SWEET POTATO DISEASES AND THEIR CONTROL

— *by* —

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Sweet potato diseases may be caused by three general groups of pathogens: fungi, nematodes, and viruses. There are a few references in the literature to sweet potato diseases caused by bacteria; however, these diseases appear to be relatively minor ones and will not be considered here. The vegetative method of propagating sweet potatoes is an aspect of sweet potato culture that (a) enhances destructive effects of pathogens to that host and (b) plays an important role in devising control measures for these diseases.

Some sweet potato diseases caused by fungi, nematodes, and viruses will be discussed briefly as to causal agents and methods of control as at present applied in the U.S.A.

DISEASES CAUSED BY FUNGI

At least 50 different fungi have been associated with diseases of the sweet potato. Distinct diseases are caused by some 25 or more of these fungi. Some of the better known fungus diseases are discussed here.

1. *Stem Rot or Wilt,* caused by *Fusarium oxysporum* f. *batatas* (Wr.) Snyd. & Hans., has been reported principally from the U.S.A. and Japan, and occurs in a few other areas of the world. In the U.S.A. stem rot is at present controlled through the use of resistant varieties. Reaction to the stem rot fungus among sweet potato selections ranges from very susceptible to highly resistant, but not approaching immunity. Practical field control of stem rot usually is attained with intermediate levels of resistance. Susceptible varieties may be grown successfully in noninfested soils by using stem rot-free planting stock.

2. *Black Rot,* caused by *Ceratocystis fimbriata* (Ell. & Halst.) J. A. Elliott, has been reported from many countries where sweet potatoes are grown. Black rot affects aerial parts of plants as well as edible roots. In the U.S.A. control measures are based largely on exclusion of the pathogen from field plantings. In the absence of the sweet potato host, the causal fungus apparently does not survive in soils in the U.S.A. for longer than two years. The use of disease-free mother roots treated with a recommended fungicide and planted in noninfested soils assures a black rot-free crop of sweet potatoes.

Supplementary control measures are necessary in instances where black rot-affected sweet potatoes are washed and packaged for shipment. These supplementary measures are concerned with disinfestation of the washing and packaging equipment with an approved fungicide to prevent spread of the disease to disease-free sweet potatoes subsequently handled in the same equipment.

The black rot fungus can be killed at temperatures which are not lethal to sweet potato roots. The following hot air treatments were used successfully in experiments where relatively small volumes of sweet potatoes were involved: 50°C for 6 hours, 43°C for 24 hours, and 35°C for 5 days.

Although there is a commercially valuable level of resistance to black rot among sweet potato selections tested, control of the disease through resistant varieties has not been attained. It is likely that the highest level of resistance at present available in sweet potato selections is not adequate to effect commercial control of black rot.

C. fimbriata has been recorded from several host plants other than sweet potato. These plants include *Hevea brasiliensis, Coffea arabica, Theobroma cacao, Platanus occidentalis, Prunus* spp., and *Crotalaria* sp. It appears, however, that these host forms of *C. fimbriata,* with the possible exception of the one from *Crotalaria* sp., are not pathogenic to sweet potatoes.

3. *Scurf,* caused by *Monilochaetes infuscans* Ell. & Halst. ex. Harter, apparently is not as widely distributed over the world as black rot. Control of scurf also is based largely on exclusion of the pathogen from field plantings in a manner similar to that described for black rot The use of cuttings instead of root-bearing sprouts is especially effective in reducing spread of the scurf pathogen from affected "seed" roots to field plantings.

There are differences in susceptibility of sweet potato selections to the scurf fungus, but known levels of resistance to it are relatively low and, therefore, of limited value in combatting the disease.

4. *Soil Rot,* caused by *Streptomyces ipomoea* (Person & W. J. Martin) Waks. & Henrici, apparently is not widely distributed over the world. It is, however, the most important field disease of sweet potatoes in the state of Louisiana, U. S. A., and is found in other parts of the country as well. Soil rot is a soil-borne disease that may become severe in soils having pH values above 5.2. One of the control measures is based on the fact that the pathogen does not cause losses in soils with pH values of 5.2 or lower . This means of control, however, poses problems where certain crops, requiring higher pH values for economical production in Louisiana soils, are used in rotation with sweet potatoes. Where manipulation of soil pH is not desirable, the soil rot fungus can be controlled by use of fungicidal fumigants (as chloropicrin, or fumigants containing methyl isothiocyanate) applied in-the-row as a preplant treatment. These fumigants are nematocidal as well as fungicidal.

