Small Batch Seed Propagation of Various Pinus Species©

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INTRODUCTION

Work on this project began in 1996. The focus of this research is centered on establishing a "pine straw" (pine needle mulch) industry in Missouri. Pine straw, an excellent mulching material used extensively in the southern United States in the landscape industry, is not widely used in the Midwest. Many sites in Missouri are capable of growing pines for commercial pine straw production if suitable species are identified. The University of Missouri Dept. of Horticulture and the Center for Agroforestry are currently investigating the feasibility of establishing a pine-straw industry in the state of Missouri. Impedance for this protocol arose from this researcher.

The focus of this project has been to test various *Pinus* species for hardiness, vigor, and suitability for producing pine straw. Seed of a variety of native, exotic, and hybrid *Pinus* species have been acquired for testing. Because of the nature of this research, only small quantities of seed were propagated at one time (grams as opposed to kilograms). Little has been published regarding small batch seed propagation of Pinus species. Most literature dealing with pine propagation is oriented to large commercial growers, or to conservation nursery operations (Dirr and Heuser, 1979; Duryea and Landis, 1984; Proc. N. Amer. Containerized Forest Tree Seedling Symp.1974; Seeds of Woody Plants in the United States: U.S. Forest Service Agriculture Handbook No. 450, 1974; Tinus and McDonald, 1979). Through searching literature, and a process of trial and error, a standardized protocol was developed for successful germination of small batches of *Pinus* seed.

MATERIALS AND METHODS

This protocol was developed for propagating small quantities of *Pinus* seed (grams as opposed to kilograms). Most *Pinus* species require a period of cold stratification (Dirr and Heuser, Jr., 1979; Seeds of Woody Plants in the United States: U.S. Forest Service Agriculture Handbook No. 450, 1974). The stratification period varies from 0 to 90 days (average 30 to 60 days) depending on the particular cultural requirements on the *Pinus* species (U.S. Forest Service, 1974). Small quantities of *Pinus* seed ranging from only a few grams to little more than an ounce were placed in Hubco cloth soil sample bags (8.9 cm × 17.7 cm) and soaked in aerated water for 48 h to re-hydrate the seed (Duryea and Landis, 1984). Cloth bags were then drip-dried on absorbent towels, and placed in polyethylene zip lock bags with approx. 2 oz of sifted sphagnum peat moss. Contents of poly bag were misted with fungicide using either Banrot or Captan 50 wettable powder (5.5 a.i.). Bags were then sealed, placed in plastic storage boxes, and refrigerated at 35°F for the stratification period. A commercial potting medium (Scott's Metro Mix 380) consisting of composted pine bark, medium grade vermiculite, sphagnum peat moss, horticulture perlite, starter

fertilizer, and wetting agent was used for the germination process. The potting medium was amended with 200 ml of Osmocote (13-13-13) slow-release fertilizer (8 to 9 mo), and 100 ml of Micromax micronutrients per 0.08 m^3 bag of soil mix. Amendments were added to ensure that the seedlings had ample nutrients available during their initial stage of development.

Deepots cells (D40) were chosen for this trial because they provided ample room (656 ml) for 1-year-old *Pinus* seedlings to develop (Proc. N. Amer. Containerized Forest Tree Seedling Symp., 1974). D40 cells were filled with the amended potting medium, 20 cells to a tray. After filling, the cells were lightly tamped with an apparatus made from an inverted tray filled with 20 D40 cells that fit directly into the soil-filled tray of cells. Cells (D40) were then topped with additional soil mix, and once again lightly tamped with a baby food jar (the same diameter of the cell) leaving approximately 1/4-inch space at the top of each cell.

Two to three *Pinus* seeds were sown per cell depending on the quantities of seed available, to assure ample germination. The seed was lightly tamped with the baby food jar, to assure contact between the seed and the soil, and mulched with approximately 1/2 tbs of chicken grit (crushed granite), and misted with fungicide to reduce the risk of contamination (Tinus and McDonald, 1979). After germination was complete, seedlings were thinned to one per cell once they acquired true leaves. Extra seedlings were transplanted to cells where germination was not complete.

