A PROGRESS REPORT ON THREE PROBLEMS IN OHIO FOREST NURSERIES

Leon S , Dochinger 1/

Thank you for your invitation to discuss my work on nursery diseases in Ohio It provides me with the opportunity to express my appreciation to the Ohio forest nurserymen for their participation and cooperation in our research program.

The forest nurserymen are most responsible for the prevention and control of diseases from seedling stage through maturity of our forests , Forest plantings generally yield a low return per unit of area, so maintenance costs must be minimized. This means that control measures--spraying, fertilizing, dusting, and special treatments--practiced in agricultural crops are rarely applicable in our forest plantings Only in forest nurseries where plants have a high return from a small planting area can intensive control procedures be employed and be economically feasible Thus, perhaps no one has such an opportunity to control plant pests as you nurserymen Concurrently, no one has as great a responsibility as you for the production of high-quality seedlings that must survive when outplanted and for the prevention of the spread of infectious agents into established forest plantings

In Ohio forest nurseries, a program of work is underway to determine (1) the pathological cause, predisposing factors , and soil fumigation control of a root rot of eastern white pine (Pinus strobus L.); (2) the effects of white pine parentage, seedling characteristics, and site upon the subsequent appearance of chlorotic dwarf trees, an air pollution disorder, in Ohio plantations; and (3) the effectiveness, timing, and frequency of fungicidal sprays for the control of Mars sonina leaf blight of bigtooth aspen (Populus grandidentata

1/ Author is Principal Plant Pathologist, Forest Insect and Disease Laboratory, Northeastern Forest Experiment Station U S F S , Delaware, Ohio

Fusarium Root Rot Of Eastern White Pine

For the past 15 years at the State Nursery in Marietta, Ohio, production records indicate a consistent loss in 1 – and 2-year old beds of eastern white pine seedlings. Three years ago, almost the entire 1965 crop of 1-0 white pine seedlings was decimated. Approximately 90 percent--3 million seedlings--were killed; and heavy mortality also occurred in many 2-0 white pine beds

The symptomatology of this problem was defined during the summer of 1966 when we observed both healthy and diseased white pine seedlings at the Marietta nurserya First symptoms consisted of a darkening and fraying of the apices of primary and lateral roots Soon these roots became blackened and roughened The cortex was sloughed on severely affected roots as they decomposed. Root rot moved from the young tissues to the mature ones, and root proliferation commonly occurred above the rotted portions of lateral roots Some of these new roots soon became infected In time, only a few lateral roots and a short tap root continued to sustain the seedlings in the upper few inches of soil.

Root rot invaded all ages of white pine seedlings, from 1-0 to 3-1 transplants, throughout the nursery. Healthy trees and diseased trees in all stages of decline were found intermixed in many nursery beds.

Above ground symptoms consisted of yellowing, dwarfing, and necrosis of foliage, and stunting of seedlings Needle color changed from a dark bluish-green to a color ranging from pale green to a dull yellow Color differences began at the needle tips and advanced towards their bases . Later, needles browned and remained attached for an indefinite time . Seedlings died in an upright position after the root systems were destroyed,

Aerial symptoms were not correlated with belowground symptoms Often, roots of trees that appeared healthy were partially or completely rotted Seedlings seldom died if overhead irrigation continued But severe mortality struck during late August and September when the nursery ceased watering to harden the seedlings for winter, Root rot was also noticed in several beds of 1-0 Norway spruce seedlings (Picea abies Karst) Their symptomatology was similar to the disease pattern observed in beds of affected white pine seedling Norway spruce losses were estimated to be 10 percent

Isolations and identifications of microorganisms from healthy and diseased white pine seedlings were begun in July 1966 Since a soil fungus probably caused the root rot, tissue sections were taken from the roots of healthy and infected seedlings Root systems were washed in tap water to remove excess soil and debris A 30-percent Clorox solution was used as a surface sterilant All root pieces,

1/ Mention of a specific product does not imply endorsement by U.S.D.A.

1/4 inch long, were immersed in this solution for about a minute Then they were aseptically transferred either to acidified potato dextrose agar (PDA) or to 2-percent Diamalt agar Petri plates

Fusarium oxysporum Schl, was the only fungus consistently isolated from diseased seedlings in all the beds sampled, It was not isolated from healthy seedlings or their root systems

In a preliminary study, 1- and 2-year-old white pine seedlings were inoculated with F . oxysporum grown in a synthetic liquid medium (10 g dextrose, 2 g . yeast extract, and 2 g, agar to 1 liter distilled water) . Root systems were soaked for 2 hours in either a sterile or Fusarium inoculated liquid medium Then seedlings were potted with a standard greenhouse soil mix. After 4 weeks, mortality counts and inspections of root systems were conducted For check plants , 53 of 56 1-year-old seedlings and 22 of 25 2-year-old seedlings were alive For inoculated plants, 21 of 56 1-year-old seedlings and 9 of 25 2-year-old seedlings were alive Comparison of root systems revealed that three times as many roots were killed in white pines surviving fungal inoculation as were killed in the check seedlings Reisolations were made from these dying white pine roots and invariably F oxysporum was obtained.

Soil fumigation is the most common method of controlling nursery diseases Changes in microbiological populations of soil after chemical treatment are an important subject of research in control of seedbed diseases After fumigation, fungus populations usually are drastically reduced; in time fungi gradually recolonize Vaartaja's (1964) review of microbial relationships and other aspects of chemical treatment of seedbeds for disease control can be consulted for additional information.

