# BLACK ROOT ROT OF PINE

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Black Root Rot of pine seedlings is caused by the combined action of two fungi, *Fusarium oxysporum* and *Macrophomina phaseolina*. Above-ground symptoms are generally absent because nursery water and nutrients are available to the point that an affected seedling can grow very well with a severely-damaged root system. But the cortex of the root becomes reddened in small areas and then swollen and dark with a rough surface. This process usually begins at the lower end of the tap root and/or the laterals. A section in the middle of the root may become rough and swollen in a band. The disease progresses up the root to a node where new laterals often proliferate. There are no healthy laterals branching from the swollen parts of the root. Although mortality in the nursery was rare, it did occur in centers where the seedlings appeared to have died rapidly. The dead seedlings were dry with straw-colored needles.

## Quantifying the Problem

It is advantageous to quantify the disease problem prior to lifting season in order to manage for intensity of culling, to determine if it will be profitable to lift beds with a high percentage of diseased seedlings, to determine if arrangements should be made to acquire replacement seedlings from alternative sources, and to determine if control measures will be necessary prior to the next planting. Another benefit is provided by having the data available to study for correlation with factors such as drainage, fertilization rates, herbicides used, proximity to risers, bed end or middle, etc., which may be contributing factors.

The survey used in the Alabama Forestry Commission was designed with help from State and Private Forestry. From previous data it was determined that 36 samples of 10 trees each should be taken in each pipeline at random spacing. The locations were determined by selecting 36 random numbers from the total number of feet in the pipeline. The number of healthy and number of diseased trees out of 10 was recorded at each

of the 36 locations. This data provides results with a relative error of ± 5% at the 68% confidence level. For example, in a pipeline 36 samples are taken at random intervals along the total of 3600 feet in the nine 400-foot rows. Each sample consists of 10 seedlings, yielding 360 seedlings in the 36 samples. If the sample shows an 8% incidence of disease, then the estimated amount of disease is 8% ± 5% with a 68% probability. In other words, the estimated amount of disease is between 3% and 13%; and this estimate will be correct 68% of the time.

The computer printout can give the mean disease incidence by Compartment, Pipeline, and Row. This value can be used to adjust inventories, culling practices, and determine where fumigation is needed.

Duncan's Multiple Range Test compares the incidence of disease in different rows of the pipeline. Significant differences are reported row by row in the pipeline to provide data to consider if proximity to the irrigation risers may be related to disease severity.

The same test is used to compare bed ends with the middles of the beds. This information is used to determine if there is a significant difference between them and provide a clue to control measures.

The Decision Process - Culling

Although the first procedure in managing a disease is identification of the cause, this was difficult in this case. Black Root Rot is described as having two associated fungi. Only one, *Fusarium oxysporum*, was consistently identified. High populations of nematodes were identified, but their locations did not correlate closely to areas of high disease incidence. There was also a suspicion that herbicides were a factor in the seedlings' poor root conditions. Upon consultation with the nurserymen, pathologists, and others involved, it was decided that the diseased seedlings should be culled because survival would be doubtful.

Cost of 10% Mortality (planting 778 trees/acre)

| | |
|---|---|
| Site prep at $90/acre x 10% | = $ 9.00 |
| 778 trees at $13.50/1,000 x 10% | = 1.05 |
| Planting at $35/acre x 10% | = 3.50 |
| | $13.55 |

Cost of Culling from 10% to 0% (778 trees)

Grading efficiency at 50% level

(778 x 13.50/1,000 x 1/2) = $5.25

78 trees/acre culled x .0135/tree = 1.05

$6.30

From this information the decision was made to cull diseased seedlings and take the loss at the AFC nurseries.

The Decision Process - Fumigation

At some level of disease protection, the benefits of fumigation will equal the costs. The variable factor in determining whether fumigation will be cost effective is the amount of disease it will prevent. In 1979 it was determined that a decrease of 1.8% of diseased seedlings would justify fumigation. Above this amount the benefits increase linearly assuming an effective fumigation. The results of the survey provide information that can save money in two ways: (1) to make sure beds are fumigated when the disease incidence is above this amount and (2) to avoid unnecessary fumigation at low disease levels.