Currutaca: A *Pythium* Soft Rot of *Xanthosoma* and *Colocasia* spp. in Puerto Rico

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INTRODUCTION

Crops of taniers [*Xanthosoma sagittaefolium* (L.) Schott.] and taro [*Colocasia esculenta* (L.) Schott.], cultivated in scattered patches throughout Puerto Rico, are damaged occasionally by a soft rot of the roots, the rhizomes and the petioles. The disease finally causes total collapse of the plant. This disease-caused condition is known locally by the name of *currutaca.*

In Puerto Rico this disease, although recognized for years, has never been the subject of serious study to disclose its nature. Cook (*3*)[2] reported two forms of root rots of tanier and he mentioned respectively the bacterium, *Erwinia carotovora* Jones, and the fungus, *Sclerotium rolfsii* Sacc., as possible causal agents, but he did not mention pathogenicity tests.

Some diseased taniers and taros were brought to our laboratory recently for diagnosis. A phycomycetous fungus, i.e., *Pythium ultimum*, Trow., was repeatedly isolated and found responsible for the soft rot mentioned through the corresponding pathogenicity tests.

This disease, or a similar one, has been reported throughout the Tropics. Ashby (*2*) in Jamaica, isolated a *Pythium* sp. from diseased taro and other crops, and found this organism pathogenic to sugarcane roots. No inoculation tests were made with taro.

Wright (*10*) in the Gold Coast, reported a root rot of cocoyame (*X. sagittaefolium* and *X. antiquorum*) as very serious and found, among various organisms in the infected material, the fungus *P. aphanidermatum* (Edson) Fitz. He failed to isolate it, and presumed the rot follows some physiological disturbance of the plants irrespective of soil moisture and soil pH.

Parris (*5*) in Hawaii, reported a malodorous soft rot of taro and attributed it to *P. aphanidermatum.* The bacterium, *E. carotovora,* also was found to be associated with the disease.

Shepherd (*9*), making reference to the various investigations conducted in Hawaii and in the Gold Coast, found a *Pythium* sp. aff. *gracile* associated with a taro soft rot, and suggested that the *Pythium* was a secondary invader, following a bacterium or perhaps a virus infection.

Posnette (*8*) also gave thought to the possibility that a virus was infect-

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[2] Italic numbers in parentheses refer to Literature Cited, p. 84.

ing *X. sagittaefolium* and causing root rot, or perhaps delibitating the plants and making them susceptible to attack by weak parasites.

SYMPTOMS

In Puerto Rico and in other tropical areas, the rot has been characterized by a mucilaginous decay of the roots, by the soft white cheesy nature of

