FOREST HEALTH REPORT

ASSESSMENT OF LOBLOLLY PINE DECLINE ON THE OAKMULGEE RANGER DISTRICT, TALLADEGA NATIONAL FOREST, ALABAMA (REVISED)

Alexandria Field Office

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Prepared by: /s/ Nolan J. Hess
Nolan J. Hess – Plant Pathologist

/s/ Lori G. Eckhardt
Lori G. Eckhardt – Plant Pathologist/Entomologist, LSU

/s/ Roger D. Menard
Roger D. Menard – Biological Science Technician

/s/ Arthur J. Goddard
Arthur J. Goddard – Soil Scientist, NF's in Alabama

Approved by: /s/ Forrest L. Oliveria
for: Wesley A. Nettleton
Director, Region 8 Forest Health Protection

SOUTHERN REGION, STATE AND PRIVATE FORESTRY
USDA, FOREST SERVICE, ATLANTA, GA 30367

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ASSESSMENT OF LOBLOLLY PINE DECLINE ON THE OAKMULGEE RANGER DISTRICT, TALLADEGA NATIONAL FOREST, ALABAMA (REVISED)

by

Nolan J. Hess [1], Lori G. Eckhardt [2], Roger D. Menard [3] and Arthur J. Goddard [4]

ABSTRACT

Declining loblolly pine, Pinus taeda L., stands have been a management concern on the Oakmulgee Ranger District, National Forest in Alabama, since the 1960's. Symptoms of the decline syndrome include sparse crowns, reduced radial growth, deterioration of fine roots, and mortality of loblolly by age 50. A three-year study was conducted to evaluate the fungi, insect, and soils associated with declining loblolly stands and to re-evaluate management options for these decline prone sites. Sixteen one-sixth-acre plots were established on the Oakmulgee Ranger District as part of a larger Forest Health Monitoring study. Three dominant/co-dominant trees were selected at each plot for detailed study. Two primary lateral roots were excavated from each sample tree and samples of the primary and the fine roots were examined and collected. Samples of root tissue and soil were taken for lab analysis. Lab samples were plated on media selective for the isolation of Heterobasidion annosum, Phytophthora cinnamomi, and Leptographium species. Root samples revealed high levels of root damage, mortality, and staining associated with Leptographium species. Leptographium spp. were recovered from 94% of the lateral roots and from soils sampled at the 16 plots. Phytophthora cinnamomi was not recovered from any of the fine roots and was only recovered from 18% of the soils. There was no H. annosum found in any of the root samples. Insects were sampled on 8 of the 16 plots using pitfall traps. Insects were identified to species and rolled on selective media for isolation of associated pathogenic fungi. These root and lower stem-infesting insects consistently carried Leptographium terebrantis, L. procerum, and L. serpens. This evaluation shows that loblolly decline is a sequence of interactions among this complex of organisms, abiotic factors, and site conditions.

[1] Plant Pathologist, USDA Forest Service, Southern Region, Forest Health Protection, Alexandria Field Office, Pineville, LA.

[2] Plant Pathologist/Entomologist, Louisiana State University, Baton Rouge, LA.

[3] Biological Science Technician, Forest Health Protection, Alexandria Field Office.

[4] Soil Scientist, USDA Forest Service, National Forests in Alabama, Montgomery, AL.

INTRODUCTION

The Oakmulgee Ranger District of the Talladega National Forest is located in portions of six west-central Alabama counties with the District Office at Brent, 35 miles south of Tuscaloosa, AL. The Oakmulgee Ranger District falls within the Upper Gulf Coastal Plain province and consists of 158,000 acres of which approximately 99,000 acres are pine forest type. The dominant forest type in the pre-settlement era was longleaf pine (*Pinus palustris* Mill.), which was extensively cut over from the late 1800s until the mid-1920's. After the logging era many of these sites were used for agriculture prior to the establishment of the Talladega National Forest (Johnson, 1947). During the 1930's the emphasis was placed on watershed protection and much of this area was planted with loblolly pine (*Pinus taeda* L.).

Declining loblolly pine was first reported within the Talladega National Forest in 1959. Symptoms were being expressed by trees in the 40-50 year age class including short, chlorotic needles, sparse crowns, and reduced radial growth. Mortality usually occurred two to three years after the first expression of symptoms.

In 1966, a five year study was established on 24 one-quarter acre plots on the Oakmulgee Ranger District to determine the cause, rate of decline, and degree of the mortality of loblolly pine stands (Brown and McDowell 1968). Further evaluation of the 24 plots was conducted in 1976. Results of these studies did not confirm a specific pathogen as the causal agent of the decline; however, several important observations were made. Symptoms of the decline generally appeared between age 40 and 50, and fine root deterioration always appeared to precede the presence of the foliar symptoms (Loomis, 1976; Hess and others, 1999). *Heterobasidion annosum* (Fr.) Bref and *Phytophthora cinnamomi* Rands were recovered from some of the plots but annosum root disease and littleleaf disease were not implicated as the primary cause of the decline. The conclusions from the evaluation and follow-up study showed that deterioration of the fine roots, site conditions and a combination of other interactions caused the decline and mortality and that loblolly pine was not well suited for these upland sites. An increase of southern pine beetle (SPB; *Dendroctonus frontalis* Zimm.) incidence was also noted on these decline sites. Recommendations were made including the reduction of the rotation age of loblolly pine on affected sites from 70 to 60 years, maintenance of a basal area of 60-70 square feet per acre, and conversion of these sites to longleaf pine management type (Loomis, 1976).

During the next 15 years, the Oakmulgee converted an average of 1,000 acres/year of these sites to longleaf pine, but there are approximately 40,000 acres of loblolly pine decline/risk sites remaining on the Oakmulgee. An additional 10,000 to 20,000 acres of similar site conditions exist on the Shoal Creek and Talladega Districts of the Talladega National Forest.

In 1998, a study was established on four compartments of the Oakmulgee Ranger District in order to re-evaluate the decline complex, and to update management options. Evaluations of these plots concluded that although *P. cinnamomi* and *Leptographium* spp. were recovered from these plots, their roles in the decline complex were not clearly defined. Revised management options for these sites included managing loblolly pine on 50-year rotations or conversion to a longleaf pine type (Hess and others, 1999).

The National Forests in Alabama recognized that the complexity of managing these sites within the scope of ecosystem management, providing a diversity of habitat, and complying with enhanced regulatory requirements, has greatly affected their ability to achieve the desired future conditions needed for a sustainable ecosystem. The Oakmulgee District also recognized that declining loblolly stands were putting their red-cockaded woodpecker (RCW) habitat at risk. The Oakmulgee is the home of the state's largest RCW population and the District is targeted with obtaining 394 active clusters. The Oakmulgee RCW population is currently threatened by the declining health of many of their stands, which has led to a lack of suitable foraging habitat in the short-term and a projected lack of sustainable nesting habitat in the long-term. During a FHP Management Review, the National Forests in Alabama requested assistance in developing strategies for long-term management of these decline sites.

