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Project Report No. 38, Average Observed Fusiform Rust Transition Paths

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Observed Fusiform Rust
Transition Paths

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REPORT 38

From

the

Fusiform rust (*Cronatrium quercuum* [Berk.] Miyabe ex Shirai f. sp. *fusiforme* L.) is a devastating disease in loblolly (*Pinus taeda* L.) and slash (*Pinus elliottii* Englem.) pine plantations throughout the southern United States. Pine stems infected with fusiform rust are subject to hazards such as wind breakage, and if a pine stem with a gall on it does survive to harvest, utilization of the infected stem piece may be down-graded from possible lumber to probable pulpwood or maybe completely discarded.

Due to the seriousness of the disease and the effects on pine plantation management, one aspect of the East Texas Pine Plantation Research Project (ETPPRP) has been to investigate the habits,trends and patterns of fusiform rust in loblolly and slash pine plantations in East Texas.........

1985. Fusiform rust occurrence. E. V. Hunt, Jr. and J. D. Lenhart. ETPPRP Report No. 1. 18 p.

1986. Fusiform rust trends in East Texas. Hunt, E. V., Jr. and J. D. Lenhart. South. J. Appl. For. 10(4):215-216.

1988. Fusiform rust occurrence in East Texas pine plantations: 1969-87. ETPPRP Report No. 18. 7 p.

1988. Fusiform rust trends in East Texas: 1969-87. Lenhart, J. D., W. T. McGrath and T. L. Hackett. South. J. Appl. For. 12(4):259-261.

1991. Fusiform rust incidence in loblolly and slash pine plantations in East Texas. Arabatzis, A. A., T. G. Gregoire and J. D. Lenhart. 15(2):79-84.

1994. Characterizing fusiform rust incidence and distribution in East Texas. Lenhart, J. D., T. G. Gregoire, G. D. Kronrad and A. G. Holley. South. J. Appl. For. 18(1):29-34.

In press Estimating survival of East Texas loblolly and slash pine plantations infected with fusiform rust. Adams, D. E., J. D. Lenhart, A. B. Vaughn and J. Lapongan. South. J. Appl. For.

As part of this continuing investigation, fusiform rust transitional patterns in East Texas pine plantations during a 9-year period were recently analyzed...................................

1995. The analysis of longitudinal data. O. Schabenberger. Ph.D. dissertation. VPI&SU. 376 p.

The ETTPRP data set driving the various analyses consists of an array of permanent plots located throughout East Texas loblolly and slash pine plantations. Field measurements began in 1982, and each plot is measured every 3 years. Thus, from 1982 => 1993 observed fusiform rust incidence values are available at 4 points in time, which provides 3 transitions.

In the process of applying various statistical techniques to predict rust transition paths, the ETPPRP data was thoroughly characterized. One characterization was to calculate the percentage of trees in a plantation that followed each of 35 possible transition paths.

Tree condition classes...
- C = Clear of rust.
- B = Rust on branch.
- S = Rust on stem.
- D = Rust-associated death.

Some of the paths were traced by fractional number of trees. For loblolly, only 9 of the paths were followed by ≥ 1% of the trees, and fourteen paths were followed by ≥ 1% of the slash pine trees. Those 23 average observed fusiform rust condition transition paths are depicted on the next two pages.

WHAT DO THE TRANSITION PATHS TELL US?

On the average during the 9-year period...

- For Loblolly pine plantations...
  - Just under three-fourths of the loblolly pines remained clear of rust.
  - To arrive at a branch-infected condition, a tree tended to be branch infected during most of the period.
  - To arrive at a stem-infected condition, a tree was more likely to convert from a clear condition to a stem-infected condition. In addition, a stem-infected tree was likely to remain stem-infected. Very few trees transited from branch-infected to stem infected.
  - No rust-associated mortality was noted.

  Rust does not appear to be a significant management problem.

- For Slash pine plantations...
  - Just under one-third of the slash pines remained clear of rust.
  - To arrive at a branch-infected condition, a tree tended to be branch infected during most of the period.
  - A stem-infected tree was likely to remain stem-infected. Next most popular path was for a stem-infected tree to have been previously clear of disease. A considerable number of trees transited from branch-infected to stem infected.
  - Rust-associated mortality tended to follow a stem-infected condition.