RESULTS

Results reported here are from trials of two native pine species (*P. echinata, P. taeda*) and one hybrid (*P. taeda* × *P. rigida*). Germination results from this trial are comparable with industry averages. Of the 20 loblolly genotypes used in this evaluation, 90% of the families achieved 87% germination within the first 14 days after sowing (Fig. 1). Germination compared favorably to industry averages of 90% germination within 17 days after sowing (Seeds of Woody Plants in the United States: US Forest Service Agriculture Handbook No. 450, 1974). Of the 10 pitch × loblolly genotypes used in this evaluation, 100% of the families achieved 85% germination within the first 12 days after sowing (Fig. 2.). Industry averages for pitch × loblolly hybrids were not available. Germination rates were comparable to industry averages gleaned from pitch and loblolly pines (U.S. Forest Service, 1974). Of the 346 shortleaf crosses used in this study, 89% of the families achieved 74% germination within the first 10 days after sowing (Fig. 3). Shortleaf pine germination was a slightly lower than industry averages (84% within 14 days) because some of the seed was more than 20 years old (U.S. Forest Service, 1974). Considering the advanced age of this seed, the germination rates compared were considered acceptable. The number of seedlings successfully germinated exceeded 3000 for the loblolly, 1500 for the pitch × loblolly, and 11,500 shortleaf pine. The total number of pine seedlings successfully germinated using this protocol exceeded 16,000.

CONCLUSION

Since the beginning of the project, I've successfully established in excess of 24 *Pinus* species and hybrids in our collection (Table 1). Because there are no pines native to central Missouri, species from around the world are being evaluated. In addition to evaluating new *Pinus* species for pine straw, this work has created an opportunity for finding new pines for the ornamental nursery industry.

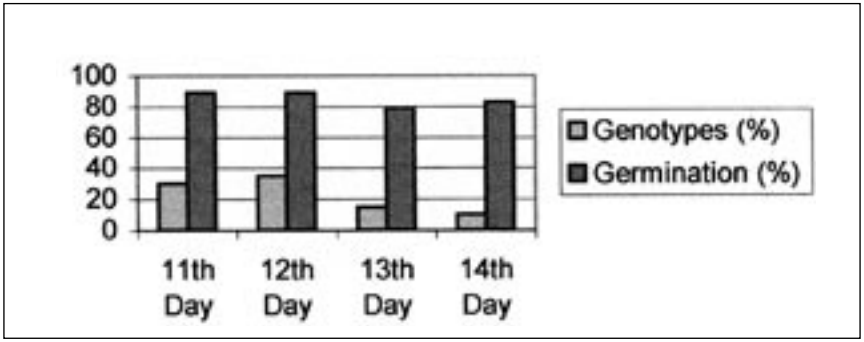

Figure 1. *Pinus taeda:* Germination on various days after seeding; 90% of genotypes achieved 87% germination within 14 days after seeding

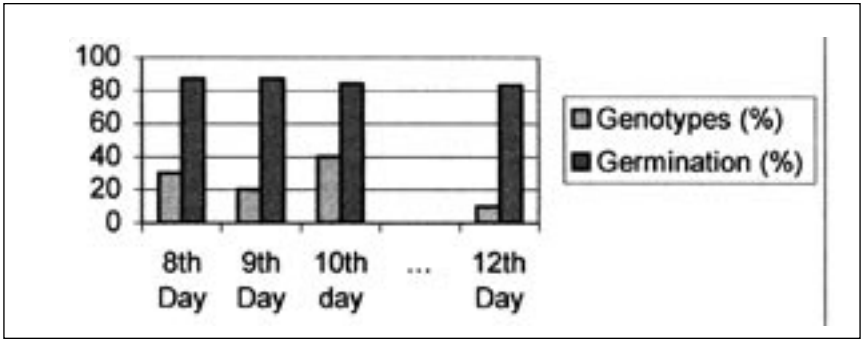

Figure 2. *Pinus taeda* × *P. rigida*: Germanation on various days after sowing; 100% of genotypes achieved 85% germination within 12 days after seeding.