Forest Health Monitoring (FHM) plots were established throughout the state in 1990. An assessment made during the mid-1990's reported that many plots in central and southern Alabama counties were showing extensive decline. The Alexandria Field Office of Forest Health Protection coordinated a 3-year effort with multiple partners to perform a comprehensive evaluation of loblolly decline in central Alabama, completed in 2002.

METHODS

Sixteen one-sixth acre plots were established on the Oakmulgee Ranger District as part of a larger Forest Health Evaluation Monitoring study (FMH-EM; Table 1). Plot locations were initially selected by visual examinations for decline symptoms versus non-symptomatic loblolly stands on upland sites. Plot establishment followed the FHM guidelines (Dunn, 1999), using a cluster of four 1/24-acre subplots per plot. Four of the 16 plots were healthy (no visual decline symptoms) control plots. The plots were located predominately in the Big Sandy Watershed, which is a critical RCW habitat area for the district.

At each location, root health assessment was accomplished. Root samples were collected from the three dominant or co-dominant pines nearest the plot center using the modified two-root excavation method (Otrosina and others, 1997). Radial growth measurements were obtained with an increment core at breast height (dbh) for each of the sample trees.

Insects were sampled from May to March on 8 of the 16 Oakmulgee plots using pitfall traps for a 3-year period (2000-2002). Insects were collected from the traps once-per-week for transport to the laboratory for identification and isolation of associated fungi. The pitfall trap method, insect identification, and isolation of associated fungi are described in Hess and others (2002), Eckhardt (2003).

Data collected in the plots included:

- Tree measurements - species, diameter at breast height, age, 5 and 10-year growth increments.
- Site/stand information - pine and total basal area (10 factor prism), and vegetation density.
- Tree health/physiology – assessed by resin sampling, crown rating and root inspection.
- Soil profile description.

Tree Health Assessment:

Tree health was monitored at each plot utilizing the FHM protocols (USDA Forest Service, 2000). Tree crown conditions were measured on all pine trees with a dbh of 5 inches or greater. The crown measurements included live crown ratio, crown light exposure, crown density, crown dieback, and foliage transparency. Live crown ratio is a measure of crown length and its relationship to total tree height. Crown light exposure and crown position are combined in analysis to determine stand and canopy structure. Once the live crown ratio, crown light exposure, and crown position are determined, the next step is to measure how much of a crown exists. Crown density, which includes foliage, branches and reproductive structures, measures the crown biomass. Crown dieback defines how much of the crown does not have foliage but has fine twigs, indicating a loss of vigor or growth potential. Foliage transparency estimates how dense the foliage is on branches, indicating a loss of vigor or stress due to foliage damage or defoliation. Tree vigor was measured using a resin sampling procedure (Eckhardt, 2003). Vegetation Density Rating (VDR) was devised to determine thickness of understory (Eckhardt, 2003). Vegetation density was determined on all plots by counting the number of stems between 1 inch dbh and 5 inches dbh and recorded as light (1)=0 to 20 stems; moderate (2) 21 to 40 stems; and heavy (3) 41 and greater. The relationship of vegetation density and prescribed burning frequency was also evaluated. The District's burning records were used to determine date and frequency of burning within the compartments and stands of plot locations. Fire intensity and soil temperatures were not measured.

Root Pathogen Assessment:

Root samples were collected from all of the 16 center plots using a two-root excavation method in which three dominant/co-dominant trees nearest to plot center were selected. Two primary lateral root segments from each of the three plot trees selected were excavated with hand tools from the opposite side of the root collar out to the approximate crown drip line. Primary roots were defined as the major lateral roots extending from the base of the trees to the drip line. Root depth was recorded and roots were examined for primary root damage and fine root presence or absence, damage, and/or death before removal from soil. All secondary and feeder roots were categorized as fine roots. Soil samples were collected from around the excavated primary roots in a specific collection pattern using a soil punch (Eckhardt, 2003). The soil samples from each root were lumped together and placed in separate plastic bags, kept on ice, and transported to the laboratory.

Roots and associated soil samples were sent to Louisiana State University Agriculture Center, Plant Pathology Department, where fungal isolations and identifications were made. Of primary interest were Pythiaceous and Ophiostomoid fungi. Standard laboratory procedures were used as described in Hess and others, (2002) and Eckhardt, (2003).

Root Damage Assessment:

During the root excavation and sampling procedures, a sub-sample consisting of 4 plots on the Oakmulgee R.D. was chosen to evaluate the fine root damage through histological examination. Random samples of unwashed fine roots were taken from the primary roots and placed in formalin/acetic acid/alcohol fixative for 14 days. Fixed root specimens were cut, dehydrated, embedded in paraffin, sliced into transverse sections and affixed to slides. Sections on the slides were stained using a variety of staining schedules. Stained sections were then catalogued into damage categories based on examination using a light microscope (Hess and others 2003).

Soil Profile Classification:

Soil was classified to series at each of the plot locations by Art Goddard, Soil Scientist for National Forest in Alabama, and Emily Carter, Research Soil Scientist, Southern Research Station. A three-inch bucket auger was used to profile the soils to a depth of 60 inches. Soil profile descriptions are presented in Appendix A.

Soil Analysis and Topographic Features:

Soil samples were taken from the established plots to allow the evaluation of physical and chemical characteristics of decline sites. Soil bulk density, porosity, and moisture content were evaluated as indicators of internal aeration and water holding capacity (Carter and Others, 2003). Soil sampling consisted of removal of four soil cores from selected plots to a depth of 0.60 m. These were subdivided into 0.10 m increments and each were measured for bulk density, total porosity, and moisture content, at the time of sampling.

Chemical analyses of soil samples collected at each center subplot were conducted by the University of Missouri Soil Characterization Laboratory. Analysis were completed using standard laboratory procedures required by Forest Health Monitoring protocols (Palmer and others, 2001).

The Loblolly Decline Risk Map (LDRM) was developed (Eckhardt, 2003) correlating biological data collected from root sampling and pitfall traps with topographical map features. The mapped locations represent probabilities of decline over a definable geographic landscape. Plot topographical feature were derived from Digital Evaluation Models (DEMs) and percent slope and aspect provided the best fit for decline risk assessment.

RESULTS

The diameters of sampled trees within the Oakmulgee plots ranged from 10 to 15 inches (Table 2). The stand age was from 30 to 65 years. Stand density was from 55 to 100 square feet. The five-year growth increments for these sites were from 4.5 to 14 mm and 10-year growth increments were 10 to 27.5 mm.

Phytophthora cinnamomi was not recovered from any root samples from the decline or control plots but was recovered from the associated soils from 3 of the decline plots.

