PEST CONTROL FOR CONTAINER-GROWN LONGLEAF PINE

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ABSTRACT—Several insect, weed, and disease pests are discussed that have been observed affecting container-grown longleaf pine (*Pinus palustris* Mill.) seedlings. The available tools to minimize the effects of these pests are limited to a few select insecticides, herbicides, and fungicides. Extreme care should be taken to ensure that the chemical chosen is used within the recommended guidelines and used with proper equipment. Accurate identification of the pest is important to ensure that the correct remedy is chosen. When growing longleaf pine seedlings in containers, pest prevention is cheaper than crisis intervention. Care should be taken to use the best available clean seed and potting media, to clean containers between crops, and to prevent stress by using the right amount of irrigation water. A list of pesticides is given to aid the grower in selecting the proper tool for pest problems.

INTRODUCTION AND CAUTIONS

If you have experience growing longleaf pine (*Pinus palustris* Mill.) seedlings in containers you may find it difficult to believe that containerization is supposed to reduce pest problems. Actually, it just changes the set of pest problems, compared to bareroot nurseries, and increases their importance by increasing the per-unit crop value. In integrated pest management (IPM), pesticides should be applied only at or above the economic threshold (ET). That is, at the point where the value of damage is just greater than the cost of the pest control. With container seedlings costing four times as much as bareroot seedlings, the ET is reduced to a fourth.

Pest control covers protecting your crop from three categories of pests: fungi, insects, and weeds. The tools for this are, not surprisingly, fungicides, insecticides, and herbicides. Each of these "tools" (pesticide categories) come with a different set of cautions associated with the consequences of making an application mistake. The wrong fungicide will not stop the disease. Careless or incorrect application of an insecticide is dangerous to the applicator and to the environment. The wrong rate or careless application of any herbicide can severely damage longleaf seedlings.

The diseases and insects presented here are those the authors have found associated with container-grown longleaf pine seedlings (table 1, 2). The herbicides shown are a shortened list of ones used in the bareroot nursery industry (table 3). We suspect the level of pesticide experience differs widely among producers of container-grown longleaf pine seedlings. Remember that workers and pesticide handlers must be trained under Worker Protection Safety (WPS) regulations every 5 years. Agriculture is not complying well with WPS regulations (<50 percent compliance), and a push for greater enforcement seems to be in the works. If caught in noncompliance you may receive a substantial fine. Contact your local county extension office for assistance in getting yourself or your workers the necessary training. Everyone must be properly trained and licensed by their State before obtaining or using most, if not all, of the products mentioned.

DISEASES

Fusarium Spp.

One of the more troublesome fungal organisms in container nurseries is the genus *Fusarium*. At least four species of the genus are generally considered opportunistic pathogens. They take advantage of stressed or weakened seedlings. The most common of these fungi are *Fusarium oxysporum*, *F. solani*, *F. piliferatum* and *F. subglutinans*. Their affects on longleaf production appear to the nursery manager as (1) poor germination, (2) damping-off, (3) root rot, (4) late-season root and crown rot, and even (5) seedling mortality after outplanting. While these fungi can be spread by wind and rain, the most common entry point into the nursery is with seed. Improperly collected and processed cones and cones from seed orchards may have a greater incidence of these fungi. Typically, mortality from these fungi are scattered or random throughout the nursery, but the percentage of seedlings infected often varies by seedlot. When environmental conditions favor spread, serious infestations may spread between container cells. The State of North Carolina now has a special local needs (24-C) registration for a Benlate® seed treatment that has improved germination and cavity fill in preliminary tests. Additional 24-C registrations are desirable in States that produce many container-grown longleaf seedlings. Seedlots suspected of extensive contamination can be treated with surface disinfectants such as hydrogen peroxide (H_2O_2), which has improved performance in some tests. Evaluations to register new fungicides to improve longleaf seed germination are in progress.

Rhizoctonia Solani

Probably the second most destructive fungus among container-grown longleaf is *Rhizoctonia solani*. This fungus is particularly serious on longleaf because of the seedlings

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Table 1—Chemicals registered for use in controlling diseases in longleaf

