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DISEASES OF AVOCADO

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Diseases cause annual crop losses and occasional tree losses to avocado growers and necessitate expenditures for their control. Control of diseases causing fruit blemishes and decay has become very important since strict grade standards are in effect. The diseases of avocado are caused primarily by fungi, but a single known virus disease is also important in avocado production. This paper describes the diseases and their causal agents and outlines appropriate control measures.

Avocado Scab

Avocado scab is the most important disease of avocado fruit and foliage in Florida. Cultivars vary in susceptibility to scab with 'Lula' must susceptible, 'Booth 7', 'Booth 8', 'Fuerte', 'Hall' and 'Taylor' moderately susceptible and 'Booth 1', 'Fuchs', 'Pollock' and 'Waldin' least susceptible.

The disease occurs on leaves as individual purplish to dark brown spots less than 3 mm in diameter. The spots are visible on both sides of the leaf and eventually the centers may fall out, leaving small irregular holes fringed with grayish brown tissue. Severe infections are manifest by lesions on the midrib and veins resulting in distorted and malformed leaves. The spots on the veins, leaf petioles and the green cortex of twigs are oval to elongate in shape and slightly raised, giving a rough feeling when lightly rubbed.

The disease occurs on the fruit as raised, circular to oval and dark brown to purplishbrown corky spots. The spots are scattered or may coalesce to form irregular, russeted areas which sometimes involve the entire surface of the fruit. Avocado scab is confined to the outer surface of the fruit; the flesh is not impaired by the disease. The fruit may be deformed or underdeveloped in severe cases and will be culled in packing. Scabinfected fruit is more susceptible to avocado anthracnose which will increase preharvest fruit drop.

Causal Factors

Avocado scab is caused by the fungus *Sphaceloma perseae* Jenkins which attacks young, tender tissue of the foliage and fruit, forming spots that produce spores. The spores are spread to other parts of the tree or to other trees by wind, rain, dew and insects. The fungus is carried over from one season to the next on leaf and stem lesions. The most critical period for fruit infection is from the time of fruit set until it has attained a third or half of its normal size.

Control Measures

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Avocado scab is controlled with monthly field sprays of 53% micronized copper at 1-2 kg/400 liters of water or Benlate® at 1.7-2.2 kg/ha. In order to insure good fungicide coverage and sticking to the young, slick leaves and fruit, 500 ml of Nu-Film 17® per 400 liters of water should also be applied.

See references 6, 7, 9, 11, 12, 14, 17, IS, 21, 25, 28, 32, 34 and 39.

Anthracnose or Black Spot

Anthracnose is commonly found on maturing fruit on the tree and is the most frequently observed rot of softening avocados in the market. The first sign of the disease is small, light brown to black, nearly circular discolorations of the skin scattered over the surface of the fruit. As the fruit matures, the spots enlarge to 10-15 mm or more in diameter. The color changes from light brown at the edge to dark brown and greenish-black in the center of the slightly sunken spot. The fungus spreads rapidly into the flesh, causing a greenish-black, relatively firm decay which eventually involves most of the fruit. The surface of the lesions may develop prominent radial and circular cracks. The fungus forms pink, waxy spore masses on the surface of the spots under high humidity. All Florida cultivars now grown are moderately susceptible to anthracnose if conditions are favorable to infection, whereas the California cultivars are more susceptible to anthracnose.

Causal Factors

Anthracnose is caused by the fungus *Colletotrichum gloeosporioides* (Penz.) Sacc. which lives as a saprophyte or weak parasite on mangos, papayas, citrus and many other fruit crops. The fungus is commonly found growing on dead twigs and in bad spots on leaves and fruit. It is a weak parasite which is unable to penetrate uninjured growing fruits but may establish latent infections on them, especially at the lenticels (33). The latent infections remain quiescent until the fruit is mature but develops quickly as the fruit softens. The fungus can establish itself actively on avocado fruits that are approaching maturity through wounds *or* cracks in the skin caused by other fungi, mechanical injuries or insects. Anthracnose can commonly infect fruit through Cercospora spot or scab lesions.

Control Measures

Anthracnose is controlled by a good field spray program to control insects, Cercospora spot and scab. Cercospora spot and scab are controlled by monthly field spray applications of Benlate® at 1.7-2.2 kg/ha. Micronized coppers at 1 .5-2 kg/400 liters are effective in the control of Cercospora spot and scab. Improper harvesting of immature fruits contributes to anthracnose development in storage and transit, since the fruits are susceptible to bruising and skin breaks caused in picking and packing.

