FUMIGATION OF FOREST NURSERIES IN THE SOUTHEAST FOR CONTROL OF WEEDS AND ROOT ROT

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During the past few years, increased numbers of forest nurseries have been found to be infected with root rot. The lower part of the seedling root system decays and swelling occurs in the live tissue just above the decayed area. Work is still under way to determine the cause of this disease. It can, however, be controlled by soil fumigation. In severe cases, control of the disease alone justifies the cost of fumigation. In other areas, nurserymen fumigate because of the additional benefit from the control of weeds, particularly nut grass.

The most effective fumigant is methyl bromide. This material applied at 300 pounds per acre under plastic covers will completely eliminate root rot, nut grass, and most other weeds during the first growing season. It is important that the soil be disked thoroughly and that its moisture content be suitable for planting seed. If the soil temperature is above 60° F., 24 hours exposure to the chemical, with the covers on, is necessary. If the soil temperature is between 50° and 60 , a 48-hour exposure is necessary. Soil cannot be successfully fur-gated at temperatures below 50°. It is safe to plant 24 hours after the covers have been removed.

Cost of fumigant is about $210 per acre. In addition, cost of plastic covers varies with the number used atone time. A crew of 4 to 6 men using 25 covers of 900 square feet each can fumigate about one-half acre per day. Labor costs increase the expense of fumigation to approximately $400 per acre. Tree growth has been outstanding on areas that have been fumigated, so some growers believe the additional expense of approximately 40c per thousand seedlings is justified.

Because of the high cost and excessive labor involved in fumigating with methyl bromide, a search has been made for a cheaper substitute. The most promising material yet tried is Vapam.21 This material used at 60 gallons per acre will completely control nut grass and give commercial control of root rot. Its cost is $180 per acre. The greatest advantage in using Vapam is the ease of application. It can be pumped into the irrigation system slowly so that it takes 20 to

1 / The author is employed under a cooperative agreement with the Georgia Forestry Commission.

2 / Vapam is now marketed by Stauffer Chemical Company and E. I du Pont de Nemours Company.

30 minutes to apply the chemical. For control, this must be followed immediately with at least one-half inch of water to seal it. Failures with this chemical have been traced to an improper seal. Vapam decomposes rapidly and evaporates as soon as it is diluted. If it has been properly sealed, it will remain in the soil for several days. Vapam will control root rot and nut grass after being sealed in the soil for 24 hours, but disking and planting should be delayed for 2 weeks to avoid any possible toxic effects to the new seedlings. Treated soil should be thoroughly disked when beds are prepared. A more complete control can be obtained by increasing the dosage to 120 gallons per acre, but in early tests it seems doubtful that the extra expense is justified.

Tests on the use of Vapam are still in progress and further refinements can be expected. This preliminary information is released because of the tremendous interest in the use of Vapam evidenced by requests from nurserymen throughout the area. It would be wise to experiment with the material on limited acreage before undertaking large-scale fumigation.

Another material which has been used in forest nurseries for several years is ethylene dibromide. This chemical controls nematodes only and has no important effect on fungi or weeds. A formulation of 85 percent ethylene dibromide by volume when used at 10 gallons per acre costs in the neighborhood of $40. It is injected into the soil 6 to 8 inches deep by a special apparatus. Soil should be prepared in the same manner as for other fumigants. It is necessary to wait two weeks after treatment before planting. Although some nurseries have obtained control of root rot by this means, there are many areas where it fails to produce the desired effect. This suggests that nematodes are a factor but not the only factor involved in the root-rot complex.

LATE WINTER PRELIFTING FERTILIZATION OF LOBLOLLY SEEDBEDS

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During the 1955 planting season the Tallahatchie Research Center studied the effects of prelifting winter fertilization of nursery seedbeds on survival and early growth of normal loblolly seedlings planted on adverse sites in north Mississippi. The fertilizer amendment as applied in this study decreased first-year survival, but had no apparent effect on vigor or height growth.

The study was installed in cooperation with the Yazoo-Little Tallahatchie Flood Prevention Project and the Ashe Nursery at Brooklyn, Miss. The purpose was to explore promising leads obtained from unpublished planting studies conducted at North Carolina State College. Early results of the Carolina studies indicated that proper winter fertilization of normal and of yellow "chlorotic" loblolly pine seedlings, shortly prior to lifting, might improve vigor, survival, growth, and especially root development.

