Application of Aerial Infrared Photography to the Ecology of Phymatotrichum Root Rot

by H. E. Bloss[*]

Color, infrared photography provides a unique tool for detecting sources of the pathogen causing Texas Root Rot and in diagnosing the disease in fruit and nut trees, as well as in field crops. Although aerial photography was used to survey diseases in plants as early as 1925, new color, infrared film records changes in color which aid in diagnosing symptoms of diseases.

Phymatotrichum omnivorum is a soil-borne fungus that attacks roots of more than 2,000 species of plants. It frequently causes rapid wilting and sudden death after penetrating roots of almond, apricot, alfalfa, pecan, pistachio and cotton. Losses are estimated to exceed $50,000,000 annually in Arizona, New Mexico, Texas and Mexico. The fungus spreads through the soil from root to root and follows roots to depths of 3-8 feet. Strands and sclerotia are formed which serve as survival mechanisms. Once these structures form on roots of trees and other perennial crops, they are extremely difficult to eradicate.

Some aspects of the ecologic factors involved in the dissemination of *P. omnivorum* in desert soils have become apparent from aerial infrared photographs taken of infected trees adjacent to native vegetation. These photographs indicate that greatest losses occur among cultivated fruit and nut trees planted along former stream beds and arroyos where mesquite, paloverde and similar native species once grew (Figure 1, bottom page 8).

Techniques are being developed in our laboratory for identifying the fungus, should it be present in desert soil or on roots of native plants. Samples are collected in plastic bags and kept moist until they can be examined in the laboratory. By carefully sieving roots and soil, strands can be separated and identified. In some instances, the strands may be large enough to be identified on the surface of roots by a trained plant pathologist. Using these techniques, roots of native plants growing near orchards are found to be sources of the fungus, although these species rarely show symptoms of the disease. Therefore, aerial surveys, supported by examination in the laboratory of appropriate samples, provide a promising method either to avoid planting in infested soils or to eradicate the fungus before more susceptible crops are planted. This principle of avoidance or eradication of the pathogen is a basic premise of plant disease control and offers one of the most promising methods for reducing losses to Phymatotrichum Root Rot.

Color, infrared film also has proven useful in detecting symptoms of the disease in existing orchards. Infected trees frequently appear pale yellow or green in contrast to the deep red color of healthy trees (Figure 2, bottom page 8). The change in color is related to the amount of infrared light reflected from the mesophyll cells of leaves under stress relative to that reflected from healthy leaves. Infected trees should be promptly removed and the soil treated either with a fumigant or a combination of manure, ammonium sulfate and sulfur to prevent spread of the fungus. Barriers of sulfur or polyethylene film placed 4-5 feet deep in trenches also may be useful in this regard.

Early diagnosis and detection of *P. omnivorum* offers the best opportunity to exclude this devastating pathogen from soil before permanent orchards are planted. Examination of soil and roots of native vegetation for the presence of the fungus is strongly recommended in the selection of potential planting sites for susceptible crops in the desert Southwest.

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Effects of ... Problems as...

This paper characterizes through aerial infrared photography certain spatial aspects of urbanization in a semi-arid desert and presents a few salient examples of problems caused by insects and arthropod pests commonly encountered *outdoors*.

Within the last 30 years Arizona has shifted from an agricultural to a largely urban society. The state's population is increasing at a rapid rate. In 1970, the total population was estimated at 1,772,483, with 79 percent of the residents distributed in urban areas. By 1980, the population is projected to increase by 34 percent, expanding urban perimeters well beyond their present limits.

Arizona's climate is considered by many to be a major factor responsible for the influx of people. The relatively short mild winters and scant rainfall of the state's semi-arid regions are conducive to a variety of outdoor activities such as gardening, golf and picnicking. Conflicts arise, however, since these climatic conditions also favor a diverse abundance of insects and related arthropod species. According to those involved in urban pest control, problems are on the increase for a variety of socio-economic and ecological reasons. For the sake of defining insect problem areas, we are dividing "urban" areas into the "inner city" and the "outer city."

Inner City

Metropolis — Figure 1, page 12, shows the contrast between concrete and vegetation patterns (the latter be-