

# **Growing Bareroot Seedlings without Fumigation at the Bowater Nursery**

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Abstract-The Bowater Newsprint Carters Nursery has been producing bareroot pine seedlings without soil fumigation for many years. Practices contributing to this success include soil organic matter amendments, good water drainage, chemical and hand weed control and quick response to pest problems. Crops are grown on a 1:1 rotation with cover crops managed intensively on areas not growing seedlings. Operating without soil fumigation increases the risk of disease and pest invasion and requires a higher tolerance for early season weed populations.

## **BACKGROUND**

The Bowater Newsprint Carters Nursery has been in operation since 1975. It was created to replace the original nursery near Vonore, Tennessee, which had been in use since the mid 1950's. That nursery was flooded by the TVA in the Tellico Lake project. The combined production of both nurseries to date has been nearly 800 million seedlings.

The primary purpose of Carters Nursery is to supply seedlings for reforestation of lands supporting the Calhoun, Tennessee newsprint mill. The predominant species grown is loblolly pine from either piedmont or mountain provenances. Small numbers of Virginia pine seedlings are grown each year for Christmas tree growers and reclamation work. Other minor pine species are occasionally grown to meet special needs or requests. Approximately 40% of the yearly crop is currently sold to outside customers.

## **SOILS**

Soils of the Carters Nursery are predominantly classified as Sullivan series; deep alluvials described as dystric fluventic eutrochrepts, fine-loamy, siliceous, thermic. Texturally, the soil ranges from a silty clay loam to a sandy clay loam. With pH values between 5.0 and 6.0 and inherently good fertility, these soils are highly productive and produce excellent seedlings. Operational drawbacks include limited ability to manipulate seedling growth through nutrient or water management and equipment access limitations during wet weather.

## **FUMIGATION**

Soil fumigation of bareroot pine seedling nurseries has been practiced for many years and is acknowledged to provide several benefits. Among these are the control of soil borne fungi and nematodes and some control of certain weed species. Additional benefits attributed to fumigation include improved seed efficiency and increased seedling size (usually reported as increased biomass per unit of growing space ) when compared to unfumigated crops. In essence, individual cultural practices are substituted for fumigation in the Bowater nursery to achieve each of these benefits.

Carters Nursery was fumigated before the initial crop was planted. Records indicate that eight acres were fumigated in 1981 to control a Pythium root rot problem and two acres were fumigated in 1987 prior to installation of a mycorrhizae study. Both treatments were made with 400 pounds per acre of MC-2. Other than these noted exceptions, the nursery has been operated without fumigation to date. The decision to manage without fumigation has not been based simply on cost avoidance or environmental concerns, but rather on the belief that it has not been necessary. Calculated seed efficiencies have consistently exceeded 0.70, targeted seedbed densities are routinely realized and field performance of the seedlings has been good.

Operating a bareroot seedling nursery without fumigation is acknowledged to carry an element of risk. In the spring of 1996, a section of the nursery that had been cover-cropped for five consecutive years was sown with loblolly pine seed. Weather conditions at time of germination allowed damping-off fungi to proliferate and cause failure of nearly one-half acre of a particular seedlot. Interestingly, adjacent beds of the same seedlot sown three days later were essentially unaffected. This occurrence serves as a reminder that each nursery manager should make their own risk-vs-cost assessment to determine whether they can afford the occasional problem that might be prevented with regular fumigation.

### **CULTURAL PRACTICES**

Successful crops of seedlings have been produced from the Bowater nursery through a disciplined cultural regime. Essentially, there are three components to the program: soil management, intensive weed control and prompt response to problem areas.

One of the most critical aspects of producing seedlings in fine textured soils is maintaining organic matter levels. The Bowater nursery is nominally on a 1: 1 rotation. Areas not in seedlings receive an application of approximately 65 cubic yards per acre of sawdust prior to planting cover crops. Corn and grain sorghum are the primary cover crops grown and are managed intensively. After grain harvest the stalks are chopped with a silage cutter, lightly disked in and overseeded with winter wheat to reduce soil erosion. Bark mulch used on the seedbeds retains its integrity for up to a year and supplements the sawdust and cover crop organic amendments. Benefits derived from elevated soil organic matter levels include enhanced soil microbial activity, better soil porosity and improved soil drainage.

Complementing management of soil organic matter has been attention to both surface and subsurface water drainage. Particular emphasis is placed on moving water off the site quickly. Fields are leveled with a land plane prior to shaping beds to eliminate any low spots. After shaping the raised beds, bed ends are graded to open the aisles and allow release of water. Internal soil drainage is enhanced by deep chisel-plowing (18 - 24") on two foot centers before shaping beds. Subterranean drains have been installed in areas that were poorly drained to move subsurface water.

### **WEED CONTROL**

Weed control requires an intensive regime of sanitation, hand weeding and herbicides. The two most persistent problem weeds in this nursery are sicklepod and yellow nutsedge. Coincidentally, fumigation does not effectively control either species. Other common but less intrusive weed species present include morning-glory, crabgrass, carpetweed, chickweed.

eclipta, prostrate surge, Johnsongrass and evening primrose. Most of these minor weeds are easily controlled by herbicides. Weed control in the seedbeds begins with sanitation in the cover crops. An effort is made to eliminate weeds before they reach maturity in cover crops, along irrigation lines and in adjacent non-crop areas.

Weed control in the seedlings consists of the accepted standards of pregermination oxyfluorfen application at sowing followed by alternating treatments or tank mixes of oxyfluorfen, sethoxydim and lactofen. Two tenets of weed control in an unfumigated nursery should be understood:

- 1) early season weed populations will be higher and
- 2) the amount of hand weeding necessary will be greater than in fumigated nurseries. Hand weeding of Carters Nursery averaged 29 man-hours per acre last year.

### **NEMATODES AND FUNGI**

One of the obvious benefits from soil fumigation is control of nematode and fungal populations. At Carters Nursery, a nematicide (ethoprop) is soil incorporated prior to planting cover crops. Pre-plant drenches and post-emergent sprays of captan are applied to control damping-off fungi. In addition, spot sprays of metalaxyl are used to control any small problem areas that might occur. While not as effective as soil fumigation, these prophylactic and remedial sprays have kept the organisms under reasonable control.

### **SUMMARY**

The Bowater nursery has produced quality bareroot pine seedlings without fumigation for many years. The key elements of this success have been soil organic matter management, intensive weed control and attention to water drainage. Managing an unfumigated nursery requires precise prescription and timing of herbicide applications. It also requires a tolerance for high early season weed populations until seedlings have reached the growth stage where herbicides can be applied.

Fumigation has been used at Carters Nursery in the past to correct specific problems and will remain a management option as long as it is available. Alternate management practices will continue to be developed as well. Trials of alternative cover crops, rate and timing refinement of herbicide applications and evaluating substitutes for methyl bromide fumigation will continue.

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