See references 4, 8, 13, 15, 17, 19, 21, 26, 27, 32, 34, 38 and 39.

Cercospora Spot or Blotch

Cercospora spot or blotch occurs throughout the avocado production areas of Florida.

None of the commercial cultivars now in production are immune to Cercospora spot once the fungus has become established in the trees. However, the fungus is most easily controlled on 'Fuchs' and 'Pollock'. This disease is able to infect previously uninjured leaves, young stems and fruit but it is of economic importance as a fruit disease. Occasionally, leaf infection may become severe enough to cause partial defoliation of the tree.

The disease appears on the leaves as individual spots, angular in shape, generally less than 2 mm in diameter and brown to chocolate brown in color. Spots frequently occur in groups or may coalesce to form irregular patches. Spots on the fruit are 3-6 mm in diameter, light to dark brown, irregular in shape and slightly sunken with a cracked or fissured surface. The skin tissue is killed by the fungus and cracks allow other fungi, especially the anthracnose fungus, to penetrate and decay the ripening fruit. Fruit infections can take place from May to September, but the most critical period appears to be from May 15 to July 1 in Florida.

Causal Factors

Cercospora spot is caused by the fungus *Cercospora purpurea* Cke. Grayish sporebearing tufts are produced on either leaf or fruit surfaces during moist periods throughout the year. The disease is carried over from one season to the next on old leaf infections. Without proper disease control, the disease tends to become more serious in an orchard.

Control Measures

Cercospora spot can be controlled by timely applications of copper sprays to developing leaves and fruit. An application of copper in early May followed by another in early June gives effective control on cultivars maturing in summer and autumn. On winter-maturing cultivars, a third application about mid-July is necessary for adequate disease control on the fruit.

See references 14, 18, 20, 21, 23, 24, 27, 28, 29, 30, 32, 34 and 38.

Verticillium

Verticillium wilt of avocado trees was first noted in Florida in 1969. The soil-borne disease is typically associated with trees grown on old land upon which Verticillium-susceptible crops such as tomato, okra, squash, musk-melon, watermelon, eggplant, peppers and cucumbers have been grown previously. The most common symptoms are a sudden wilting of all the leaves on a part of the tree, or on the entire tree, and the rapid death of the leaves. The tree looks as though it has been fired, since the leaves turn brown and remain attached to the branches for an extended period. If the bark is peeled back on branches and roots, the vascular areas will look darkened and brownish, instead of the normal light greenish color. Severely affected young trees occasionally die but vigorous trees will only lose a few branches in the majority of the cases. Trees which show wilt in a few branches usually recover and the disease seldom recurs.

Causal Factors

The fungus *Verticillium albo-atrum* is the cause of Verticillium wilt in avocados. The soilborne pathogen has been reported on nearly 200 species widely separated in classification.

Control Measures

Young avocado trees should not be planted in land previously planted to Verticilliumsusceptible crops where the fungus has multiplied and there is a build-up of inoculum in the soil.

Field observations indicate that where the iron chelate Sequestrene 138® was used on young avocado trees planted on old tomato land, there is no loss of trees to Verticillium wilt. Pruning of the wilt-affected branches appeared to speed recovery of young trees.

See references 10 and 38.

Algal Spot

Red alga is a disease of little economic importance to the avocado industry of the Caribbean and Florida. The prominent greenish-gray circular spots may be found on a large number of leaves with no apparent permanent damage to the tissue. This is in contrast with algal infection on citrus where girdling of young branches may occur due to the killing of the cortex tissue. The older spots become reddish brown due to the masses of fruiting bodies.

Causal Factors

Red algal spot caused by *Cephaleuros virescens* Kze. is found on mango, citrus and many ornamentals in areas where high humidity is prevalent. The alga is found on the leaves and occasionally on fruit in unsprayed orchards.

Control Measures

Avocado trees that are being sprayed with copper fungicides for other diseases are generally free of red alga. However, those orchards sprayed with Benlate® may have to receive a couple of copper sprays at 0.5 kg/400 liters in June and July to prevent red alga infections.

See references 16 and 27.

Powdery Mildew

Powdery mildew is generally of minor importance. It frequently occurs on the foliage of nursery and field-grown trees, but is seldom very serious in commercial orchards because of the monthly applications of fungicides for fruit disease control. However, powdery mildew may become serious enough in the nursery to warrant an application of fungicide. Greenish areas appear on the upper surface of; young, expanding leaves which show the characteristic powdery, white, spore-bearing growth on the lower surface. Infection on mature leaves generally appear purplish-brown at first and may or may not be covered with the white, powdery growth. The white surface growth may disappear as the leaf matures and climatic conditions favorable to fungus change,

leaving obvious netlike markings at the infection sites. These markings appear against transmitted light as conspicuous yellowish areas devoid of chlorophyll.