Leptographium spp. was recovered from the primary and fine roots from 14 of the 16 plots and from the soils of 8 of the 16 plots (Table 3). *Leptographium* spp. isolated from the root samples were *L. terebrantis* Barras & Perry, *L. procerum* (Kendr.) Wingfield, *L. serpens* (Goid.) Wingfield. The overall proportion of *Leptographium* spp. isolated was significantly higher from roots of symptomatic plots (86%) than those from asymptomatic plots (40%)(Table 4). Only *L. procerum* was isolated from the soil samples, and was generally more common in symptomatic than asymptomatic plots (Eckhardt, 2003).

Leptographium spp. was also recovered from the surface of fourteen species of root-feeding bark beetles and weevils trapped from the 8 plots. Eighty-one percent of the fourteen insect species trapped carried *Leptographium* spp. *Leptographium* incidence was positively correlated with high populations of root-feeding bark beetles and weevils. Increased root-feeding bark beetle and weevil populations were seen during the same year of prescribed burning and the year following, but once the plots were three years past burn date, insect populations on the plots returned to a low steady population similar to that seen in unburned and asymptomatic plots (Eckhardt, 2003).

The predominant root feeding insects associated with incidence of *Leptographium* spp. fall within three groups; pitch eating weevils, phloem (inner bark) feeding beetles, and bark beetles that feed into the xylem (sapwood) of the trees. The pitch feeding weevils including pales weevil showed a consistent recovery of *L. terebrantis* and *L. procerum.* The pitch-feeding group introduces *Leptographium* into the phloem through incidental wounds while feeding on the pitch. The phloem-feeding group includes black turpentine beetle (BTB) and nitidulid beetle. The *Leptographium* spp. found to be associated with this insect group were *L. terebrantis* and *L. procerum.* The root feeding bark beetle recovered from pitfall traps included two species of *Hylastes* and ambrosia beetles that feed on the xylem tissues and carried *L. serpens* (Echhardt, 2003)

Root system damage was statistically higher in symptomatic trees than in asymptomatic trees. Symptomatic trees had consistently fewer fine roots with more damage and staining of their primary root systems and higher incidence of *Leptographium* spp. Trees with symptoms of decline had deteriorating root systems (absence of fine roots, dead or decaying lateral roots) and obvious staining compared to apparently healthy trees which had healthy root systems that were essentially free of stain. The histological evaluation of the fine roots from declining trees revealed extensive wounding, poor root health, and starch starvation preceding root death. The relationship between wounded roots and reduced radial growth was shown to be significant (Hess and others, 2003).

H. annosum was not found in any of the root samples, nor were any fruiting bodies of the fungus found during the field survey.

The soil evaluation showed that decline plots had higher bulk density values and lower total porosity with depth compared to the control plots. Soil pH ranged between 4.0 and 5.7. The soil profiles and classifications (Table 3 and Appendix A) show that all of the Oakmulgee plots are located on sandy loam or loamy sand, moderately well drained to well drained soils.

Risk rating for root diseases in the southern forest has traditionally be accomplished by identifying soil characteristics most often associated with specific root diseases i.e. deep, well drained sandy soils for annosum root disease and heavy clay, poorly drained soils for littleleaf disease. Risk rating systems utilized soil series descriptions to assess the risk factors. During the pine decline study, detailed soil descriptions were accomplished for each plot (Appendix A). During the analysis of *Leptographium* incidence from roots and associated soils, evaluation of landform had a more significant role in determining loblolly pine decline risk sites (Eckhardt 2003). However it was also noted that one species of *Leptopraphium*, *L. procerum* was isolated from soils associated with declining roots. Further investigation of *L. procerum* is needed to determine any association with soil characteristics.

DISCUSSION

Loblolly pine decline results from the debilitation of root systems by *Leptographium* species, which are associated with root feeding insects, which in turn are affected by site conditions (Eckhardt and others, 2004). *Leptographium* species were consistently associated with declining trees and the damage in these root systems were statistically higher in symptomatic trees. Symptomatic trees consistently possessed fewer fine roots and generally more insect and fire damage to the primary root systems than the asymptomatic trees.

Root system damage was positively correlated with insect abundance, which may have led to an increase in *Leptographium* incidence. Boles of the trees did not show significant wounding but colonization by *Leptographium* spp. within the roots was extensive.

Symptomatic plots also had lower vegetation ratings, apparently due to prescribed burns, than did asymptomatic plots. Plots with low vegetation ratings and high insect numbers also exhibited high incidence of *Leptographium*, which correlates with lower crown rating, reduced resin flow, and damaged roots. The above ground symptoms of radial growth reduction, foliar transparency, and crown density, within symptomatic plots as compared to controls, corresponded to the root conditions, and are consistent with results from studies of other pines associated with *Leptographium* spp. (Leaphart and Gill, 1959; Wagener and Mielke, 1961).

Littleleaf disease as described in the literature (Campbell and Copeland, 1954) and loblolly pine decline are not the same disease. Littleleaf typically occurs on poorly drained eroded clay soils, but loblolly decline occurs on relatively well-drained sandy loam soils. Littleleaf is associated with the occurrence of *P cinnamomi*, while *P. cinnamomi* was not isolated from loblolly decline trees (Eckhardt, 2003).

The role of *P. cinnamomi* in littleleaf disease was attributed to its ability to kill fine roots (Campbell and Copeland, 1954) and thus inhibit root growth and nutrient absorption. Torrey and Clarkson (1980) and Zimmerman and Brown (1971) determined that fine roots generally live from 1 to 4 yrs, and their mortality is associated with: cold weather; excessive soil moisture; poor soil drainage and aeration; drought; attacks by insects; fungi and other organisms; and foliage loss. The recovery of *P. cinnamomi* from the Oakmulgee plots was limited to soils on three plots. The histology of the fine roots showed significant wounding, cellular damage, and starch starvation, which indicate that factors other than *P. cinnamomi* are playing a key role in the deterioration of the fine roots in the loblolly decline syndrome.

CONCLUSIONS

Loblolly decline is a complex caused by the interactions among several biotic and abiotic stressors. Predisposing factors are primarily related to site condition and host (Hess and Others, 2003). Decline sites are predominantly upland sites with a history of previous agriculture and are not well suited for long-term management of loblolly pine for RCW habitat. Conditions which incite decline include fine root deterioration and soil factors. Loblolly decline symptoms are similar to the symptoms of littleleaf disease; however, these upland sites do not have the characteristic eroded clay soils associated with littleleaf disease. The final phase contributing to the decline complex includes root-feeding insects on the primary roots and the introduction of *Leptographium* species. Other factors to consider are landform, drought, and impact of prescribed fire. As loblolly stands decline with increased stress and stand age, they also become more susceptible to attack by southern pine beetle.

Management Options:

1. Utilize the Loblolly Decline Risk Map (LDRM) to estimate condition class of existing loblolly stands and project their life expectancy. The LDRM will assist the Oakmulgee Ranger District in planning for RCW habitat needs by projecting the age classes, stand health, and rotation ages that can be integrated with the habitat needs. The Arc View project file will be installed on the District's computers to be used to assess decline risk at the stand level. The LDRM is a generated risk map using landform, digital elevation maps, the District's shape files and integrated with root health information.