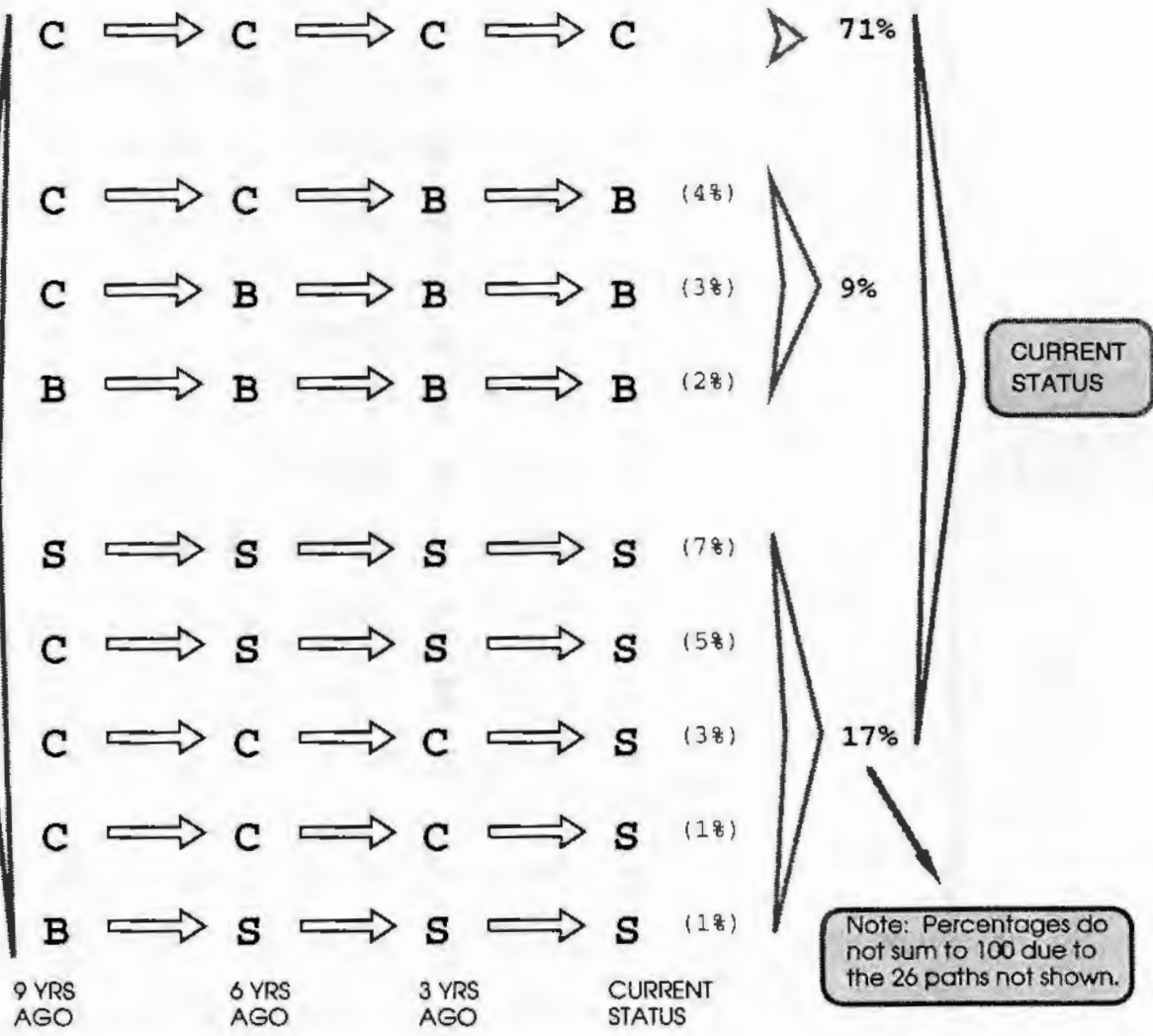 *Rust does appear to be a significant management problem.*

AVERAGE OBSERVED
FUSIFORM RUST CONDITION TRANSITION PATHS
FOR
EAST TEXAS LOBLOLLY PINE PLANTATIONS
DURING A 9-YEAR PERIOD
(FROM AVERAGE AGES OF 8 YEARS TO 17 YEARS)

EACH OF THE 9 DEPICTED PATHS WAS FOLLOWED BY ≥1% OF THE TREES.
EACH OF THE OTHER 26 POSSIBLE YET NOT DEPICTED PATHS WAS FOLLOWED BY <1% OF THE TREES.

C = Clear   B = Branch infection   S = Stem infection   D = Rust-associated mortality

C ⟹ C ⟹ C ⟹ C   71%

C ⟹ C ⟹ B ⟹ B (4%)
C ⟹ B ⟹ B ⟹ B (3%)   9%
B ⟹ B ⟹ B ⟹ B (2%)

STATUS
9 YRS AGO
C = 84%
B = 4%
S = 12%

CURRENT
STATUS

S ⟹ S ⟹ S ⟹ S (7%)
C ⟹ S ⟹ S ⟹ S (5%)
C ⟹ C ⟹ C ⟹ S (3%)   17%
C ⟹ C ⟹ C ⟹ S (1%)
B ⟹ S ⟹ S ⟹ S (1%)