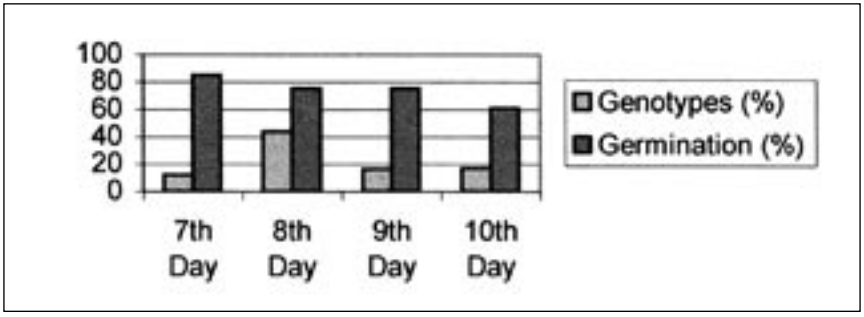

Figure 3. *Pinus echinata*: germination on various days after sowing; 89% of genotypes achieved 74% germination within 10 days after seeding.

Table 1. *Pines evaluated.*

Pines germinated

Pinus attenuata
Pinus attenuata × *P. radiata*
Pinus coulterii
Pinus densiflora
Pinus echinata
Pinus hwangshanensis
Pinus jeffreyi
Pinus massoniana
Pinus nigra
Pinus peuce
Pinus ponderosa
Pinus rigida × *P. taeda*
Pinus shenkanensis
Pinus strobiformis
Pinus tabuliformis
Pinus taeda
Pinus wallichiana

Pines not germinated from seed

Pinus ayacahuite × *P. strobus*
Pinus cembra
Pinus lambertiana × *P. koraiensis*
Pinus monticola × *P. parviflora*
Pinus monticola × *P. strobus*
Pinus rigida × *P. echinata*
Pinus strobus × *P. wallichiana see P.* ×*schwerinii*

Information acquired from these trials has contributed to developing a standard procedure for the propagation of small batches of *Pinus* seeds that may be applicable to others. Cooperative research is currently underway between the University of Missouri Dept. of Horticulture and the Center for Agroforestry to establish a pine straw industry in Missouri. Suitable pine species are being investigated for pine straw production, as well as nursery stock potential. Propagation techniques have been developed suitable for small batches of seed (grams as opposed to kilograms) needed to test a variety of exotic, domestic, and hybrid *Pinus* species. Following this procedure, successful germination was achieved comparable to industry averages.

LITERATURE CITED

Dirr, M.A. and **C.W. Heuser, Jr.** 1979. Reference manual of woody plant propagation: From seed to tissue culture. Varsity Press, Inc. Athens, Georgia. pp.11-22, 167-171.

Duryea, M.L. and **T.D. Landis.** 1984. Forest nursery manual: Production of bareroot seedlings. Martinus Nijhoff and Dr. W. Junk Pub., The Hague pp.34-35.

Proceedings of the North American Containerized Forest Tree Seedling Symposium. R.W. Tinus, W.I. Stein, and W.E. Balmer (eds). Denver, Colorado, 1974. Great Plains Agricultural Council Pub. No. 68. p.237-240.

Seeds of Woody Plants in the United States. 1974. U.S. Forest Service Agriculture Handbook No. 450. Washington D.C., pp.598-638.

Tinus, R.W. and **S.E. McDonald.** 1979. How to grow tree seedlings in containers in greenhouses. U.S.F.S. General Technical Report RM-60. p.148.