Sweet potato selections range from very susceptible to moderately resistant in their reaction to the soil rot fungus. At present, there are no varieties with adequate soil rot resistance to effect commercial control of the disease; however, progress is being made in developing varieties that may be useful toward that end.

5. *Soft, Rot,* caused by *Rhizopus stolonifer* (Ehr. ex Fr.) Lind. and several other species of *Rhizopus,* principally affects edible roots. Soft rot probably is widely distributed wherever sweet potatoes are grown, but apparently causes greater losses in more temperate areas. Control measures are based on prevention of wounding sweet potatoes (to avoid creating portals of entry for the fungus), and proper curing of roots before storage. A most effective chemical, 2, 6-dichloro-4-nitroaniline, has been approved for use on sweet potatoes in the U.S.A. with a 10 ppm tolerance on sweet potatoes. Applied at 3 to 4 ppm on roots the chemical is highly effective in preventing soft rot development in sweet potatoes.

Sweet potato selections differ considerably in their susceptibility to the soft rot fungus. No acceptable level of resistance to soft rot in sweet potatoes has been discovered to date.

6. *Sclerotial Blight and Circular Spot,* caused by *Sclerotium rolfsii* Sacc., are diseases that affect the aerial parts of plants (blight) as well as the edible root (circular spot). The sclerotial blight often becomes severe in plant beds. Recent experiments indicate the effectiveness of 2, 6-dichloro-4-nitroaniline in preventing this disease in plant beds; it is possible that an economically feasible control measure will result from these experiments. At present control measures are based only upon exclusion of the pathogen through rotation.

7. *Java Black Rot,* caused by *Diplodia tubericola* (Ell. & Ev.) Taub. *(Physalospora rhodina* (Berk. & Curt.) Cke.), is a disease of the enlarged root, but may also cause damage in plant beds. Under conditions in Louisiana, U.S.A., the disease becomes severe mainly in cases where sweet potatoes have been subjected to such stress conditions as excessive heat or cold and excessive soil moisture.

Limited screening for resistance to the Java black rot fungus suggests differences in susceptibility among sweet potato selections.

8. *Charcoal Rot,* caused by *Macrophomina phaseoli* (Maubl.) Ashby, is found commonly in the U.S.A. and other parts of the world. In the U.S.A. it is severe mainly following previous injury to the sweet potatoes. Little is known about possible resistance to charcoal rot.

9. *Leaf Diseases* caused by fungi are of relatively little importance in the U.S.A. *Phyllosticta* leaf blight caused by *Phyllosticta batatas* (Thuem.) Cke., and white rust, caused by *Albugo ipomoeae-panduratae* (Schw.) Swing. are found generally in sweet potato plantings. Relatively high levels of resistance to both diseases are available among sweet potato selections. Rust caused by *Coleosporium ipomoeae* (Schw.) Burr., and *Cercospora* leaf spot, caused by *Cercospora* sp., have been reported on sweet potatoes from some sections of the U.S.A., but are not commonly found. *Alternaria* leaf spot is occasionally observed; it is believed that *Alternaria* sp. is primarily a secondary invader.

10. *Other Diseases* caused by fungi include foot rot caused by *Plenodomus destruens* Harter, which damages plants in seed beds and occasionally affects enlarged roots; dry rot caused by *Diaporthe batatatis* Harter and Field; surface rot caused by *Fusarium* spp: *Penicillium* decay; mottle necrosis caused by species of *Pythium* and *Phytophthora;* etc.

DISEASES CAUSED BY NEMATODES

There are many species of plant parasitic nematodes commonly found associated with sweet potato roots. Some of these nematodes are known to feed and propagate on roots of sweet potatoes without causing appreciable pathologic effects. Among this group are several species of *Pratylenchus, Helicotylenchus* sp.,*Tylenchorhynchus martini* Fielding 1956, *Tylenchorhynchus* sp., *Trichodorus christei* Allen,1957, and *Trichodorus* sp.

