

DISEASES OF THE AVOCADO

C. W. Carpenter

Associate Pathologist Experiment Station, H. S. P. A., Honolulu, T. H.

The diseases of the avocado in Hawaii have received comparatively little attention from pathologists. This introductory paper on the subject is presented to the Avocado Association of Hawaii at the invitation of Dr. W. D. Baldwin. The material is largely an interpretation of the literature as it seems to apply to our local industry. Critical studies of the local avocado diseases which should serve as a foundation for an authoritative discussion of the subject have not been made. If this paper serves in any degree to clarify the confusion that exists in the subject of avocado diseases its purpose will have been fulfilled. In Hawaii, the various spots and blemishes of the avocado fruit have not been clearly differentiated nor the causes ascertained with sufficient accuracy to be of much value. The literature from other countries is often not accessible and offers too much confusion of names of diseases and causal parasitic organisms to be readily useful to the avocado grower. A similar condition prevails with the diseases of the leaves, branches and trunk of the tree.

This discussion of local avocado diseases is chiefly concerned with those caused by parasitic fungi, yet mention will be made of certain blemishes of other origin which are likely to be met by the growers. A few remarks about the nature of fungi are necessary to a simple and brief discussion of fungous diseases. The fungi we are concerned with are minute plants with the general characteristics of the molds often seen on bread or vegetables stored in damp places. There are an almost infinite number and variety of these fungi differing in habit of growth and manner of fruiting. The great majority obtain their food from dead organic matter, a considerable number live at the expense of living or dead plant material, as occasion requires, while relatively few are strictly parasitic. The fungi are propagated and spread about chiefly by microscopic spores which are comparable to the seeds of higher plants. These spores, formed in countless numbers under favorable conditions, are responsible for the rapid spreading of fungous diseases, since they are readily carried by wind, spattering rain, garden tools, etc.

If one considers the descriptions of avocado diseases from various localities the local names applied are very confusing. Of the semi-technical names the term "anthracnose" has been much abused. This name indicates a disease or blemish of pustular or ulcerous type and has been so loosely used as to have little significance. It is commonly used, however, for diseases caused by the fungi known as *Colletotrichum* and *Gloeosporium*, two practically identical groups of fungi, prevalent in the literature of plant diseases. In the literature the following diseases are discussed separately with distinctive names for each trouble according to the part of the tree affected, or the parasitic fungus suspected: anthracnose of leaf, leaf blight, rusty leaf blight; anthracnose, die back and wither tip of branches and fruit spurs; blossom blight, black

fruit spot, bark rot and canker or girdling of branches and trunk. Yet all appear to be caused by very closely related species of *Colletotrichum* or *Gloeosporium*, the anthracnose fungi. Reasons will be presented below for considering this formidable array of diseases as the manifestations of one fungous disease on various parts of the avocado tree. Until the contrary shall be demonstrated it simplifies the subject considerably to adopt this viewpoint.

A similar confusion long existed with respect to the various manifestations of the similarly named disease of the apple—the black fruit spot, leaf spot and, canker. It is now recognized that in its various stages this apple disease affects:

1. The fruit as it approaches maturity.
2. The limbs and twigs causing blight and cankers.
3. The leaves causing characteristic leaf spots.

The fruit rot was first studied and various names applied, for example: black spot, ring rot, blossom-end rot and brown rot. On twigs and leaves the disease was described as die-back, twig blight, apple canker, canker and black rot. On the leaves the disease was termed leaf spot, leaf blight, brown spot and frog eye. Various fungi found on leaf, twig and fruit were blamed for the respective diseases. Finally, one fungus was determined to be the cause of the several forms of disease and it was named *Physalospora cydoniae*. *Physalospora* represents the higher fruiting stages of *Gloeosporium* and *Colletotrichum*.

The analogy of the history of this black spot and canker of apple and of avocado is close. It does not appear presumptuous to predict that in this same way the Hawaiian avocado diseases, black spot, leaf spot, die-back or wither tip and canker will be ultimately demonstrated to be due to a single fungus *Physalospora perseae*, Doidge. This fungus, already determined elsewhere as the higher stage of the avocado *Gloeosporium* or *Colletotrichum*, is closely related to the apple *Physalospora*, above mentioned.

The avocado fungus probably gains entrance to and infects the flowers, the young twigs, fruit spurs and the leaves under favorable weather conditions and also enters small wounds or sunburned places on the branches and trunk. This fungus is said to be a weak parasite which possibly requires some predisposing factors to favor its entry, such as lowered vitality from over-bearing, malnutrition or poor drainage. Favoring conditions are wet weather at flowering time, sunburn injury, wounds of fruit and bark, etc. Both the avocado and mango appear much more susceptible at flowering time, especially if high humidity and heavy dews or rainy weather prevail.