2. Longleaf pine is the preferred management species for the upland pine sites on the Oakmulgee Ranger District. Restoration of the longleaf pine ecosystem on these sites will provide for long-term RCW habitat needs, reduce SPB risk and will allow the District to manage for desired future conditions of a healthy forest.

3. Thinning the overstocked loblolly stands in the 20 to 40 year old age classes will also reduce the risk of southern pine beetle attacks. SPB risk models are available to identify high-risk sites and give basal area guidelines for reducing the risk (Appendix B).

Loblolly pine can be managed on the Oakmulgee upland pine sites on a rotation age of 50 years. Age classes beyond age 50 will have increased risk of reduction in growth rates, mortality, and susceptibility to southern pine beetle. The Loblolly Decline Risk Map can be used to identify sites/stands that may exceed the 50-year of age with minimal risk.

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Table 1. Oakmulgee loblolly pine decline plot locations & sub sample for insects and histology samples.

Plot Number	Compartment	Location	County	Sub-sample
12	13	N 32° 58".802 W 87° 27".123	Bibb	
13	14	N 32° 58".249 W 87° 23".180	Bibb	
14	24	N 32° 57".928 W 87° 24".715	Bibb	
15	19	N 32° 59".835 W 87° 29".780	Hale	PFT
16	20	N 32° 59".741 W 87° 29".733	Hale	H, PFT
17	31	N 32° 57".850 W 87° 22".933	Bibb	PFT
18	30	N 32° 57".767 W 87° 22".805	Bibb	H, PFT
19	31	N 32° 55".911 W 87° 23".147	Bibb	PFT
20	49	N 32° 54".484 W 87° 22".836	Bibb	
21	43	N 32° 55".818 W 87° 25".595	Hale	H
22	42	N 32° 56".113 W 87° 26".420	Hale	
32	129	N 32° 47".302 W 87° 01".456	Perry	H
Control 4	26	N 32° 58".511 W 87° 20".751	Bibb	PFT
Control 5	26	N 32° 58".392 W 87° 20".811	Bibb	PFT
Control 6	49	N 32° 54".307 W 87° 22".788	Bibb	
Control 7	129	N 32° 46".117 W 86° 59".283	Chilton	PFT

Sub-sample Legend: H = Histology of fine roots
PFT = Pit Fall Traps

Table 2. Averages of several tree characteristics by plot.

Plot and Compartment Numbers	dbh (avg. of plots in inches)	Age	Growth Increment (mm) 5 Years	10 Years	Basal Area sq. ft. (pine)	Total BA
Plot 12	10	54	7	14	90	90
Plot 13	13	59	8	15	60	70
Plot 14	10	62	6	13	50	70
Plot 15	13	59	10	19	100	110
Plot 16	15	59	7	16	70	80
Plot 17	12	59	7	14	80	100
Plot 18	15	65	11	24	70	90
Plot 19	10	55	7	12	90	110
Plot 20	9	65	2	4	110	110
Plot 21	13	56	10	19	70	90
Plot 22	12	46	6	15	50	70
Plot 32	16	60	5	10	40	60
Control 4	10	31	12	23	40	50
Control 5	11	30	16	32	70	80
Control 6	18	64	7	17	100	100
Control 7	10	54	5	10	100	130

Table 3. Recovery of pathogenic fungi from root, soil, and insects, by plot and soil series.

Plot and Compartment	Soil Series (See Appendix B for soil descriptions)	*Leptographium* Spp.					
		Roots		Soil		Insects	
		Yes	No	Yes	No	Yes	No
Plot 12, C-13	Maubila flaggy sandy loam	X		X		NT	NT
Plot 13, C-14	Maubila flaggy sandy loam	X		X		NT	NT
Plot 14, C-24	Wadley loamy sand	X		X		X	
Plot 15, C-19	Smithdale sandy loam	X		X		X	
Plot 16, C-20	Riverview sandy loam	X			X	NT	NT
Plot 17, C-31	Maubila flaggy sandy loam	X			X	X	
Plot 18, C-30	Maubila flaggy sandy loam	X			X	X	
Plot 19, C-31	Suffolk loamy sand	X		X		X	
Plot 20, C-49	Maubila flaggy sandy loam	X		X		X	
Plot 21, C-43	Smithdale sandy loam	X		X		X	
Plot 22, C-42	Maubila flaggy sandy loam	X		X		NT	NT
Plot 32, C-129	Suffolk loamy sand	X			X	NT	NT
Control; 4. C-26	Suffolk loamy sand	X		X		NT	NT
Control 5, C-26	Wadley loamy sand		X		X	NT	NT
Control 6, C-49	Wadley loamy sand	X		X		NT	NT
Control 7, C-129	Smithdale sandy loam		X		X	X	

NT = Pitfall traps were not installed on these plots.

Table 4. Percentage of isolates from loblolly pine roots that were identifiable as blue-stain fungi.

Fungal Species	Asymptomatic		Symptomatic	
	2000	2001	2000	2001
Leptographium procerum	43	43	84	92
Leptographium serpens	14	14	42	44
Leptographium terebrantis	43	36	81	84
Pooled *Leptographium* spp.	43	38	88	86

Appendix A... Soil Series Descriptions by Art Goddard.

Appendix B... National Forest Risk for Southern Pine Beetle - Coastal Plain Model.

Appendix A

Soil Series Descriptions by Art Goddard.

Forest Health
Soil Plot Descriptions – Art Goddard,
Oakmulgee Ranger District

Following are soil profile descriptions taken on April 1 thru 4, 2002 with Emily Carter, Southern Research Station, Auburn, AL, on the Oakmulgee Ranger District, Talladega National Forest. Soil described from an auger. Soil moisture is moist. Soil colors described are for moist soil.

Plot 12	Bibb County; site has been burned in last three years. Plot located on upper mid side slope with slopes ranging from 10 to 15 per cent.

Maubila flaggy sandy loam – very deep, moderately well drained soils that formed in stratified clayey and loamy marine sediments of the coastal plain. Permeability is slow.

A--0 to 1 inches; brown (10YR 4/3) sandy loam; weak fine granular structure; friable; many fine and few coarse roots; approximately 20 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

E--2 to 11 inches; strong brown (10YR 5/6) sandy loam; weak fine granular structure; friable; common medium and few coarse roots; approximately 30 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

Bt1-11 to 22 inches; yellowish red (7.5 YR 5/8) clay loam; weak medium subangular blocky structure; friable; few fine and medium roots; few faint clay films on faces of peds; approximately 20 percent angular fragments of ironstone; very strongly acid; clear wavy boundary.

