

Influence of an Aluminum Amendment on Phosphorus Leaching from a Container Medium

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Abstract. Columns of an incubated (25°C, 11% volumetric moisture for 30 days) 2 milled pine bark : 1 Canadian sphagnum peat : 1 builders' sand (by volume) medium amended with the equivalent of 270 g P·m⁻³ from radioactive superphosphate (8.7% P) and the equivalent of 0, 33, 200, or 1200 g Al·m⁻³ from aluminum acetate (13.2% Al) were leached daily with 16 ml deionized water. Eighty percent of the ³²P amendment leached during days one to 21 from the medium not amended with Al, whereas 0.3% leached when amended with 1200 g Al·m⁻³. Leachate ³²P levels ranged from 840, 711, 91, and 2.0 µg·ml⁻¹ on day 1 to 2.3, 3.3, 7.6, and 0.9 µg·ml⁻¹ on day 77 for the medium with Al amendments of 0, 33, 200, and 1200 g·m⁻³, respectively.

Soilless container media are amended with superphosphate, because P is fixed as Al and/or Fe complexes and does not leach readily from most mineral soils; however, organic soils do not contain the Al or Fe quantities commonly found in mineral soils (3). Consequently, less P is adsorbed by organic colloids, and adsorbed P in organic soils is more water soluble than adsorbed P in mineral soils (3). Larsen et al. (4) determined a leached virgin muck soil retained less P than a leached mineral soil.

Recent research indicates that pine bark (10) and Canadian peat (5) have small P adsorption capacities; consequently P leaches from media composed primarily of these components. Yeager and Barrett (9) determined that 76% of a ³²P amendment leached in 3 weeks from a 2 milled pine bark : 1 Canadian peat : 1 builders' sand (by volume) medium amended with superphosphate. The medium in that study had a negligible anion exchange capacity (Arvel Hunter, personal communication) possibly due to the indigenous Al (0.24%). The following research was conducted to determine the influence of an

Al amendment on P leaching from a superphosphate-amended soilless medium. An oven dried 2 milled pine bark : 1 Ca-

Table 1. Influence of Al from an aluminum acetate (13.2% Al) amendment on ³²P after 1 and 21 days leaching from a 2 milled pine bark : 1 Canadian peat : 1 builders' sand (by volume)^z.

Al amendment (g·m ⁻³)	³² P leached (percentage of applied)	
	Day 1	Days 1-21
0	32.4	79.7
33	26.8	72.4
200	3.7	27.4
1200	0.1	0.3
R ^{2y}	0.71****	0.86***

^zMedium amended with 270 g ³²P·m⁻³ from ³²P-superphosphate (8.7% P).

^yRegression equations for arcsin transformed data are as follows: arcsin percentage (Day 1) = -0.02 Al + 28.10, arcsin percentage (Days 1-21) = -0.05 Al + 55.35.

x,***Significant at 0.1% level.

nadian peat : 1 builders' sand (by volume) medium with 20% air space (6) and a particle size distribution (by weight) of 44.6% less than 0.5 mm, 34.3% between 0.5 and 1.4 mm, 18.6% between 1.4 mm and 4.0 mm, and 2.5% between 4.0 and 6.4 mm (U.S. Series sieve nos. 35, 14, 5, and 3, respectively) was used for this study. Particle size

