Nitrogen fertilization stimulates germination of dormant pin cherry seed

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The first experiment was installed to test overstory response to fertilizers. No dramatic changes were expected in the seedling understory; nevertheless, one block was selected at the start of the study to monitor regeneration. Seedlings were counted on six randomly located 0.4-m² plots in each treatment (24 plots total). In years 3 and 4, counts were made only in mid-June. When extensive pin cherry germination was discovered on these plots, qualitative observations were made at the other five test sites, but no counts were taken.

The second experiment was designed to test the effect of several N carriers and N rates on germination of dormant

Methods

The mechanism responsible for germination has long been associated with forest disturbance, and hence with accompanying changes in light intensity and quality, mechanical stirring of the forest floor, and different soil temperature and moisture regimes. This paper provides evidence that germination is also promoted by increased soluble N concentrations in the soil.

Pin cherry (Prunus pensylvanica L.), a component of many eastern upland hardwood forests in North America, regenerates after heavy cutting, windthrow, or fire; however, it rarely persists in these stands for more than 35 years. After a forest disturbance, pin cherry seedlings develop from seed that has remained dormant in the forest floor for many years. These seeds originate from pin cherry in the initial stand and from deposits by birds and small mammals. Estimates of dormant pin cherry seed contained in the duff of certain middle-aged northeastern deciduous forests range from 250,000 to more than 4.5 million per hectare (Olmsted and Curtis 1947; Marks 1974; Marquis 1975). Rarely do more than a few of these seeds germinate annually unless forests are disturbed.

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In both studies, 1000 seedlings per hectare in an uncut 60-year-old Allegheny hardwood stand after two annual fertilizer applications (fertilizers broadcast in years 1 and 2)

<table>
<thead>
<tr>
<th>Time of germination</th>
<th>Unfertilized</th>
<th>N</th>
<th>NP</th>
<th>NPK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Year 2</td>
<td>0</td>
<td>272</td>
<td>675</td>
<td>424</td>
</tr>
<tr>
<td>Year 3</td>
<td>0</td>
<td>17</td>
<td>169</td>
<td>152</td>
</tr>
<tr>
<td>Year 4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>289</td>
<td>844</td>
<td>576</td>
</tr>
</tbody>
</table>

*Differences among N, NP, and NPK are not significant (P < 0.05).

In the second experiment, urea, calcium nitrate, and ammonium sulfate promoted pin cherry germination at all rates except ammonium sulfate at 56 kg/ha N (Table 2). All germination was complete by mid-June of the first season after fertilization in the previous fall. There were no significant differences (P < 0.05) among nitrogen carriers or rates (except 56 kg/ha N from ammonium sulfate), which suggests that even moderate increases in soluble N will trigger germination.

**Discussion**

After application to the soil, urea and ammonium sulfate would undergo transformation, including conversion of ammonium to nitrate. Of the several products occurring in these transformations (NH₃, NH₄⁺, NO₂⁻, NO₃⁻), only nitrate (NO₃⁻) is common to all three carriers, which suggests that nitrate was responsible for breaking seed dormancy. This interpretation seems plausible in view of the results from other studies which have shown that nitrate-containing compounds are effective in stimulating germination of dormant seeds, but that ammonium sources usually are not (Vegis 1964; Hendricks and Taylorson 1974). An alternative, but less likely explanation, is that nitrogen compounds stimulate germination indirectly by increasing the release or production of some other substance from humus or through soil microorganisms.

The results of both experiments suggest that a chilling period is necessary to break dormancy after buried pin cherry seeds have been exposed to increased NO₃⁻ concentrations. In both studies, germination occurred only after an overwinter period had followed high soluble N concentrations in the soil. Although the duration of exposure to...
NO$_3^-$ is probably important as well, the minimum time seems to have been exceeded even with the fall fertilizer applications.

The apparent large differences in seedling numbers among the fertilizer treatments (Table 1) seem due to the irregular distribution and variable numbers of seeds on the plots at the time of fertilization, and not to the addition of P and K fertilizers. This was substantiated by observations at the other five test sites, where all N-treated plots had large and about equal numbers of newly germinated pin cherry regardless of whether P or K had been applied.

From the present studies it seems that repeated applications of N to existing sawtimber stands could reduce the pin cherry in future stands. In situations where pin cherry outgrows other more desirable species after regeneration cuttings, N fertilization might be used beneficially in maturing stands to increase growth rates of residual trees and to reduce the numbers of pin cherry seeds that would germinate and later compete with preferred reproduction.


