Fungal and Bacterial Diseases of Sugarbeets in Arizona

Michael E. Stanghellini, Professor of Plant Pathology

University of Arizona

Sugarbeets are subject to approximately 30 different fungal and/or bacterial diseases. In Arizona, one bacterial and nine fungal diseases have been identified and are listed in Table 1. Diseases of sugarbeets can be divided into two major categories: 1) those which primarily affect the foliage and 2) those which affect the storage root.

Foliage diseases, with the exception of powdery mildew (Erysiphe sp.) which occurs statewide, are more prevalent on sugarbeets grown at the higher elevations of the state. Disease incidence coincides with the onset of the summer rains. Currently, control of foliage diseases is based on the use of fungicidal chemicals. Control, however, is dependent upon accurate pathogen identification and timely application of appropriate chemicals. Certain chemicals, such as benomyl, are not effective in controlling foliage diseases incited by Alternaria and Phoma. These latter two fungi were recently isolated and identified (July, 1976) from diseased leaf specimens obtained from the Willcox area. It is not known if the leaf disease incited by these two fungi are new to this production area since similar disease symptoms are produced by the fungus Cercospora, which historically has been the major leaf pathogen. Field diagnosis based solely on symptomatology can be difficult and often misleading. Thus, laboratory identification of the various beet pathogen(s) and the economic significance of each must be determined in order to achieve effective disease control.

Root diseases are among the more destructive in Arizona since they generally tend to occur late in the growing season. The more important root diseases are those caused by 1) Pythium aphanidermatum, 2) Sclerotium rolfsii, 3) Erwinia carotovora var. atroseptica, 4) Rhizopus arrhizus, 5) Phymatotrichum omnivorum, and 6) Macrophomina phaseoli. All of these pathogens incite root rot primarily during the summer months when air and soil temperatures are maximal. Such high temperatures are coincident with the growth temperature optima (32-39° C) of all these root pathogens.

Accurate field diagnoses of the pathogen responsible for root rot is not possible since all of the above fungi, with the exception of S. rolfsii, produce similar, if not identical, root disease symptoms. Isolation and subsequent laboratory identification is necessary for (i) determination of the exact cause of the root rot in specific production areas of the state and (ii) recommendation of appropriate control procedures. Since several pathogens are responsible for root rot, they are discussed separately below.

I. Pythium Root Rot.-Pythium aphanidermatum, a soilborne fungus, was first reported as the cause of a sever root rot in Safford, Arizona in 1967 (1). Subsequent investigations (2) showed that P. aphanidermatum was indigenous to Arizona on several native plant species in their natural habitat and widely distributed throughout all the major agricultural areas of the

state on both weed and numerous cultivated plants. These results provide an explanation for the occurrence of Pythium root rot on land cropped to sugarbeets for the first time. Root rot occurs primarily during mid-July and early August when soil temperatures are at a maximum, an environmental factor which favors the growth of the fungus. Pythium has an optimum temperature of 37 C for maximum germination and growth rate (3). Disease incidence is greatest in the Gila River Valley and Sulphur Spring Valley where sugarbeets are grown through the hot summer months. Sugarbeets in the Salt River Valley generally escape root rot because most of the beets are harvested by late June to mid-July. However, if harvest is extended into late July, extensive losses have and will occur as evidenced by the extent of Pythium root rot during the 1976 campaign.

Investigations (4,5) on the soil biology of P. aphanidermatum have shown that the fungus can persist in fallow soil as oospores, the sexual stage, for greater than two years. Additionally, this fungus occurs at soil depths to ca. 60 cm and can survive soil temperatures between 17 and 130° F. Studies on the soil populations of the fungus necessary to cause root rot showed that almost all agriculture soils in Arizona contain between 10-300 oospores per gram of soil (6,7). However, only 0.2 oospores/gram of soil are necessary to cause root rot. Thus, attempts to control this particular fungus by rotation, fallow periods and other cultural procedures have not met with success. Chemical control studies have been conducted at the Safford Farm continuously since 1970. The recent development of two new systemic fungicides which show activity against Pythium are currently being tested in field plots.

