FOREST NURSERY DISEASE MANAGEMENT
EASTERN SESSION - WILLIAMSBURG, VIRGINIA

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INTRODUCTION

Thirty-three percent of all forest tree nurseries in the U. S. and 43 percent of the nursery acreage are located in the South. Southern nurseries produce 69.9% of the annual seedling crop. The average southern nursery is 63.9 acres in size, and 99.4% of its annual crop is bare root stock. Since at least three nurseries are under construction in the South, this region may be widening its lead in forest regeneration activity.

The high and increasing costs of producing nursery seedlings has increased the impact of disease losses. At the last Nurserymen's Conference in Charleston, I stated that the importance of nursery diseases is too often measured by the impact on seedling production. Too many responsible people, including many in attendance at this meeting, measure the importance of a disease by the number of seedlings lost in nursery beds. The real impact, however, is the loss in plantations due to the presence of a disease in nursery planting. Even a 1 percent growth reduction in a plantation over a 20-year rotation is a substantial monetary loss to a landowner.

OBJECTIVES

The objectives of our nursery disease management session are to inform you of recent developments in forest nursery disease research, to impress you with the importance of good disease control practices, and to stress the importance of seedling quality to survival and growth in plantations. This session is divided into two parts with a few minutes after each part for questions and answers. The first part will deal with fusiform rust and the last with black root rot.

CONTROL OF FUSIFORM RUST IN A SLASH PINE OUTPLANTING WITH A SYSTEMIC FUNGICIDE - C. E. AFFELTRANGER

One or two foliar and soil drench applications of the systemic fungicide benodanil during April and May successfully controlled fusiform

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The following adjuvants were tested at the indicated rates.

Triton X-100	1 pint/100 gallons
Triton X-45	1 pint/100 gallons
Plyac	1 pint/100 gallons
Exhalt-800	1 pint/100 gallons
Dupont Spreader Sticker	4 oz./100 gallons
Olde Worlde	1 pint/100 gallons
Ortho X-77	6 oz./100 gallons
Atlas Surfactant	4 pint/100 gallons
Security Spreader Sticker	1/2 pint/100 gallons
Plant-Gard	20 gallons/100 gallons
Bio-Film	6 oz./100 gallons
Nu-Film	1 pint/100 gallons
Ortho-Chevron Spreader Sticker	1/2 pint/100 gallons

It should be noted that the rating of the four adjuvants as superior in this test does not constitute an endorsement or recommendation for their use to the exclusion of others. Since all 13 adjuvants were equally effective without rain, a post-rain application that included any one of the tested adjuvants may have increased the degree of control obtained and probably would have made all 13 adjuvants equally effective.

MECHANICAL ROOT INJURY LOWERS SEEDLING SURVIVAL MORE THAN SEVERE BLACK ROOT ROT - S. J. ROWAN

Loblolly pine seedlings from six nurseries and slash pine seedlings from one nursery were planted on a deep sand (Lakeland) in Wilkinson County, Georgia. In nurseries where significant root rot was found, both seedlings with severe root rot and seedlings with little or no root rot were collected and outplanted. The amount of root rot on each group of seedlings was determined by measuring the length of primary and secondary roots and determining the percentage of their length with root lesions. Mechanical root injury was inflicted with a dull knife on loblolly seedlings of average quality from the Herty, Morgan, Continental Can, and Great Southern nurseries in Georgia. In this manner, numbers of feeder roots were reduced by 50% or 75%. The study design was a randomized block, with each of the five blocks containing 19 treatment rows of 25 seedlings planted at a 5-by-8-foot spacing. Seedling mortality was recorded 21 weeks after planting.

