LOOKING FOR NEEDLES -- BUT NOT IN HAYSTACKS

Paul D. Keener

The most serious diseases of economic importance, such as root rots, in Arizona crops are caused by soil-inhabiting organisms (pathogens). These generally enter the plants via the root systems.

Other disease-inducing agents attacking the foliage of plants also occur in the state. These foliage pathogens are usually fungi and they often escape notice because the disturbances they produce in infected plants frequently resemble those which have come to be accepted as due to short or prolonged periods of drouth. This is especially true of a number of fungi causing "blight" and "casting" of needles in Ponderosa pine (*Pinus ponderosa Laws.*) and Piñon pine (*Pinus edulis* Engelm.).

Some of the last remaining acreages of virgin Ponderosa pine occur in the Southwest, with extensive stands in Arizona and New Mexico. The assessment of losses in these stands due to needle-infecting fungi is difficult to make. However, some of the economic impacts involved in the attacks by both blight and cast organisms may be pin-pointed, keeping in mind that the losses incurred often depend on the use for which any given stand is intended.

With the increased emphasis on "multiple use" for the forests of the United States, lowered economic values due to attacks by fungi and insects, formerly not considered important, now assume new dimensions. In Arizona, the economic importance of needle-infecting fungi is related to at least three categories of use for which stands are intended.

Intended use for stand	Why economic value due to needle-infecting fungi is lowered.
Lumber Production*	Needle-infecting fungi cause discolorations interrupting the normal rate and amounts of food manufacture. Discolored needles finally die and tree becomes defoliated. What needles remain on the tree may become deformed. In many cases, deformations assume the character of brush-like growths known as "witches'-brooms". All of these abnormalities add up to reduced annual increase in growth, compared with that in non-infected trees. Reduced annual increment in growth also poses problems for the timber manager, due to "set backs" in maturity dates, etc. Trees undergoing some "pathogenic stress" fall prey to the attacks of bark beetles. The latter finish off the tree as far as usefulness to mankind is concerned.
Watersheds and Watershed Management	All of the factors mentioned under "Lumber Production" with the addition of: Defoliated trees permit the forest canopy to become more open and therefore subjected to fluctuations in temperatures, humidities and radiations. Associated vegetation on the ground under trees infected by needle fungi, also suffers as a result of the altered environment resulting from defoliations. Eventually, the plants comprising the ground cover become diseased because of the "foreign environment" and this in turn creates abnormal conditions at the soil level and a few inches below. Thus, the soil-inhabiting organisms, both fauna and flora, are influenced by those changes which started with needle-infecting fungi on a large species of plant, the tree.
Recreational Areas	Needle-infecting fungi on Ponderosa Pine cause yellowing, browning and finally death and casting. Many times the attacks are on the needles of the previous season, leaving normal appearing green needles of the current growth. Current growth needles thus remain free of disturbances until the following year. This alternating brownish-green needle coloration does not add to the attractiveness of the trees in recreational areas. Since "tourism" is here to stay, especially with population pressures pushing traffic into the Southwest, any means of preventing unsightly trees in areas devoted to scenic views, camping, etc. lessens the economic impact of the attacks by needle fungi.

*Recently released figures indicate that the lumber and pulp industries rank fourth in greatest economic returns to Arizona.

The most frequently encountered needle-infecting fungus on any species of *Pinus* in Arizona, is *Elytroderma deformans* (Weir) Darker. This fungus causes a true needle-cast of attacked trees and has been found in all of the national forests in the state. Its peculiar habit of producing fruiting structures on different species of pine is unique among needle-infecting pathogens. In *P. ponderosa* matured fruiting structures of the fungus occur anywhere throughout the entire length of a needle. In *P. edulis*, these structures are almost invariably situated at the mid-point. Often attacks by this pathogen cause abnormalities in branch growth resulting in masses of closely-spaced needles known as "witches'-brooms". These abnormal growths vary from a few inches to several feet in diameter.

Elytroderma deformans invades all of the needle tissues, including the veinal components which are responsible for the movement of raw materials and elaborated foods. When fungus elements block these areas, water conduction and uptake are hindered and this results in the "drouth effect" mentioned previously.

No panacea for controlling needle-blight and needle-cast fungi can be offered at this time. There is evidence that certain trees have some resistance to attack, and if this proves conclusive, such stock would be important in any future program, such as breeding for resistance to these specific pathogens.

Dr. Keener is a professor of Plant Pathology.