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GROWTH OF *SPATHIPHYLLUM* 'PETITE' IN SUBSTRATES INOCULATED WITH MYCORRHIZAE

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Abstract. **The growth of *Spathiphyllum* Schott 'Petite' plants was compared at two phosphorus levels (high and low) in a peat-based substrate inoculated with vesicular-arbuscular mycorrhizal (VAM) fungi and in a peat-based media without VAM fungi. Tissue culture plantlets of *Spathiphyllum* were transplanted into 2.4-liter pots filled with either modified Pro-Mix 'HP' or modified Pro-Mix 'HP' with Mycorise™. The modified Pro-Mix 'HP' with Mycorise™ was made by adding *Glomus intraradices* Schenck & Smith inoculum to a modified Pro-Mix 'HP' substrate at a rate of ~1 g (fresh mass) of leek roots colonized by the appropriate fungus for every 60 cm³ of substrate. Plants grown in substrates with VAM fungi exhibited some root colonization by week 15 while none of the plants grown in substrates without VAM exhibited root colonization. There was no significant difference in the percentage of roots colonized by *Glomus intraradices* between the high and low substrate P treatments. Although colonization did occur, there was no significant difference in plant growth among any of the treatments.**

Introduction

There is a potential to use peat-based substrates inoculated with vesicular-arbuscular mycorrhizal (VAM) fungi in commercial container production (e.g., foliage production). VAM fungi will colonize the roots of numerous plants grown in a wide range of substrates. However, substrate characteristics and cultural practices can affect VAM fungal distribution, activity, survival, and root colonization (Biermann and Linderman, 1983; Datnoff et al., 1991; Hayman, 1982).

Studies comparing the growth of inoculated and non-inoculated plants in various peat-based substrates report differences based on the phosphorus (P) concentration in the substrate. For example, Ponton et al. (1990) reported that Boston fern growth was higher in inoculated substrates with low P fertilization than in control substrates with low P, but that Boston fern growth in inoculated substrates with high P fertilization was less than the non-inoculated control substrates with high P. No work has been conducted on the growth of *Spathiphyllum* in peat-based substrates containing VAM fungi. The objective of this experiment was to compare the growth of *Spathiphyllum* 'Petite' at two phosphorus concentrations in a peat-based substrate inoculated with VAM fungi and in a peat-based media without VAM fungi.

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Materials and Methods

On 24 May 24 1997, tissue culture plantlets of *Spathiphyllum* 'Petite' (Foremost Foliage, Miami, Fla.) were transplanted into 2.4-liter pots filled with either modified Pro-Mix 'HP' or modified Pro-Mix 'HP' with Mycorise™ (Premier, Red Hill, Pa.). Modified Pro-Mix 'HP', a high porosity medium, was prepared by Premier and contained sphagnum peat, coarse perlite, dolomitic and calcitic limestone and had an initial substrate P concentration of 10-20 $\mu g \cdot g^{-1}$. Premier also prepared the modified Pro-Mix 'HP' with Mycorise™ by adding *Glomus intraradices* inoculum to the modified Pro-Mix 'HP' substrate. The VAM inoculum was produced by the Centre de Recherche Premier (Riviere-du-Loup, Quebec) using the pot culture method of Plenchette et al. (1982). Approximately 1 g (fresh mass) of leek roots colonized by the appropriate fungus was added for every 60 cm³ of substrate (Ponton et al., 1990).

This experiment was conducted in a greenhouse held at 24 to 33°C with a relative humidity of 68% to 84% at the University of Florida Fort Lauderdale Research and Education Center. Daylight intensities in the greenhouse varied from 21 to 105 $\mu mol \cdot m^{-2} \cdot s^{-1}$. Plants were arranged in a randomized complete block design of five blocks with 20 plants per block (10 plants per substrate treatment). One week after transplanting, five plants per substrate treatment were top-dressed with 25 $mg \cdot liter^{-1}$ P (300g/pot) as triple super-phosphate (0N-19.8P-0K) (Lyke Ari-Sales, Fort Pierce, Fla.). The remaining five plants did not receive any P (low P treatment).

All plants were watered as needed with 33.4 $mg \cdot liter^{-1}$ N as Peter's 21N-2.2P-16.6K and 67.5 $mg \cdot L^{-1}$ N as Peter's 15N-2.2P-12.45K (The Scotts Company, Marysville, Ohio). Every seventh watering was with water without added nutrients. Plant height and width were measured every two weeks throughout the experiment. Height was measured from the surface of the substrate to the apical meristem and was averaged with plant width to determine plant size.