Bt2--22 to 31 inches; yellowish red (5YR 5/8) clay loam; moderate medium subangular blocky structure; firm; few medium roots; common faint clay films on faces of peds; common medium prominent red (2.5 YR 4/6) and distinct yellowish brown (10YR 5/8) masses of iron accumulation; common medium distinct light brownish gray (10YR 6/2) iron depletions; approximately 15 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

Bt3--31 to 41 inches; yellowish red (5YR 5/8) clay loam; weak coarse subangular blocky structure which parts to strong fine subangular structure; firm; common distinct clay films on faces of peds; many fine and medium distinct yellowish brown (10YR 5/6) and prominent red (2.5 YR 4/8) masses of iron accumulation; many medium distinct light gray (10YR 7/2) iron depletions; approximately 15 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

BC--44 to 60 inches; 30 percent gray (10YR 6/1), 25 percent strong brown (7.5YR 5/6), 25 percent yellowish brown (10YR 5/6), and 20 percent red (10R 4/6) clay loam; moderate weak coarse subangular blocky structure; friable; areas with gray color are iron depletions and areas with red and brown colors are iron accumulations; approximately 15 percent angular fragments of ironstone; common fine flakes of mica; very strongly acid.

C--60 to 64+ inches; 40 percent gray (10YR 6/1), 25 percent strong brown (7.5YR 5/6), 25 percent yellowish brown (10YR 5/6), and 10 percent red (10R 4/6) clay; massive; firm; few thin pockets of clay loam; areas with gray color are iron depletions and areas with red and brown colors are iron accumulations; approximately 10 percent angular fragments of ironstone; many fine flakes of mica; very strongly acid.

Plot 13	Bibb County; site has been burned in last three years. Plot located on upper mid side slope with slopes ranging from 15 to 20 per cent.

Maubila flaggy sandy loam – very deep, moderately well drained soils that formed in stratified clayey and loamy marine sediments of the coastal plain. Permeability is slow.

A--0 to 1 inches; brown (10YR 4/3) sandy loam; weak fine granular structure; friable; many fine and few coarse roots; approximately 15 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

E--1 to 14 inches; strong brown (10YR 5/6) loamy fine sand; weak fine granular structure; friable; common medium and few coarse roots; approximately 20 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

Bt1-14 to 22 inches; yellowish red (7.5 YR 5/8) clay loam; weak medium subangular blocky structure; friable; few fine and medium roots; few faint clay films on faces of peds; approximately 5 percent angular fragments of ironstone; very strongly acid; clear wavy boundary.

Bt2--22 to 33 inches; red (2.5YR 5/8) clay loam; moderate medium subangular blocky structure; firm; few medium roots; common faint clay films on faces of peds; common medium prominent red (2.5 YR 4/6) and distinct yellowish brown (10YR 5/8) masses of iron accumulation; common medium distinct light brownish gray (10YR 6/2) iron depletions; approximately 15 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

Bt3--33 to 42 inches; light red (2.5YR 6/8) clay loam; weak coarse subangular blocky structure which parts to strong fine subangular structure; firm; common distinct clay films on faces of peds; many fine and medium distinct yellowish brown (10YR 5/6) and prominent red (2.5 YR 4/8) masses of iron accumulation; many medium distinct light gray (10YR 7/2) iron depletions; approximately 15 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

BC--42 to 55 inches; 30 percent gray (10YR 6/1), 25 percent strong brown (7.5YR 5/6), 25 percent yellowish brown (10YR 5/6), and 20 percent red (10R 4/6) clay loam; moderate weak coarse subangular blocky structure; friable; areas with gray color are iron depletions and areas with red and brown colors are iron accumulations; approximately 15 percent angular fragments of ironstone; common fine flakes of mica; very strongly acid.

C--55 to 64+ inches; 40 percent gray (10YR 6/1), 25 percent strong brown (7.5YR 5/6), 25 percent yellowish brown (10YR 5/6), and 10 percent red (10R 4/6) clay; massive; firm; few thin pockets of clay loam; areas with gray color are iron depletions and areas with red and brown colors are iron accumulations; approximately 10 percent angular fragments of ironstone; many fine flakes of mica; very strongly acid.

Plot 14	Bibb County; site burned in last year. Plot located on upper mid side slope with slopes ranging from 25 to 30 per cent.

Wadley loamy sand – very deep, well drained and somewhat excessively drained soils that formed in sandy and loamy marine sediments. Permeability is rapid in the A and E horizons and moderate in the Bt horizon.

A--0 to 3 inches; brown (10YR 4/3) loamy sand; single grain; loose; few fine and medium and many coarse roots; strongly acid; clear smooth boundary.

E1--3 to 8 inches; yellowish brown (10YR 5/4) loamy sand; single grain; loose; common fine and medium and few coarse roots; approximately 5 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

E2--8 to 65+ inches; yellowish brown (10YR 5/8) loamy sand; single grain; loose; few fine and medium roots; approximately 15 percent angular fragments of ironstone; few fine faint yellow (10YR 7/8) masses of iron accumulation; few fine and medium very pale yellow (10YR 7/4) pockets and streaks of uncoated sand grains; strongly acid.

Plot 15	Hale County; site burned in last year. Plot located on old field terrace mid side slope with slopes ranging from 5 to 10 per cent.

Smithdale sandy loam – deep, well drained soils that formed in thick beds of loamy upper coastal plain sediments. Permeability is moderate.

Ap--0 to 4 inches; brown (10YR 4/3) loamy sand. Weak fine granular structure; friable; common fine and medium roots; approximately 5 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

BE--4 to 8 inches; dark yellowish brown (10YR 4/6) loamy sand; weak fine granular structure; friable; few fine and common medium roots; approximately 5 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

Bt1--8 to 18 inches; yellowish red (5YR 5/6) sandy clay loam; weak fine granular structure; firm; few medium roots; common thin clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2--18 to 38 inches; yellowish red (5YR 5/8) clay loam; moderate medium subangular blocky structure; firm; sand grains coated and bridged with clay and oxides; strongly acid; gradual wavy boundary.

Bt3--38 to 56 inches; yellowish red (5YR 5/8) sandy clay loam; moderate medium subangular blocky structure; firm; sand grains coated and bridged with clay and oxides; approximately 5 percent angular fragments of ironstone; strongly acid.

Bt4--56 to 63+ inches; yellowish red (5YR 5/8) sandy loam; weak medium subangular blocky structure; friable; sand grains coated and bridged with clay and oxides; few medium faint red strong brown (7.5YR 5/8) masses of iron accumulation; approximately 5 percent angular fragments of ironstone; strongly

Plot 16	Hale County; site has been burned in last three years. Plot (center) located within drainage head (transect dissects the drain, with Maubila soils located on side slopes). The drainage area had been farmed in the past. Slopes range from 2 to 5 per cent.

Riverview sandy loam – very deep, well drained soils that formed in loamy alluvium on floodplains. Permeability is moderate.

Ap--0 to 6 inches; brown (10YR 4/3) sandy loam; weak fine granular structure; very friable; many fine and few medium roots; strongly acid; abrupt smooth boundary.

A2--6 to 12 inches; dark yellowish brown (10YR 4/4) loam; moderate medium granular structure; friable; few fine and common medium roots; few fine flakes of mica; strongly acid; clear wavy boundary

Bw1--12 to 23 inches; dark yellowish brown (10YR 4/6) loam; weak medium subangular blocky structure; friable; few medium roots; common fine flakes of mica; strongly acid; clear wavy boundary.