The control or remedial treatments most commonly suggested are those sanitary measures designed to prevent infection. The following measures are recommended:

1. Maintenance of a clean orchard—infected limbs being pruned out and burned.
2. Frequent spraying with bordeaux mixture, especially at flowering time.
3. Frequent disinfection of pruning tools and treatment of wounds with lead paint, bordeaux paint or other disinfecting wound preparations, as seals.

4. Avoiding injury to bark of limbs and trunk by ladders and implements.
5. Frequent inspection of trunk and limbs for early infections of bark canker.
6. When bark canker is located on large limbs or trunk, cut away infected bark to healthy tissue, disinfect and coat with disinfectant paint or other seal to prevent reinfection until nature heals the wound by the gradual overgrowth of cambium.
7. For prevention of sunburn of limbs and trunk which seems to favor canker, the advisability of spraying the exposed parts with a protective coat of whitewash, as is done with apple trees in the dormant season, might be considered.

Brief extracts of the descriptions of several fruit spots are presented below. The probability that the appearance of the spots may be somewhat different on the several varieties of avocado should be appreciated.

Black Spot of Fruit (*Colletotrichum* sp.) *Physalospora Persea* Doidge

The following is quoted from "Avocado Diseases" by H. E. Stevens, Bulletin 161, University of Florida—Agricultural Experiment Station, 1922, Page 12.

"The injury appears as definite spots scattered over the surface of the affected fruit. These spots are round, brown to dark brown or black in color and vary from one-eighth to one-half of an inch in diameter. They are composed of hard, dry, corky tissue which penetrates the skin of the fruit down to the meat.

"The surface of a spot is slightly sunken, often cracked or fissured, and in some cases a zoned effect is observed. When once formed, the spots do not appear to increase in size on the surface of the skin, but a decay of the meat below may follow, especially in matured fruit. Affected fruit may show a few or many spots of various sizes. Frequently spots merge to form irregular patches, the surfaces of which are deeply cracked or broken. Severe attacks on less matured fruit may misshape or dwarf them.

"Spots also appear in the bark of young shoots and on fruit stems somewhat similar to the spots on fruit. Infections on the fruit stems generally appear some time in advance of those on the fruit."

A description, probably of the same fruit spot, is given by E. V. Abbott in the Year Book of the California Avocado Association, 1929, pp. 131-134, under the title, "Anthracnose of the Avocado in Peru." This paper offers the best discussion that has come to my attention of the "anthracnose" as one disease affecting various above ground parts of the trees. The anthracnose is attributed to *Physalospora persea*. Three paragraphs from page 132 are quoted verbatim:

"Anthracnose may attack any of the above-ground parts of the tree, but its most serious damage is caused when the main trunk and fruiting branches are involved. On these organs the infection begins as a dark reddish-brown area which enlarges gradually, usually more rapidly horizontally than vertically, until it forms a lesion which eventually girdles the affected part. The canker is at first sunken, especially in young, tender tissue, but as the disease advances the bark dries, cracks, and buckles out, giving the affected portion a bulged appearance. The dried bark sloughs off and the limb slowly

dies. The sap of the tree flows out through the cracks in the bark and on drying leaves a whitish, crystalline substance, the presence of which is characteristic of the disease. The fungus has not been observed penetrating into the woody portions of the trunks or limbs, the infection apparently being limited to the cortex.

"On the fruit anthracnose produces round, sunken, reddish-brown spots which are usually from one to two centimeters in diameter. The centers of the fruit lesions may be pale pink in color caused by the production of spores of the fungus. As a rule the decay does not extend deeply into the flesh of the fruit, although the diseased spots offer ideal means of entrance for other fungi, particularly *Rhizopus nigricans*, which may cause more rapid decay of the fruit than the anthracnose itself. The decayed areas have only rarely been observed penetrating to the seed.

"On the leaves the disease causes circular, chocolate-colored spots. Infected blossoms may turn black and fall. Leaf and blossom infection, however, is of secondary importance compared with the damage which is caused to the tree by the destruction of the trunk and branches and the rotting of the fruit."

Avocado Blotch

Avocado fruit spotting or blotch, as described by Stevens (loc. cit. pp. 17-21), resembles the avocado blast discussed by C. O. Smith in the California Citrograph, March, 1926, p. 163. The avocado blotch is said to be caused by a species of the fungus known as *Cercospora*, while blast is caused by the same species of bacteria which causes citrus blast. Either one or both diseases may be present in Hawaii but they have not been properly identified. The following description is quoted from Stevens:

"Blotch is a surface spotting of seedling avocado fruit which is most noticeable as the fruit approaches maturity. The first spots may occur when the fruit is less than half grown, after which a succession of spots will follow until the surface is nearly covered. Mature blotch spots appear as small, slightly sunken, irregular blotches on the surface of the fruit, usually black in color, but often showing short, white fungous growth at the centers.