On 19 July 1997 (week 8), 4 Sep. 1997 (week 15), and 25 Sep. 1997 (week 18) four random plants per block (one plant from each substrate and P combination) were harvested to determine shoot fresh weight, shoot nutrient concentration, and mycorrhizal colonization of roots. Substrate samples also were taken on these dates to determine substrate nutrient concentration. Premier Horticulture Laboratories (Athens, Ga.) determined substrate and shoot nutrient concentrations while Premier Laboratories (Quebec, Canada) determined mycorrhizal colonization of roots. On 25 Sep. 1997 (week 18), remaining shoots were cut at the surface of the medium, dried for 48 hr at 93°C and weighed. All data were analyzed by analysis of variance procedures.

Results and Discussion

Spathiphyllum plants grown in substrates inoculated with VAM fungi exhibited root colonization by week 15 while none of the plants grown in substrates without VAM fungi exhibited any root colonization (Table 1). Similar percentages of

Table 1. Average percentage of *Spathiphyllum* 'Petite' root segments colonized by *Glomus intraradices.* Plants were grown with either a high or low phosphorus concentration in a peat-based substrate inoculated with VAM fungi or in a peat-based substrate not inoculated. Values are means of five replications.

		Root age (weeks)		
Substrate	Phosphorus	8	15	18
With VAM fungi	High	0	11.2	11.8
	Low	0	8.8	13.5
Without VAM fungi	High	0	0	0
	Low	0	0	0
Significance[z]				
Substrate		NS	**	***
Phosphorus		NS	NS	NS

[z]NS,**, *** indicate a nonsignificant response or significant response at $P \leq 0.01$, or 0.001, respectively.

roots were colonized by *Glomus intraradices* between the high and low substrate P treatments applied to the substrates with VAM.

Although root colonization occurred, *Spathiphyllum* size was not different among the treatments (Fig. 1). Plants grown in substrates with VAM fungi were the same size as plants grown in substrates without VAM fungi. Similarly, plant growth at high P concentrations was the same as at low P concentrations.

It is well established that soil moisture, soil fertility, pH, and soil organic matter can affect VAM fungal distribution, activity, survival, and colonization rates (Hayman, 1982). For example, high levels of acid peat, soluble P, soluble salts, and NH_4-N in soilless substrates can reduce VAM colonization and plant growth responses (Biermann and Linderman, 1983; Datnoff et al., 1991; Di Bonito et al., 1994; Ponton et al., 1990). However, in our experiment there were no significant differences in substrate nutrient concentration between the two substrates (Table 2). Although substrates top-dressed with triple super phosphate had significantly higher P concentrations than substrates not top-dressed, plant response to VAM infection is governed by the concentration of P within the host plant (Carling and Brown, 1983). At elevated P concentrations within the host, there is a reduction in host membrane permeability, a reduction in the release of root exudates, and a decrease in VAM root colonization (Carling

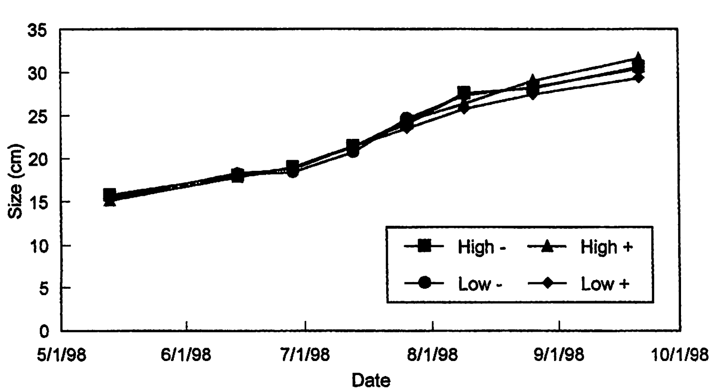

Figure 1. Change in *Spathiphyllum* 'Petite' plant size (fresh weight) over time for plants grown with either a high or low phosphorus concentration in a peat-based substrate inoculated with VAM fungi (+) or in a peat-based substrate not inoculated with VAM fungi (-). Values are means of five replicates.

Table 2. Average substrate electrical conductivity (EC) and nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) concentrations in peat-based substrates with either high or low phosphorus treatments and inoculated with VAM fungi or not-inoculated with VAM fungi. Because there was no significant difference in substrate nutrient concentrations among the three sample dates, values were combined (n = 15).

		EC	N	P	K	Ca	Mg
Substrate	Phosphorus	($dS \cdot m^{-1}$)	$\mu g \cdot g^{-1}$				
With VAM fungi	High	0.40	19.8	4.64	14.6	25.5	5.3
	Low	0.37	17.2	3.09	13.8	22.3	4.8
Without VAM fungi	High	0.57	26.6	4.20	20.4	32.7	6.8
	Low	0.33	16.7	2.61	12.9	19.4	3.8
Significance[z]							
Substrate		NS	NS	NS	NS	NS	NS
Phosphorus		NS	NS	**	NS	NS	NS
Suggested standard[y]		0.7-2.0	40-200	5-30	40-200	40-200	25-80

[z]NS,** indicate a nonsignificant response or significant response at $P \leq 0.01$, respectively.

