

**AN ASSESSMENT OF FUSIFORM RUST and
SELECTED NON-NATIVE INVASIVE PEST PLANTS
IN LONGLEAF and SLASH PINE
PLANTATIONS ESTABLISHED with
FLORIDA DIVISION of FORESTRY SEEDLINGS**

**E.L. Barnard and A.N. Van Loan
Forest Pathologist and Biologist, respectively
Division of Forestry Florida Department of Agriculture and
Consumer Services**



Fusiform Rust



**A project supported with funding from the U.S.D.A.
Forest Service Region 8 Forest Health Monitoring Program**



Japanese Climbing Fern *Lygodium japonicum*



Mimosa (*Albizia julibrissin*)



Chinese privet (*Ligustrum sinense*)

**An Assessment of Fusiform Rust and Selected Non-Native Invasive
Pest Plants in Longleaf and Slash Pine Plantations Established
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Abstract

A survey of 280 pine plantations established with Division of Forestry seedlings across 29 counties in north and west Florida was conducted in 2002. Mean fusiform rust infection levels among longleaf, improved slash and rust-resistant slash pines were significantly different ($p \leq 0.05$); 4.9%, 34.4%, 27.6% stem infections, respectively. Variation in rust infection among individual plantations was considerable, and three longleaf plantations had rust infection levels exceeding 30%. At least one of seven targeted non-native invasive pest plant species was detected in 39% of the surveyed plantations (87% of surveyed slash pine plantations, but only 25% of surveyed longleaf plantations). Japanese climbing fern, Chinese privet and mimosa/silk tree were detected in 49, 52, and 53 of the 280 surveyed plantations, respectively.

Fusiform rust, a fungus-caused disease which deforms and kills susceptible pine hosts, is considered the most serious disease affecting loblolly and slash pines in plantation forestry across the southern United States. Perhaps the most effective strategy to minimize losses to this disease is the identification and use of genetic resistance to the pathogen (*Cronartium quercuum f.sp. fusiforme*) (Cubbage *et al.* 2000; Schmidt 1998;

Schmidt *et al.* 1999). Forest industries, universities, the U.S.D.A. Forest Service, and state forestry agencies have cooperated for years to identify, test, develop, and deploy rust resistance in seedlings they plant and/or sell for the establishment of production pine plantations.

In recent years, non-industrial private forest landowners and others in Florida have expressed concerns about serious and “worsening” losses to fusiform rust in young planted pines. Responding to this concern, and wanting to assess the comparative field performance of seedlings sold by the Florida Division of Forestry, we surveyed some 280 slash and longleaf pine plantations in 29 counties across north and west Florida (Figure 1:A-C). Our main interest was the comparative performance of improved and rust-resistant slash pines; longleaf pine was included because of currently increasing interest in the species and known and reported rust infections therein (Walkinshaw and Barnett 1992).

In addition, growing concerns exist about the impacts of non-native invasive plants on the productivity, management, biodiversity and health of public and private forest systems, and the lack of quantifiable data on the occurrence of such species on private lands in the survey area. Therefore, as each plantation was surveyed, the presence/absence of seven non-native invasive pest plant species (Table 1) was noted. These species were selected for record due to their known distribution in the area surveyed and their anticipated occurrence in forest situations, particularly on sites treated with standard forestry practices involving soil and canopy disturbance. In this report we summarize our findings and discuss their implications.

Table 1 : Occurrence of selected non-native invasive pest plants in north and west Florida pine plantations 2002^a

	EDGE	INTERIOR	Total
Cogon grass <i>Imperata cylindrica</i>	7	8	15
Japanese climbing fern <i>Lygodium japonicum</i>	8	41	49
Chinese privet <i>Ligustrum sinense</i>	11	41	52
Chinese tallow <i>Triadica sebifera</i>	1	17	18
Air potato <i>Dioscorea bulbifera</i>	2	4	6
Kudzu <i>Pueraria lobata</i>	1	1	2
Mimosa <i>Albizia julibrissin</i>	23	30	53

^a Numbers of plantations exhibiting edge and interior invasions out of a total of 280 plantations surveyed.

Materials & Methods

Potential survey plantations were first identified from sales records maintained at the Division of Forestry's Andrews Nursery in Chiefland. Five plantations for each of three "treatments" (i.e., longleaf pine, and improved and rust-resistant slash pines) were selected, site unseen, and targeted for evaluation in each of the 29 counties surveyed. All surveyed plantations were established during the 1990-91 to 1995-96 planting seasons. Thus, all plantations were between 7 and 11 years of age at the time they were surveyed.

Student survey crews (three crews of two persons each) were hired, trained in a day-long training session, provided with plantation ownership/location information, vehicles and

maps, and dispatched regionally across the survey area. Working with local County Foresters, crews located the target plantations and assessed the presence of fusiform rust therein using the Yandle-Roth ratio estimation method (U.S.D.A. Forest Service 1971 – see appendix).

Occurrence of the seven non-native invasive pest plant species (Table 1) was noted on data sheets for each plantation (see appendix for field data sheet). Specifically, crews recorded any observation (“edge” or “interior”) of the target invasive species while conducting the in-stand rust assessment. Edge assessments were performed for the entire length of two stand boundary lines. These included the boundary with the highest level of human traffic (commonly the roadside boundary), and one other boundary line selected by the crews. Any occurrence of the selected species within 50 feet of the plantation border was recorded as “edge”; occurrence inside of 50 feet of the plantation border was considered “interior”.

Occasional field visits by Forest Health Section personnel were conducted during the survey to observe and assist field crews.

Upon receipt and review of field data sheets, it appeared that some of the fusiform rust numbers were suspect. Accordingly, nursery sales records were reviewed and re-checks of 63 plantations were solicited from Division of Forestry County Foresters. For these plantations, data submitted by student crews was compared to that submitted by County Foresters. In addition, nine longleaf pine plantations with reportedly high or otherwise suspect levels of fusiform rust were re-visited by Forest Health Section personnel. Plantations that were obviously misidentified or improperly assessed were deleted from data analyses and summaries. Where appropriate, corrected data was substituted. Otherwise, all student field crew fusiform rust data were included in the final analyses, which included simple analyses of variance (ANOVA) with “treatment” differences accepted whenever $p \leq 0.05$.

Results & Discussion

Fusiform rust. Differences in mean rust levels among the three “treatments” (i.e., longleaf, improved slash, and rust-resistant slash pines) were substantial and statistically significant. These differences were apparent regardless of whether comparisons were made on the basis of stem infections, branch infections, or total tree (inclusive of stem and branch) infections (Figure 2). There was, however, considerable variation in infection levels among individual plantations; stem infection levels in longleaf pine, rust-resistant, and improved slash pines ranging from 0-33%, 0-78%, and 0-87%, respectively. Comparison of field crew data with those provided via County Forester re-checks (Figures 3-5) showed inconsistencies in branch (and therefore total tree) assessments, while field crew and County Forester assessments of stem infections were generally consistent. Overall, County Forester assessments of branch (and therefore total tree) infections were much lower than those of the student field crews. We do not have a simple or verifiable explanation for these discrepancies. Accordingly, we are confining our assessments and discussion, for the most part, to stem infections. On a scale of 0-100%, rust-resistant slash pines averaged c. 7% ($34.4 - 27.6 = 6.8\%$) fewer stem infections than their improved slash pine counterparts (Figure 2). Alternatively, rust-resistant slash pines displayed 20% less stem rust infections than improved slash pines (using 34% as the point of reference; $7 \div 34 = .205$). Were we to include field crew branch (and therefore total tree) data in similar comparisons, the expression of resistance in the rust-resistant slash pines would be even stronger. Not surprisingly, longleaf pines had the lowest mean incidence of stem rust infections ($< 10\%$ overall, Figure 2), although three plantations in high rust hazard locations had stem rust incidence exceeding 30%. Viewed still another way, nearly 86% of the surveyed longleaf pine plantations exhibited stem rust infection

levels within the U.S.D.A. Forest Service's "low" hazard rating (0 - 9.9%). On the other hand, stem rust levels in improved and rust-resistant slash pine plantations fell into the Forest Service's "moderate" hazard rating 37% and 52% of the time, respectively, and into the "high" hazard rating 56% and 38% of the time, respectively (Figure 6). Had our survey been conducted on 3 or 5-year-old trees, results may have varied somewhat as they would have included some rust infections undoubtedly "lost" due to natural (or rust-induced) early tree mortality.

