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A NEW DISEASE OF PAPAYA IN ST. CROIX

by

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In 1955 a seemingly new disease was observed affecting several varieties of papaya at the Federal Agricultural Station in St. Croix, U. S. Virgin Islands.

The upper parts of the stems of affected plants first develop "grease spots". This led some to denominate the disease "greasy spot". The mysterious nature of the malady led others to call it "X disease". As of late, and in view of the fact that most of the damage is suffered by the canopy we have been referring to the disease as "leaf scorch".

In Hawaii, Bembower (2) observed water soaked spots on the stems of papayas and determined that they were caused by Phytophthora parasitica. Water-soaked spots or "greasy spots" also develop on the upper parts of the stems of plants affected by bunchy top and southern coast mosaic, two virus diseases that occur in Puerto Rico.

In 1961 a review of the symptoms found on St. Croix was made and compared again with the Hawaiian description. In Hawaii the fruits were attacked also, and showed a whitish deposit. Later the fruits shriveled and dropped to the ground. Such symptoms on fruit were never found on diseased plants in St. Croix.

Samples of roots taken from 'solo' papaya plants displaying the stem lesions were sent by air to the University of California on several occasions but no Phytophthora organisms were isolated. The disease was one of the major causes of loss of bearing trees during three years' field work in St. Croix (6).

In the spring of 1963 a report (10) was received that there was a leaf spot disease on these 'Solo' plants and that it probably was caused by a Cercospora. The stem symptoms were also present, however, and thus the symptoms in the Virgin Islands did not agree with a description of Cercospora in Hawaii (1). The authors noted the following symptoms of the disease in 1963.

The foliage of affected plants appears scant, rigid and generally chlorotic. Diseased plants develop an umbrella-like shape which resembles that associated with papaya bunchy top (3, 4), but close observation shows that this disease is not related to bunchy top since:

1- Latex issues from the tissues of plants affected by the St. Croix disease.

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2- The leafhopper vector of bunchy top, Empoasca papayae was not found in the papaya fields of St. Croix. (Though in 1946 Martorell and Adsuar (7) collected an apparently new species of Empoasca breeding on papaya in St. Croix.)

3- Symptoms of the two diseases differ in many other respects.

In the field the lower leaves of affected plants were dotted with yellow spots were generally necrotic. Leaves of affected plants were often found dried up and hanging alongside the stem. In some instances, if the petiole was detached from the stem, water-soaked cankerous lesions were found. This suggested that the leaf spotting agent was gaining access to and infecting stem tissue.

Many of the plants with "soaked" lesions, had bumpy areas on the lower part of their stems. We refer to this condition as "bumpy stem". Bumpy sections were not found on the stems of all the plants that showed a reduced canopy and other symptoms of the disease.

Slight ringspotting, as well as curling of the leaves, was observed in several plantations. None of these symptoms could be associated with those of any of the virus diseases that occur in the Caribbean area.

Some of the native (cruzan) papaya plants were found to be relatively free of leafspots, although in some individual cases the malady was severe. The native papayas also showed the bumpy stem condition but seemed in general not to be greatly injured by it.

Isolation and inoculation studies

Specimens from lesioned areas of the stems and from leafspot-affected, curled, and ringspotted leaves were collected from various fields in St. Croix, washed with tap water and placed in polyethylene bags. The material was divided, and part was plated on acidified PDA after surface desinfection with "Clorox" (1/20). Another batch was used for isolation of bacterial and a third batch (curled and ringspotted leaves) ground in order to secure sap for mechanical inoculation of various plant hosts. No bacteria could be isolated from affected stem or foliage tissues. A series of test plants belonging to several families and including such species as: Carica papaya ('Solo', 'Cruzan', and Puerto Rican varieties), Nicotiana tabacum, Nicotiana glutinosa, Phytolacca decandra, Chenopodium amaranticolor, Capsicum Annuum, and Cucumis sativus were dusted with carborundum and mechanically inoculated with the sap expressed from curled and ringspotted leaves. Ten plants of each of the above mentioned species and varieties were inoculated in each of two treatments and observed daily for a period of three months. None of these plants developed symptoms of disease, thus indicating that no mechanically transmissible virus is associated with this disease of papaya in St. Croix.

The lesioned tissues from the upper parts of the stem as well as spotted areas from the leaves yielded several fungi on acidified (pH 5) potato dextrose agar. This included species of Fusarium which were discarded as contaminants since they represented a very minor percentage of the isolates in contrast with a fungus that arose from about 90% of the plated tissue bits. This last fungus

was characterized by a cottony, gray mycellial growth, which changed the color of the substratum from light caramel to dark brown and even to jet black. Microscopic examination of bits of affected upper stem, leaf, and petiolar tissue frequently disclosed slende., cylindrical conidia suggestive of Cercospora, or occasionally of a Helminthosporium. Subcultures of the gray fungus from the plated tissues formed conidia, always of the same type, and very similar to those detected on the affected papaya tissues.