"Fully developed blotch spots may vary from one-eighth to one-fourth of an inch in diameter. The beginning of such a spot is indicated by a pale green area, showing one or more brown or black dots which are smaller than a pin's head. Gradually the pale green area becomes brownish to black in color, and eventually develops into an irregular sunken pit or spot which is typical of the disease. These spots may be scattered freely over the surface of the infected fruit or several may merge to form irregular black patches. The spots are confined chiefly to the rind of the fruit, but more advanced stages may penetrate into the edge of the meat. The interior of a spot is composed of brown, spongy tissue made up of dead, collapsed cells of the fruit rind, intermingled with the dark-colored mycolium of the fungus. The disease is confined apparently to the fruit. However, in a few cases the fungus has been found in spots on fruit stems similar to those on the fruit."

Avocado blotch is said to be controlled by bordeaux sprays as used for anthracnose or black spot.

Avocado Blast

The following description is quoted from C. O. Smith (loc. cit. p. 163).

"The fruit exhibited a marked cracking which was the most severe near the blossom end. In addition to the cracking, definite brownish, or more often black irregular or nearly circular, spots were found which were situated near or surrounding a lenticel. The disease is superficial, being limited almost entirely to the rind. In the older spots, the tissue about the lenticel has become torn and the margin appears somewhat elevated as if ruptured. The spots are slightly, if at all, depressed. They are variable in size from the younger stages, when the beginning of the spot is just visible, to a mature spot that may measure from 1/8 to 1/4 -inch in diameter, or even larger by the coalescence of several spots. The cracking of the fruit is believed to follow a severe spotting (infection) of the fruit as this condition would allow the tissue to dry out.

"The cause of the trouble, as has been indicated, has been found to be a species of bacteria that was first described as causing a spot on lemons known as 'black pit.' "

Varieties are said to vary in susceptibility, Knight being most severely attacked and Fuerte very slightly.

Avocado Scab, Russet Fruit, Carapace

The three blemishes of fruit called avocado scab, russet fruit and carapace spot are characterized by a roughness of the skin of the fruit.

Avocado Scab

Avocado scab may not occur in Hawaii. It affects both foliage and fruit. The disease is said to attack only young and tender growth. The injury to fruit is superficial, marring the appearance but not affecting the quality. Again quoting from Stevens, p. 10:

"The spots (on the leaves) are generally small, circular to irregular in outline and vary from one-sixteenth to one-eighth of an inch or more in diameter. They are purplish brown to dark in color and may appear scattered over the surface or several may grow together to form irregular areas. . . ."

"On the young shoots, twigs and leaf petioles the spots appear darker and more elevated . . . On the fruit occurs the same oval-shaped, raised type of spot that is found on the twigs. The spots may be scattered or clustered together to form an irregular scabby mass."

Avocado scab is said to be more prevalent in young plants in the nursery. Timely applications of bordeaux mixture are reported to be beneficial as a control procedure.

Russet Fruit

Russet fruit is variously attributed to mechanical abrasion of young fruits by the foliage. Thrips, mites and fungi have been mentioned as causes. Locally, the russet blotches and bands of russetting or occasional "ring-neck" apparently have not been satisfactorily

explained. Much of this type of blemish appears to be due to foliage abrasion and other injuries when the fruits are small.

Carapace Spot

In the 1929 Year Book of the California Avocado Association, p. 129, William T. Horne discusses a rough, cracked, superficial skin blemish which resembles a turtle's back. On account of this resemblance he named this blemish "carapace spot." The cause is undetermined but it is suggested that this blemish is due to slight skin injuries of young fruit which do not scratch or break the skin.

Conclusion

In conclusion, we may summarize the local avocado disease situation as follows: The anthracnose of leaf, fruit, branches and trunk is the most troublesome fungous disease with which the grower has to contend. Frequent spraying with bordeaux mixture and the maintenance of a clean orchard are the best means of control. Cankered or dead branches should be removed and burned as soon as they are detected. Cankered spots on the trunk should be cleaned out to undoubted sound bark and wood, disinfected and sealed with disinfectant paint, wax or tar; and possibly other measures taken to assist the closing of the wound. Pruning tools should be disinfected frequently and wounds painted.

Several diseases described in other countries may occur here but they appear to be relatively unimportant and the sanitary measures used for anthracnose or black spot should also tend to control them.

C. W. Carpenter
Associate Pathologist
Experiment Station, H. S. P. A.,
Honolulu, T. H.

November, 1930.