Drastic Temperature Fluctuation-The Key to Efficient Germination of Pin Cherry

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*The germination rate of pin cherry (*Prunus pensylvanica *L.) was greatly improved by drastic temperature fluctuation treatment. The optimum treatment regimen was a 24-hour soak followed by 30 days of stratification with 5 days at 5 °C alternating with 5 days at 30 °C, followed by 60 to 90 days of stratification at 5 °C, followed by a 10-day germination period with 12 hours at 5 °C alternating with 12 hours at 30 °C. The germination rate with this treatment was over 75%.* Tree Planters' Notes 38(3):30-32; 1987.

Efficient production of containerized seedlings of pin cherry (*Prunus pensylvanica* L.) has proven to be a problem because of the apparent deep dormancy of the seed. Stratification treatments that give good results with other Prunus species (30 days of stratification at 20 °C followed by 60 to 120 days of stratification at 5 °C followed by a 10to 20-day germination period at 20 °C) result, in the author's experience, in germination rates for pin cherry of less than 10% when seed viability is near 100%.

The USDA Agriculture Handbook No. 450 (5) records a germination rate of 62% with 60 days of warm stratification followed by 90 days of cold stratification followed by a 60-day germination period with day/night temperature fluctuation from 25 to 10 °C. Although this germination rate approaches an acceptable level, the germination period is too long for efficient production of containerized seedlings.

Marks (4), working in the northeastern hardwoods forest of the Unites States, found that pin cherry exhibits a "buried seed strategy" for maintaining itself in the forest landscape. The species is only moderately shade tolerant and eventually dies out beneath a canopy of trees. While reproductively active, however, the shrub produces heavy crops of seed that fall to the forest floor and become buried in the duff. The seed maintain their viability for many years. Germination beneath a closed forest canopy is rare. However, when the canopy is removed by disturbance, germination is extensive, and the stand is reestablished. Marks (4) tested a variety of seed treatments to promote germination; the only treatment that gave good results was removal of the endocarp, which raised germination from 0 to 45%.

Auchmoody (1) found that fertilization of closed canopy northeastern hardwood forest with urea, ammonium, and nitrate resulted in heavy germination of buried pin cherry seed.

The author conducted a preliminary study and a series of formal experiments on germination of pin cherry, described in detail in two reports *(2,3).* The overall objective of the study was to achieve over 75% germination during a 10-day germination period that follows a stratification period of less than 6 months.

Temperature Regime Within the First 30 Days of Stratification. One experiment examined the impact on rate of endocarp splitting and germination of seven temperature regimes (assume ± 2 °C for all temperatures) applied over the first 30 days of stratification:

1. Continuous 5 °C.
2. Continuous 20 °C.
3. Continuous 30 °C.
4. Five days at 5 °C alternating with 5 days at 20 °C.
5. Five days at 5 °C alternating with 5 days at 30 °C.
6. One day at 5 °C alternating with 1 day at 20 °C.
7. One day at 5 °C alternating with 1 day at 30 °C.

Air-dried seeds were given a 48-hour soak in distilled water, then placed in moist peat in polyethylene bags. The 30 days of stratification was followed by 120 days of stratification at 5 °C. At 60, 90, 120, and 150 total days of stratification, the percentage of seeds having split endocarps was determined. Stratification was followed by a 10-day germination test at steady 30 °C.

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The progression of endocarp splitting and the results of the germination test are shown in figure 1. The figure shows the benefit of drastic temperature fluctuation (from 5 to 30 °C) in the early part of stratification. The test results were attained with treatments 5 and 7. Treatment 5, involving fewer temperature shifts, is the more convenient and gave good results in all later experiments.

The Germination Period

The preliminary study showed that germination was more rapid and reached higher levels if the test was run at steady 30 °C rather than steady 20 °C. Steady 30 °C was still not satisfactory, however, as shown in figure 1. In treatments 5 and 7, only 42% and 44%, respectively, of the seeds having split endocarps actually germinated. It was initially thought that in seeds with split endocarps that did not germinate, the endocarp had split relatively late and the seeds required additional cold stratification.

However, a subsequent experiment showed that application of temperature fluctuation (5 °C/ 30 °C) on a 12-hour/12-hour cycle over the 10-day germination period resulted in near 100% germination of seeds with split endocarps and 34% germination of seeds having intact endocarps at the beginning of the germination period.