Overall, these data are encouraging; i.e., there is a measurable and significantly lower level of fusiform rust infection in the Division of Forestry's rust-resistant slash pine planting stock. While some may consider the measured improvement disappointing or less than "could be" or "should be", several factors require attention. First, the majority of the seedlots from which surveyed plantations were established were bulk collections of half-sib families obtained from mixed slash pine seed orchards (i.e., orchards with both rust-resistant and non-rust-resistant clones). Accordingly, rust resistance contributed by ramets of rust resistant mother trees (clones) was most certainly and variably influenced by pollen contamination from associated non-rust-resistant trees. Further, the level of rust resistance in Division of Forestry improved slash pine seed is, in all likelihood, greater than that in the general population. This would tend to "close the gap" between the levels of rust incidence recorded in our survey between the improved and rust-resistant treatments. And lastly, the overall average rust incidence levels recorded in our survey included comparisons among treatments in low hazard rust areas, a reality that again would shrink differences between improved and rust-resistant slash pines. As the Division of Forestry continues to evaluate and rogue undesirable seed orchard clones and moves into its rust resistant slash pine seed orchard, undesirable pollen

contaminations and seedlot variability will be reduced, and the deployment of useful rust resistance will be enhanced. Improved capture and utilization of the inherent resistance can also be facilitated simply by collecting seed from only the best clones, and avoiding collection from clones with lesser demonstrated resistance.

At this juncture, our analyses of the performance of Division of Forestry slash pine seedlings with respect to fusiform rust infection levels has not taken into account the R_{50} values (% rust expected for a given seedlot in an area where unimproved material would show 50% infection) of the respective seedlots. Nor has particular attention been given to the specific locations of surveyed plantations with respect to the U.S.D.A. Forest Service's low, moderate, and high hazard zones for slash pine in Florida. Seedlot identities and composition are now being acquired from Division of Forestry files, and further evaluations are planned. Sorting and analyzing survey data with these factors accounted for will further refine our understanding and the meaning of the results. Upon completion of these additional analyses, a supplementary report will be prepared.

Non-Native Invasive Pest Plants. Due to the nature of the fusiform rust survey methodology used, invasive plant data reported and discussed herein represent a relatively limited sampling of potential occurrence in each plantation. The target species might occur in many more plantations than reported, but with infestations not visibly noticeable from the linear transects traveled by the surveyors. However, the noted occurrences are helpful in understanding some aspects of their occurrence and distribution in plantation forestry throughout the survey area; with perhaps some degree of application statewide.

At least one of the non-native invasive species on the target list were identified in 110 (39%) of the surveyed plantations. Three of the target species were detected in a higher number of plantations than the other species (Table 1). Japanese climbing fern (Figure 7) and Chinese privet (Figure 8) were identified in 49 and 52 plantations respectively, generally concentrated in the western panhandle. Mimosa/silk-tree (Figure 9) was detected in 53 plantations, evenly distributed across the survey area. Contrary to expectations, cogon grass (Figure 10) was found in only 15 plantations; Chinese tallow, air potato and kudzu were also infrequently observed (Figures 11 – 13).

Forty five percent (45%) of the invaded plantations contained more than one target non-native species. A regionally higher incidence of occurrence of target species was recorded in the western panhandle than elsewhere in the survey area (Figure 14), due primarily to the prevalence of Japanese climbing fern and Chinese privet. No target species were observed in plantations in Bay, Franklin and Gilchrist Counties. However, only four plantations each were surveyed in Bay and Franklin Counties, whereas twelve plantations were surveyed in Gilchrist County.

Eighty-seven percent (87%) of the slash pine plantations surveyed were invaded by one or more of the target non-native species. In comparison, only twenty five percent (25%) of the surveyed longleaf pine plantations were similarly invaded. This difference may be due to variations in stand management practices, or general site conditions associated with selection and establishment of the two respective pine species (e.g., slash pine is often planted in more mesic sites, overlapping with site conditions suitable to Chinese privet and Japanese climbing

fern, whereas longleaf pine is often planted on more xeric sites, sites generally less suitable to the target non-native plant species).

In invaded plantations, Japanese climbing fern, Chinese privet, and Chinese tallow were observed to occur primarily in plantation interiors (83%, 79%, and 94% of the time respectively). This increased occurrence in the stand interiors may indicate: more extensive regional establishment, greater tolerance of shaded conditions, a dispersal strategy suited to interior invasion, or a combination of these and other factors. In contrast, cogon grass, often initially an edge/roadside invader, and commonly spread through movement of contaminated soil during road construction and maintenance, was found in plantation interiors in only 53 % of the plantations in which it was recorded. Similarly, mimosa, an edge-adapted species, was found in plantation interiors in only 57% of the plantations in which it was detected (Table 1).

The information gained from this survey effort serves expand our understanding of the types of plant invasions occurring in north and west Florida pine plantations by providing a very basic initial report of key species, regional occurrence levels, and other factors. A better understanding of the problem(s) represented by these invasions awaits more thorough assessment of the size, pattern, distributions, and impacts of same within infested plantations. Also, as other non-native pest plants are identified as potentially important invaders in such forest systems, they should receive attention as well.