Agent	LD_{50}	Used	Fungus	Rate(lbs/acre)[a]
Bayleton Triadimefon	363	Foliar	Rusts	0.25–0.5
Captan	9,000	Seed Foliar	Damping-off *Botrytis*	0.5–5.0 ai 0.06–0.6/100 1bs seed
Thiram Gustafson-42S	780	Seed	Damping-off Birds, rats	2 gal = 10 oz Latex/100 lbs seed
PCNB Terraclor	12,000	Soil Seed	*Rhizoctonia*	5–200 ai or 0.5–0.75/bu
Chlorothanil Bravo	10,000	Foliar	*Anthracnose* *Botrytis*, etc.	0.75–1.0 ai
Iprodione Chipco-26019	3,500	Contact Foliar	*Botrytis* *Alternaria*	0.25–2.0 ai
Fosetyl-AL Aliete	2,000	Foliar Systemic	Phycomycetes *Rhizoctonia*	1.5–2.0 ai
Thiophanate Cleary-3336-F	15,000	Soil Foliar	*Fusarium* *Botrytis,* etc.	0.12 ai
Thiophanate methyl + terrazole = Banrot	1,070	Soil	Phycomycetes	0.38 A *Fusarium* *Rhizoctonia*
Metalaxyl Subdue	669	Soil Foliar	Phycomycetes	0.6 ai

LD_{50} rates of application are given for comparative references between products and not as guided to safety or application and use rates. For application rates consult product label which must be on site at use.

stature. Rhizoctonia may be in planting media, and when this gets on the buds of longleaf seedlings, which are just above ground level, the fungus can infect both bud and needle tissue. After infection, the fungus causes a rapid death of the bud and needles and is capable of spreading rapidly through the container sets. Symptoms first appear as a water-soaked lesion that quickly turns yellow, then brown, and then darken as the bud and needles decay. The tightly packed nature of longleaf seedlings in containers and irrigation systems common in nurseries favor the growth and spread of this fungus. Circular areas of brown, dead, and dying seedlings are a good indication of *Rhizoctonia* infection. Seedlings symptomatic of this disease should be placed away from the general population to reduce spread. This fungus can remain in soil particles left in containers from year to year in resistant structures called sclerotia. Sanitation is important to minimize carryover. Other container crops have benefited by the disinfestation of containers. This disease is also a problem in bareroot nurseries, and recent tests in South Carolina indicate that Chipco 26019® was effective at reducing disease incidence among bareroot seedlings.

Pythium Spp. and *Phytophthora* Spp.

Two other fungi that may be responsible for mortality in longleaf are *Pythium* and *Phytophthora*. These, too, are opportunistic pathogens that take advantage of stressed seedlings, especially seedlings that are over-watered. These fungi are considered water molds, as they move through the soil/water using a whip-like tail. Mortality by *Pythium* and *Phytophthora* appears as either damping-off or root rot early in the growing season and typically is scattered among the sets. As the seedling matures and becomes lignified, these pathogens are not a problem. Many, perhaps most, growers of container longleaf alternate some schedule of treatments with Subdue®, Cleary's®, and/or Aliete® to prevent damage by these water molds. Whether this works or if problems would be rare anyway is hard to tell. We have noticed that some plant diagnostic clinics find one or both of these organisms in every sample they receive. That doesn't necessarily indicate they were the problem.

Table 2—Chemicals registered for controlling insects in longleaf pine

Agent	LD_{50} [a]	Family	Used	Insects	Rate/acre
Chloropyrifos Dursban, Lorsban	96	OP[b]	Contact	Corn borer Stomach	0.1–5 A lb
Esfenvalerate Assana	325	Perethroid	Contact Stomach	Lygus	0.1–1 lb ai
Pernethrin Pounce	430	Perethroid	Residual Activity	Lepidoptera Weevils	0.05–0.2 lb ai
Diazinon Spectracide	300	OP	Long Residual	Many	0.25–2 A lbs
Malathion	1,375	OP	Foliage	Many and mites	0.5–3 A lbs
Bifenthrin Talstar Firebrand?	54	Perethroid	Contact Stomach	Fire ants	

[a] LD_{50} and rates of application are given for comparative references between products and not as a guide to safety or application use rates.
[b] The EPA may soon ban all OP (organophosphates)

Table 3—Herbicides registered or probably registered for growing container longleaf

Product	Crop plant	Container	PPE[a]	REI	Rate/acre[b]
Goal	Conifers	Yes	1,3,4,5	24	Pre 1–2 pts Post 1–2 pts
Cobra[c]	*P. palustris*	Yes	1,2,3,4,5	12	Pre 0.5–1 pt Post 0.04–1 pt
Vantage	*P. palustris*	(Bedding plants)	1,2,3	12	Post 2.25–3.75 pts
Fusilade[d]	Conifers	(Nursery beds)	1,2,4	12	Post 1–2 pts

[a] PPE code = 1 shoes + socks, 2 long sleeve shirt, 3 coveralls, 4 gloves, 5 eye protection.
[b] Rates of application are given for comparative reference between products and not as guides to safety or application use rates. For application rates consult product label which must be on site at use.
[c] In general, pine are more tolerant to Cobra that to Goal.
[d] Fusilade should probably be used without recommended COC or NIS.

OTHER DISEASES

Two other diseases that can infect longleaf pine at the nursery but will only be noticed after outplanting are pine needle rust and brown spot needle blight.