II. Sclerotium rolfsii Root Rot.-Root rot incited by this soilborne fungus has increased significantly since 1974. Numerous outbreaks have been reported from the Salt River Valley and the Sulphur Springs Valley. Considerable information exists on the biology of this fungus. According to published reports (8), S. rolfsii attacks plants primarily at or near the soil surface and disease incidence is favored by high quantities of undecayed organic matter or plant debris. Control measures employed in Southern states include rotation and/or deep plowing to bury sclerotia (the survival structure of the fungus) and all undecayed organic matter or plant debris. Whether these cultural control methods would be feasible in Arizona are questionable. Field observations on this particular disease in Arizona do not conform to the reported behavioral characteristics of the fungus. In Arizona, S. rolfsii primarily attacks the lower tap root, approximately 5-8 inches below ground level, and then progresses up the root. Whether this is due to our local environmental factors or possibly a different strain of the fungus is not known. Information is needed on the longevity of S. rolfsii in soil in Arizona and experimental data is needed on the feasibility of both chemical and cultural control measures on acreage already known to be infested with this fungus. Limited acreage available for sugarbeet production necessitates such investigations.

III. Root Rot incited by soft-rot Erwinia sp.-Bacterial soft-rot of sugarbeets, previously reported only in Washington (10) and California (9) was observed for the first time in June 1975 in Chandler, Arizona and in July 1975, Kansas Settlement, Arizona. Pectolytic Erwinia, identified as E. carotovora var. atroseptica, were recovered from infected root tissue. Serological and physiological tests (11) showed, contrary to the findings

of Ruppel (10), that distinct serological and physiological strains of the sugarbeet pathogen are found in widely separated sugarbeet production areas. The pathogenic diversity of these strains is not known but should be taken into consideration in any program aimed at breeding for resisistance.

The origin of the sugarbeet bacterial pathogen is not known. The existance of more than one pathotype and the isolation of the sugarbeet pathogen from potatoes nearly 3 years before the reported incidence of the disease in sugarbeets indicates regional selection by the host from a mixed population residing naturally in soil. Investigations on the soilborne nature of the sugarbeet bacterium are currently under limited investigation.

IV. Rhizopus Root Rot.-Rhizopus arrhizus, a ubiquitous fungus, was first isolated from decayed sugarbeet roots obtained from Litchfield and Kansas Settlement, Arizona, in 1973-74. Infection occurred below ground and, although of academic interest, was not considered an economically important disease. However, in 1976, approximately 200 acres in the Sacaton and Litchfield production areas sustained considerable loss due to this fungus. Infection, however, originated in the crown of the sugarbeet plants and spread into the root where extensive decay was noticed on approximately 20% of the sugarbeets. A literature review revealed that this fungus had not been previously reported as the cause of a field problem in the United States but has been reported from Canada and Italy. Laboratory studies in Arizona, showed that the fungus has a temperature optima of 37° C and is primarily a wound pathogen capable of killing sugarbeets within three days under appropriate temperature conditions. Disease incited of this fungus under field conditions occurred during late June and early July when air temperatures were optimal for the fungus. While the exact mode of entrance of the fungus into the beets is not known, it was observed that beets within these production areas were severely infested with lepidopterous larvae which were feeding extensively in the crown of the beets.

Such feeding activities could have provided the wounds necessary for subsequent fungal invasion. Control of lepidopterous larvae may therefore result in control of crown infections by Rhizopus but not infections originating below ground level. Due to the rapid invasion capabilities of this fungus, Rhizopus should be considered as a threat to the industry. Chemical control studies involving insecticides and fungicides are warranted.

V. Phymatotrichum omnivorum Root Rot.-Disease incidence incited by this native soilborne fungus is apparently restricted to elevations below 4,500 ft. As with other root rot pathogens in Arizona, this fungus is primarily active during the hot summer months and can occasionally cause considerable losses particularly in virgin land cropped to sugarbeets for the first time. Control resides in rotation with small grains and avoidance of fields previously cropped to cotton and other susceptible crops which have a known history of the disease.

VI. Marcrophomina phaseoli (Charcoal Root Rot).-This particular fungus was identified for the first time as the cause of considerable losses in the Salt River Valley in July 1976. The fungus is primarily active during the hot summer months and is a destructive pathogen on plants under stress.

It is doubtful if this soilborne fungus will constitute a major threat to the industry. Control, however, resides in determination and prevention of stress conditions which occur during the latter part of the growing season in the Salt River Valley.

LITERATURE REVIEW

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TABLE 1. Bacterial and Fungal Diseases of Sugarbeets in Arizona

Foliar Pathogens	Known Geographical Distribution
Cercospora beticola	Willcox, Safford
Alternaria sp.	Willcox, Safford
Phoma betae	Willcox, Safford
Erysiphe polygoni	State wide
Root Pathogens	
Pythium aphanidermatum	State wide
Sclerotium rolfsii	State wide
Rhizopus arrhizus	Salt River Valley, Willcox
Erwinia carotovora var. *atroseptica*	Willcox, Salt River Valley
Phymatotrichum omnivorum	Salt River Valley, Safford
Macrophomina phaseoli	Salt River Valley