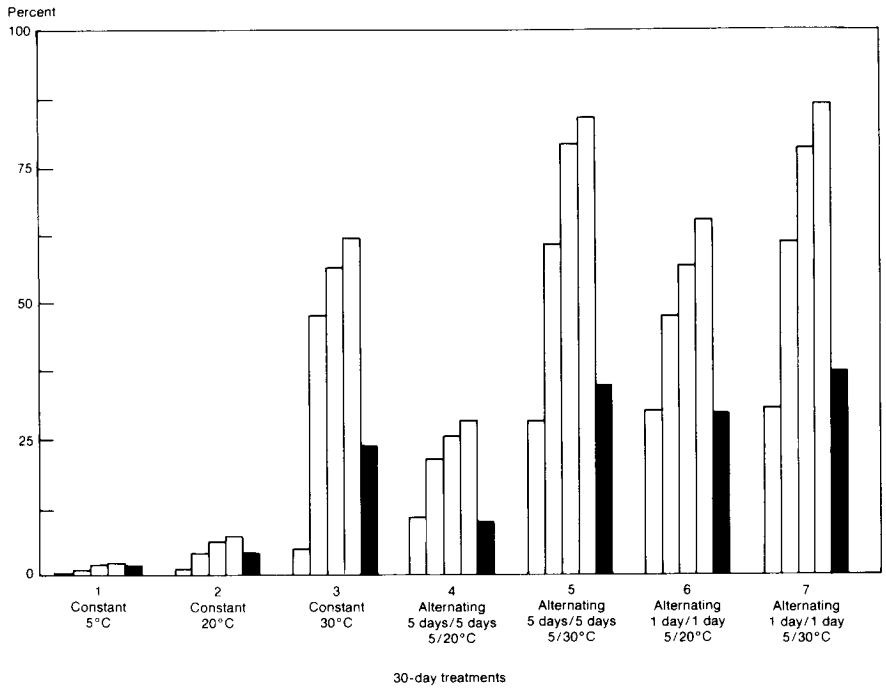

Figure 1—*Mean percentage of seeds with split endocarps at 60, 90, 120, and 150 days of stratification (open columns, left to right, respectively) and mean percentage of germination (solid columns).*

Minimizing Uncontrolled Germination. It is desirable to minimize uncontrolled germination, that is, germination during stratification, for such germinants are usually discarded and represent a loss of seed. Pin cherry seed with split endocarps will germinate if exposed to drastic temperature fluctuation. Some endocarp splitting and uncontrolled germination can occur in the latter part of the 30-day period of temperature fluctuation, but in the author's experience, it is negligible. A portion of the seed will germinate at 5 °C if kept long enough at this temperature. The author found that extending cold stratification beyond 90 days added little to the percentage of seeds having split endocarps and markedly increased uncontrolled germination.

Other Seed Treatments

In the preliminary study, the endocarp of some seeds were punctured by clipping off the radicle end before stratification.

The technique was tedious, required great care to avoid obvious damage to the embryo, and even with such care, resulted in disease and deformation of many germinants. Although puncturing or removing the endocarp is not recommended for routine mass production of seedlings, it may have application where a small number of seedlings is required in the shortest possible time. The removal of the endocarp would be followed by 5°C/30°C temperature fluctuation on a 12-hour/12-hour cycle.

The preliminary study found that a 24-hour soak of air-dried seed in 0.02 M calcium nitrate markedly increased the rate of endocarp splitting over a distilled water soak. Later experiments showed no benefit from a nitrate soak, but many details of stratification differed from the preliminary study. Urea, nitrite, ammonium, and hydroxylammonium were also tested; the only form of nitrogen that consistently increased the rate of endocarp splitting (slightly but significantly) was hydroxylammonium chloride at 0.05 to 0.5 M. Further work on the impact of nitrogen is planned.

Conclusions

The recommended treatment for pin cherry seed is a 24-hour soak in 0.5 M hydroxylammonium chloride followed by 30 days stratification with 5 days at 5 °C alternating with 5 days at 30 °C, followed by 60 to 90 days of stratification at 5 °C, followed by a 10-day germination period with 12 hours at 5 °C alternating with 12 hours at 30 °C.

It would appear that the factor that triggers heavy germination of buried pin cherry seed following forest disturbance is the more extreme temperature fluctuation within the clearing.

Literature Cited

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*Available on a loan basis from Environ mental Affairs, Nova, An Alberta Corpora tion, Box 2535, Postal Station M, Calgary, Alberta T2P 2N6.