This microbial reinfestation of the soil is a dynamic process that results from the interactions of various organisms with their environment. Direct parasitism by saprophytes is of some importance in reducing the incidence of soil pathogens This was probably first suggested by Buttner (1903) , And Hartley (1921), in his work with Pythium spp,, first demonstrated that saprophytes inhibit pathogens

Recently, more findings were published on saprophytic competition and survival of soil fungi, Bliss (1951) found Trichoderma viride Pers , ex Fr, was one of the earliest invaders of sterilized soil. Wood and Tveit (1955) believed this fungus was antagonistic to many pathogenic species and is important in controlling soil-borne diseases Park (1959) indicated that F. oxysporum lives in soil primarily as dormant spores that are sometimes passively carried by water and only occasionally initiate very limited growth in fresh debris Rao (1959) declared F. oxysporum could not compete against commonly present saprophytes,

Soil dilution tests indicate that F. oxysporum and T viride are the most common soil fungi inhabitants in the Marietta nursery beds Thus, the nature of fungitoxicants and their effects in controlling the root rot of white pine seedlings could be clarified further by study of the behavior of these two organisms as they recolonize treated nursery beds

Currently, we are studying the activity of chemical soil fumigants and their effects upon fungus population, recolonization, and root rot disease of white pine seedlings in nursery beds From these studies we hope for a better understanding of microbial interactions in the soil. This knowledge may provide basic information towards more effective use of soil sterilants in control of root rot diseases

Chlorotic Dwarf Disease Of Eastern White Pine

Chlorotic dwarf is a serious disorder of eastern white pine in young plantations , Diseased trees are stunted and possess only current mottled foliage,, Investigations into chlorotic dwarf were to define its symptomatology and etiology and to develop measures for control. Previous work had shown that susceptibility to chlorotic dwarf is genetically controlled and that the disease results from an aerological agent acting directly upon the foliage „ By controlling the atmosphere around chlorotic dwarf field trees, evidence obtained to prove that chlorotic dwarf is effected by the injury of gaseous dispersoids on the foliage of susceptible individuals

Current findings indicate one or more pollutants--ozone and sulfur dioxide--acting independently or possibly synergistically may promote the initial symptoms of needle mottling and premature defoliation, For the first time the production of chlorotic dwarf symptoms on white pine susceptible ramets by single and multiple gases in controlled chambers is correlated with similar concentrations of these same gases in forest plantations In our long term, low level, continuous fumigation runs , we have observed continued chlorophyll breakdown and foliar loss; so the final manifestation of stunted growth can be expected, The etiology of other white pine needle blights that appear related to air pollution may be caused by a mixture of two or more pollutants When recorded levels of single gases alone are not high enough to damage white pines, these gases may combine and injure trees before either pollutant itself would cause damage Environmental factors also directly influence the sensitivity of white pines to the action of one or more pollutants Further study of these interactions between the suscept and its environment should aid in explaining the reasons for the acute and chronic symptoms commonly observed on trees ,

Probably one of the best means to control chlorotic dwarf is in collecting seed from resistant trees° Dochinger and Seliskar (1965) reported that scions from chlorotic dwarf trees when grafted to healthy trees exhibit the identical symptom intensity each year as did their parent tree, And scions from resistant trees continued vigorous when grafted to diseased trees These responses suggest that tree-to-tree variations in chlorotic dwarf are controlled by inherited factors Thus , resistance to chlorotic dwarf probably can be developed through breeding and selection programs

Breeding for genetic resistance is normally expensive and time consuming: But, these disadvantages may be bypassed by using trees in plantings that were exposed to high fume emissions for many years More seeds immune to aerological damage would result from cross pollination among trees surviving in such areas than would result from pollination between susceptible and resistant white pine trees found in pollution-free locations

Now, we are assessing the effects of parentage, seedling characteristics, and site upon white pine nursery plants that become diseased when outplanted in Ohio plantations , Statistical correlations were established between seedling and subsequent disease development., Of 11 seedling characteristics, needle mottle was an excellent basis for classifying white pines as diseased; those without mottling were classified as healthy. Using this classification of trees, we called a healthy seedling diseased only 5 percent of the time; and we never incorrectly graded a diseased seedling as healthy. This method will allow us to detect early laten chlorotic dwarfs in nursery beds and to eradicate them during normal grading practices

Mars sonina Leaf Blight Of Bigtooth Aspen

Mars sonina leaf blight is the most devastating disease of bigtooth aspen seedlings in Ohio forest nurseries . Mortality is usually above 90 percent among seedlings in nursery beds Also, trees weakened in the nursery probably have poor survival when outplanted,

The fungus Marssonina is common to both Europe and North America , Almost all species of Populus are susceptible to this causal agent Its life history is unknown, and no attempt has been made to determine how the fungus overwinters in the United States

Lesions affected by the fungus appear as irregular, black spots and blotches that usually coalesce to cover the entire leaf , In southern Ohio infected aspen leaves change color in mid-July , Premature defoliation usually results by early August Twigs and the main stem are invaded, and mortality occurs Epidemic infections are enhanced by temperatures above 60 F. and characterized by heavy rainfall during spring and early summer, In 1968, fungicides were applied to 1-0 bigtooth aspen seedlings in the Marietta State Nursery Beds were spring-sown with seed obtained from local aspen trees When seedlings were approximately 1 inch high, spraying began and has been continued at 14-day intervals, Sprays are applied to the point of runoff . Data will be collected late this fall

Preliminary observations suggest that some fungicides are active against Mars sonina leaf blight. More study is needed to determine rates and time of fungicidal application before a control can be recommended

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