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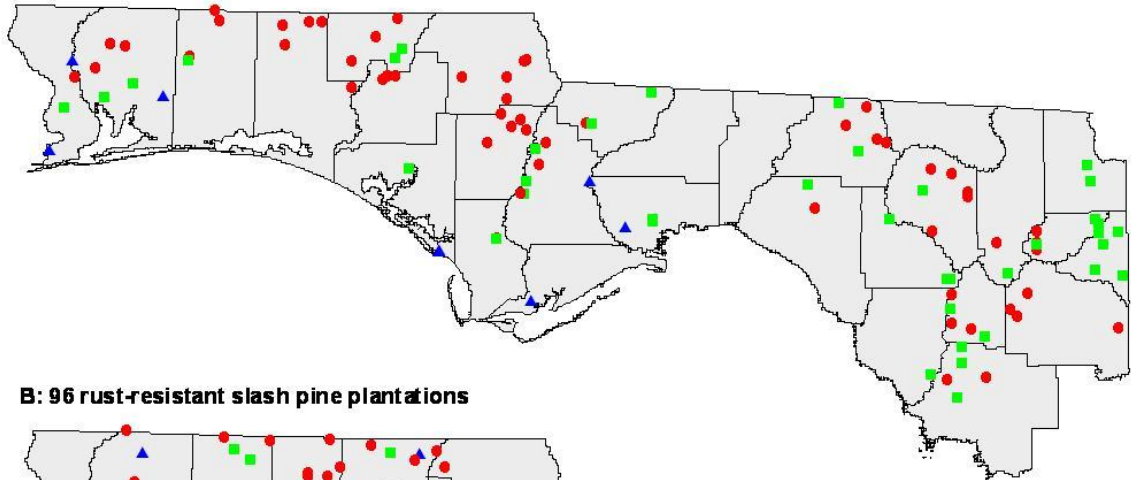
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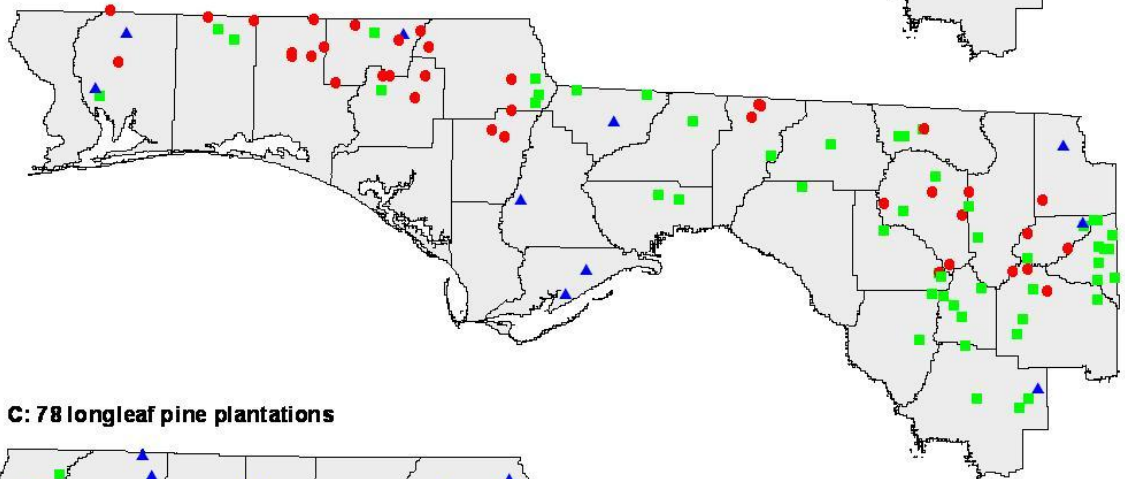
Walkinshaw, C.H., and J.P. Barnett. 1992. Fusiform rust in longleaf pines. *Forest Farmer*: October 1992, pages 10-13.

Figure 1: Distribution of pine plantations evaluated for fusiform rust in north and west Florida, 2002. Symbols indicate individual plantations having infection levels falling within U.S. Forest Service hazard rating classes (see key below).

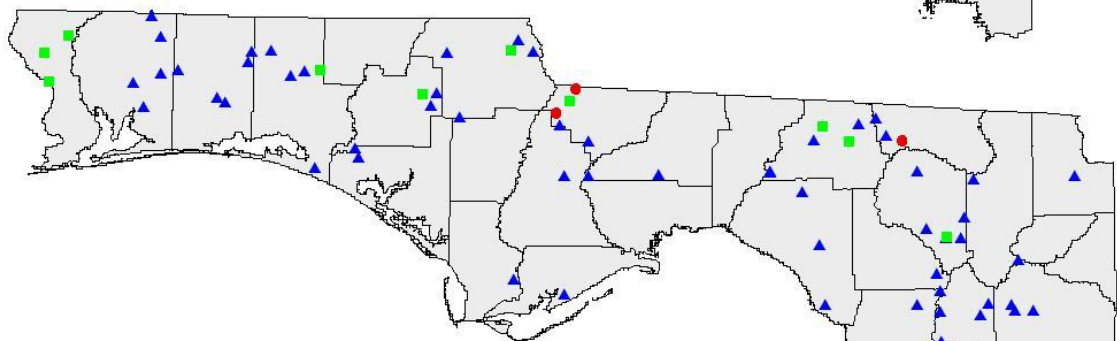
A: 106 improved slash pine plantations



B: 96 rust-resistant slash pine plantations

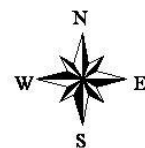


C: 78 longleaf pine plantations



USFS Fusiform Rust Hazard Classification

- High (>30% Infection)
- Moderate (10-30% Infection)
- ▲ Low (0-9.9% Infection)



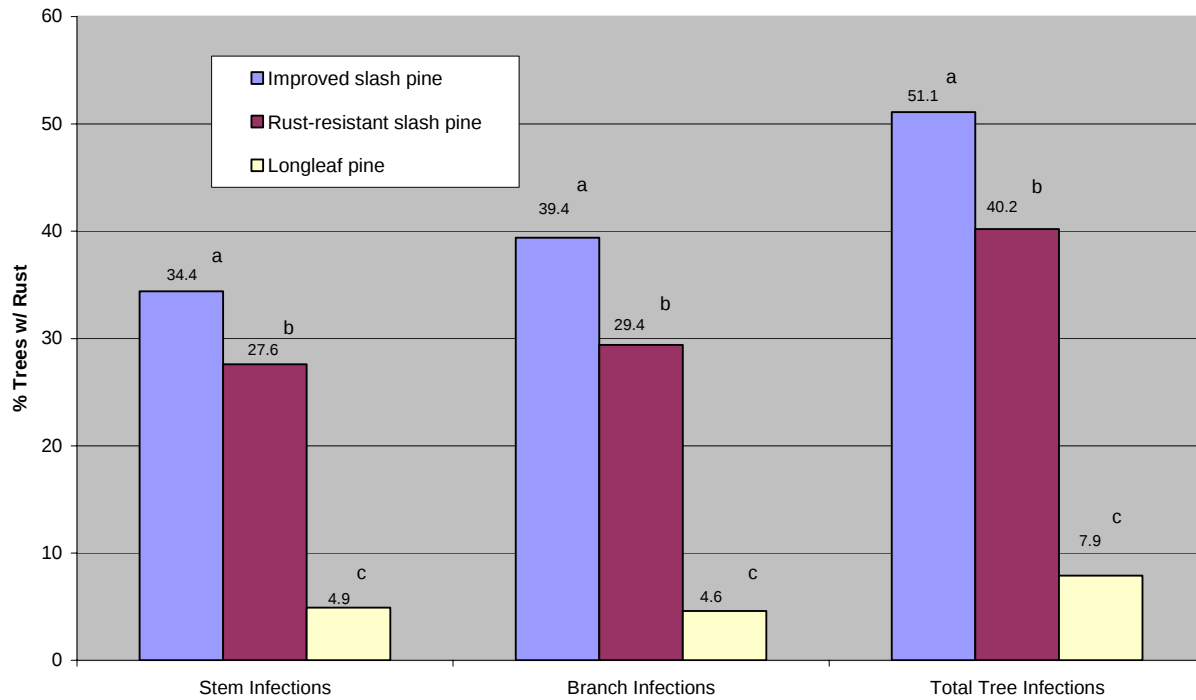


Figure 2: Mean occurrence of fusiform rust infections in three types of pines across north and west Florida (field crew data only; 280 plantations.) Within infection types, means noted with the same letters (a,b,c) do not differ significantly ($p \leq 0.05$).

