Phosphorus Stimulates Growth Of Yellow Birch Seedlings

Peter R. Hannah,
Associate Research Forester,
University of Vermont,1
Burlington, Vt.

During the fall of 1970, seeds from a yellow birch *(Betula alleghaniensis* Britton) were collected, dried, and placed in a cold storage room for dry stratification. In February 1971, seeds were sown in greenhouse flats containing a mixture of potting soil and placed in a greenhouse to germinate. Germination began in about 12 days.

While these seedlings were still in the cotyledon stage, we decided to test their response to applications of phosphorus, potassium, and lime. The first two elements are standard constituents of commercial fertilizers and usually they stimulate growth. Lime was used in the experiment because many podzol soils in northern regions are believed to have toxic concentrations of aluminum and manganese in the subsoil and are often deficient in calcium (1).

The planting medium for this fertilizer test was A and B horizon material of a sandy loam soil collected from a mixed hardwoodconifer stand near Burlington, Vt. Thirty small styrofoam cups were filled with A horizon material; another 30 cups filled with B horizon material. Ten fertilizer combinations of N, P, K, and lime (L in figure 1) were mixed into the cups for each horizon (three cups per treatment) (table 1). Three yellow birch seedlings in the cotyledon stage were then transplanted into each cup. Nitrogen was applied to all treatments. A treatment containing nitrogen *only* served as the control treatment. The complete control with no nutrient supplements and some other combinations excluding lime had to be omitted because of limited greenhouse space.

The 60 cups for the two horizons were placed at random on a greenhouse bench under supplemental light to provide a 15-hour day. Cups were rotated at least twice during a 10-week period to minimize the effects of variability in light quality and quantity. Seedlings were well watered during the period. Dead seedlings were replaced 15 and 26 days into the experiment.

Results

Some mortality occurred following transplanting. At the end of the study, one seedling was dead in A horizon cups and five in B horizon cups-two from the same cup. In some cups, one seedling clearly outgrew the other two, introducing variability within a treatment. Replacements also increased variation. Despite this variability, the responses to fertilizer treatments seem clear.

Differences among treatments were noticeable in 6 weeks. At the end of 10 weeks, seedlings in both A and B soil horizon material had responded dramatically to phosphorus (table 1) . Data testing showed, within each horizon, a highly statistically significant difference associated with treatments. Figure 1 illustrates typical responses for the 10 treatments on two horizons. All seedlings that had P added at 200, 400, or 600

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pounds per acre were about twice as tall as seedlings in soils with no P added (table 1).

Phosphorus is obviously the important nutrient additive on A horizon material. Seedlings that had potassium eliminated in the treatment grew no differently than seedlings treated with the complete fertilizer (N, P, K, lime). Omission of lime in the treatments does not appear to lessen growth either,

