

Effects of Fertilization, Site, and Vertical Position on the Susceptibility of Loblolly Pine Seedlings to Fusiform Rust

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ABSTRACT

Loblolly pine seedlings in greenhouse flats were exposed in 1968 and 1969 to natural inoculum at 0.5 and 3.0 m above the ground at three sites which differed markedly in incidence of rust in 1964-65. Some seedlings were fertilized with a nutrient solution (12-6-6, N-P-K) while others were not fertilized. Fertilization and site factors other than soil influenced the susceptibility of the seedlings to fusiform rust, but vertical position apparently did not do so. Fertilization caused a marked increase in rust susceptibility on the three sites tested.

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Observations of fusiform rust in young plantations have given rise to certain assumptions about the influence of site, vertical position within the stand, and fertilization on the susceptibility of loblolly (*Pinus taeda* L.) and slash (*Pinus elliottii* Engelm. var. *elliottii*) pines to fusiform

rust caused by *Cronartium fusiforme* Hegc. & Hunt ex Cumm. This investigation was an attempt to evaluate the following assumptions: (i) the amount of rust observed within a given locality can vary markedly from site to site; (ii) the probability of rust infection is greater close to the ground than higher up in young plantations; (iii) fertilization of seedlings increases susceptibility to fusiform rust; and (iv) amount of rust infection expected on a given site can be predicted by measuring the number of basidiospores in the air and certain meteorological parameters suggested by Snow et al. (4).

MATERIALS AND METHODS.—The sites selected for this investigation were those used for the 1963 plantings of the Loblolly Pine Heritability Study (5) established near Bainbridge, Georgia. The three sites are identified according to their previous cultural history as the former Peanut Field, Fallow Field, and Residual Forest. The first two sites are adjacent, and the third is about 3 km distant. When 70 families of loblolly pine were planted on each site in 1963, the average percentages of seedlings infected in 1964-65 were 80%, 48%, and 32%, respectively (3).

The influence of site on incidence of fusiform rust can be attributed to differences in: (i) amount of inoculum, (ii) amount of susceptible host tissue present, and (iii) meteorological conditions, or (iv) edaphic factors that influence the susceptibility of pines to this disease. The above differences in trees infected were attributed by Kinloch and Stonecypher (3) to edaphic factors. In the present investigation, we attempted to measure differences in factors (i) and (iii) with simple weathervane

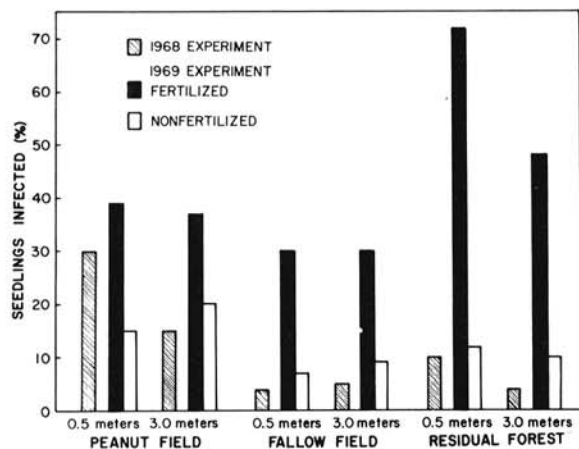


Fig. 1. Influence of site, fertilization, and vertical position (meters above the ground) on the susceptibility of loblolly pine seedlings to fusiform rust.

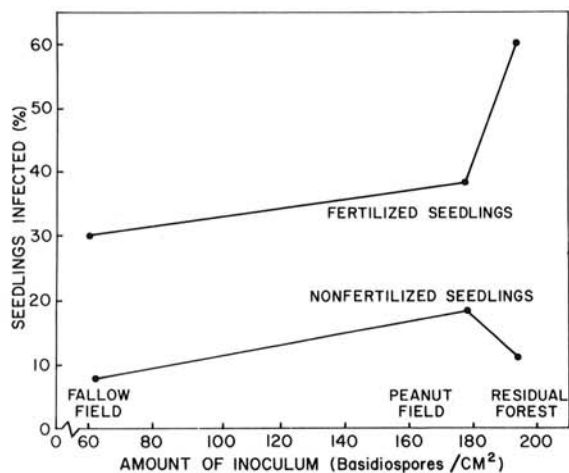


Fig. 2. Relationship between incidence of fusiform rust and amount of inoculum. Amount of inoculum is given as the cumulative number of basidiospores trapped on each site during the period of basidiospore flight in 1969. Percentage of seedlings infected is the average for seedlings exposed at 0.5 and 3.0 m above the ground.

spore traps (2) and hygrothermographs while controlling factors (ii) and (iv) by planting rust-susceptible seedlings in greenhouse flats containing a mixture of soil:sand:peat moss (1:1:1, v/v). In 1968, flats containing 60 seedlings at each site were suspended at 0.5 m (about the height of most of the stem infections), and at 3 m (midway in the live crown of the surrounding saplings). In 1969, two flats were suspended in each position; one was fertilized twice with 0.65 liters of liquid Ortho-Gro (Chevron Chemical Corp., 12-6-6, N-P-K) and the other was not fertilized. Greased-slide spore traps and recording hygrothermographs were installed in 1969. In both 1968 and 1969, the seedlings were exposed to the natural inoculum from 1 April to 30 June.

RESULTS AND DISCUSSION.—Seedlings in the 1968 Experiment and the nonfertilized seedlings in the 1969 Experiment, showed greater infection on the Peanut Field than on the adjacent Fallow Field even though the seedlings were grown in a uniform edaphic environment (Fig. 1). The seedlings exposed at the Residual Forest site showed a greater percentage of rust-infected seedlings than would be predicted on examination of the trees planted in 1963—perhaps due to the increase in oak sprouts (alternate host for *C. fusiforme*) at this site.

No consistent difference could be found in percentage infection between the two vertical positions; this indicates that rust hazard was not greatly different at 0.5 m and 3 m.

Fertilization caused a striking and statistically significant increase in susceptibility of loblolly pine seedlings to fusiform rust (Fig. 1). The fertilized seedlings exposed at both vertical positions on all sites showed at least a twofold (and up to a sixfold) increase in infection compared to nonfertilized seedlings exposed at the same location and vertical position. These data are consistent with other evidence that fertilization can greatly increase the susceptibility of both pines to fusiform rust (1).

The data for the Peanut Field and Fallow Field show the expected direct relationship between amount of inoculum and percentage of both fertilized and nonfertilized seedlings infected (Fig. 2); on the Residual Forest site, however, there was both an unexpectedly smaller percentage of nonfertilized seedlings infected and an unexpectedly larger percentage of fertilized seedlings infected.

Contrary to expectations from the data of Snow, et al. (4), we could not find a significant relationship between either (i) the total number of hours with relative humidity equal to or greater than 97% and temp greater than 16 C, or (ii) the number of hours greater than 9 daily with these same conditions and the percentage of seedlings infected. Nor were (i) and (ii) significantly related to the number of basidiospores impacted on the slides exposed on each site. This suggests that spore traps and weather instruments used in this study were not adequate to define the relationship between microclimate and inoculum potential.

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