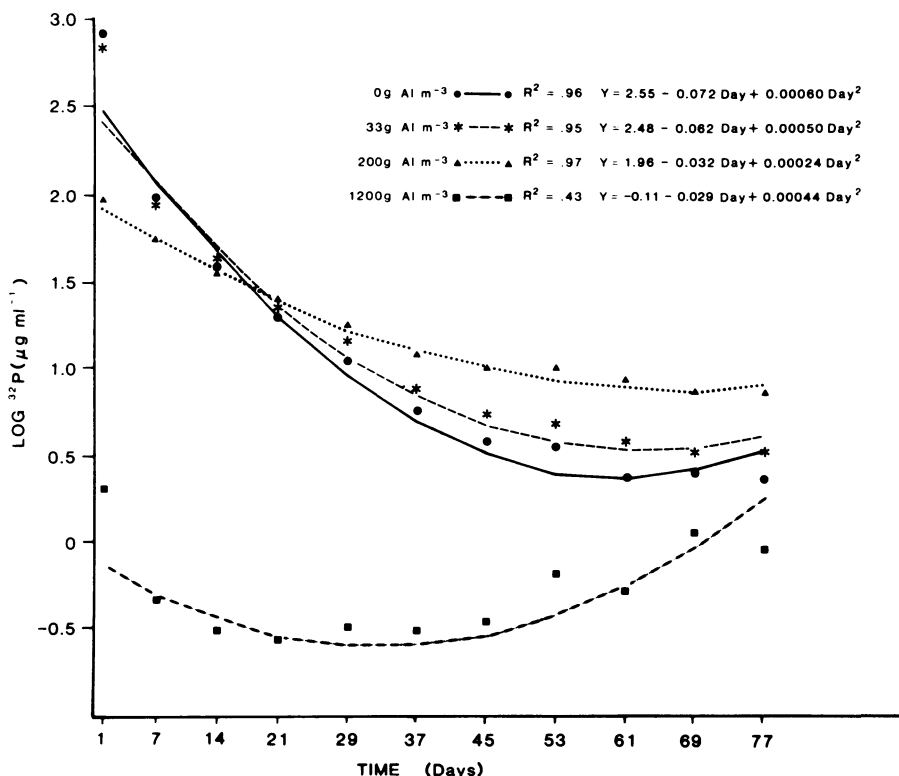


Fig. 1. Leachate ³²P levels from columns of a 2 milled pine bark : 1 Canadian peat : 1 builders' sand (by volume) medium amended with the equivalent of 270 g ³²P·m⁻³ from ³²P-superphosphate and either 0, 33, 200, or 1200 g Al·m⁻³ from aluminum acetate (13.2% Al). Columns were leached daily with 16 ml·hr⁻¹ deionized water (pH 5.5). Slope comparisons are as follows [**Significant at 1% level, using modified t test (2)].

Leach Day
1, 7, 14 and 21
β _(●) vs. β _(*) **
β _(●) vs. β _(▲) **
β _(●) vs. β _(■) **
Leach Day
61, 69 and 77
β _(●) vs. β _(▲) **

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distribution was obtained by shaking 3 replicate samples on a Tyler Portable Sieve Shaker (W.S. Tyler Inc., 8200 Tyler Blvd. Mentor, Ohio) for 20 min. The medium was amended with the equivalent of 4.2 kg·m⁻³ of dolomitic limestone, and 93 g of medium were placed in 28 plastic bags. Seven replicate bags of medium were amended with 0, 33, 200, or 1200 g Al·m⁻³ from aluminum acetate (13.2% Al), and radioactive superphosphate [8.7% P, 300 μCi·g⁻¹P (1 Ci = 37 GBq)] was added to each bag at a rate equivalent to 270 g P·m⁻³. Each bag was hand shaken for 1 min after addition of aluminum acetate and superphosphate, 19 g of deionized water were added, and each bag was again shaken for 1 min. Bags of media were incubated at 25°C in a Precision Incubator Model 818 (SGA/Precision Scientific Group, Chicago, IL 60647). Deionized water was added to each medium about every 2 days during incubation to maintain 11% volumetric moisture (20% gravimetric).

After 30 days, medium in each bag was placed in a polyvinyl chloride column (4 × 15 cm) described previously (9). Columns, supported by a metal frame in the laboratory (21° to 26°C), were arranged in a completely randomized design. Each column was leached the first day with 48 ml of deionized water (pH 5.5) in 3 hr. Thereafter, each column received 16 ml in 1 hr, daily, until termination of the experiment on day 77. For 21 consecutive days and every 4th day thereafter, leachate volume was recorded; pH determined using a Corning Model 12 pH meter (Corning Glass Works, Medfield, MA 02052); and an aliquot placed in a scintillation vial containing 10 ml of Scintiverse II (Fisher Scientific Co., 711 Forbes Ave., Pittsburgh, PA 15219). Radioactivity in each sample was determined by liquid scintillation spectrophotometry techniques (8). Corrections were made for background and decay. Quantity of ³²P leached from each column for 21 consecutive days was calculated as a percentage of ³²P initially placed in each column and analyzed after arcsin transformations. Leachate ³²P concentrations were calculated from radioactivity of the leachate. Leachate concentrations were regressed with time (1) and slopes compared by a modified *t* test (2).