9 YRS   6 YRS   3 YRS   CURRENT
AGO   AGO   AGO   STATUS

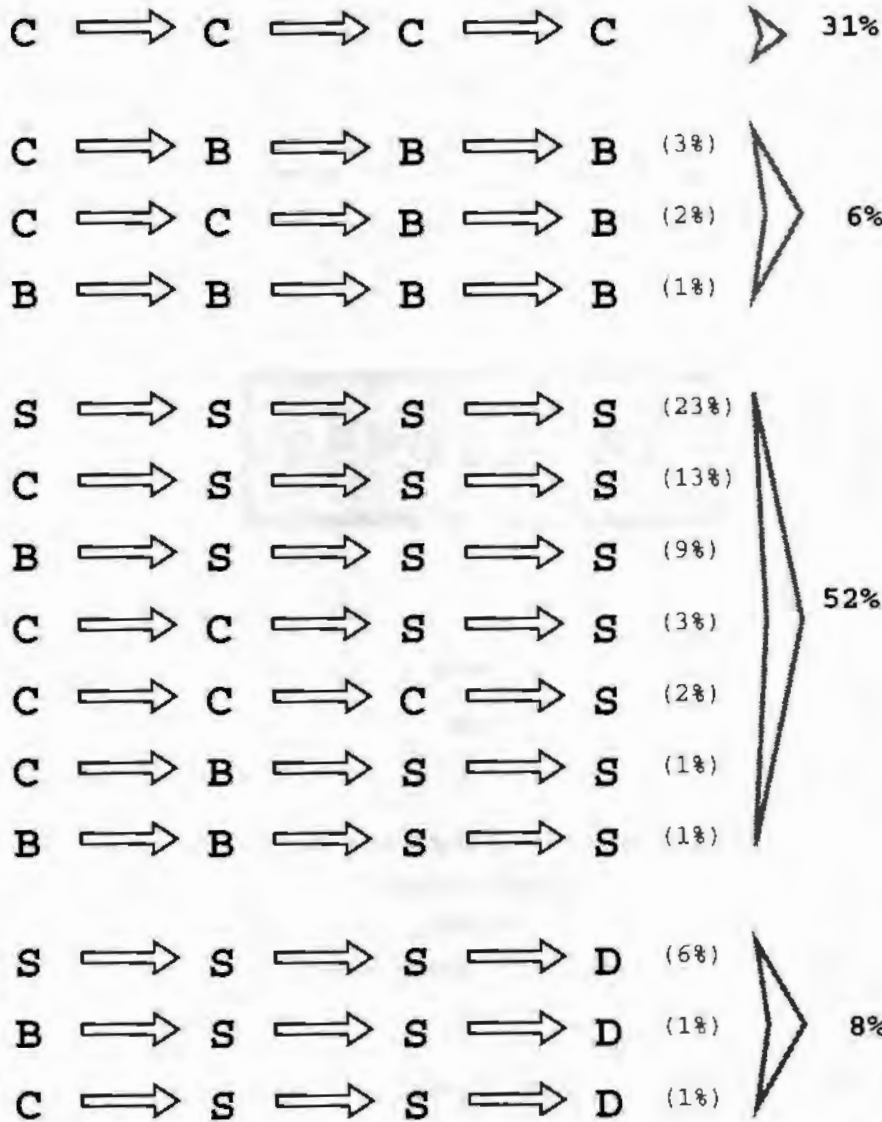Note: Percentages do
not sum to 100 due to
the 26 paths not shown.

AVERAGE OBSERVED
FUSIFORM RUST CONDITION TRANSITION PATHS
FOR
EAST TEXAS SLASH PINE PLANTATIONS
DURING A 9-YEAR PERIOD
(FROM AVERAGE AGES OF 8 YEARS TO 17 YEARS)

EACH OF THE 14 DEPICTED PATHS WAS FOLLOWED BY ≥1% OF THE TREES.
EACH OF THE OTHER 21 POSSIBLE YET NOT DEPICTED PATHS WAS FOLLOWED BY <1% OF THE TREES.

C = Clear   B = Branch infection   S = Stem infection   D = Rust-associated mortality

C ⟹ C ⟹ C ⟹ C   31%

C ⟹ B ⟹ B ⟹ B   (3%)
C ⟹ C ⟹ B ⟹ B   (2%)   6%
B ⟹ B ⟹ B ⟹ B   (1%)

S ⟹ S ⟹ S ⟹ S   (23%)
C ⟹ S ⟹ S ⟹ S   (13%)
B ⟹ S ⟹ S ⟹ S   (9%)
C ⟹ C ⟹ S ⟹ S   (3%)   52%
C ⟹ C ⟹ C ⟹ S   (2%)
C ⟹ B ⟹ S ⟹ S   (1%)
B ⟹ B ⟹ S ⟹ S   (1%)

S ⟹ S ⟹ S ⟹ D   (6%)
B ⟹ S ⟹ S ⟹ D   (1%)   8%
C ⟹ S ⟹ S ⟹ D   (1%)

STATUS
9 YRS AGO
C = 49%
B = 5%
S = 42%
D = 4%

CURRENT
STATUS

9 YRS AGO   6 YRS AGO   3 YRS AGO   CURRENT STATUS

Note: Percentages do not sum to 100 due to the 21 paths not shown.