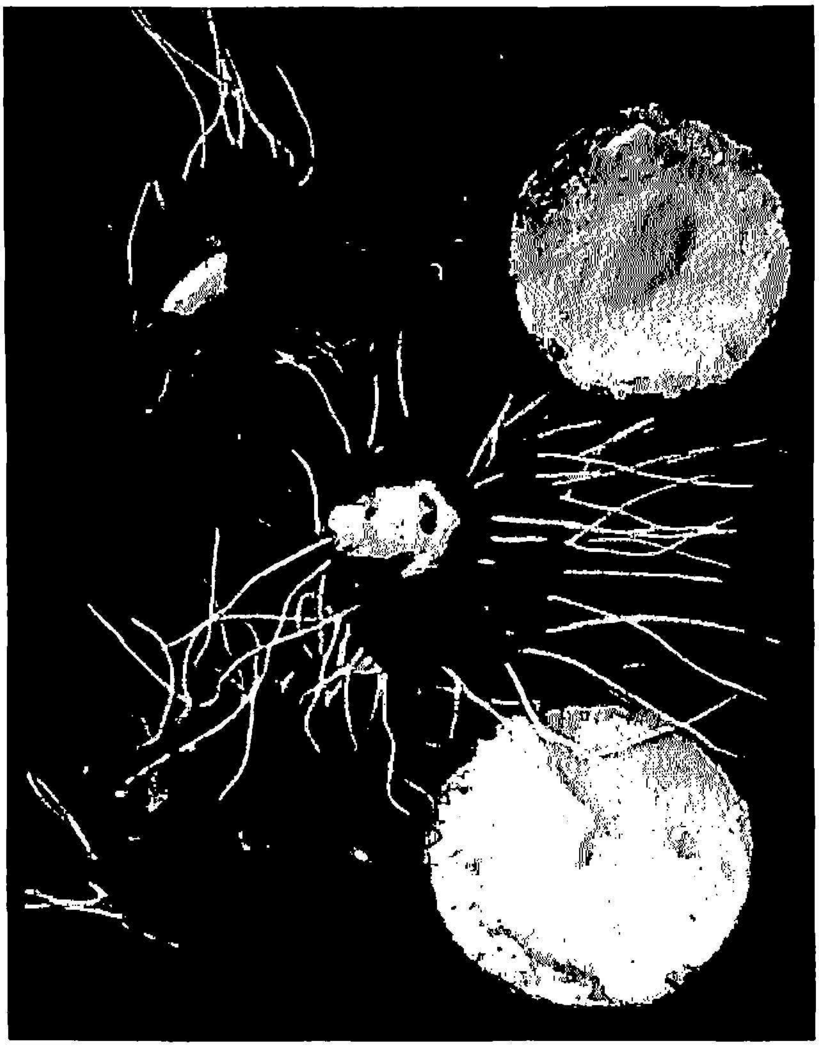

FIG. 1.—Soft rot symptoms on rhizomes and roots of tanier, artificially inoculated with *Pythium ultimum* Trow.

the rotted rhizomes (fig. 1), by a water-soaked disintegration of the tissues at the base of the petioles, and eventually by the final collapse of the plant.

The white, cheesy consistency of the infected rhizomes is, in all probability, the result of the enzymatic action on the pectin of the middle lamella, and the protein materials within the cell. The soft, white, mushy mass is composed of agglutinated non-digested starch granules. Poole (7) has indicated that *P. ultimum* produces pectinase and protease, but neither diastase or cytase. The disintegration of the middle lamella was evident in the infected tissues of diseased roots, rhizomes and petioles of the tanier and taro specimens examined. In some of the naturally-infected rhizomes, a yellowish, bacterial, slimy growth was observed. A yellow bacterium resembling morphologically an *Erwinia* also was isolated.

THE PATHOGEN

P. ultimum is a phycomycete widely distributed throughout the Tropics. We have found it causing damping-off disease of vegetable crops, and also a black rot disease of orchid plants (*1*).

The organism is characterized, among other attributes, by the capacity of its sporangia to germinate through germ tubes. Sporangia are readily formed in culture, and abundantly at temperatures ranging from 20° to 30° C., but failed to grow at temperatures below 12° C. or above 36° C.

PATHOGENICITY TESTS

In preliminary studies, the fungus *P. ultimum* was found to be very aggressive and capable of causing the disintegration of rhizome tissues of tanier and taro plants. Infections with *P. ultimum* were obtained readily when rhizomes of tanier and taro were wound-inoculated or when inoculating directly through the roots without wounding.

The tissues of infected rhizomes became cheesy with no apparent indication of mycelial growth of *P. ultimum*. The organism was detected microscopically in the cheesy mass, however, forming abundant sporangia. No oospores were observed (fig. 2). At rather high temperatures, from 20° to 30° C., the sporangia germinated by the development of germ tubes (fig. 3).

A virulent strain of *E. carotovora* and the yellow bacteria, isolated from taniers and taros, were compared as to pathogenicity. It was found that the latter was not able to dissolve the pectin of the cells of the carrot roots in contrast with the rapid lysis resulting from the enzymatic activities of *E. carotovora*. Both the yellow bacteria and the *E. carotovora* were unable to disintegrate the cells of the rhizomes of taniers and taros, which was the case when inoculating with a stock culture of *E. carotovora* var. *aroideae*. The yellow bacterium multiplied profusely when inoculated simultaneously with *P. ultimum*. The bacterium most likely used the by-products resulting from the digestion of tissues of those rhizomes by the fungus for its nutrition.

VARIETAL TESTS

Clean rhizomes of taro and of taniers of varieties Viequera, Rascana and Vinola, surface-sterilized by immersing them in alcohol and flaming, were placed in moist chambers at 20° C. Ten slices of each variety were cut aseptically and surface-inoculated with small, ½ $cm.^2$, PDA mycelial discs

FIG. 2.—Sporangia of *Pythium ultimum* cultured on potato dextrose agar, at 24° C.