Design

The study included two morphological grades, large and small, of fertilized and unfertilized seedlings. Seedlings of either grade had a minimum root length of 5 inches, a minimum ground-line stem diameter of 1/8 inch, winter buds, and at least a few secondary needles. After outplanting, initial heights of large seedlings averaged 0.6 foot and of small seedlings, 0.4 foot.

Planting sites were: (1) eroded, loessial old fields, (2) eroded, sandy old fields, and (3) under a brushed and girdled overstory of ridge hardwoods. Two randomized blocks were established on each of three locations of each site condition. Each block included four plots, representing all possible combinations of the two grades and two fertilizer treatments. Each plot consisted of 25 test seedlings plus single-row isolation strips.

Procedure

A seedbed with normal loblolly stock, planted with seed from a single seed source, was selected for the study. One-half of each of three small, randomly selected plots within the bed was fertilized. A 2-foot isolation strip separated the fertilized and unfertilized seedlings. A total of 160 pounds of N plus 200 pounds of K_2O per acre was applied, one-third on January 6, 1955, one-third on January 10, and one-third on January 14. The fertilizer was broadcast by hand and brushed from the foliage.

On February 15, one month after the last application of fertilizer, the seedlings were carefully lifted, packed in standard Forest Service bales, and shipped to Oxford, Miss. Upon receipt at Oxford the next day, they were immediately culled, graded, and repacked for shipment to the field. Approximately equal numbers of seedlings of a given grade from each of the three fertilized nursery plots were pooled to minimize any possible effect of site variation in the nursery bed; the same was done with unfertilized stock. Seedlings were planted during February 16-23.

While grading, it was observed that the fertilized seedlings had more fibrous roots. There was no discernible difference in color or appearance of the foliage, even, though a fertilized bed observed earlier at the nursery had shown a striking color contrast as compared to adjacent unfertilized beds.

Soil moisture during the growing season was generally favorable. August and September, however, were droughty months with rainfall less than half of normal.

Results

As recorded in mid-October 1955, first-year survival for all seedlings averaged 75 percent. Differences in first-year survival were tested by analysis of variance. Results of the survival analysis may be summarized as follows

1. There was no apparent difference in survival due to site.

2. There was no apparent advantage in using large as opposed to small planting stock.

3. Late seedbed fertilization in the nursery as applied in this study had a detrimental effect on seedling survival. Survival of fertilized trees averaged 69 percent while survival of unfertilized seedlings averaged 81 percent. Statistically, the differences are highly significant.

First-year height growth for all the study trees averaged 0.57 foot. Differences in first-year height growth were also tested by variance analysis, with these results:

1. Differences in height growth due to site were significant.

Height growth under a deadened overstory of ridge hardwoods was significantly better than on either of the old-field sites. Height growth averaged 0.67 foot on the released site and 0.52 foot on both the old-field sites.

2. Fertilization, independent of seedling grade, had no apparent effect on height growth.

3. The difference in height growth, independent of fertilization, between small and large stock was highly significant. Height growth averaged 0.50 foot for small seedlings and 0.64 foot for large seedlings.

Discussion

On the basis of this limited test, prelifting winter fertilization of normal loblolly seedlings to improve field performance cannot be recommended. The one-level fertilizer treatment decreased survival, and did not improve vigor or height growth. This does not, however, discount the value of prelifting fertilization of unthrifty or chlorotic stock, as only normal seedlings were used in the test.

While the fertilizer in some way reduced survival, the effect of the fertilizer on the physiology of the seedlings was not evaluated. Developing superior physiological grades of seedlings (especially for planting adverse sites) through proper nursery amendments still holds considerable promise. There is need for more systematic trials combined with information on the physiology of seedlings through foliar analysis or other techniques.

With the criteria used in the study, "large" seedlings were primarily of standard morphological grade 1, while "small" seedlings were predominantly grade 2. Considering height growth alone, results indicate the desirability of planting the sturdier grade 1 stock on adverse sites.

In this study, first-year height growth of seedlings under a deadened overstory of ridge hardwoods was superior to that of seedlings planted in old fields. Survival, however, was not superior. This is contrary to the general belief that under north Mississippi conditions survival of seedlings planted under girdled ridge hardwoods is consistently better than survival on old fields.