for Aphelandra squarrosa Nees. ‘Dania’, Maranta leuconeura Kerchovieana E. Morr., Philodendron scandens subsp. oxycardium (Schott) Bunt., and Brassia actinophylla Endl. Aphelandra transpiration was 1.5 to 2 times more per unit leaf area than other species. The hypostomatous leaves of Aphelandra and Brassia had 151 and 131 stomata per mm2; stomatal density per mm2 was 66 for Maranta and 29 for Philodendron on abaxial surface, and 12 and 9, respectively, on adaxial surface. Midday abaxial water vapor conductance was 0.46, 0.26, 0.16, and 0.06 cm sec–1 for Aphelandra, Brassia, Maranta, and Philodendron, respectively.

Greenhouse foliage producers generally use large quantities of water, as much as 20,000 kl ha–1yr–1, for crop production (3). Most foliage plant species are mesophytes, which produce maximum growth when well watered and not subjected to drought stress (1, 2, 3, 4, 5, 7). Concerns over water shortages have made commercial foliage plant growers aware of the need to reduce water usage. Some water conservation could be achieved by growing plants that consume less irrigation water. Water use by foliage plants is known to vary considerably (3), but little work has been done to delineate water use patterns by individual species. Conover and Poole (2) reported that Aphelandra were shorter when grown with weekly irrigation compared to daily or twice-weekly irrigation. Water tem-
temperature between 5 and 20°C had little effect on plant height or quality for *Aphelandra* and *Maranta* (6). Work with *Aphelandra* (2) and *Ficus benjamina* (4) indicated that exposing foliage plants during production to levels of drought stress, which cause reduced growth, resulted in better acclimation for interior environments. This research examines water use for 4 popular foliage plant species: *Aphelandra*, considered by commercial growers to have a high water requirement, *Maranta* (considered to have a low water requirement), *Philodendron* and *Brassaia* (average water requirement).

Plants were obtained from commercial sources and held for 2 weeks in a double polyethylene-covered greenhouse before experiments were conducted. Maximum photosynthetic photon flux density was 270\(\mu\)E m\(^{-2}\)sec\(^{-1}\), daily maximum temperature was 31°C, and minimum relative humidity was 65%. Plants were of normal commercial size for marketing. *Aphelandra* were grown in 12.5-cm plastic pots and the other 3 species were in 10-cm plastic pots. The experimental design was a randomized complete block with 3 replications and 4 plants per experimental unit. Plant spacing was 50 cm on center to reduce effects by adjacent plants. The experiment was conducted twice, in June 1979 and June 1981, with plants from different sources. Results for both years were similar and data from 1981 experiment are presented.

Containers were watered, allowed to drain, weighed, and reweighed after 24 hr to determine evapotranspiration. For determining transpiration, the containers were then rewatered, allowed to drain, and enclosed in a plastic bag sealed around the plant stem. Containers were then weighed and reweighed after 24 hr. At 1330 hr on the second day, abaxial water vapor conductance was determined with a steady state porometer (Lambda Instruments Corporation, Model LI-1600). After the second day, stomatal densities were determined using silicone rubber impressions. Leaf areas were obtained with an area meter (Lambda Instruments Corporation, Model LI-3000 in conveyer mode).

*Aphelandra* had greater leaf area and shoot dry weight than other species (Table 1). *Maranta* had less dry weight than *Philodendron*, and *Brassaia* had less leaf area than *Philodendron*. Whole plant water loss measured as either evapotranspiration or transpiration was about 3 times greater for *Aphelandra* than for the other 3 species. Some of the additional water use was because *Aphelandra* were larger plants. However, transpiration per unit leaf area was greater in *Aphelandra* than in the other 3 species by a factor of 1.5 to 2.0. *Philodendron* transpired less water per unit leaf area than *Brassaia*.

Since *Aphelandra* was transpiring more water per unit leaf area, the total transpiration per plant would have been greater for *Aphelandra* than for the other species even if all plants had been a similar size. Plant size is probably better expressed in terms of leaf area than weight, since weight does not directly affect transpiration, whereas leaf area does through differences in interception of solar radiation. The greater transpiration per unit area can be explained by stomatal density and water vapor conductance (Table 1). *Aphelandra* and *Brassaia* had hypostomatic leaves with 151 and 131 stomata per mm\(^2\), respectively. *Maranta* and *Philodendron* had amphistomatic leaves with 66 and 29 per mm\(^2\), respectively, on the abaxial side and 12 and 9 per mm\(^2\), respectively, on the adaxial side. Stomatal frequency in most plant species is between 40 and 300 per mm\(^2\) and about one-third have amphistomatic leaves (8). Abaxial conductance, which was a function of stomatal and mesophyll conductance, was greatest for *Aphelandra* at 0.46 cm sec\(^{-1}\) and quite low for *Philodendron* at 0.06 cm sec\(^{-1}\).

These results demonstrate that there is considerable difference in the amount of water used by foliage plants when grown under a well-watered regime where they are not exposed to drought stress. A conservation system that utilizes a reduction in the amount of irrigation water supplied, thus imposing some degree of drought stress, may alter the water use patterns from those observed in this study.

**Table 1.** Leaf area, evapotranspiration, transpiration, stomatal density, and conductance for 4 foliage plant species.

<table>
<thead>
<tr>
<th>Species</th>
<th>Leaf area (cm(^2))</th>
<th>Evapotranspiration (g day(^{-1}))</th>
<th>Per plant (g day(^{-1}))</th>
<th>Per leaf area (mg cm(^{-2}) day(^{-1}))</th>
<th>Stomata mm(^{-2})</th>
<th>Abaxial conductance (cm sec(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aphelandra squarrosa</em></td>
<td>1626</td>
<td>60</td>
<td>63</td>
<td>39</td>
<td>151 0</td>
<td>0.46</td>
</tr>
<tr>
<td><em>Brassaia actinophylla</em></td>
<td>691</td>
<td>20</td>
<td>17</td>
<td>25</td>
<td>131 0</td>
<td>0.26</td>
</tr>
<tr>
<td><em>Maranta leuconeura</em></td>
<td>915</td>
<td>21</td>
<td>19</td>
<td>21</td>
<td>66 12</td>
<td>0.16</td>
</tr>
<tr>
<td><em>Philodendron scandens</em></td>
<td>subsp. oxycardium</td>
<td>1061</td>
<td>21</td>
<td>19 18</td>
<td>29 9</td>
<td>0.06</td>
</tr>
<tr>
<td><em>Philodendron scandens</em></td>
<td>HSD 5%</td>
<td>323</td>
<td>7</td>
<td>8 6</td>
<td>56 7</td>
<td>0.19</td>
</tr>
<tr>
<td><em>Philodendron scandens</em></td>
<td>1%</td>
<td>436</td>
<td>9</td>
<td>10 8</td>
<td>75 10</td>
<td>0.26</td>
</tr>
</tbody>
</table>

**Literature Cited**