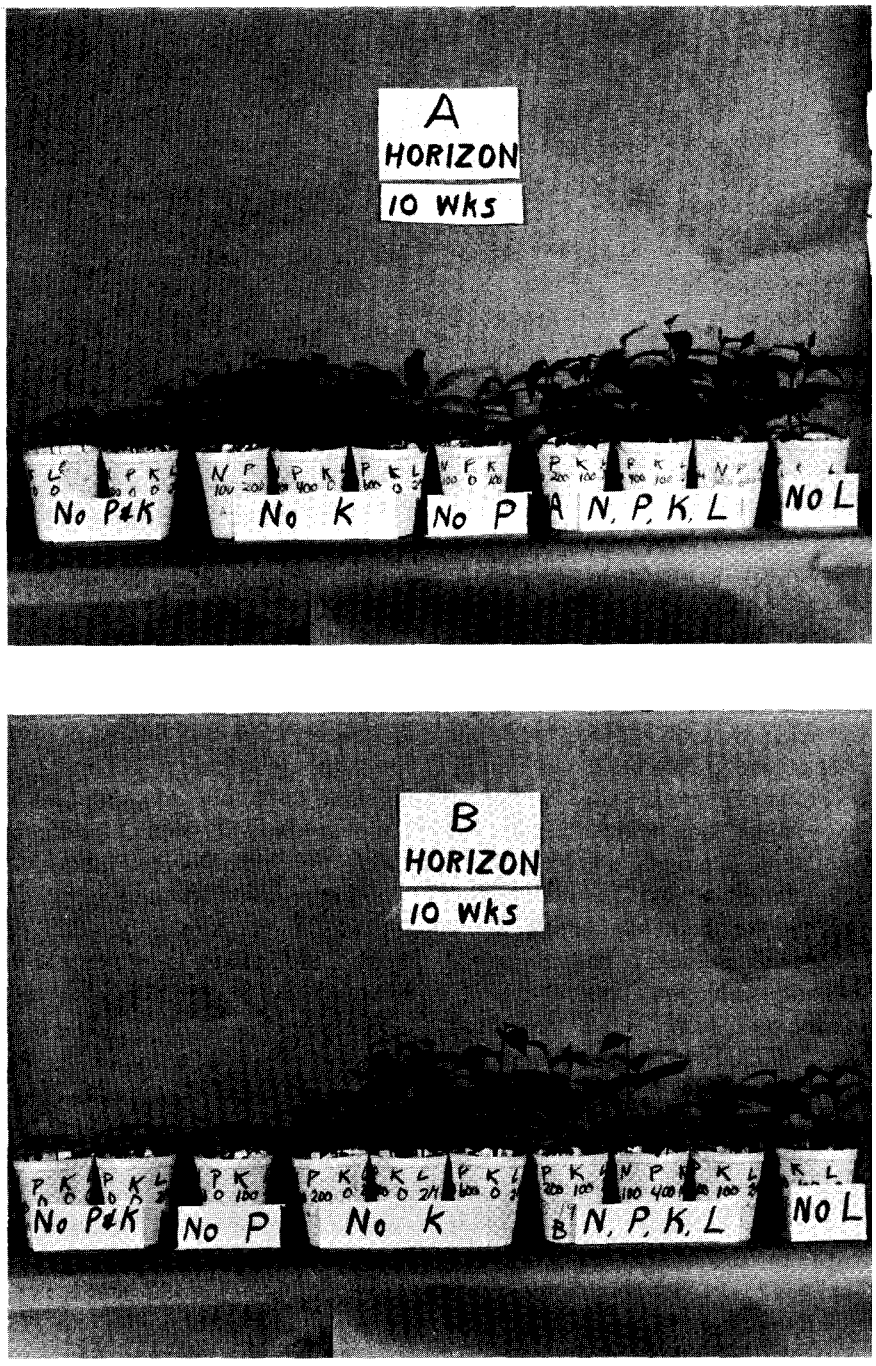

Figure 1. Typical 10-week response of yellow birch seedlings to 10 combinations of N, P, K and lime on soil from an A horizon and a B horizon.

but if phosphorus is eliminated, seedling growth is noticeably less. Nitrogen was not a variable in this experiment, but it would appear the addition of 100#/A of N resulted in little growth response.

On B horizon soil material, seedlings with fertilizer additions that included phosphorus grew about as well as seedlings on the A horizon soil. A test of data showed no significant difference in tree response associated with soil horizons. Elimination of the phosphorus resulted in considerably less growth, about like that on the A horizon lacking the phosphorus supplement. Adding lime to the B horizon (1 ton per acre) did not appear to increase seedling growth, suggesting calcium is not a limiting factor and aluminum and manganese are not at toxic levels in this particular soil. The strong similarity of plant response on both horizons strengthens this contention. Except for the low values in treatment 9 of the B horizon, most average values for the two horizons agreed closely. Poor response in treatment 9 is unexplainable.

This experiment suggests that, among nutrients tested, phosphorus is the main one limiting growth of yellow birch seedlings on the particular soil used. This suggests that phosphorus may be a limiting factor on many other soils in Vermont. The results of this study may have practical application for yellow birch seedling production in nurseries and for seedlings planted on forest sites.

Literature Cited

1. Hoyle, Merrill C. and John C. Bjorkbom
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