Bw2--23 to 44 inches; dark yellowish brown (10YR 4/6) sandy loam; weak medium subangular blocky structure; friable; common fine flakes of mica; very strongly acid; gradual wavy boundary.

C--44 to 63+ inches; yellowish brown (10YR 5/6) thinly stratified loamy sand; single grain; loose; common fine flakes of mica; very strongly acid.

Plot 17	Bibb County; site has not been burned in last 5 years or more. Plot located on upper mid side slope with slopes ranging from 0 to 5 per cent.

Maubila flaggy sandy loam, eroded – very deep, moderately well drained soils that formed in stratified clayey and loamy marine sediments of the coastal plain. Permeability is slow.

Bt1--0 to 3 inches; yellowish red (5YR 4/6) clay loam; weak medium subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; approximately 5 percent angular fragments of ironstone; very strongly acid; clear wavy boundary.

Bt2--3 to 18 inches; yellowish red (5YR 5/8) clay; moderate medium subangular blocky structure; firm; few medium roots; common faint clay films on faces of peds; common medium prominent red (2.5 YR 4/6) and distinct yellowish brown (10YR 5/8) masses of iron accumulation; common medium distinct light brownish gray (10YR 6/2) iron depletions; approximately 15 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

Bt3--18 to 32 inches; yellowish red (5YR 5/8) clay; weak coarse subangular blocky structure which parts to strong fine subangular structure; firm; common distinct clay films on faces of peds; many fine and medium distinct yellowish brown (10YR 5/6) and prominent red (2.5 YR 4/8) masses of iron accumulation; many medium distinct light gray (10YR 7/2) iron depletions; approximately 10 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

BC--32 to 49 inches (hit thick ironstone to hard to bore thru); 30 percent gray (10YR 6/1), 25 percent strong brown (7.5YR 5/6), 25 percent yellowish brown (10YR 5/6), and 20 percent red (10R 4/6) clay loam; moderate weak coarse subangular blocky structure; friable; areas with gray color are iron depletions and areas with red and brown colors are iron accumulations; approximately 10 percent angular fragments of ironstone; common fine flakes of mica; very strongly acid.

Plot 18	Bibb County; site has been burned in last year. Plot located on upper mid side slope with slopes ranging from 30 to 35 per cent.

Maubila flaggy sandy loam – very deep, moderately well drained soils that formed in stratified clayey and loamy marine sediments of the coastal plain. Permeability is slow.

A--0 to 3 inches; brown (10YR 4/3) sandy loam; weak fine granular structure; friable; many fine and few coarse roots; approximately 5 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

E--3 to 16 inches; yellowish brown (10YR 5/4) sandy loam; weak fine granular structure; friable; common medium and few coarse roots; approximately 10 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

Bt1--16 to 23 inches; strong brown (7.5 YR 5/8) clay loam; weak medium subangular blocky structure; friable; few fine and medium roots; few faint clay films on faces of peds; approximately 10 percent angular fragments of ironstone; very strongly acid; clear wavy boundary.

Bt2--23 to 32 inches; yellowish red (5YR 5/8) clay; moderate medium subangular blocky structure; firm; few medium roots; common faint clay films on faces of peds; common medium prominent red (2.5 YR 4/6) and distinct yellowish brown (10YR 5/8) masses of iron accumulation; common medium distinct light brownish gray (10YR 6/2) iron depletions; approximately 15 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

Bt3--32 to 44 inches; yellowish red (5YR 5/8) clay; weak coarse subangular blocky structure which parts to strong fine subangular structure; firm; common distinct clay films on faces of peds; many fine and medium distinct yellowish brown (10YR 5/6) and prominent red (2.5 YR 4/8) masses of iron accumulation; many medium distinct light gray (10YR 7/2) iron depletions; approximately 10 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

BC--44 to 60 inches; 30 percent gray (10YR 6/1), 25 percent strong brown (7.5YR 5/6), 25 percent yellowish brown (10YR 5/6), and 20 percent red (10R 4/6) clay loam; moderate weak coarse subangular blocky structure; friable; areas with gray color are iron depletions and areas with red and brown colors are iron accumulations; approximately 10 percent angular fragments of ironstone; common fine flakes of mica; very strongly acid.

C--60 to 64+ inches; 40 percent gray (10YR 6/1), 25 percent strong brown (7.5YR 5/6), 25 percent yellowish brown (10YR 5/6), and 10 percent red (10R 4/6) clay; massive; firm; few thin pockets of clay loam; areas with gray color are iron depletions and areas with red and brown colors are iron accumulations; approximately 10 percent angular fragments of ironstone; many fine flakes of mica; very strongly acid.

Plot 19	Bibb County; site burned in last three years. Plot located mid side slope with slopes ranging from 30 to 35 per cent.

Suffolk loamy sand – very deep, well drained soils that formed in loamy fluvial and marine sediments of the coastal plain. Permeability is moderate.

A--0 to 4 inches; brown (10YR 4/3) loamy sand; weak fine granular structure; friable; common fine and few medium roots; strongly acid; clear smooth boundary.

E--4 to 10 inches; yellowish brown (10YR 5/6) sandy loam; weak fine granular structure; few fine and medium roots; strongly acid; clear wavy boundary.

Bt1--10 to 19 inches; strong brown (7.5YR 5/8) sandy clay loam; weak medium subangular blocky structure; firm; few fine and medium roots; few faint clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt2--19 to 28 inches; strong brown (7.5YR 5/8) sandy clay loam; weak medium subangular blocky structure; firm; few faint clay films on faces of peds; very strongly acid; gradual wavy boundary.

Bt3--28 to 36 inches; brownish yellow (10YR 6/6) clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; very strongly acid; gradual wavy boundary.

Bt4--36 to 44 inches; yellowish brown (10YR 5/8) clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; very strongly acid; gradual wavy boundary.

C--44 to 60+ inches; yellowish brown (10YR 5/8) sandy loam; few, coarse, distinct strong brown (7.5YR 5/8) Fe masses; single grain; loose, strong brown Fe masses are firm and massive; very strongly acid.

Plot 20	Bibb County; site has been burned in last three years. Plot located on upper mid side slope with slopes ranging from 25 to 30 per cent.

Maubila flaggy sandy loam – very deep, moderately well drained soils that formed in stratified clayey and loamy marine sediments of the coastal plain. Permeability is slow.

A--0 to 2 inches; brown (10YR 4/3) sandy loam; weak fine granular structure; friable; many fine and few coarse roots; approximately 5 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

E--2 to 6 inches; brown (10YR 5/4) sandy loam; weak fine granular structure; friable; common medium and few coarse roots; approximately 25 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

Bt1--6 to 12 inches; reddish yellow (7.5 YR 6/6) clay loam; weak medium subangular blocky structure; friable; few fine and medium roots; few faint clay films on faces of peds; approximately 15 percent angular fragments of ironstone; very strongly acid; clear wavy boundary.