The percentage of ³²P amendment leached on day 1 and during days 1–21 decreased with increasing Al amendment rates (Table 1). Reduction in ³²P leached on day 1 was not directly related to leachate volume, which averaged between 17 and 24 ml on day 1 and 231 and 242 ml for days 1–21.

Leachate pH on day 1 and days 1–21 averaged 4.6, 4.7, 5.7, and 6.6; and 5.5, 5.5, 5.9, and 7.3 for 0, 33, 200, and 1200 g Al·m⁻³, respectively. However, it is doubtful the reduction in ³²P leached was a result of hydrogen ion concentration, since, in previous experimentation (9), more ³²P leached with higher pH. Also, acid soils usually have increased anion adsorption (7).

Leaching rate of ³²P on days 1, 7, 14, and 21 decreased with each Al amendment rate (Fig. 1). Leaching rate was greater on days 61, 69, and 77 for the unamended medium

than for medium amended with 200 g Al·m⁻³, indicating the Al amendment may have resulted in a stronger P retention than indigenous medium components. However, the μg ³²P per ml of leachate were greater [as determined by HSD (1% level), data not shown] on days 20 through 77 for the 200 g·m⁻³ amendment than for the unamended medium.

These data indicate that ³²P leaching was reduced with aluminum acetate. After 21 days of leaching, 80% of the ³²P amendment leached from the medium not amended with aluminum; whereas only 0.3% leached when amended with Al at 1200 g·m⁻³. Leachate ³²P levels ranged from 840, 711, 91, and 2.0 μg·ml⁻¹ on day 1 to 2.3, 3.3, 7.6, and 0.9 μg·ml⁻¹ on day 77 for Al amendments of 0, 33, 200, and 1200 g·m⁻³, respectively.

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Growth Retardants as an Aid to Adapting Freesia to Pot Culture

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Abstract. *Freesia (Freesia hybrida Bailey)* corms were treated with paclobutrazol or ancymidol as a 5 mg a.i. soil drench, or with paclobutrazol as a 250 ppm preplant corm soak treatment. Both growth retardants significantly reduced plant height and inflorescence length, but had no effect on number of flowering spikes per pot or number of days to flowering. The preplant corm soak treatment was even more effective for height control than the soil drench application. Both compounds can be used to reduce plant height, allowing the adaptation of freesia to pot plant culture. Chemical names used: β-[(4-chlorophenyl)methyl]-α-(1,1-dimethylethyl)-1H-1,2,4 triazole-1-ethanol (paclobutrazol) and α-cyclopropyl-α-(4-methoxyphenyl)-5-pyrimidinemethanol (ancymidol).

Freesia is grown extensively in Europe and Japan as a cut flower crop. *Freesia* corms produce a vividly colored and fragrant inflorescence 30–50 cm long in 4 to 5 months in the greenhouse. The plants require cool temperatures (10° to 15°C) for both growth and floral initiation (2) and could therefore become an important winter greenhouse crop

in the United States for either cut flower production or pot plant production.

Adaptation to pot plant culture has been limited because the leaves and long flowering spikes require staking or wire-frame supports to maintain an upright growth habit (1). Growth retardants, however, have been used to prevent excessive stem growth in Easter lily (4) and tulip (3) when these crops are produced as potted plants. This report describes our results using ancymidol and paclobutrazol as a soil drench or as a preplant corm treatment for height control of freesia.

Nondormant freesia corms were obtained commercially. Five corms were potted in 15.2 cm pots in a mix of sphagnum peat (50%) and vermiculite (50%) (v/v). The media con-

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