There are several other nematodes that cause distinct damage to sweet potatoes. The diseases caused by these nematodes are discussed briefly.

1. *Root Knot,* caused by *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949; *Meloidogyne hapla* Chitwood, 1949; and *Meloidogyne javanica* (Treub, 1885) Chitwood, 1949, is widely distributed throughout the world. It is commonly found where susceptible sweet potato varieties are grown. Control of the root knot nematodes in susceptible varieties of sweet potatoes involves the use of disease-free "seed" bedded in nematocide-treated beds and planted in root knot nematode-free soils, or in soils treated with nematocides.

There are root knot nematode-resistant varieties available for planting in some sections of the U.S.A. A desirable moist-type sweet potato variety (so called because the sweet potato flesh is moist after baking, in contrast to the dry type that is dry and mealy after baking), having adequate resistance to root knot is not yet available. Progress is being made toward development of such a root knot-resistant, moist-flesh variety in the breeding programme at Louisiana State University.

2. *Sting Nematode Damage,* caused by *Belonolaimus* sp., is a destructive disease in a limited acreage of infested soils in the U.S.A. The sting nematode is an ectoparasite that causes severe stunting of sweet potato plants thereby greatly reducing yields. Soil fumigation with nematocides reduces damage by the sting nematode.

3. *Reniform Nematode Damage,* caused by *Rotylenchulus reniformis* Lindford and Oliveira, 1940, is also destructive in a limited acreage of infested soils in the U.S.A. The reniform nematode has been recorded from many tropical and sub-tropical areas of the world. It is an endoparasite that propagates abundantly on sweet potatoes and causes striking yield reductions. Fumigation of infested soils with the dichloropropenes results in good yield increases.

There appears to be some level of resistance among the relatively few sweet potato selections that have been screened for resistance to this nematode. Apparently factors that govern resistance to the reniform nematode are different from those that govern resistance to root-knot nematodes.

4. *Other Nematode Diseases* have been reported as caused by *Radopholus similis* (Cobb, 1893) Thorne, 1949, and by *Ditylenchus dipsaci* (Kuhn, 1857) Filipjev, 1936. These diseases have rarely been recorded after their original description.

DISEASES CAUSED BY VIRUSES

During the past two decades several virus diseases of sweet potatoes have been recognized. The causal viruses all appear to be systemic and readily transmitted from sweet potato to sweet potato by grafting either from enlarged roots or from stem portions. There are nonpersisent as well as persistent viruses involved. Among the nonpersistent viruses all, except one, are readily transmitted from sweet potato to sweet potato by aphids; the one exception (investigated by O. H. Elmer, 1960) was transmitted from sweet potato to sweet potato by grafting only. Apparently the nonpersistent viruses that infect sweet potatoes are transmitted from sweet potato to sweet potato with difficulty, if at all, by mechanical means other than by grafting and aphid inoculation. The persistent viruses that infect sweet potato are transmitted by whiteflies.

Relatively few investigations have been made on specific viruses that cause diseases of sweet potatoes. The nonpersistent viruses appear to be very unstable.

The persistent viruses (whitefly-transmitted viruses) have been recognized only in recent years as causing diseases of sweet potatoes. Therefore, characterization of viruses that cause diseases of sweet potatoes, is at present limited to symptomatology and transmission.

The sweet potato virus diseases as herein grouped by the writer are discussed briefly.

1. *Internal Cork,* a disease caused by a virus or a complex of viruses, is characterized by internal root necrosis prominent in enlarged roots of the sweet potato. Yields appear not to be affected. Symptoms on the growing plant consist of chlorotic leaf spotting, vein-clearing, vein-banding, and purple ring-spotting of foliage. These above-ground symptoms are similar, if not identical, with those caused by the leaf spot virus.

The virus is readily transmitted by several aphids, the most efficient in Louisiana, U.S.A., being the cotton aphid, *Aphis gossypii* (Glover). The aphids acquire the virus within a few seconds and lose infectivity within a few minutes, generally. The host range of the virus or viruses involved appears to be limited to plants of the Convolvulaceae.

