IMPROVING SEEDING NUTRITION IN THE NURSERY TO INCREASE SEEDLING PERFORMANCE IN THE FIELD

Principal Investigators:

Victor R. Timmer	Thomas Jopson	Possibly other
Faculty of Forestry	Cal Forest Nursery	IFM Cooperative
University of Toronto, Ontario	Etna, CA	nursery managers

Objectives:

1. Determine optimal nutrition for planting stock of Douglas-fir, white fir, and ponderosa pine to ensure high field survival and rapid early growth.

2. Identify nursery nutritional practices to accomplish this.

Background:

Technology advanced by Timmer and others show that we have the capacity to produce seedlings with a balance of nutrients at nearly any desired content or concentration. Seedlings grown with constant and sufficient internal nutrient concentrations achieved through appropriate fertilization are free of nutrient stress. By modifying this technique, seedlings can be produced with balanced, high reserves of nutrients superior to those possible through late-season heavy fertilization. This is the concept of "steady-state luxury consumption" (nutrient loading) (Timmer and Aldelbaum 1996). Presumably, balanced, surplus reserves of nutrients at planting favors growth that is rapid enough to offset weed competition and soil drought. Questions remain as to (1) What techniques are best for western species? (2) Do nutrition advantages vary by site quality?

Procedures:

At one or more forest nurseries, raise seedlings according to the following nutrient regimes:

1. Conventional fertilization practice.
2. The same fertilizer mix and load as in (1), but applied exponentially.
3. Nutrients applied at 2, 4, and 6 times those in (2).

This produces five nursery treatments that bracket the range of conventional through exponential nutrient loading treatments. Of the latter, several will constitute "luxury consumption." Growth and nutrient status of the seedlings will be assessed at 2-week intervals during the culture period to chart the progress and adjust nutrient supply schedules. Techniques and periodic measurements will follow those described by Timmer and Aldetbaum (1996) and Xu and Timmer (1998). At lifting, seedlings will have nutrient contents that vary incrementally from moderate to very high values, and should identify a treatment optimal for outplant success.

Outplanting will be done on cooperator field sites representing three levels of potential productivity (possibly defined as low, medium and high levels of available soil water). Because the study only addresses early stages of growth, trees will be planted at 4-ft spacing on plots measuring 44 by 48 feet (0.048 acre). Each plot consists of 132 seedlings of a single species. The outer two plot rows will be

buffer trees, leaving 56 trees in the inner measurement plot. All plots will be kept weed-free and all seedlings will be protected from animal browsing. At five replications of five treatments per site and three species per treatment, this requires 3.64 acres per site and 3300 seedlings per species. For ponderosa pine, white fir, and Douglas-fir, 3.64 acres are needed per site.

132 seedlings/rep x 5 reps x 5 treatments = 3300 per site, or

9900 seedlings of a single species per experiment on three sites

Plot layout and planting will be overseen by Gary Fiddler of PSW. The field research design is a randomized block experiment repeated at three locations (sites). Blocking will be based on topographic position or landform and both species (as pure plantings) and treatments will be assigned randomly within blocks. A narrow planting spacing allows us to get statistically reliable results from a minimal plot area (56 measurement trees per plot within a 2-tree buffer).

If we carry the study beyond 5 years, this design allows for a thinning that maintains statistical validity. Removing every 2nd row and every 2nd tree in the remaining rows leaves 16 measurement trees with a 1-row buffer. Thinning from below will reduce variance so that the sample tree size is adequate. We believe that this should be seen as a short-term study that centers on survival and early growth. Therefore, the study can be completed at 5 years, or 10 years at the most. At that point, a firm decision can be reached on the best treatment(s) to apply to operational planning.

Nursery measurements will include dimensional and foliar nutrient analyses according to procedures described by Timmer and Aldelbaum (1996) and Xu and Timmer (1998). Field measurements at the end of growing years 1, 3, 5 and 10 will include stem caliper at 15 cm, total height, and foliar nutrient concentration from fully-expanded needles according to Powers (1984). Measurements will be overseen by Gary Fiddler.

Budget:

Approximately $30,000 annually through the nursery and planting stage and again at outplant year 5, subject to reductions in outplant years 2, 4, and 6-9.

References.

Powers, R.F. 1984. Estimating soil nitrogen availability through soil and foliar analysis. P. 353-373. In: E.L. Stone (ed.) Forest soils and treatment impacts. Proc. 6thNorth Am. Forest Soils Conf, June 1983. The University of Tennessee, Knoxville.

Timmer, V.R.; Aidebaum, A.S. 996. Manual for exponential nutrient loading of seedlings to improve outplanting performance on competitive forest sites. NODA/NFP Tech. Rep. TR-25. Northern Forestry Program, Ontario, Canada. 21 p,

Xu, X.; Timmer, V.R. 1998. Biomass and nutrient dynamics of Chinese fir seedlings under conventional and exponential fertilization regimes. Plant and Soil 203: 313-322.