Although black root rot was severe on seedlings from the Hauss, Continental Can, and Great Southern nurseries, root rot increased mortality only in seedlings from the Hauss nursery (Table 1). Mechanical root injury, however, significantly increased mortality of seedlings from the Herty, Morgan, Great Southern, and Continental Can nurseries Root injury or seedling quality as measured by the number of feeder roots is a most important attribute of pine seedlings, and is significantly correlated with field survival. Root rot severity was also correlated with survival, but this correlation was barely significant at the 5% level (Table 2). Because mechanical lifting often destroys feeder roots, this nursery practice must be given very careful attention at all nurseries and steps must be taken to eliminate problems.

rust in a one-year-old slash pine plantation. Approximately one-half as many branch galls and one-quarter as many stem galls appeared on treated trees as those left untreated. The evaluation is continuing.

TIME BETWEEN APPLICATION OF FERBAM AND IRRIGATION IMPORTANT FOR FUSIFORM RUST CONTROL - S. J. ROWAN

Slash pine seedlings were sprayed with ferbam (4 oz. Dupont spreader sticker and 3 lbs. ferbam per 100 gallons) at a rate of 200 gallons per acre. Five, 30, 60, and 120 minutes after the ferbam sprays were applied, 1/4 inch of rain was artifically applied and the seedlings were inoculated with fusiform rust. The following percentages of seedlings were infected 6 months after inoculation:

Treatment	Percent infected
Nonsprayed-Check	94.7
5 minutes	43.0
30 minutes	27.1
60 minutes	13.5
120 minutes	7.2

The obvious conclusion to be drawn from these data is that ferbam sprays must be allowed to dry before irrigating or before rainfall begins.

SPRAY ADJUVANTS (SPREADER-STICKERS, SURFACTANTS) AND FUSIFORM RUST CONTROL - S. J. ROWAN

Although ferbam sprays have been used to control fusiform rust for several years in forest nurseries, very little attention has been given to the effects of spray adjuvants on the degree of rust control obtained. An adjuvant is any substance added to a formulation to improve the effectiveness of the pesticide. The term includes wetting agents, spreaders, emulsifiers, dispersing agents, foaming adjuvants, foam suppressants, penetrants, and correctives. A spray adjuvant may contain one or more surfactants, solvents, solubilizers, buffering agents, and stickers.

Because ferbam is a protective fungicide, its effectiveness for fusiform rust control depends upon the degree of coverage of susceptible pine tissue. Not only must the spray be applied to all susceptible pine tissue, it must also remain in place until the next spray is applied. Additional sprays are needed as seedlings grow and expose new tissues and after ferbam spray residues are removed by wind, rain, or irrigation. In essence, the effectiveness of ferbam sprays depends upon coverage, tenacity, and spray frequency. Coverage and tenacity are both affected by spray adjuvants.

All of 13 adjuvants tested were equally effective in the absence of rain, however, when 2 inches of rainfall were applied 2 days after spray application, four adjuvants proved superior to the other nine. These were Nu-film, Exhalt-800, Triton X-45, and Plant-Gard.

Table 1. Percent mortality of mechanically injured and black-root-rot-affected seedlings 21 weeks after planting on a deep sand in Georgia in January 1978.

Nursery	Pine species	Average seedlings	Root Rot seedlings	Seedlings feeder roots reduced 50%	Seedlings feeder roots reduced 75%
Herty, Georgia	Loblolly	1.6 a	0.0 a	5.6 ab	21.6 cde
Morgan, Georgia	Loblolly	15.2 abcd	-	23.2 def	37.6 f
Great Southern, Georgia	Loblolly	11.2 abcd	9.6 abcd	34.4 efg	57.6 h
Continental Can, Georgia	Loblolly	46.4 gh	19.2 bcde	76.8 i	83.2 i
Hauss, Alabama	Loblolly	24.0 def	47.2 gh	-	-
Walker, Georgia	Loblolly	12.8 abcd	-	-	-
Morgan, Georgia	Slash	7.2 abc	-	-	-

Means followed by a common letter do not differ at P=0.05 according to Duncan's Multiple Range Test.