Reaction of sweet potato selections ranges from very susceptible to highly resistant to internal cork, or, more specifically, to the root necrosis characteristic of the disease. The virus (or viruses) that causes the necrotic spotting in susceptible varieties appears to be carried in all of the resistant selections assayed. Resistance to the root necrosis appears to predominate among sweet potato selections that have been tested. Resistant varieties (e.g., Centennial, Julian, Nugget) have been developed in the U.S.A.

Control of internal cork in susceptible varieties is relatively easily attained in Louisiana, U.S.A., by growing internal cork-free plants even at relatively short distances away from diseased plantings.

2. *Leaf Spot,* caused by a nonpersistent, aphid-transmitted virus, is characterized by the same above-ground symptoms as those described for internal cork. Root necrosis does not develop when sweet potato varieties susceptible to internal cork, but free of the disease, are inoculated with the leaf spot virus. However, internal cork root necrosis does develop when the internal cork virus is introduced into susceptible varieties already infected with the leaf spot virus. Thus, there appears to be no protection by the leaf spot virus against infection by the internal cork virus.

Leaf spot virus apparently does not affect sweet potato yields. Resistance to leaf spot virus has not been found among sweet potato selections tested.

3. *Feathery Mottle Complex,* caused by a complex of viruses, is characterized by dwarfing of plants, resulting in striking yield reductions. The viruses involved in this disease appear to be the internal cork virus or viruses, the leaf spot virus, and a whitefly-transmitted virus. None of the viruses individually seems to cause the severe symptoms that result when the three viruses are present together. The whiteflies implicated in transmission of the third virus in the complex are *Bemisia tabaci* (Genn.) and *Trialeurodes abutilonea* (Hald.). This disease is limited in distribution in the U.S.A., and it has been reduced to insignificant proportions by a

combination of removal of diseased plants and use of insecticides in areas where it had become severe.

Relatively little research has been done on the feathery mottle complex. However, it is suggested that this disease possibly is similar to several virus diseases described from other parts of the world. It has been reported that the whitefly-transmitted virus has been eliminated from affected plants by a combination of heat treatment and tip cuttings.

Relatively little is known about varietal reaction to feathery mottle complex. Resistance was not discovered from limited screening of sweet potato selections in the U.S.A.

4. *Mosiac,* caused by a strain of tobacco mosiac virus, is a disease of certain dry-flesh, or Jersey-type sweet potato varieties in the U.S.A. Mosiac has been reported from relatively few plants in one or two isolated areas. The disease has been readily transmitted from sweet potato to sweet potato by grafting but not by any other means. There is relatively little spread of mosaic under field conditions. Transmission from sweet potato root sap to tobacco plants has been reported. Transmission by sap inoculation from tobacco to tobacco and a number of other plants, including sweet potatoes, has been reported. Apparently there is resistance to mosaic among sweet potato selections.

5. *Russet Crack,* described in 1964, is characterized by a russet type of discoloration and cracking of the enlarged roots. Chlorotic spotting followed by necrotic spotting of the foliage of certain varieties is associated with the disease. The disease is transmitted from diseased to healthy sweet potato plants by grafting. Spread of russet crack in field plantings has been abundant in some cases. The disease is at present limited to the north-eastern part of the U.S.A. Indications are that a whitefly, *Trialeurodes abutilonea* (Hald.), is a vector of russet crack virus, and that the virus involved is distinct from the whitefly-transmitted virus in the feathery mottle complex.

6. *Other Viruses* reported from sweet potatoes include strains of tobacco ringspot virus and cucumber mosaic virus.

SUMMARY

It is apparent that disease resistance at present plays an important role in controlling the ravages of sweet potato diseases. The author believes that resistance to additional diseases will be discovered as more and more sweet potato seedlings and selections are systematically screened for resistance to particular diseases. It is also apparent that other control measures are very important in combatting sweet potato diseases. These include the following practices : (a) use of disease-free "seed" potatoes; (b) selection of planting sites; (c) "seed" and soil treatment with fungicides and/or nematocides; and (d) use of cuttings instead of root-bearing sprouts for making field plantings.

APPENDIX

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