form seedling growth for both species was in the intermittent mist treatment.

Seed germination of *K. latifolia* was highest (90%) in the treatment employing intermittent mist and 24-hr photoperiod. *R. maximum* germination was highest with intermittent mist watering, with no difference between 10-hr (85%) and 24-hr (86%) photoperiods.

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Growth of *Juniperus chinensis* var. *sargentii* as Influenced by Vesicular-arbuscular Mycorrhizae and Soil Fertility[1]

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Additional index words. *Gigaspora margarita, Glomus fasciculatum, Glomus mosseae,* juniper

Abstract. **Total fresh weight and crown spread of *Juniperus chinensis* var. *sargentii* Henry plants, grown in microplots containing a low fertility medium of 4 soil:1 sand:1 milled pine bark and amended with 10N–4.4P–8.3K fertilizer at rates of 0, 110, or 220 µg/g, were significantly increased by inoculation with a spore mixture of 3 different vesicular-arbuscular (VA) mycorrhizal fungi. Higher fertilizer concentrations improved crown spread but did not affect plant growth. Root colonization by the endophytes ranged from 24.4 to 39.2% and was unaffected by fertilization rates.**

An understanding of the role that VA mycorrhizae play in plant health has led to attempts to manipulate the symbiotic relationship to improve certain crop management systems, such as tree nurseries (12). VA mycorrhizae are involved in mineral absorption (4), primarily phosphorus, and may improve water uptake (4) and transplantability (6, 8, 9, 10). Most reports of plant growth stimulation by VA mycorrhizae have resulted from pot studies using low P soils that are usually treated to eliminate the native microflora (4). Since soil mixes and various potting media used in container production of ornamental plants are often fumigated or treated, these systems offer an excellent opportunity to introduce inoculum and utilize the benefits of VA mycorrhizal fungi (8).

Potential use of VA mycorrhizae has been demonstrated with such crops as poinsettia (1), viburnum, podocarpus and pittosporum (3), rhododendron (7), and magnolia (9). An experiment was designed to evaluate the effects of inoculation with VA mycorrhizal fungi and application of various fertilization rates on root colonization by the endophytes and subsequent growth of *Juniperus chinensis* var. *sargentii*.

On July 23, 1976, 4-month-old, heavily rooted cuttings of *J. chinensis* var. *sargentii* were planted directly into microplots containing a mix of 4 parts forest clay loam soil, 1 part washed river sand, and 1 part milled pine bark (v/v/v). Prior to mixing, soil analysis results as determined by the Soil and Plant Analysis Laboratory, Cooperative Extension Service, University of Georgia, were: P 10, K 30, Ca 144, Mg 20, Zn 2, Mn 60, B 0.5, and NO_3-N 7 µg/g, 5×10^{-5} mhos soluble salts, pH 5.7, and 2.1% organic matter.

During medium mixing, differential fertilization treatments were established by incorporation of a 10N–4.4P–8.3K fertilizer at the rates of 0, 110, or 220 µg/g of mix. The media were fumigated under a polyethylene cover for 48 hr with methyl bromide (Dowfume MC-2), vented, and placed in outdoor microplots. The soil on which the microplots were placed was first drenched with 200 µg/ml (pentachloronitrobenzene) Terraclor and covered with black polyethylene to suppress contamination by the native VA mycorrhizal fungi. The microplots were constructed of 5 × 30-cm lumber with outside dimensions of 61 cm length, 91 cm width, and 30 cm depth, and were spaced 1.2 m apart within and between rows. The interior of each microplot was treated with a 25% NaClO drench and each unit received 0.17 m^3 of medium.

VA mycorrhizal fungi were increased on *Sorghum bicolor* (L.) Moench. 'Shallu' grown in greenhouse pot culture. Spores of *Glomus fasciculatum* (Thaxt. sensu Gerd.) Gerd. & Trappe, *G. mosseae* (Nicol. & Gerd.) Gerd. & Trappe, and *Gigaspora margarita* Becker & Hall were extracted using a modified centrifugal-flotation technique (5). At planting, each microplot received 1 juniper cutting, the root system of which was drenched with a suspension of 4450 spores in 100 ml of water comprised of the following ratio: *G. fasciculatum* (3500), *G. margarita* (600), and *G. mosseae* (350). A mixed spore suspension was used to increase the possibility of development of mycorrhizae, since little is known about fungal symbionts that success fully colonize juniper roots. Each control cutting received 100 ml of spore filtrate collected after passage through Whatman #1 filter paper.

After planting, cuttings were covered with polypropylene shade cloth to reduce light intensity 30%. All plants were irrigated as needed and were fertilized twice during the fall of 1976 with 20N–8.8P–16.6K liquid fertilizer containing micronutrients with each plant receiving 200 µg/g of mix. On May 17, 1977, all plants were fertilized with NH_4NO_3 at the rate of 79 µg/g of mix. In October 1977, plants were harvested and horizontal crown spread and total plant fresh weight were determined. Young feeder roots were collected at random throughout the root system and were assayed for mycorrhizae by clearing and staining (2). The percentage of colonization was determined by measuring the length of root containing mycorrhizae in 20 sections per plant, each 1.5-cm-long. The experiment was a 2 × 3 factorial in a randomized complete block design with 6 replications.

VA mycorrhizae significantly increased both plant fresh weight and crown spread, whereas additional fertilization of 110 or 220 µg/g of mix improved only crown spread by 25–28% (Table 1). VA mycorrhizae increased plant weight by 112–172% and crown spread by 26–54% when compared with nonmycorrhi-

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

Mycorrhizal treatment	Fertilization level 10N–4.4P–8.3K (μg/g mix)	Total fresh wt (g)	Crown[z] spread (cm)	Root colonization (%)
Noninoculated	0	58.8 d[y]	26.1 d	3.9 d
	110	99.1 cd	35.9 c	18.5 bcd
	220	119.8 cd	34.6 c	7.1 cd
Inoculated	0	159.7 bc	40.3 bc	39.2 a
	110	209.6 ab	45.8 ab	24.4 abc
	220	279.6 a	52.7 a	36.4 ab

[z]Avg of maximum length × width measurements.
[y]Mean separation by Duncan's multiple range test, 5% level.

zal plants at the same fertilization rate. The degree of mycorrhizal-induced growth response was significant enough to surpass the effect of fertilization; mycorrhizal plants receiving 110 μg fertilizer/g of mix exceeded the growth and crown spread of nonmycorrhizal plants fertilized with 220 μg/g of mix by 57 and 34%, respectively.

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 P/g 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 surmize 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 (*J. 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.

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Evapotranspiration and Transpiration for Four Foliage Plants[1]

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Abstract. **Evapotranspiration and transpiration were determined for *Aphalandra squarrosa* Nees. 'Dania', *Maranta leuconeura Kerchoviana* E. Morr., *Philodendron scandens* subsp. *oxycardium* (Schott) Bunt., and *Brassaia actinophylla* Endl. *Aphelandra* transpiration was 1.5 to 2 times more per unit leaf area than other species. The hypostomatous leaves of *Aphelandra* and *Brassaia* had 151 and 131 stomata per mm^2; stomatal density per mm^2 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, Brassaia, Maranta,* and *Philodendron*, respectively.**

Greenhouse foliage producers generally use large quantities of water, as much as 20,000 kl ha^{-1}yr^{-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-

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