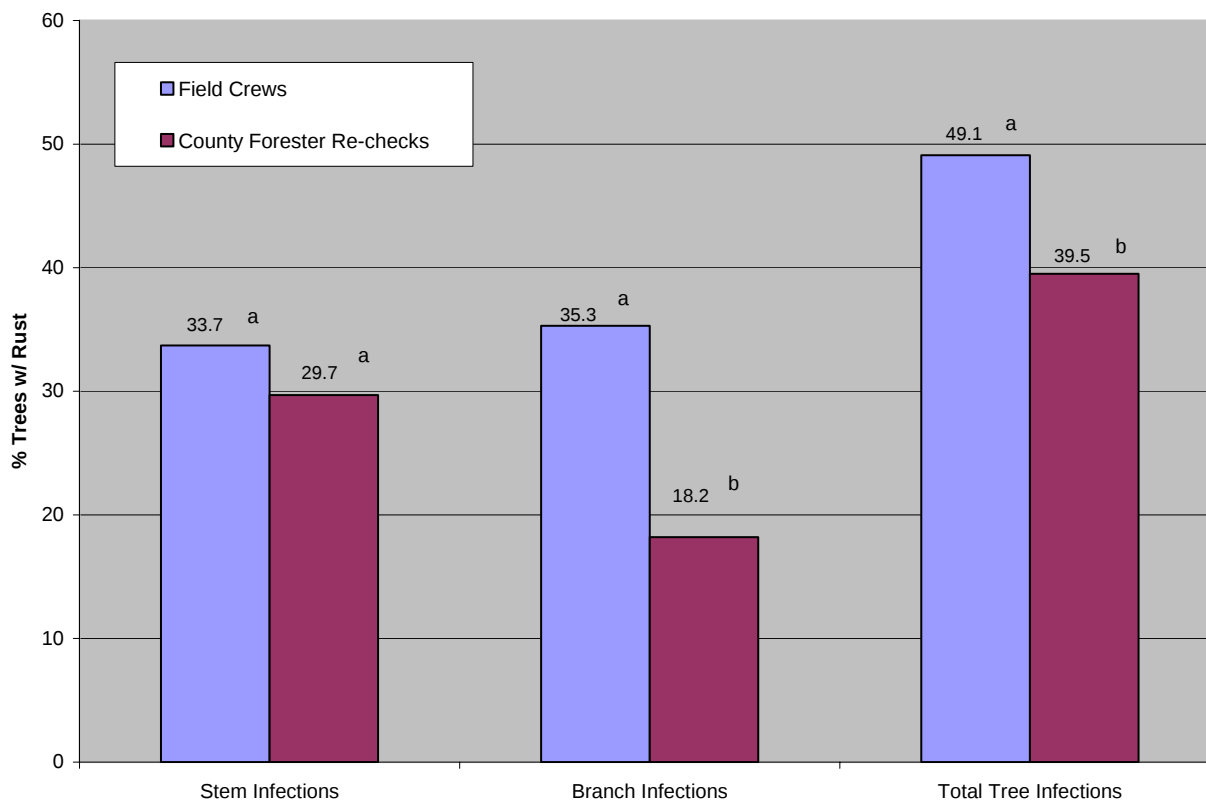


Figure 3: Comparison of mean fusiform rust levels as assessed by field crews and as re-checked by County Foresters. Includes longleaf, improved slash, and rust-resistant slash pines; 63 plantations. Within infection types, means noted with the same letters (a,b,c) do not differ significantly ($p \leq 0.05$). (No comparable re-checks for improved slash pines.)

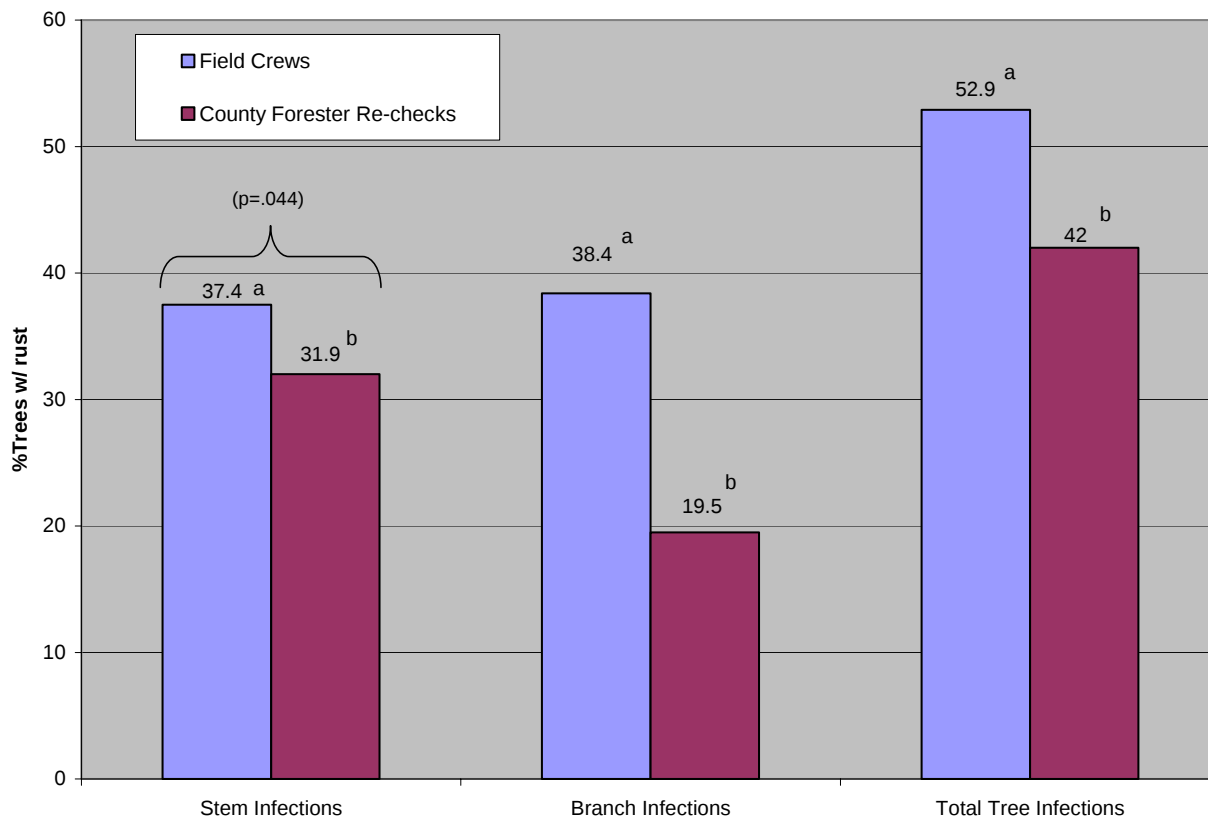


Figure 4: Comparison of mean fusiform rust levels as assessed by field crews and as re-checked by County Foresters. Includes rust-resistant slash pine; 50 plantations. Within infection types, means noted with the same letters (a,b,c) do not differ significantly ($p \leq 0.05$). (No comparable re-checks for improved slash pines.)

