HARDWOOD NURSERY MANAGEMENT - CLOSING THE INFORMATION GAP

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Abstract.--The major concern of users of high quality hardwood seedlings is the high cost of production. This cost may be ten times that of pine seedlings. Efficient production of high quality seedlings requires increased knowledge in two areas. One, experience and initiative are needed to solve mechanical problems. Better seeders, better lifters, better packing and storage systems are all needed. Two, the greater need is to understand the fundamental physiological responses of hardwoods to cultural treatments beginning with seed production. When we learn the biological requirements necessary for consistent production of high quality hardwood seedlings, the mechanical problems will be easily solved.

INTRODUCTION

After operating for three years in blissful ignorance with neither total failure nor success, it became apparent that we really do not know enough about producing hardwood seedlings. Each year we have adjusted techniques to make the job easier or more efficient. None of these changes made a significant contribution to improving seedling quality. In our case, quality and size is synonymous. The problem is we do not grow enough seedlings large enough.

Improvement of equipment and facilities is important. Opportunities to capitalize on bright ideas should not be missed, but the real emphasis should be on learning what makes hardwoods grow or not grow. High speed harvesting of an inferior product is a futile exercise.

Preliminary results from our current hardwood nursery related research indicates:

1. Definite seedling response to various levels and sources of nitrogen fertilizers.

2. A suspected response to endomycorrhizal inoculation.

3. A possible response by sweetgum (*Liquidambar styraciflua*) to two hour night lighting.

4. Two herbicides, Treflan and Devrinol, are at least moderately effective in controlling weeds without noticable damage to hardwood seedlings.

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More research is needed in every area of nursery management. Priorities are difficult to determine. Everything needs to come first. Some questions I would like to have answered include:

1. Seedling Nutrition - Which fertilizer(s) should be used? How much is needed? When is it needed? What is the interaction with mycorrhizal fungi? What are the responses at various levels of irrigation or rainfall?

2. Seed Quality - How do we get the most out of wild seed while waiting for improved seed? Where do we go for seed or seedlings when local sources are not available? How should non-dormant seed be stored? How is physiological dormancy broken to enhance uniform germination?

3. Seedling Quality - How big is big enough? What is a balanced hardwood seedling? How can maximum growth and early hardening off be reconciled?

4. Pests: Diseases - What causes unexplained failures? Is fumigation essential for disease prevention? Does storage mold affect live tissue?

5. Pests: Weeds - Which herbicide should we try? What is its effect on seedlings, target plants, and soil organisms? Does it build up in the soil or carryover to subsequent crops?

NURSERY RESEARCH IN PROGRESS

In conjunction with our Woodlands Research Department, we have either initiated or are participating in several hardwood nursery research projects which should fill some of the information gap. Because the studies are in progress, hard data are not yet available, but there are observable responses.

Seed Quality

The observation that larger seedlings were usually produced from larger willow-water oak seed, led me to wonder if this is not the case with sweetgum. In cooperation with NCSU Hardwood Cooperative and the U. S. Forest Service, three sweetgum seed lots were separated into four size fractions each. Among the fractions size ranged from 144,000 seed to 81,000 seed/lb. There was a direct correlation between seed size and percent germination with the largest seed having the highest germination. The high and low germination was 95% and 43%, respectively.

Seedlings produced from these seed fractions are now being grown in a green house. Differences, if any, in seedling growth will be measured.

What is the practical implication if we get green house growth differences? By removing the poorest fraction of a given seed lot, uniformity of germination and subsequent seedling crop should be improved. Improved uniformity reduces the seedling cull factor. Low seedling density per unit of area is the factor that contributes the most to high seedling cost.

Seedling Nutrition

Sometimes it is more important to just get the job done than be overly concerned with efficiency. This type of situation prompted us to undertake a rather intensive fertilizer study. The study is in cooperation with Dr. C. B. Davey of NCSU and Mr. G. W. Bengtson of TVA.

