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# Ammonium Nitrogen Accumulation and Leaching from an All Pine Bark Medium[1]

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*Abstract.* **When a 200 ppm N solution as $(NH_4)_2SO_4$ was percolated through a wet pine bark medium, 6 times the medium volume of the N solution was required to reach an equilibrium of N in the bark. Once equilibrium was reached, the water added, leaching of the ammonium ion was rapid. When twice the medium volume of water was passed through the medium, 85% of the ammonium ions were leached. After analysis of the leachate indicated no N being leached from the bark, 60 ppm of N remained in the bark.**

Pine bark is suggested for use as a medium for short term crops provided adequate N is supplied and the acidity is controlled (5). Because of the coarse nature of pine bark, more frequent watering is required, leading to an increase in leaching of nutrients. Numerous sites exist on the internal surfaces of the bark particles for the absorption of water and nutrients (1,2,12). These small cellular connections may be the reason bark is difficult to saturate.

It has been determined that pine bark induces a drain on the N supply in the soil (4) which requires replacement. This N reduction may be caused by microorganisms in the medium competing for available N. Recent studies with nitropyran, a nitrification inhibitor, indicate that ammonium is rapidly absorbed by pine bark and that it may be available to the plant (7). The advantages of pine bark in a growing medium outweigh the disadvantages. It is inexpensive, lightweight, uniform, reproduceable, and generally available (8). It has been shown to be useful as an amendment as well as a growing medium (9,10,12). Research indicates that pine bark compares favorably with, and substitutes well for other organic amendments, such as peat moss, in the growing medium. However, adequate N management is necessary in a highly organic medium to maintain optimum levels for crop production.

The purpose of this study was to determine the amount of ammonium N required to bring the bark to a N equilibrium, how rapidly it is leached, and to what extent ammonium N is retained by pine bark.

The medium used was 100% pine bark, primarily from *Pinus taeda,* that was milled to pass a 6.35 mm screen. The range of particle sizes in the bark was fine (under .60 mm), 35.6%; medium (.60 mm to 1.00mm), 32.8%; and coarse (1.00 mm to 6.35 mm), 31.6%. The medium bulk density was 0.275 g/cc and the pH was 4.2.

The pine bark was completely saturated with deionized water for 72 hr as described by Pokorney et al. (11). The saturated bark was packed into a glass column 50 cm in diameter to a height of 16.5 cm comparable to the depth of a standard 2.8 liter nursery container. Glass wool was used at the base of the column to hold the bark in the column. Distilled water was eluted through the column initially, and analyzed to varify the lack of ammonium ions in the medium.

A 200 ppm N solution from ammonium sulfate was constantly dripped on the column until the concentration of N solution eluting from the bark medium reached equilibrium. After equilibrium was reached, about 3 liters more of the ammonium sulfate solution were passed through the column. Then deionized water was dripped through the column until no detectable N was removed from the bark substrate.

The initial 200 ppm ammonium solution was varified by analysis. Each 100 ml fraction passing through the medium was collected. These fractions were immediately analyzed for N by the macro-Kjeldahl method (13–. The volume of ammonium sulfate solution necessary to saturate the bark with ammonium and the volume of water necessary to remove all leachable ammonium were determined. Bark from the column was analyzed (13) at the end of the experiment to determine the amount of N retained by the bark and verify any difference between total N added and total N leached. The pH of the medium did not change during the 7 hr required to introduce the ammonium and remove all that was leachable. The variation of ammonium concentration in sample fractions from 4 simultaneous columns were not found to be significantly different.

Six times the container volume of applied ammonium solution was required to bring the ammonium level of the medium to equilibrium as indicated by the N levels of the leachate fractions becoming constant (Fig. 1). The N content of the accumulated leachate fractions when equilibrium was reached was 7-8 ppm less than that being added. The difference in the amount of N added and that recovered is an indication of the capacity of pine bark to retain ammonium N. When the bark was leached with water, twice the container volume of water reduced the recoverable ammonium N by 85-90%. When the analysis of the leachate fractions indicated no recoverable ammonium N present; 19.4 mg of applied N or 1.94% of the total applied N remained in the system. This amount was equivalent to 60 ppm N in the substrate.

The total N analysis of the bark substrate indicated that 99.4% of the added N not leached from the medium was retained by the bark. The inability to remove this N by watering indicated that it was absorbed by the bark.

These findings are contrary to previous authors (7) who indicate that ammonium ions are rapidly absorbed by a pine bark substrate. Their conclusions are supported by the absence of stem lesion on tomatoes, an ammonium sensitive species. The present study indicates that the ammonium ions were rapidly leached from the bark medium, leaving only a very small amount. Those ions not removed by water are apparently absorbed by the bark.

The ammonium retained by the medium can be explained in several ways. The greatest amount of the added ammonium is accounted for by the 99.4% retained in the bark itself. Volatilization of the unrecovered N was minimal due to the low pH of the substrate and the rapid rate of leaching (6,14). The conversion of ammonium N to nitrate N by microbial activity was unlikely because: a) the pH of the medium was too low for nitrifying bacteria to have a significant effect, b) water tension in this loose medium should reduce nitrification, and c) the time required to bring the medium to ammonium equilibrium and to leach out all recoverable ammonium was only 7 hr, allowing insufficient time for nitrification occurrence (3).