Bt2--12 to 24 inches; yellowish red (5YR 5/8) clay; moderate medium subangular blocky structure; firm; few medium roots; common faint clay films on faces of peds; common medium prominent red (2.5 YR 4/6) and distinct yellowish brown (10YR 5/8) masses of iron accumulation; common medium distinct light brownish gray (10YR 6/2) iron depletions; approximately 15 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

Bt3--24 to 42 inches; yellowish red (5YR 5/8) clay; weak coarse subangular blocky structure which parts to strong fine subangular structure; firm; common distinct clay films on faces of peds; many fine and medium distinct yellowish brown (10YR 5/6) and prominent red (2.5 YR 4/8) masses of iron accumulation; many medium distinct light gray (10YR 7/2) iron depletions; approximately 10 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

BC--44 to 56 inches; 30 percent gray (10YR 6/1), 25 percent strong brown (7.5YR 5/6), 25 percent yellowish brown (10YR 5/6), and 20 percent red (10R 4/6) clay loam; moderate weak coarse subangular blocky structure; friable; areas with gray color are iron depletions and areas with red and brown colors are iron accumulations; approximately 10 percent angular fragments of ironstone; common fine flakes of mica; very strongly acid.

C--56 to 64+ inches; 40 percent gray (10YR 6/1), 25 percent strong brown (7.5YR 5/6), 25 percent yellowish brown (10YR 5/6), and 10 percent red (10R 4/6) clay; massive; firm; few thin pockets of clay loam; areas with gray color are iron depletions and areas with red and brown colors are iron accumulations; approximately 10 percent angular fragments of ironstone; many fine flakes of mica; very strongly acid.

Plot 21	Hale County; site burned in last three years. Plot located mid side slope with slopes ranging from 20 to 25 per cent.

<u>Smithdale sandy loam</u> – deep, well drained soils that formed in thick beds of loamy upper coastal plain sediments. Permeability is moderate.

A--0 to 6 inches; brown (10YR 4/3) sandy loam. Weak fine granular structure; friable; common fine and medium roots; approximately 5 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

E--6 to 13 inches; strong brown (7.5YR 4/6) sandy loam; weak fine granular structure; friable; few fine and common medium roots; approximately 5 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

Bt1--13 to 21 inches; yellowish red (5YR 5/6) sandy loam; weak fine granular structure; friable; few medium roots; common thin clay films on faces of peds; approximately 15 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

Bt2--21 to 51 inches; yellowish red (5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; sand grains coated and bridged with clay and oxides; approximately 25 percent angular fragments of ironstone; strongly acid; gradual wavy boundary.

Bt3--51 to 61+ inches; yellowish red (5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; sand grains coated and bridged with clay and oxides; few medium faint red strong brown (7.5YR 5/8) masses of iron accumulation; approximately 10 percent angular fragments of ironstone; strongly acid.

Plot 22	Hale County; site has not been burned in last five years or more. Plot located on upper mid side slope with slopes ranging from 25 to 30 per cent.

Maubila flaggy sandy loam – very deep, moderately well drained soils that formed in stratified clayey and loamy marine sediments of the coastal plain. Permeability is slow.

A--0 to 2 inches; brown (10YR 4/3) sandy loam; weak fine granular structure; friable; many fine and few coarse roots; approximately 5 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

E--2 to 6 inches; brown (10YR 5/4) sandy loam; weak fine granular structure; friable; common medium and few coarse roots; approximately 25 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

Bt1--6 to 12 inches; reddish yellow (7.5 YR 6/6) clay loam; weak medium subangular blocky structure; friable; few fine and medium roots; few faint clay films on faces of peds; approximately 15 percent angular fragments of ironstone; very strongly acid; clear wavy boundary.

Bt2--12 to 24 inches; yellowish red (5YR 5/8) clay; moderate medium subangular blocky structure; firm; few medium roots; common faint clay films on faces of peds; common medium prominent red (2.5 YR 4/6) and distinct yellowish brown (10YR 5/8) masses of iron accumulation; common medium distinct light brownish gray (10YR 6/2) iron depletions; approximately 15 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

Bt3--24 to 38+ inches (hit thick ironstone to hard to bore thru); yellowish red (5YR 5/8) clay; weak coarse subangular blocky structure which parts to strong fine subangular structure; firm; common distinct clay films on faces of peds; many fine and medium distinct yellowish brown (10YR 5/6) and prominent red (2.5 YR 4/8) masses of iron accumulation; many medium distinct light gray (10YR 7/2) iron depletions; approximately 10 percent angular fragments of ironstone; few fine flakes of mica; very strongly acid; clear wavy boundary.

Plot 32	Perry County; site burned in last three years. Plot located upper side slope with slopes ranging from 4 to 6 per cent.

Suffolk loamy sand – very deep, well drained soils that formed in loamy fluvial and marine sediments of the coastal plain. Permeability is moderate.

A--0 to 5 inches; brown (10YR 4/3) fine sandy loam; weak fine granular structure; friable; common fine and few medium roots; approximately 5 percent gravel; strongly acid; clear smooth boundary.

E--5 to 11 inches; yellowish brown (10YR 5/6) sandy loam; weak medium granular structure; friable; few fine and medium roots; approximately 5 percent gravel; strongly acid; clear wavy boundary.

BE--11 to 18 inches; light yellowish brown (10YR 6/4) sandy loam; weak medium subangular blocky structure; friable; few fine and medium roots; approximately 2 percent gravel; few faint clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt1--18 to 26 inches; strong brown (7.5YR 5/6) sandy clay loam; weak medium subangular blocky structure; firm; few faint clay films on faces of peds; few medium faint yellowish red (5YR 5/6) masses of iron accumulation; very strongly acid; gradual wavy boundary.

Bt2--26 to 32 inches; strong brown (7.5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; few medium distinct red (2.5YR 5/6) masses of iron accumulation; very strongly acid; gradual wavy boundary.

Bt3--32 to 40 inches; strong brown (7.5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; few fine faint pale brown and common medium distinct red (2.5 YR 5/6) masses of iron accumulation; few fine mica flakes; very strongly acid; gradual wavy boundary.

Bt4—40 to 55 inches; strong brown (7.5YR 5/6) sandy clay loam; weak coarse prismatic to moderate medium subangular blocky structure; friable; few faint clay films on faces of peds; approximately 2 percent gravel; common medium distinct pale brown (10YR 6/3) and yellowish red (5YR 4/6) masses of iron accumulation; common fine mica flakes; very strongly acid; gradual wavy boundary.

C--55 to 63+ inches; yellowish brown (10YR 5/6) sandy loam; massive; friable; few inclusions of sandy clay loam; common medium distinct strong brown (7.5 YR 5/6) and yellowish red (5YR 4/6) masses of iron accumulation; few medium distinct brownish gray (10YR 6/2) iron depletions; very strongly acid.