The study measures the response of sweetgum and green ash (Fraxinus pennsylvanica) to seven sources of nitrogen fertilizers applied at three rates of elemental N. The sources are sulfur coated urea, 11% dissolution rate (SCU 11); sulfur coated urea, 24% dissolution rate (SCU 24); isobutylidene diurea (IBDU); ammonium nitrate; nitrate of soda; sulfate of ammonia; and urea. SCU 11, SCU 24, and IBDU are slow release fertilizers and were applied preplant only. The other sources were applied as a top dressing throughout the growing season. The rates of application are 200, 300 and 400 lb/ac of elemental N.

Differences in response to the various sources are pronounced. The poorest treatment appears to be nitrate of soda. The better treatments appear to be sulfate of ammonia and SCU 24. Both of the better treatments are better than the operational fertilization which is ammonium nitrate at the 400 lb N level.

Our intention is to both refine and expand this study. It will be expanded to measure responses of sycamore (Platanus occidentalis), and the willow-water oaks (Quercus phellos & nigra) to various sources and levels of N. It will likely be refined to measure response to timing of applications, and also measure response to combinations of slow release and soluble sources.

When all the data are analyzed, we should know what is best for us, and more importantly what is good enough. We have already concluded that the operational top dress applications can be changed from weekly to bi-weekly. The better treatments appear at least as effective at the 300 lb rate than does the operational treatment at the 400 lb. rate. If this proves to be so, an immediate benefit is a 25% reduction in the N fertilizer required.

Again in cooperation with NCSU, and Abbott Laboratories, we are involved in testing various levels of inoculum of the endomycorrhiza, Glomus faciculatus. Dramatic responses to this and other onoculations are not apparent at our nursery. The nursery soil has an inherently high level of phosphorous, which ranges above 90 lb/ac. The availability of phosphorus may be reducing or eliminating the seedlings' need for mycorrhizal infection.

The response of outplanted hardwood seedlings inoculated with endomycorrhiza may prove to be of much greater importance than nursery response. With the short rotations contemplated for intensively managed hardwood plantations, relatively small early gains in growth assume importance.

Pest Control

Union Camp recently joined the Auburn Weed Control Cooperative. During the current season, we are participating in the operational nursery herbicide study and herbicide screening tests.

The operational test is a post plant pre-emerge application of Treflan followed by a "piggy-back" application of Devrinol after germination is complete. Preliminary measurements show that this method is approximately 50% effective. The degree of control is not observable without measurement, and is not impressive until you consider that no weed control resulted in hand weeding requirements up to 180 man hours/ac each month.

The treatments were applied to sweetgum, sycamore and green ash. There are no observable negative effects to the seedlings. However, final measurements of growth and survival have not been made.

Photoperiod

Also in progress is a test measuring the response of sweetgum to night lighting at various levels of intensity for a two hour period around midnight each night throughout the growing season. Responses will be measured from levels ranging from a high of 40 foot candles down to zero foot candles artificial light. The observable response is not dramatic, but seedlings do appear slightly larger under the lights than the average operationally grown seedlings.

The practical value of this test will be determined by (1) the light intensity required to get increased growth, and (2) the presence or absence of a better alternative method of achieving the same results.

EQUIPMENT DEVELOPMENT

Fertilization

Based on an idea developed by the late Gerald Black of Weyerhaeuser, a granular fertilizer applicator was built that fertilizes three seed beds simultaneously. The agitating or tumbling bar within the applicator is hydraulically driven rather than ground driven. The hydraulic drive allows operation at ground speeds up to 6 mph. The production rate is approximately 5 ac/hr at 6 mph. This is at least a 75% reduction in application time from our single bed, ground drive application method.

Seedling Harvesting

Initially, hardwood seedlings were transported from the field to the packing house on a trailer. The seedlings were unloaded by hand and the trailer returned for another load. Either field labor came in with the trailer to unload, or the packing crew stopped packing to unload.

In late 1977, the trailer was replaced with large 3 sided pallet boxes, and a lift fork was installed on a farm tractor front-end loader. Pallet boxes are moved from the field to the packing house with the fork lift tractor. The fork lift places the full pallet box on a platform equipped with casters. The loaded pallet can then be moved by hand into storage or position on the packing line. Empty pallet boxes are returned to the field by the fork lift tractor.

The elimination of the unloading procedure paid for the additional equipment the first year of use.