[y]Suggested standards are from recommendations from Premier Horticulture Laboratories (Athens, Ga.) who used a saturated media extract technique.

Table 3. Average shoot nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) concentration of *Spathiphyllum* 'Petite' grown with either a high or low phosphorus concentration in a peat-based substrate inoculated with VAM fungi or in a peat-based substrate not inoculated. Because there was no significant difference in substrate nutrient concentrations among the three sample dates, values were combined (n = 15).

		N	P	K	Ca	Mg
Substrate	Phosphorus	$\mu g \cdot g^{-1}$				
With VAM fungi	High	3.28	0.39	6.09	1.01	0.37
	Low	3.26	0.37	5.80	1.03	0.38
Without VAM fungi	High	3.44	0.44	7.00	1.19	0.40
	Low	3.29	0.39	6.02	1.22	0.40
Significance[z]						
Substrate		NS	NS	NS	NS	NS
Phosphorus		NS	NS	NS	NS	NS
Suggested standards[y]		3.3-5.0	0.2-1.0	2.3-6.0	0.8-2.0	0.2-1.0

[z]NS indicates a nonsignificant response.

[y]Suggested standards are from recommendations from Premier Horticulture Laboratories (Athens, Ga.).

and Brown, 1983). There were no significant differences in shoot N, P, K, Ca, or Mg concentrations among the treatments (Table 3). Shoot nutrient concentrations were within the recommended guidelines reported by Griffith (1998) and by the Premier Horticulture Laboratories (Athens, Ga.).

Under optimum growing conditions, non-mycorrhizal plants will grow as well as mycorrhizal plants. For example, when nutrients are not growth limiting, non-mycorrhizal plants can exploit nutrient resources as well as mycorrhizal plants (Marschner, 1995). In this experiment there appeared to be no added benefit to having VAM fungi in the substrate because the *Spathiphyllum* plants were grown with adequate to optimum fertilizer concentrations, light levels, temperature, and humidity.

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PHYTOTOXICITY OF MULTIPLE APPLICATIONS OF PREEMERGENCE HERBICIDES TO LIRIOPE

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Abstract. **Two applications of two rates each of isoxaben, metolachlor, oxadiazon and pendimethalin, and single combinations of the low or high rate of metolachlor, oxadiazon and pendimethalin with isoxaben were evaluated for phytotoxicity and growth effects on 'Evergreen Giant' liriope at a commercial nursery in Palmetto, Fla. during the spring and summer of 1991. Little phytotoxicity was observed after the first application with any treatment and that which did occur was of minimal concern. A second application 8 weeks after the first produced injury sooner and to a greater extent than the first application with several treatments. Early injury was greatest with combinations of isoxaben and oxadiazon, and the low rate of isoxaben + pendimethalin. The high rate of oxadiazon (9 kg/ha) and the low rate of isoxaben (1.1 kg/ha) also produced some injury. Combinations of isoxaben with oxadiazon or pendimethalin reduced liriope plant vigor the most. No herbicide treatment reduced liriope plant height or root weight; however, plants receiving the low rate of oxadiazon (4.5 kg/ha) were taller and had greater root weight than those in many treatments, including the nontreated control. There were more differences in foliage weight than in root weight in this study. Foliage weight was reduced by the high rate of isoxaben (2.2 kg/ha), and most combinations of isoxaben with metolachlor, oxadiazon or pendimethalin.**

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Introduction

Weed control in container grown ornamentals is especially important to the nursery grower because profit depends upon rapid turnover of plant material. Weed competition can reduce growth significantly (47% to 75% in some studies) (Fretz, 1972a; Gibson, 1985) and it has been estimated to take 625 hours of hand weeding to produce 0.4 ha of marketable plants (Carpenter, 1973; Fretz, 1972a; Fretz, 1972b). A single application of preemergence herbicide has been shown to reduce manual labor requirements by as much as 50% for some species of container grown ornamentals (Bingham, 1968). Multiple applications of herbicide over the course of a production cycle may achieve even greater labor savings. In addition to reduced growth from weed competition and the increase in labor required to grow the crop, there is the increase in time required for the crop to reach a marketable size and the loss of quality and the resultant decline in price commanded by the plant material. Thus, poor weed control may extract a very high price from the grower.

Efficacy of weed control has been well documented for most of the commonly available herbicides, but there are large data gaps in crop tolerance for ornamental species. Much of the research has focused on plant material which is not grown extensively in the deep southern U.S. and little has been done with liriope (*Liriope muscari* (Decne.) L. H. Bailey) (Hood and Klett, 1992; Neal and Senesac, 1990a; Skroch et al., 1994; Stamps and Neal, 1990). Additionally, previous research often involved single applications of individual preemergence herbicides, while nursery crops are generally grown with at least two applications before reaching marketable size. Thus, potential injury from the multiple applications was not always addressed.