Field Propagation of Light Sensitive Species by Seed

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INTRODUCTION

Lawyer Nursery of Plains, Montana has been in the business of producing seed propagated liners and understock since 1959. In 1988, the company purchased a bare root nursery facility in Olympia, Washington in order to take advantage of the coastal climate and add diversity to the product line.

The bare root seedlings and transplants produced in Montana and Washington are marketed throughout the United States and Canada. Our product line is shipped to nurseries, commercial orchardists, conservation districts, highway departments, reclamation projects, and the like.

In order to propagate 275 different species of woody trees and shrubs, we utilize numerous specific seed treatments designed to overcome seed dormancy. Seed treatments vary from simple cold stratification or acid scarification to burying seed below the frost line for 2 to 4 years. We typically sow some seed every month of the year in Washington with the exception of January and February. The largest part of the crop in Washington is sown in the spring. In Montana, the majority of the sowing occurs in early fall.

This discussion will focus on our work with three distinct crops as well as six species of *Betula* to overcome photodormancy or light sensitivity.

The basic mechanism of light sensitivity in seeds involves a photochemically reactive pigment called phytochrome (Hartmann et al., 1990) When the imbibed seed is exposed to red light, the phytochrome pigment is altered and this reaction stimulates germination. In addition to six species of *Betula*, we have successfully treated *Paulownia tomentosa, Populus tremuloides,* and *Buddleja davidii* as light-sensitive crops.

Our birch program includes the following species: *Betula papyrifera, B. pendula, B. nigra, B. platyphylla* var. *japonica*, B. *maximowicziana,* and *B. lenta.* Although birch species are routinely propagated by tissue culture and stem cuttings, there remains a strong demand for two-year seedlings as understock, conservation material, etc. In some species of birch, the requirement for light during germination can be overcome by cold stratification (Young and Young, 1992). We sow dry seed in late spring. We achieved good stands this spring with all of these species except for *Betula lenta.*

Paulownia tomentosa, the Empress tree, is a native of China that has attracted attention in this country for a number of reasons. Its rapid growth, unusually large leaves and high-quality wood have made it popular as an ornamental and a timber species, particularly in the southeastern United States. The wood of paulownia is actively sought by Japanese buyers and has brought prices comparable to that of black walnut. This tree has also been used for strip mine reclamation in Kentucky (Immel et al., 1980). *Paulownia* seeds require long exposures to light for germination (Schopmeyer, 1974). This light requirement can be reduced by stratification, gibberellic acid, and dry cold storage (Carpenter and Smith, 1981). Because of the

small seed size (about 6000 seeds per gram), we have found the crop easier to handle by providing light during germination rather than stratification. We sell the stock as two-year root crowns since the tops are usually injured by the first frost and do not tolerate cold storage.

Buddleja davidii, or butterfly bush, is an old-fashioned, multi-stemmed, semi-herbaceous shrub. It is useful in the landscape because of its profuse summer flowers and its tolerance of a wide range of sites. There are several well-known selections of this plant in the trade which are routinely propagated from cuttings. We have offered bare-root seedlings in our catalog for several years and we have had a good response. Although the seeds of *Buddleja* do not require any pre-treatment for germination, we have had our best success treating this crop as if it were light sensitive. The seed is very small and our attempts to cover the seed at all have resulted in poor stands. This crop is also sold as a two-year root crown due to the herbaceous nature of the tops.

Populus tremuloides, quaking aspen, is the most widely distributed tree in North America (Dirr, 1990). Bare root seedlings are used as ornamentals, native plants and as conservation material because of the tremendous adaptability of the species. The seed of*Populus tremuloides,* like that of*Buddleja*, does not require any pretreatment. Because of the small size of *P. tremuloides* seed and the relative weakness of the germinants, we also treat this crop as if it were light sensitive. Two-year-old seedlings in Olympia range in size from 18 in. to about 6 ft. The crop requires a rigid fungicide program the second year to control several foliage diseases including *Mycosphaerella populorum* and Venturia shoot blight.

NURSERY PRACTICE

The largest portion of the sowing at Lawyer Nursery is accomplished with an Oyjord seed drill. This particular drill is quite versatile; it can accommodate a wide range of seed sizes and can drill seed at an impressive range of densities. It will also sow at a 4-row or 8-row configuration which can be changed quite simply. Seed of the species in this discussion, however, are sown by hand since some of these seeds, *Paulownia* in particular, are so light. The seed is distributed by hand on a raised 42-in. bed marked with 8 or 4 rills which are spaced evenly across the bed. It has been our practice in the past to form and rill the seedbeds about 4 to 6 weeks prior to sowing. During this period we would irrigate the beds on a regular basis to promote weed seed germination and pack the seedbed prior to sowing. The rationale was that we could burn off the weed cover with paraquat just prior to sowing the crop and the rills would be sufficiently compacted to prevent the crop seed from getting covered. While we attained excellent weed control with this practice, we noticed that with some species the seed would germinate, but many of the germinants would stall out soon after germination and eventually disappear. We felt that our seedbeds had become compacted just enough to restrict the growth of the very fragile germinants of *Populus* and *Paulownia.* At this time we are sowing seed directly after forming and rilling the bed.

The key to success with these light sensitive crops is frequent irrigation of short duration. We have experimented with several different heads and microjets but what we have ended up with is a customized spacing of our existing lateral lines. Most of the nursery is set up with 2-in. lateral handlines set-up on 52-ft spacing with 14V rainbirds with 7/64-in. nozzles spaced 30 ft apart in the line. In the area

that we designate for these light sensitive crops, we moved the lateral lines 26 ft apart instead of 52 ft and replaced the 7/64-in. nozzles with 5/64-in. nozzles. These lines are turned on and off by hand during the first 6 weeks. After 8 weeks we replace the small nozzles and remove the extra line.

Another practice we changed this year was the use of Terrasorb gel. In the past we would broadcast dry Terrasorb, a starch gel, over the seed. As the Terra sorb absorbed moisture, it would form a clear gelatinous slime over the seed and keep the germinating seed hydrated. By changing the configuration of the irrigation lines, we were able to abandon our Terra-sorb program.

We do experience some problems with *Paulownia* and *Buddleja* seed being splashed out of the rills by the irrigation water and wind. We will end up with seedlings scattered throughout the bed, in the rills as well as up on the ridges between the rills and in the aisles between the beds. The birch seed usually stays intact in the rills. The *Populus* seed typically germinates in 48 to 72 hours after sowing and does not experience any movement.

With all these crops we hope to achieve a second year seedbed density of 15 to 20 seedlings per square foot. The first year density is usually significantly greater than this but the seedling population is reduced to an adequate level during the winter. Our cool temperatures this summer resulted in excellent germination and slow growth of the germinants. We sow these crops late partly to control their size. They do not achieve market size in one growing season and two full seasons provides a larger finished product than we want.

To achieve successful stands with field germinated seedlings, constant attention by the grower and the irrigator is required. Treating the seed to overcome dormancy is just the beginning. We like to brag about our sandy loam soil in Olympia, touting it as the best bare root nursery soil in the world. The reality is, however, that our seedbeds really represent a rather harsh environment when compared to the petri-dish in the germination chamber.

By paying special attention to the specific needs of difficult-to-propagate crops such as these, we attempt to close the gap between the germination potential of the seed lot and the actual field performance.

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