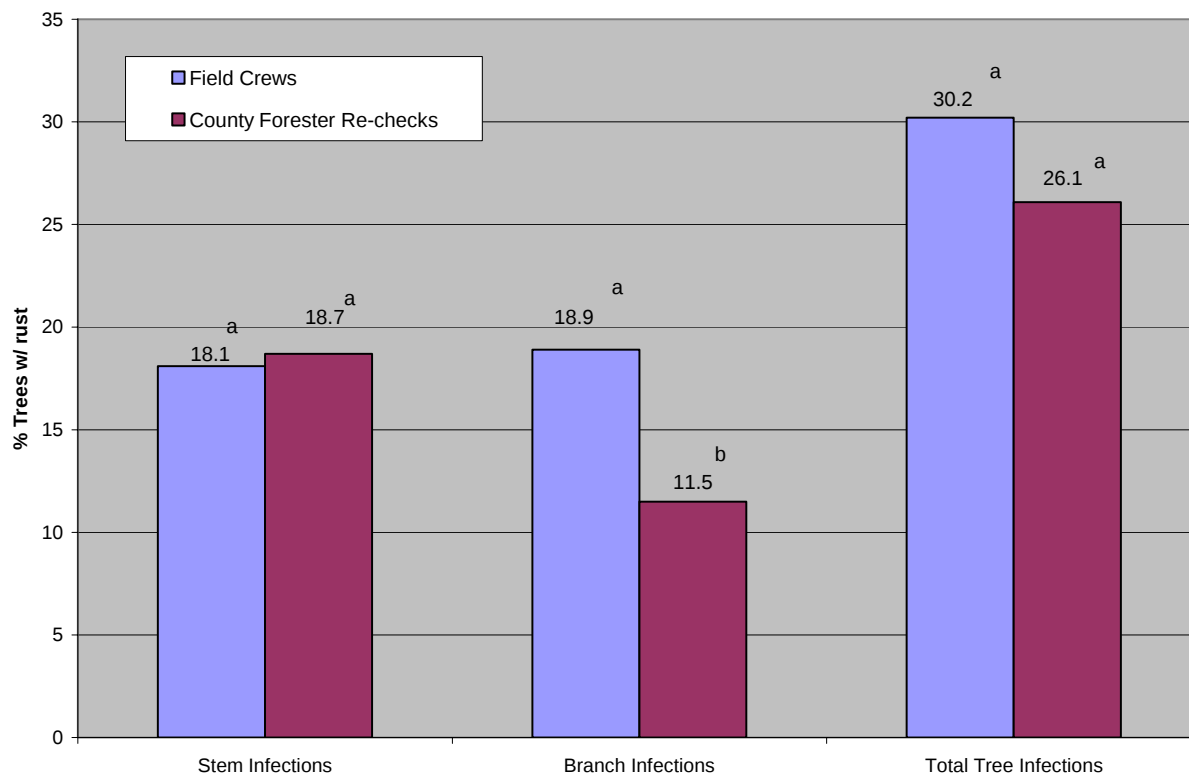


Figure 5: Comparison of mean fusiform rust levels as assessed by field crews and as re-checked by County Foresters. Includes longleaf pine; 10 plantations. Within infection types, means noted with the same letters (a,b,c) do not differ significantly ($p \leq 0.05$). (No comparable re-checks for improved slash pines.)

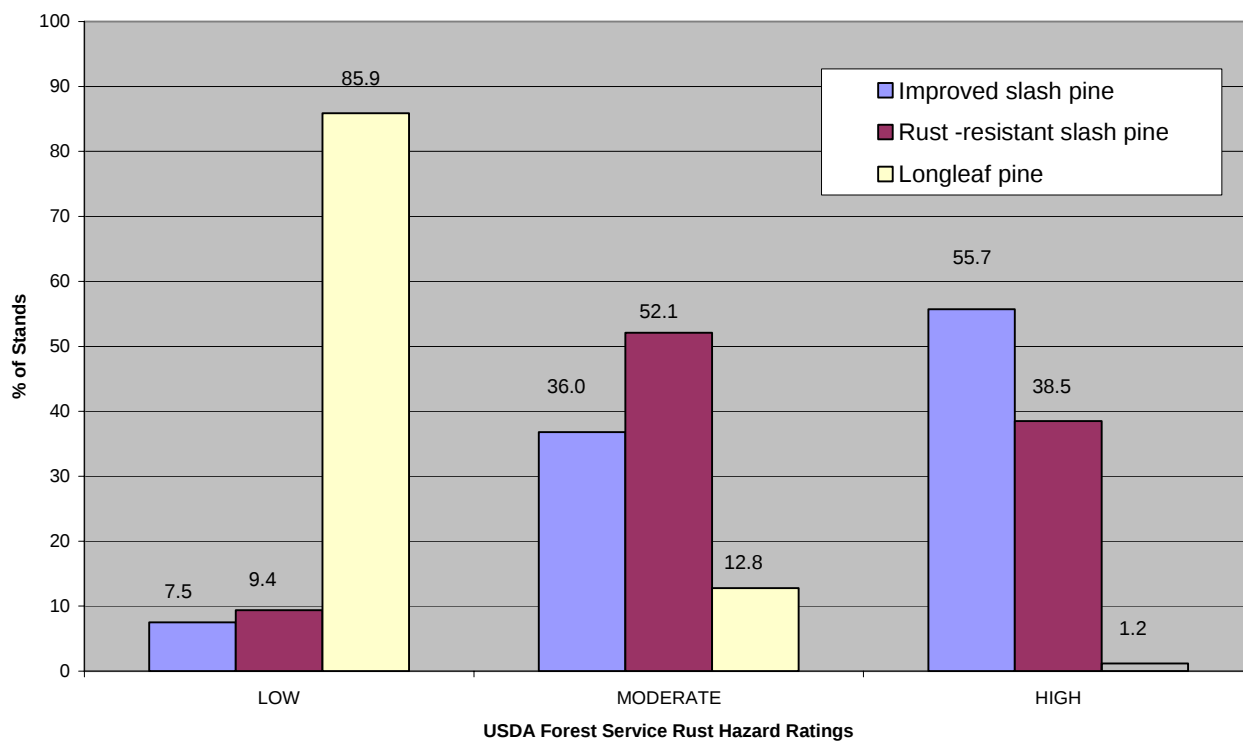


Figure 6: Frequency distribution of surveyed plantations by U.S.D.A. Forest Service fusiform rust hazard classifications (see appendix).

Figure 7: Japanese climbing fern occurrence in 49 of 280 pine plantations surveyed in north and west Florida, 2002.

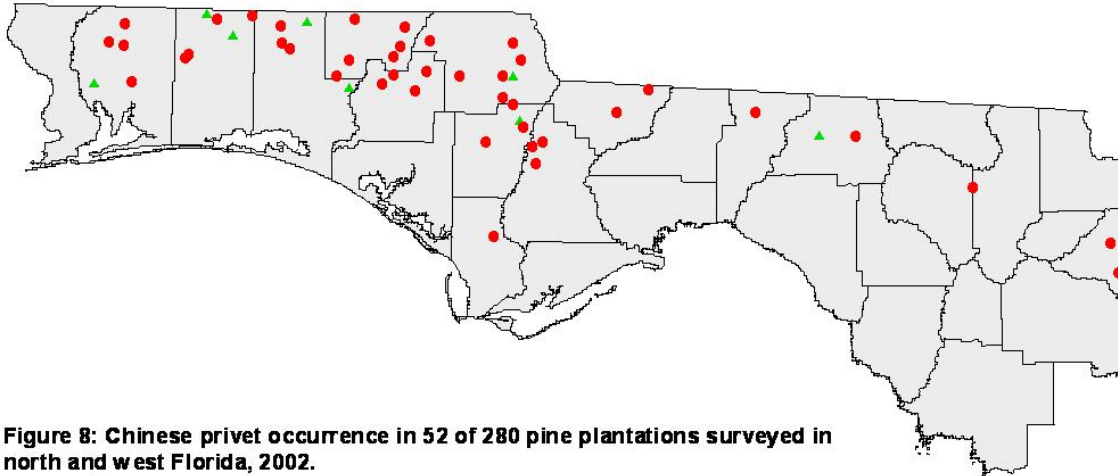


Figure 8: Chinese privet occurrence in 52 of 280 pine plantations surveyed in north and west Florida, 2002.

