

# 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.

## 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-

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# Urbanization on Landscape Insect-Pest Revealed by Aerial Infrared Photos

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ing shown in various shades of red). The inner city is typical of a "man-altered" environment. Turfgrass and landscape plantings create a background for human activity in such urban spaces as malls, plazas, street medians and multiple-housing units. The concrete and pavement serve as physical barriers insulating plantings from the ambient desert. Consequently, the diversity of insect species associated with landscape plants in the inner city is presumed to be low.

The few pest infestations encountered can normally be controlled by properly-timed spot applications of pesticides. Since pedestrian movement is greatest during the daylight hours, control treatments are best applied and least offensive during the early morning hours.

"Outbreaks" of one or more insect species may occur periodically. An example is the movement of grasshoppers from the open desert to the bright lights of the city. The adults fly to city lights in great numbers creating fear in some people, and causing roads to become slippery with dead grasshoppers. Lower light intensities reduce the number of grasshoppers, by minimizing immigration.

*Residential and Recreational*—Numerous turfgrass areas and a variety of trees, shrubs and flowers are

found in inner city residential and recreational landscapes (Fig. 2, page 12). Insect pest problems are largely dependent on the plant species grown, (i.e. leaf-footed plantbug, or elm leaf beetle). Golf courses and parks are highly specialized outdoor environments. Good insect-pest management practices are important under these circumstances for the protection of both nontarget plants and the public. Maintenance of landscaped public areas is generally the responsibility of city personnel.

On the other hand, residential landscapes are maintained by individual homeowners. The urban dweller develops a home landscape which reflects his personal taste and "life style." To a large extent this determines what plants are grown and how associated insects will be managed.

## Outer City

*Suburban-Desert Interface*—Suburban encroachment on a natural drainage system is shown in Figure 3, page 12. These areas represent a transition between high density inner city living and such rural activities as small plot agriculture and aggregations of livestock (i.e. stabled horses).

Water run-off from newly developed housing often alters drainage patterns and creates mosquito breeding areas. House fly breeding is also common in these areas because many residents maintain livestock. Both situations contribute to an area-wide mosquito and house fly problem. Com-

munity action is often required to abate these nuisances.

Many native insect species, innocuous in the open desert, elevate to pest status when we utilize their food plants (i.e. mesquite, paloverde, etc.) as "specimen" landscape plants. Key pests in this group include bark beetles, twig borers and girdlers, webworms, and scale insects.

*Suburban Desert*—Figure 4, page 12, shows the effects of low density housing in predominantly native vegetation. The impact of irrigation to create golf courses and occasional lawn areas in dry desert environment is clearly evident.

Several varieties of "weeds" often support large numbers of both beneficial and pestiferous insects. When dry weather exerts its seasonal effect on these weeds and desert vegetation, many insect species are attracted to the more hospitable artificial environments provided by man. Invasions of false chinch bugs or leafhoppers that vector curly top virus to tomatoes are examples of insects in this category.

This outer city environment supports a high diversity of arthropod species, many of which are displaced by homes and temporarily become elevated to pest status (i.e. buck moth caterpillars, scorpions, etc.). Until a new balance with man is achieved, they can be quite numerous in these newly developed areas.

It should be emphasized that no one method or technique of insect control or pest management is effective

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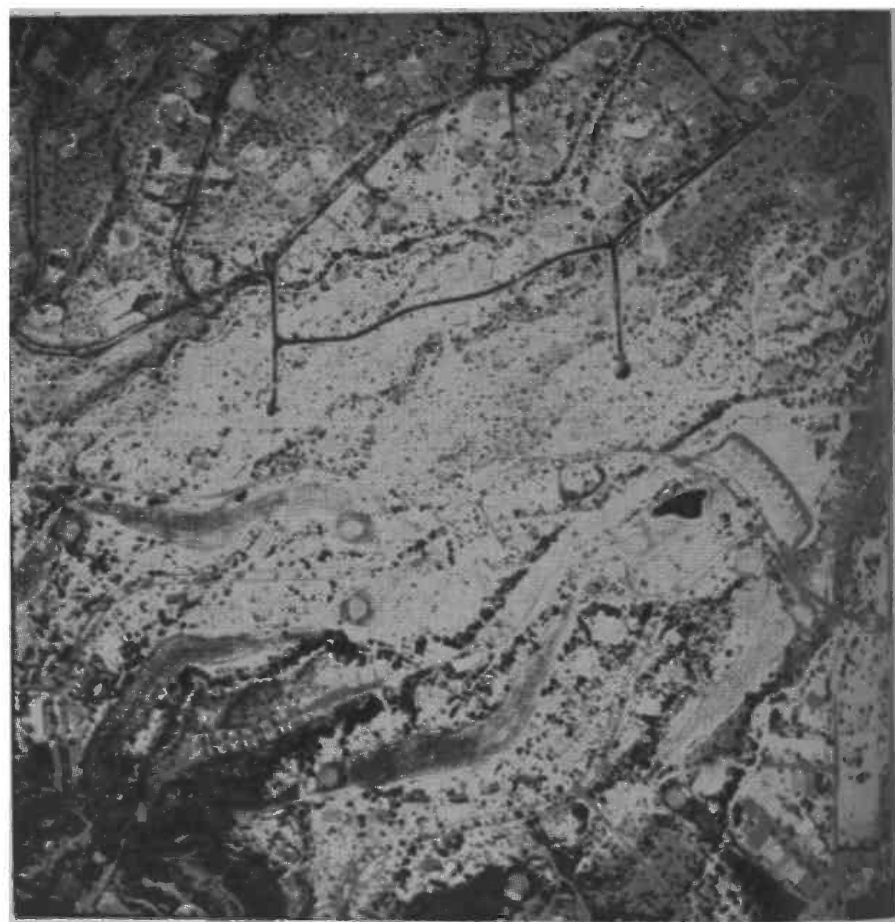
**Fig. 1.—The predominance of concrete over landscape plantings of the inner city area of Tucson.**



**Fig. 2.—A high diversity of turf and ornamental plantings exemplify inner city residential and recreational areas of Tucson.**



**Fig. 3.—Encroachment of the outer city suburbs into natural drainage systems and livestock areas increases mosquito and house fly problems.**



**Fig. 4.—Desert vegetation patterns and irrigated residential and recreational areas of the outer city suburbs contributes to an array of pest problems.**

against all insects in every location described above. There is little doubt that insect populations are profoundly modified by rapid urbanization, which increases the number of insect

problems, particularly as the suburbs encroach upon desert areas. There appears to be a need for more quantitative data to support many of the foregoing observations. The oppor-

tunities for research and Extension programs in the broad area of urban landscape insect pest problems are immense and definitely warrant increased attention.