Causal Factors

The fungus *Oidium* spp. causes powdery mildew of avocado foliage. The white, powdery coating of mycelia and spores is entirely superficial. The pathogen produces masses of conidia during the dry period of February-April. It is carried over from one season to another on leaf lesions.

Control Measures

Powdery mildew is controlled with the use of wettable sulfur at 2-3 kg/400 liters of water.

See reference 27.

Stem-End Rot

Stem-end rot can occasionally result in considerable losses of fruit in Florida and the West Indies during storage and transit. The rot starts at the stem end as a small, dark brown ring with affected tissue having a firm texture. The disease progresses more rapidly near the skin, but eventually the flesh is invaded to the seed, causing a dark brown to black discoloration. The invaded flesh is at first soft and spongy and later more or less firm.

Causal Factors

There are 3 fungi which are involved in stem-end rot in Florida. The diseases caused by the 3 fungi are similar in appearance during the early stages of development. The fruit in the late stages may have a surface growth of short, felt-like fungal mass that varies in color and amount with the fungus causing the rot. The fungi most frequently associated with stem-end rot are *Diplodia natalensis* Polo Evans, *Phomopsis* spp. and *Dothiorella* spp.

Control Measures

Picking and packing immature fruit should lie avoided since stern-end rot seems more severe at this stage of fruit development. No special fungicide appears to be necessary when mature fruit free of harvest bruises are shipped in well-ventilated containers and kept refrigerated within safe limits.

See references 2, 3, 4, 5, 14, 27, 32, 33, 35, 36, 38, 39 and 40.

Sun-Blotch

Sun-blotch is the only known virus disease of avocado. Only a few trees in Florida showed symptoms of this virus before 1969. Stevens reported the disease in Florida for the first time in 1929 (31). Diseased trees have been reported from Tampa, Canal Point and over a wide area of Dade County. At present the only known method of transmission is through grafting or use of seeds from infected trees.

Symptoms generally associated with sun-blotch are depressed, yellow streaking of the

young, green stems and branches and a yellow streak on the fruit. The symptoms on green, mature fruits are sunken, white or yellowish lesions running in a stem-toblossom-end direction. The leaves are occasionally malformed, with vein clearing. Sunblotch-affected trees tend to have a conspicuous, recumbent, willowy type of growth and some trees are dwarfed.

This virus has no known insect vector. The spread of sun-blotch is mainly due to infected seed used as rootstock and diseased budwood. There is strong evidence that the virus may have moved through root grafts in an old orchard in Dade County. This is apparent due to the fact that 2 different cultivars growing close to one another are showing the disease.

Control Measures

The most effective control is destruction of diseased trees. Some trees and fruit are symptomless or the symptoms are so subtle that they are difficult to recognize, particularly for the propagator collecting budwood. A careful selection of disease-free scion and seed for rootstock is extremely important in the cultivation of healthy trees.

See references 27 and 31.

Seedling Blight

This nursery disease, first reported in 1948 by Conover (1), occurs occasionally in the summer months. The fungus attacks the tender buds and leaves of nursery-grown trees. The lesions on the leaves are reddish-brown and enlarge rapidly along the larger veins. Lesions on young leaves are brownish-black and frequently cause curling and twisting of the leaves. Terminal buds are killed outright. The symptoms on the young, tender stems are dark, sunken, elongated lesions which occasionally split open.

Causal Factors

Seedling blight is caused by the fungus *Phytophthora palmivora* Butler. Conidia are occasionally found in necrotic lesions on the leaf. The disease occurs in periods of heavy rainfall and high humidity.

Control Measures

Nursery stock should be raised off the ground at a height sufficient to avoid rain or irrigation water from splashing soil onto the foliage.

See references 1 and 27.

Avocado Root Rot

Avocado root rot has been a problem on the poorly drained Florida soils along the eastern edge of Lake Okeechobee and in old avocado orchards near Lake Placid. It was a serious problem on avocado trees in Dade County after a period of high water due to an excessively wet hurricane in 1947. In all cases the tree symptoms are pale green wilted leaves with tip dieback in the tops. *Phytophthora cinnamomi* Rands has been isolated consistently from trees showing these symptoms.

See references 27 thru 41 and the article by Zentmyer on p. 75 of this Proceedings.

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