Cultures of this fungus were forwarded to Dr. B. Ellis, Commonwealth Mycological Institute, Kew, Surrey, Great Britain, and to Dr. Charles Chupp, Cornell University, Ithaca, New York, for identification. Chupp stated that the fungus did not belong in the genus Cercospora. Ellis identified the fungus as Corynespora cassiicola (Berk. & Curt.) Wei.

In 1950 Wei (9) stated that Cercospora melonis and C. vignola (or Helminthosporium vignae) were species of Corynespora. He found that sixteen collections on 11 hosts from the tropics, previously identified as Helminthosporium cassiicola also belonged to Corynespora. Wei (9) believes Corynespora to be a valid genus, probably most closely related to Helminthosporium which has the same type of conidial structure. The writers agree, although they have observed that the shape and length of conidia of Corynespora cassiicola is variable to some extent. Conidia formed on papaya plants are generally large, slender and light olive in color, at times almost hyaline. Those produced on acidified PDA by the same fungus are generally cylindrical and thicker, their color ranging from light brown to dark brown. In the first case the conidia look rather like those of Cercospora while in the second they are more suggestive of the Helminthosporium. There is no question, however, as to the validity of Ellis' identification of our cultures. Descriptions of the fungus are given by Wei (9) and Ellis (5).

Inoculation studies

Mycelial mats of cultures, from the same isolate that was forwarded to Ellis, were suspended in sterile distilled water. This material was homogenized in a sterile Waring Blendor and the supernatant was transferred to a sterile Erlenmeyer flask (250cc.) for inoculation.

Six flats each containing 50 healthy 1-foot high papaya test plants of the 'Solo' variety were kept in a moist chamber at 90-100 percent relative humidity. Two flats each containing 50 healthy control plants were kept in a contiguous chamber at the same relative humidity and temperature (+83°F.) For inoculation the supernatant was stirred and transferred to a DeVilbiss No. 151 atomizer. The suspension was impelled by air at 20 pounds p.s.i. and directed from a distance of approximately one foot to the foliage and stems of the test plants. The control plants were sprayed with sterile distilled water, and both the test and control plants were kept in the moist chambers.

At the end of about four days the leaves of most of the inoculated plants developed small, round, yellowish water soaked areas. These spots were about one-eight inch in diameter and their centers were slightly grayish in color suggesting tissue breakdown. The succulent green parts of the upper stems developed grease-like spots in places. These more or less lenticular spots were of the same general size as the leaf spots. Their centers were of the same general size as the leaf spots. Their centers were visibly breaking down also. After a week the leaf lesions on the inoculated plants were

visibly larger and in some cases coalescene of lesions had resulted in the breakdown of entire leaves. Tissue breakdown and necrosis was evident on the petioles and lower part of the stem of some inoculated plants. The older upper-stem lesions were gummy and many of them were eroded at this time. The control plants remained healthy throughout this test.

At the end of eight days the control and test plants were taken out the moist chambers and into the greenhouse. Dropping of infected leaves was common. At times these hung along the stem without becoming fully abscissed. Leafspots and "grease" spots of the stem were like those encountered in the field. At the end of about one month most of the inoculated plants had lost their lower leaves with only the four or five youngest remaining. A number was completely defoliated, and apical necrosis resulted in several instances.

As time passed (two months) conditions in the greenhouse became extremely dry and a number of plants showed improved vigor and some remission of symptoms, but these plants were only among those that had retained a good leaf canopy. Corynespora was recovered from the artificially inoculated plants (one week, two weeks, three weeks and one and one-half months after inoculation) from stem leaves and petiolar lesions. Cultures thus obtained were found to be identical to the original isolates.

At the end of three months some of the "recovered" plants were found to be vigorous and healthy, but others showed little or no progress. Many of the plants with lesions on their lower stems developed sizeable bumps at this level.

It appears to us that many of the symptoms of the decline disease of the 'Solo' papaya in St. Croix were reproduced under controlled conditions in Puerto Rico by inoculation with Corynespora cassiicola. Similar results were obtained on a second test using subcultures from the original isolates.

Since Olive, et al. (8) reported that race I of Helminthosporium vignae (=Corynespora cassiicola) lost its pathogenicity after three or four transfers, we repeated the test described above, using the same isolates after four transfers on acidified PDA. Not a single papaya plant developed symptoms of disease; this beyond doubt shows that virulence was lost on transferring this organism in the medium used.

Corynespora cassiicola is a highly pathogenic organism although it loses its virulence after series transfers through artificial media. In St. Croix it can severely affect papaya orchards receiving poor care, though apparently manzate D gives satisfactory control if applied every week or ten days.

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