Needle Rust

Pine needle rust is caused by fungi in the genus *Coleosporium*. This disease may cause inconspicuous spots on the foliage at the nursery in the fall that may appear similar to brown spot. The next spring, after outplanting, small, yellow-white blisters form on the needles. These blisters are full of white to yellow aeciospores that do not infect pine, but rather infect other rust hosts, which are several common “weed” species such as goldenrod and morning-glory. Although fungicidal control would seldom be justified, Bayleton® would work. Even with spectacular needle infections, pine seedlings will normally survive without any problems. If seedling appearance is important to the customer, then locating the nursery away from the alternate host, or elimination via mowing or herbicides, is the best method to control this disease.

Brown Spot

Brown spot needle blight is the last of the common diseases that may occur in the production of longleaf pine. This disease, caused by the fungus *Mycosphaerella dearnessii*, occurs throughout the Southeastern United States. Other pine species seldom get brown spot needle blight, and the disease is economically important only to longleaf pine. The fungus is spread via wind and rain splash of spores, and infection occurs throughout the year. The disease first appears as small gray spots on the foliage of longleaf, which become yellow, then brown, as the infection progresses. Each infection site has three distinct zones: green, yellow, and brown; multiple infections eventually coalesce on the needle giving it a mottled appearance. Infected seedlings rarely die, but severely infected trees will not commence height growth and may be defoliated and lose vigor to such a point that other agents kill it after outplanting. If experience shows that fungicidal control is regularly needed, Bravo® or Maneb® will prevent infection when prophylactically applied. This disease was once considered a major problem to reestablishment of longleaf pine in some regions of the South. The production of more vigorous seedlings and site treatments that shorten the "grass stage" of longleaf seedling development have greatly reduced the impact of this disease outside the nursery. Prevention and sanitation is the best method to control this disease.

INSECTS

Fire Ants, Tip Moth, Pine Webworm, Saw Flies, Fungus Gnats

There are few, if any, insect pests in container-grown longleaf that warrant prophylactic treatments (Table 2). Instead, these pests are probably all controlled adequately by appropriate measures after the insects are discovered in the early stages of an infestation. This may not be true at all locations, and local experience may indicate exceptions with time. The types of actions required will differ depending on the quantity of seedlings being produced. For example, typical infestations of saw flies and/or pine webworms can be controlled through physical "squishing" at all but the largest container nurseries. Tip moths once caused a significant problem in bareroot longleaf, and they have the potential to damage container seedlings. If experience determined that under your conditions as little as 3 or 4 percent of your seedlings were destroyed by tip moths, some preventative treatment would probably be justifiable. Fire ants are certainly not amenable to squishing, and these are a predictable occurrence at some locations. In addition, certain quarantine restrictions can be triggered if fire ants are detected in a nursery or a shipment of seedlings. Fungus gnats have been suspected of causing problems among longleaf seedlings at some nurseries. Although physically capable of damaging fine roots, the gnats usually become noticeably abundant only when potting media is kept wetter than is optimal for the seedlings. It is my opinion that the damage sometimes attributed to these pests is largely due to disease organisms and poor root development caused by too much water.

WEEDS

Northern producers report that weeds are not a problem in their containers. It takes little investigation to determine that the South is different. However, the "science" of weed control in container production for southern pines is still in its very early stages, and there is nothing like the fairly standard protocol that exists for bareroot nurseries. Hand weeding is an option in small operations and some fairly large productions are still "crisis oriented" with respect to weeding or herbicide application. This will have to change where many seedlings are produced, and small productions should benefit economically if preventative measures were employed. Small weeds are controlled by much lower rates of herbicides than are larger weeds.

The information presented here was obtained from a telephone survey and may be a starting point for a weed control program appropriate for some nurseries (Table 3). There is a very short list of herbicides that should have selective activity, and the use of any of these should be initiated with great caution. One thing that makes a control program difficult to formulate is that both the weeds and possibly the activity of pre-emergent herbicides will differ with peat from different sources. The only "weed" species mentioned by several nurserymen was willow, and that is probably just a function of wind-blown seeds. Some nurserymen believe that weed seed comes in some of the media they purchase.

Of many sick and dead seedlings observed by the authors, in many cases, herbicide damage is the cause of the problem, even though disease is usually the first culprit suspected. This paper is not to be considered to provide an endorsement of safety or efficacy of any pesticide discussed or listed. The tables are provided to help reduce the number of herbicides you might otherwise have to look through if you have limited experience in this area. Always when using an herbicide for the first time apply to a test plot of no more than you are prepared to loose. Reactions can change from year to year. Soil or planting media affect the way plants respond to herbicides. Any kind of stress will change the response of plants. You must have an appropriate label on site to use a pesticide and you really should read it and follow directions.