With field container nursery production in 1 gallon containers (3.8 liters) 5.5 liters of water passing through the substrate will leach up to 90% ammoni-

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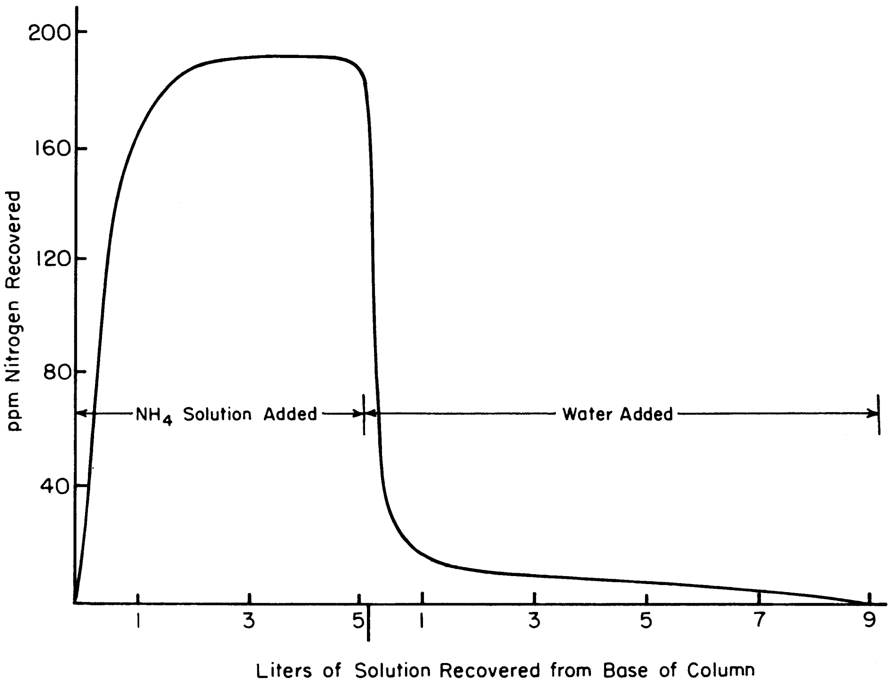


Fig. 1. Nitrogen eluted from a column of milled pinebark when added over a 7 hr period as 200 ppm N from $(NH_4)_2SO_4$, then flushed with water.

um nitrogen from a pine bark medium. The ammonium N levels in a pine bark substrate are reduced below optimum levels for plant growth with as few as 3 irrigations. The amount of ammonium remaining in a pine bark substrate after leaching is small.

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# Preemergent Herbicides for Seeded Nursery Crops[1]

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*Abstract.* **Ten preemergent herbicides were applied to the medium surface of nursery containers 1 day after seeds of *Gymnocladus dioicus* (L.) K. Koch, *Gleditsia triacanthos* L., and *Robinia pseudoacacia* L. were planted to test herbicide effects on seedling survival and growth. Species varied in response to herbicides, with *Robinia* most affected by treatments. Most herbicides did not reduce seedling survival, plant height, or dry weight.**

High labor costs have made hand weeding non-economical for tree seedling production. Abbott and Fitch (1) reported that hand weeding can represent 10 to 90% of total production costs in seedling nurseries. Much of the past weed control research on woody plants has focused on preemergent herbicides on established stock, which do not eliminate the need for hand weeding during germination and early seedling stages (2, 4, 5, 7).

Studies by the Prairie Farm Rehabilitation Administration (PFRA) demonstrated that diphenamid + dinoseb applied at seeding did not significantly reduce germination of *Ulmus pumila* L., *Ulmus americana* L., or *Elaeagnus angustifolia* L. (8). In later studies, the PFRA noted that trifluralin at 2.2 kg/ha was not phytotoxic to germinating seeds of *Fraxinus pennsylvanica* Marsh., but reduced the stand of *Ulmus pumila* (3). Dill and Carter (6) reported that *Robinia pseudoacacia* was tolerant of 2× the rates of trifuluralin and EPTC applied to seedbeds. South, Crowley, and Gjerstad (9) also found that *Pinus* species were tolerant of herbicides applied after planting and mulching. Trifluralin at 1.1, diphenamid at 4.5, and profluralin at 2.2 kg/ha controlled weeds without affecting seedling production, but *Pinus* seedlings were nontolerant of oryzalin at 2.2 kg/ha and napropamide at 6.7 kg/ha.

Results from these studies indicate that preemergent herbicides may be used on selected woody plants without affecting germination, however, tolerance to herbicides varies with tree species.

The purpose of this study was to test survival and growth of *Gymnocladus dioicus, Gleditsia triacanthos,* and *Robinia pseudoacacia* treated with preemergent herbicide 1 day after seeds were planted.

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