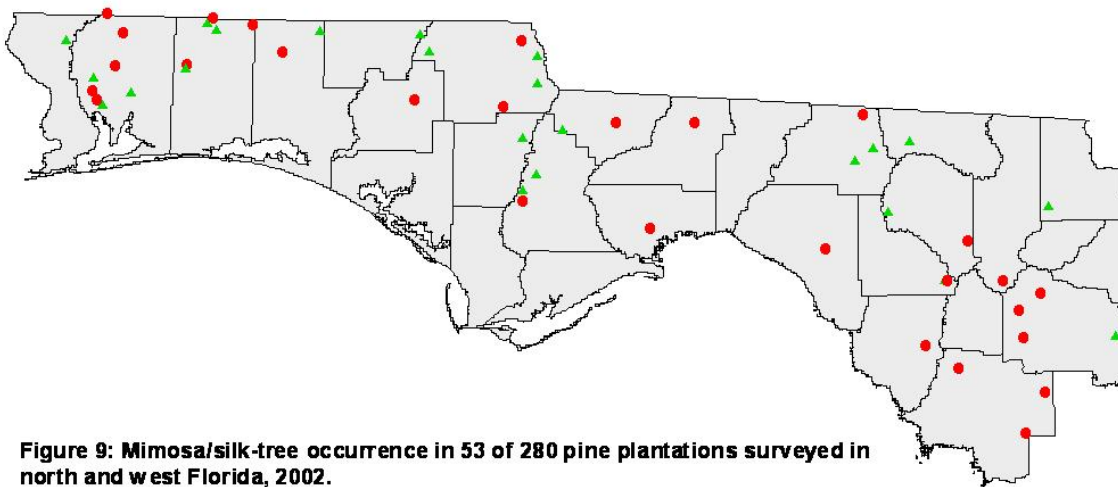


Figure 9: Mimosa/silk-tree occurrence in 53 of 280 pine plantations surveyed in north and west Florida, 2002.

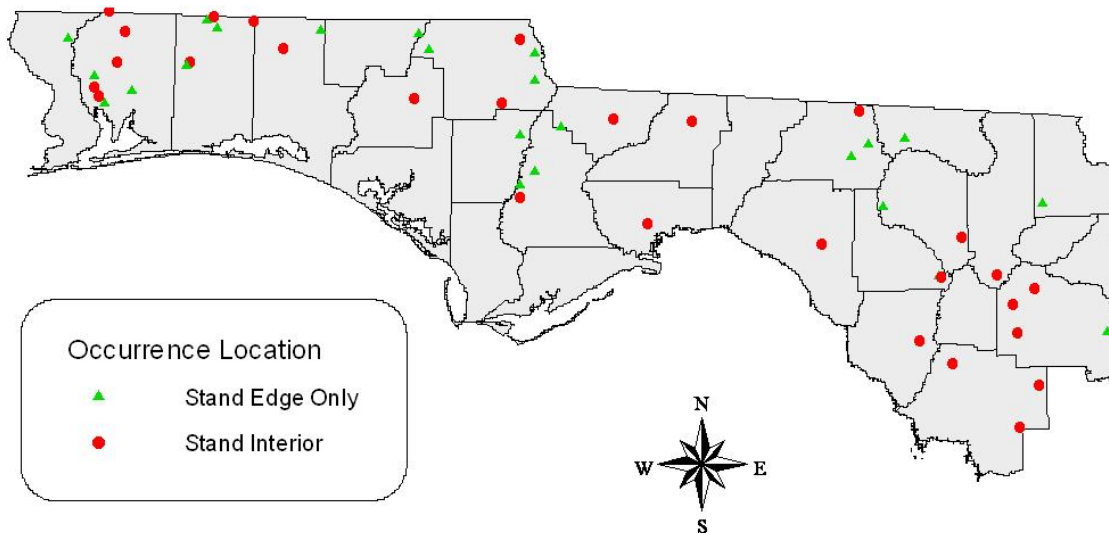


Figure 10: Cogon grass occurrence in 15 of 280 pine plantations surveyed in north and west Florida, 2002.

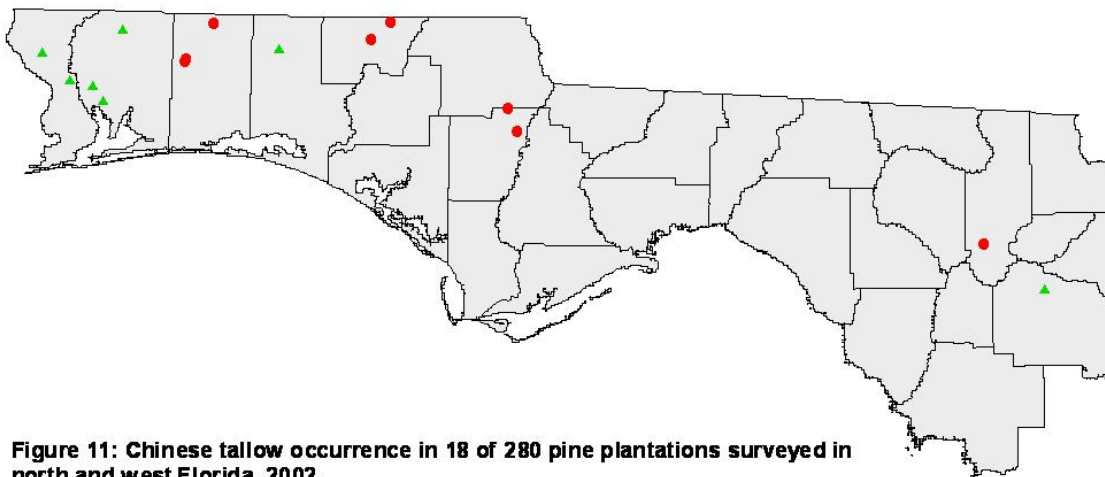


Figure 11: Chinese tallow occurrence in 18 of 280 pine plantations surveyed in north and west Florida, 2002.

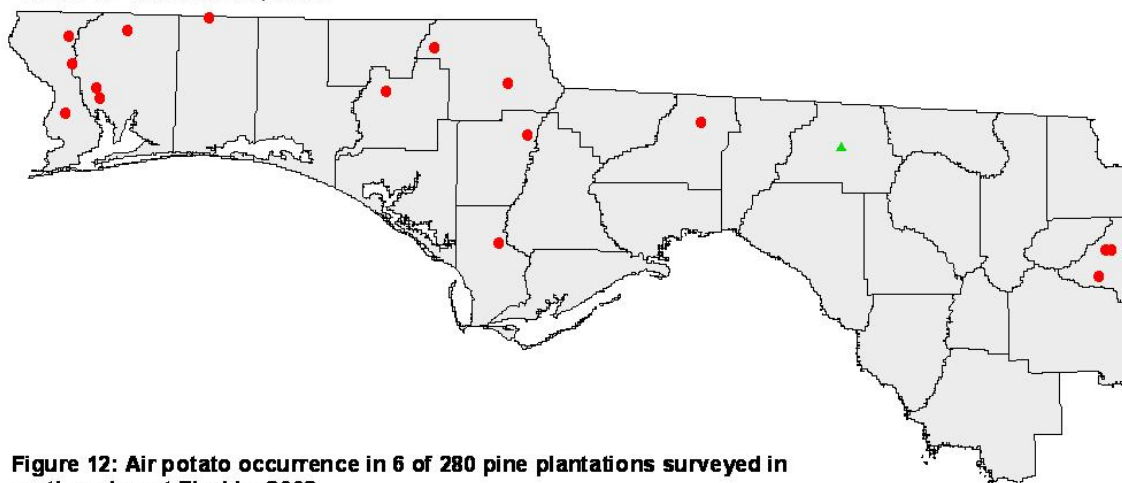


Figure 12: Air potato occurrence in 6 of 280 pine plantations surveyed in north and west Florida, 2002.