Table 2. Relationship between black root rot severity and mortality 21-weeks after planting of pine seedlings on a deep sand in Georgia in January 1978.

Nursery	Pine species	Root Rot severity %	Mortality %	Seedlings lifted by
Morgan	Loblolly	0.2	15.2	Hand
Morgan	Slash	0.2	7.2	Hand
Walker	Loblolly	2.3	4.0	Hand
Great Southern	Loblolly	6.0	11.2	Mechanical
Continental Can	Loblolly	6.0	46.4	Mechanical
Herty	Loblolly	8.0	1.6	Hand
Herty	Loblolly	28.5	0.0	Hand
Hauss	Loblolly	38.4	24.0	Hand
Continental Can	Loblolly	39.0	19.2	Hand
Hauss	Loblolly	66.4	47.2	Hand
Great Southern	Loblolly	86.2	9.6	Hand

CHARCOAL ROOT ROT IN FLORIDA - E. L. Barnard

Charcoal root rot caused by Macrophomina phaseolina (Tassi) Goid. (= Sclerotium bataticola Taub.) is currently regarded as the most serious disease affecting pine seedlings in Florida tree nurseries. This disease was known to occur in Florida as early as the late 1950's and by the mid 1960's was considered to be the most important disease in at least three pine nurseries. In 1976-1977 the threat represented by charcoal root rot was dramatically emphasized in one Florida nursery where approximately 16.5 million pine seedlings valued at an estimated $148,000 were lost to the disease. First evidence of the problem was detected in late summer of 1976 and attempts to save the affected seedlings through a combination of root pruning, top pruning, and fungicide treatments were unsuccessful. In January of 1977 the seedlings were quarantined and plowed into the ground.

Charcoal root rot is particularly dangerous and warrants the attention of southern forest nurserymen for a number of reasons. For example, evidence of the occurrence of the disease in nursery seedbeds may be far less than dramatic. Above ground symptom expression may include nothing more than slight stunting and yellowing of affected seedlings. Indeed, even these symptoms may be masked as a result of the optimal growing conditions (fertility, irrigation, etc.) provided by the nursery environment. Consequently, the disease may be present and yet go unheeded as a problem of any significance. In addition, M. phaseolina increases in activity in late summer when soil temperatures are at their peak, often becoming problematic when remedial action may be too late to save the affected crop. Further, M. phaseolina forms persistent survival structures (sclerotia) in the soil which are resistant to many standard fungicides and soil fumigants, and which may remain viable in the soil for years. Finally, M. phaseolina not only attacks pines, it also attacks a variety of other plant species including cover crops such as corn and soybeans. As a result, this fungus can easily develop into economically disastrous populations if susceptible host crops are routinely grown in rotation in nursery soils.

While losses resulting from charcoal root rot may be incurred at the nursery in the forms of seedling mortality and/or increased numbers of cull seedlings, perhaps the most serious damages are sustained in terms of lost growth and replant costs resulting from plantation failures. Loss of and/or damage to seedling roots due to infection by M. phaseolina often results in seedlings which are unable to survive stresses (drought, etc.) in the field following outplanting. In Florida, outplant performance of diseased seedlings as well as the fate of M. phaseolina transported to the field on infected stock continue to be areas of concern and investigation.

Fortunately, effective control measures for charcoal root rot in the nursery are available. In addition to quality nursery practices, these include the use of non-host cover crops such as millet, rye, or a similar grain to avoid buildups in the fungus population and judicious application of a methyl bromide formulation equivalent to MC-33 at 350

lbs./acre under a 2 mil polyethylene tarp. Adoption of these measures in Florida is providing effective control of M. phaseolina in nursery seedbeds.

In summary, a healthy respect for charcoal root rot and the threat it poses to southern forest regeneration is encouraged. Particular caution is advised when considering management alternatives (cover crops; fumigation materials, rates, schedules, etc) which might serve to expand acceptably low populations of M. phaseolina into economically damaging levels.