Plot C4	Bibb County; site has not been burned in last 5 years or more. Plot located on upper mid side slope with slopes ranging from 15 to 20 per cent.

Suffolk loamy sand – very deep, well drained soils that formed in loamy fluvial and marine sediments of the coastal plain. Permeability is moderate.

A--0 to 6 inches; very dark grayish brown (10YR 3/2) sandy loam; weak fine granular structure; friable; common fine and few medium roots; strongly acid; clear smooth boundary.

E--6 to 15 inches; yellowish brown (10YR 5/4) sandy loam; weak fine granular structure; few fine and medium roots; strongly acid; clear wavy boundary.

Bt1--15 to 24 inches; dark yellowish brown (10YR 4/6) sandy clay loam; moderate medium subangular blocky structure; firm; few fine and medium roots; few faint clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt2--24 to 36 inches; strong brown (7.5YR 5/6) sandy clay loam; weak medium subangular blocky structure; firm; few faint clay films on faces of peds; very strongly acid; gradual wavy boundary.

Bt3--36 to 45 inches; reddish yellow (5YR 5/8) sandy clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; common medium distinct red (2.5Yr 5/8) masses of iron accumulation; few fine quartz pebbles; strongly acid; gradual wavy boundary.

Bt4--45 to 60+ inches; yellowish red (5YR 5/8) sandy clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; common medium distinct reddish yellow (7.5YR 5/8) masses of iron accumulation; few fine quartz pebbles; strongly acid.

Plot C5	Bibb County; site has not been burned in last 5 years or more. Plot located on upper mid side slope with slopes ranging from 25 to 30 per cent.

Wadley loamy sand – very deep, well drained and somewhat excessively drained soils that formed in sandy and loamy marine sediments. Permeability is rapid in the A and E horizons and moderate in the Bt horizon.

A--0 to 4 inches; brown (10YR 4/3) loamy sand; single grain; loose; few fine and medium and many coarse roots; strongly acid; clear smooth boundary.

E1--4 to 28 inches; yellowish brown (10YR 5/6) loamy sand; single grain; loose; common fine and medium and few coarse roots; approximately 5 percent angular fragments of ironstone; strongly acid; clear smooth boundary.

Bw--28 to 55 inches; strong brown (7.5YR 5/8) sandy loam; weak medium subangular blocky structure; friable; few fine reddish yellow (7.5YR 6/6) pockets and streaks of uncoated sand grains; strongly acid; diffuse wavy boundary.

C--55+ inches; strong brown (7.5YR 5/8) and reddish yellow (7.5YR 6/6) sand; single grain; loose; few fine pink (7.5YR 7/4) pockets and streaks of uncoated sand grains; strongly acid.

Plot C6	Bibb County; site has been burned in last 3 years or more. Plot located on upper mid side slope within a colluvial (drain) site with slopes ranging from 10 to 15 per cent.

Wadley loamy sand – (this soil closely resembles Wadley except for the surface layers being sandy loam) very deep, well drained and somewhat excessively drained soils that formed in sandy and loamy marine sediments. Permeability is rapid in the A and E horizons and moderate in the Bt horizon.

A--0 to 6 inches; brown (10YR 4/3) sandy loam; weak fine granular; very friable; few fine and medium and many coarse roots; strongly acid; clear smooth boundary.

E1--6 to 14 inches; brown (7.5YR 5/4) sandy loam; weak fine granular; very friable; common fine and medium and few coarse roots; strongly acid; clear smooth boundary.

E2--14 to 51 inches; yellowish brown (10YR 5/4) loamy sand; single grain; loose; few fine and medium roots; few fine faint yellow (10YR 7/8) masses of iron accumulation; few fine and medium very pale brown (10YR 7/3) pockets and streaks of uncoated sand grains; strongly acid.

Bt--51 to 65+ inches; strong brown (10YR 4/6) loamy sand; single grain; loose; few fine and medium roots; few fine faint yellow (10YR 7/8) masses of iron accumulation; few fine and medium very pale brown (10YR 7/3) pockets and streaks of uncoated sand grains; strongly acid.

Plot C7	Chilton County; site burned in last three years. Site is an old farm field, terraces on site. Plot located upper side slope with slopes ranging from 12 to 15 per cent.

Smithdale sandy loam – deep, well drained soils that formed in thick beds of loamy upper coastal plain sediments. Permeability is moderate.

Ap--0 to 8 inches; yellowish brown (10YR 5/6) loamy sand. Weak fine granular structure; friable; common fine and few medium roots; strongly acid; clear smooth boundary.

Bt1--8 to 21 inches; reddish yellow (7.5YR 6/8) sandy loam; weak fine granular structure; friable; few fine and medium roots; few thin clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2--21 to 38 inches; reddish yellow (5YR 6/8) sandy clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; few medium distinct red (2.5YR 5/8) masses of iron accumulation; strongly acid; gradual wavy boundary.

Bt3--38 to 50 inches; reddish yellow (5YR 6/8) sandy clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; common medium distinct red (2.5Yr 5/8) masses of iron accumulation; few fine quartz pebbles; strongly acid; gradual wavy boundary.

Bt4--50 to 60+ inches; red (2.5YR 5/8) sandy clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; common medium distinct reddish yellow (7.5YR 5/8) masses of iron accumulation; few fine quartz pebbles; strongly acid.

Appendix B

National Forest Risk for Southern Pine Beetle Coastal Plain Model.

National Forest Risk (COASTAL PLAIN)

Stand classifications for southern pine beetle losses for National Forests in the Coastal Plain were developed through the cooperation of the Southern Research Station and Forest Health Protection. Because it cannot be predicted exactly when and where infestations will occur, the following classifications are intended to identify those stands in which infestations are most likely to occur, cause significant losses, and produce the most beetles—if and when an outbreak develops—over the next three to five years.

Table 3: Southern Pine Beetle Risk (Coastal Plain)

A. Stands with forest type **loblolly pine** (31), **shortleaf pine** (32), **loblolly pine-hardwood** (13), or **shortleaf pine-oak** (12) will have a high or medium hazard classification according to total stand height and pine basal area as follows:

Total Height	High Hazard	Medium Hazard
	------------Pine Basal Area	-------------
56-65		>80
66-75	>90	80-0
76-105	>90	70-90
106+	>100	70-100

B. Stands with forest type **slash pine** (22), **longleaf pine** (21), or **bottomland hardwood-pine** (46) will have a medium hazard classification according to total stand height and pine basal area as follows:

Total Height	High Hazard	Medium Hazard
	------------Pine Basal Area	-------------
66-75		>80
76-105		>90
106+		>100

C. Seedling-sappling stands (CC13) of **loblolly** (31), **slash** (22), and **shortleaf** (32) pine age 5 to 15 and immature poletimber stands (CC11) age 15 to 25 with average dbh 5"-10" that are overstocked and have not been pre-commercially thinned will be rated as HIGH hazard for SPB. Pre-commercially thinned will be rated as MEDUIM to LOW risk.

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