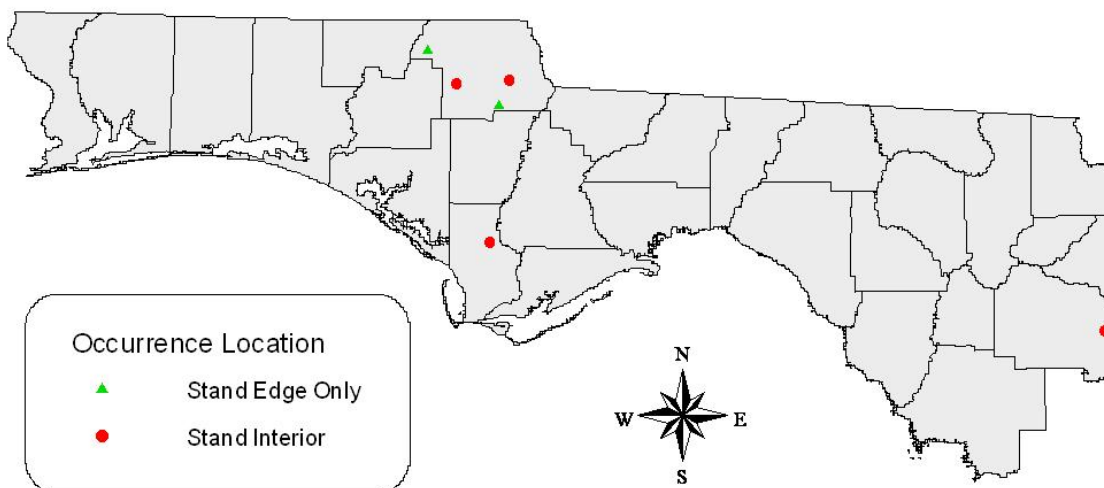


Figure 13: Kudzu occurrence in 2 of 280 pine plantations surveyed in north and west Florida, 2002.

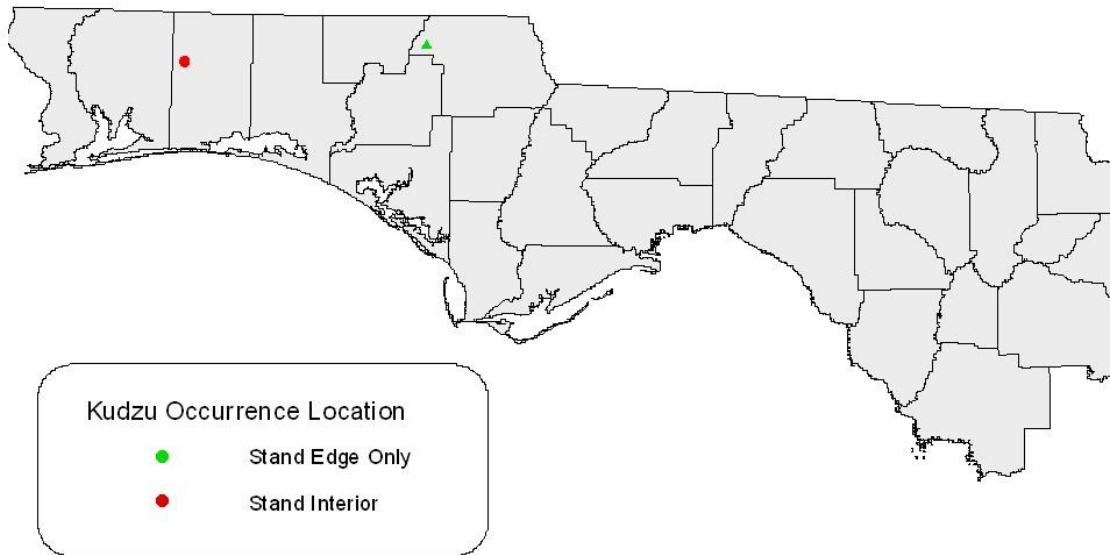
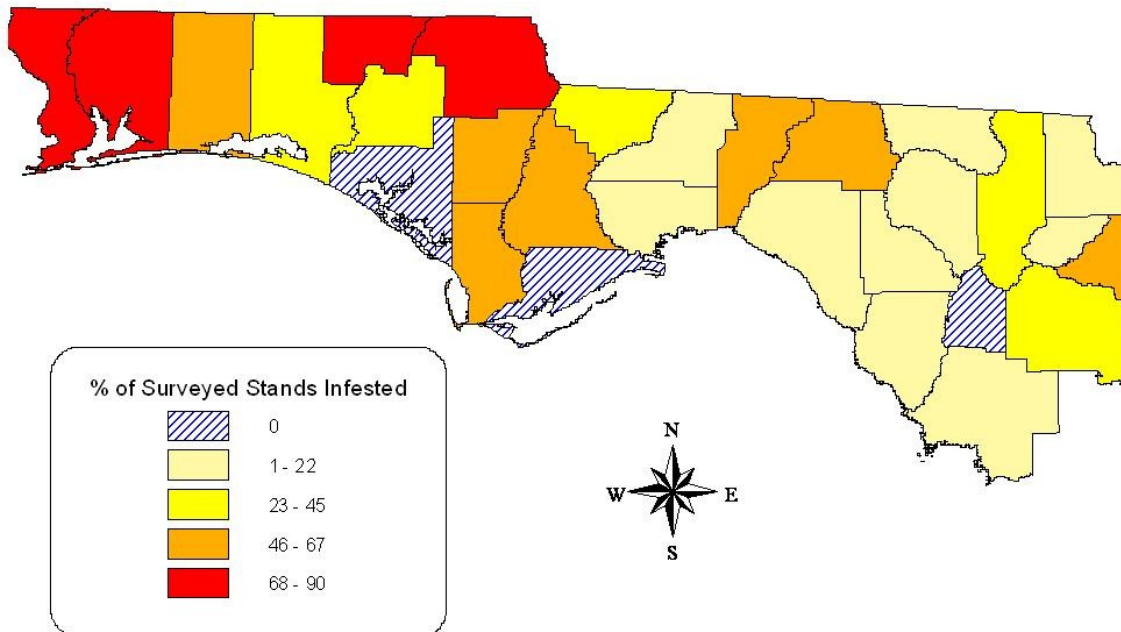


Figure 14: County-level percentage of 280 north and west Florida pine plantations invaded by one or more of seven selected non-native invasive pest plant species (ref. Table 1. for selected species.)



APPENDIX

A SURVEY PROCEDURE FOR FUSIFORM RUST

Fusiform rust survey method has been developed 1) to measure the intensity of infection in established plantations so that the land owner can make a decision on future management and 2) to define rust hazards and where it is safe to establish new plantations. This method is one that is simple, rapid, and easily used by individuals having a minimum of training in the procedure. This sampling method, as developed by Hille and Roth 1- can be used on large and small plantations and natural stands. It was shown that in surveying individual plantations, a three row sample could give adequate precision. It is desirable that individual, industrial, federal and state land managers use this survey procedure to conduct the needed surveys.

SAMPLING METHOD AND PROCEDURES

In sampling a plantation, three rows are randomly selected for examination (Figure 1). This random selection is made by assignment of a number to each plantation row and a subsequent selection of three numbers by draw or use of a table of random numbers. 7 times the rows near the corners of plantations are selected and contain only a few trees. When one of these rows is selected as a sample row, it is suggested that such a short row be combined with adjacent rows to make a row of approximately average length.

The same type survey is applicable to natural stands. In making this type survey it is necessary to measure the width of the stand. Then, establish imaginary transect lines every 10 feet, assign a number to each and select three transects as explained above for rows. In natural stands, each preselected transect, healthy and diseased trees should be tallied three feet to the right and left of the transect line.

Plantations or natural stands that are 500 acres or more in size, it is desirable to divide the area into two or more blocks and sample three rows in each block. The dividing line should be some natural boundary such as a top, creek, road, trail or other natural feature (Figure

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1- id. - in so. tn. in pi- plantations - wb- it. l. d to Forest

Trees in each of these pre-selected rows are examined and infection recorded as to whether each tree is 1) healthy or 2) diseased or dead.

If a plantation had 1000 trees per acre and 38.5 percent of the trees were infected with fusiform rust, 615 healthy trees per acre would be left.

1 - Number of trees per acre

2 - Infected trees

3 - Number of healthy trees per acre

In large scale surveys, compilation of individual representative plantations and natural stands could be made and combined into a total overall analysis of fusiform rust infection, or they could be considered individually if percentage of infection varied between plantations.

It has been found that pine stands tend to have a greater amount of infection as they get older, at least up to about 30 years of age. Plantations to be sampled when working large areas should preferably be in the same age class, say 8 to 11 years, so that results would be uniform in number of rust years to which each plantation had been subjected. For the small landowner, an individual plantation of any age may be sampled. Plantations with 10 percent infection would be considered lightly infected, 31 to 70 percent moderately infected and over 70 percent severely infected. Diseased trees in stands in the lightly and moderately infected category should be

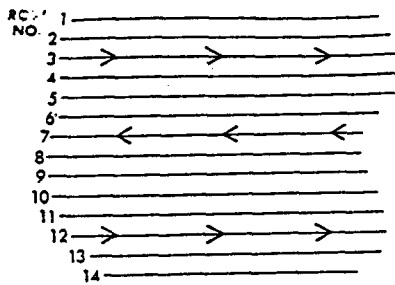


Figure 1:

Figure 1: Sampling methods for small plantations and natural stands.

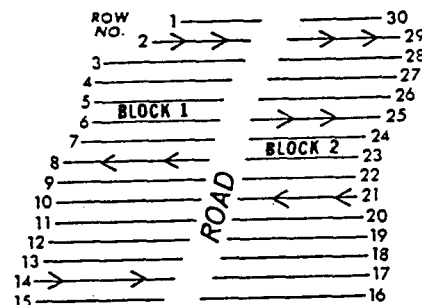


Figure 2: Sampling methods for large plantations and natural stands.

thinned out at the earliest possible time in keeping with good management practices. If a stand is found to be in the severely infected category, the land manager should consider carefully the future management of the area. Those stands which are severely infected may be clear cut and planted to less susceptible species or it may be decided to maintain the healthy trees to maturity. A minimum stocking for a commercial stand is considered to be 40 square feet of basal area per square acre. This determination can be made by consulting a qualified

from fusiform rust. Figure 3 gives a sample plot data work sheet. The number of diseased trees divided by the total number of trees times 100 will give the percentage of diseased trees.

For our purpose, a tree is considered diseased if it has either a stem or branch canker.

LARGE SCALE SURVEYS

This method will give an acceptable estimate of the percentage of infection for an individual plantation or natural stand and can be adapted to large scale county or state-wide surveys. This can be accomplished by requiring a sampling of a predetermined number of plantations or natural stands in that particular Ranger District, National Forest, county or state. The number and species of plantations or natural stands to be sampled would depend on their respective number in the sample area. There should be no less than ten sampled. The sample distribution between slash and loblolly areas should be in the same ratio as they occur in the area, and should be well distributed over each National Forest, county or state. This is necessary so that a map showing the range of variation of infection can be prepared.

Such large scale surveys can be easily analyzed using automatic data processing equipment. The Division of Forest Pest Control, U.S. Forest Service should be contacted for assistance if a large scale survey is desired.

DATA ANALYSIS

An example of the analysis of data for each plantation or natural stand would be calculated as follows. If the survey showed 400 healthy trees and 250 fusiform infected trees the following calculations would be made for each plantation or natural stand.

Percent infection = $\frac{\text{Fusiform infected trees}}{\text{Infected trees} + \text{Healthy trees}} \times 100$

$\frac{250}{250+400} \times 100 = \frac{250}{650} \times 100 = 38.5\% \text{ infection}$

STATE	COUNTY	DATE
PLANTATION NUMBER	ROW NUMBER	
1	1	1
1	2	2
1	3	3
1	4	4
1	5	5
1	6	6
1	7	7
1	8	8
1	9	9
1	10	10
1	11	11
1	12	12
1	13	13
1	14	14
1	15	15
1	16	16
1	17	17
1	18	18
1	19	19
1	20	20
1	21	21
1	22	22
1	23	23
1	24	24
1	25	25
1	26	26
1	27	27
1	28	28
1	29	29
1	30	30

Figure 3: Plot data work sheet - Fusiform Rust Survey.



Figure 4: Fusiform rust infected plantation.

Surveys for fusiform rust can be conducted at any time *of* year as it is relatively easy to distinguish the swellings caused by the rust fungus. While it may be easier to see the swellings when they are covered with orange-yellow aeciospores, many *of* the cankers do not fruit every year, so fruiting cannot be depended upon to discover all the cankers. Also, the fruiting season only lasts about six weeks in the spring,

If additional information or assistance is needed to conduct a fusiform rust survey contact your nearest

.... State Forester or local unit Forester

.... Local District Ranger, U.S. Forest Service Forest Pest Control office:

P.O. Box 5895

Asheville, North Carolina 28803 or

2500 Shreveport Highway

Pineville, Louisiana 713bU

Forest Health Atlas

Fusiform Rust Hazard Rating Process

Prepared by: Edwin K. Yockey

Date: July 9, 2003

Data Source

The dataset is from plot data collected by FIA. The dataset includes data from FIA inventory cycles 4, 5, 6, and 7. The data for Florida is from cycle 7 (1994). The dataset is corrected for consistency between cycles. The dataset includes the following items: survey cycle, forest type, percent infection, stand origin, stand age, number of forest type stems per acre, latitude, longitude, state FIPS code, county FIPS code, plot location ID, and area expansion factor.

Hazard Rating Process

The hazard rating process was based on procedures developed by Robert Anderson and others as documented in the Forest Health Monitoring write-up for the Fusiform Rust Atlas Layer. The process is the same for Loblolly and Slash Forest Types.

Step 1 – Create Point Coverage from Dataset

The dataset was converted into coverage of points representing the FIA plot locations. The latitude and longitude were used to create the FIS coverage.

Step 2 – Reselecting the Data

The points were selected for further analysis using the following criteria:

Forest Type – Forest Type = 31 (Loblolly) or Forest Type = 22 (Slash)

Current Data – Cycle = 7 for Florida (1994)

Fusiform Infection – Infection ≥ 0.0

Stand Origin – Natural Stands with Stand Age between 5 and 15 Years Planted Stands with Infection equal or greater than 30%

Forest Health Atlas

Fusiform Rust Hazard Rating Process

Step 3 Create GRID from Point Coverage

GIS GRID created from the selected points. The percent infection is used as the Z value in the grid. The value for each grid cell is based on a weighted average of the Z values in the point coverage. The weight factor is based on the inverse of the distance squared. Each cell value is interpolated from points within 100 miles (160 kilometers) up to a maximum of 12 points. The grid cell size is 3000 meters square.

Step 4 Reclass the grid

Another grid was created from the grid in Step 3 using the RECLASS function in GIA. The RECLASS is based on:

Infection (Percent)	Grid-code (Grid Attribute)	Hazard Rating
0 to 9.99999 %	1	L = Low
10.0 to 30.0 %	2	M = Moderate
> 30.0 %	3	H = High
No Data	-9999	N = Not Rated

Step 5 Create Hazard polygon coverage from the GIS Grid

Create a GIS polygon coverage with the Hazard Rating as an attribute from the grid using the GRIDPOLY function in GRID.

Step 6 Reclassify Hazard Polygon Coverage

Reclassify areas of the GIS polygon coverage for counties having 0.0 acres of the appropriate forest type (Loblolly or Slash Forest Type – FIA County Summaries) as Not Rated.

Step 7 Create Map

Create a map from the GIS polygon coverage using GIS tools.

Fusiform Rust Hazard - Slash Pine Florida



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Forest Health Protection
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