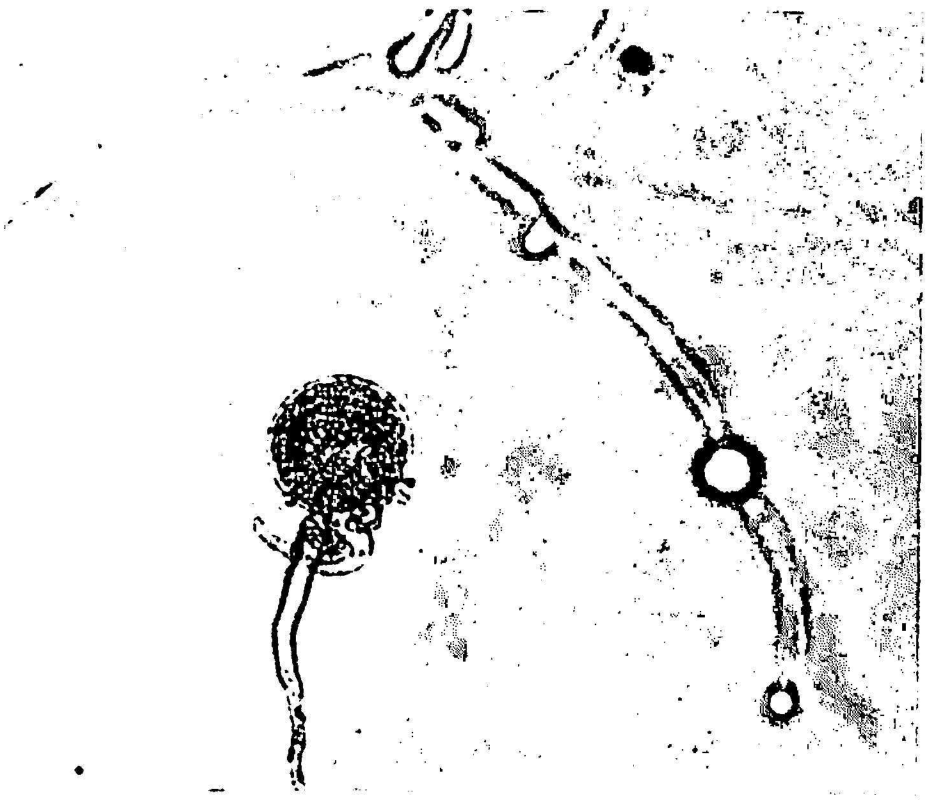

FIG. 3.—Sporangium of *Pythium ultimum* germinating through germ tube.

cut from a 5-day old pure culture of *P. ultimum*, and kept at 20° C., in moist chambers.

Controls were treated similarly but the discs consisted of plain PDA medium.

All the varieties of taniers and taro tested proved to be susceptible to rotting by *P. ultimum* in the following order from low to high susceptibility: Amarilla, Vinola, Rascana, Viequera among the *Xanthosoma* spp. and taro (*Colocasia* sp.).

Under a 60-percent relative humidity and a temperature of 20° C., in the air-conditioned laboratory, infection did not progress even in the most susceptible tanier variety, Viequera. *P. ultimum* apparently needs a humid environment, for a relative long period of time after inoculation, to cause infection and disintegration of the roots, the rhizomes, and the petioles.

CONTROL

In Puerto Rico, Díaz and Busó (*4*) attempted to eliminate the disease in a field test by using non-infected planting material (rhizomes) from healthy plants. The test demonstrated that taniers produced from clean "seed" were apparently healthy and produced good quality rhizomes. In contrast, poor yields and poor quality rhizomes were obtained from plants grown from non-selected "seed".

According to Wright (*10*), *P. aphanidermatum* is not borne by the "seed", and the soil moisture and the soil pH have nothing to do with incidence of the disease. It also has been reported that a potash deficiency in the soil is a primary factor for infection. These conclusions were not confirmed by formal experiment, but simply implied from casual field observations. In contrast, in Hawaii (*6*), practical control of the disease has been obtained by plowing between crops, and by sun-drying the soil for 3 weeks. High soil acidity seems to favor the incidence of the disease as shown by the following data: 40-percent infection at pH 2.00 and 3.00, 20-percent infection at pH 6.00, and 10-percent infection at pH 7.2. Applications of sulfur also increased the incidence of the disease; liming reduced it.

Posnette (*8*) reported that a farmer succeeded in the temporary control of the soft rot of tanier by rogueing all diseased plants and dormant rhizomes from the field, and by replanting with healthy "seed." He also believed that the causal agent of infection is borne by the seed, as shown by the results of field trials, and that infection is caused by dispersal of an unknown pathogen.

Parris (*5*) pointed out the possibility that application of sodium nitrate at the time when the plants are approaching maturity favors the incidence of the soft rot disease.

In all probability, the pathogen is carried with the propagating material. Because the organism can persist in the soil, new infections are liable to occur of course even when using clean "seed". Lack of rotation, lack of potash, high acidity, and high soil moisture, as well as varietal resistance, are each important factors to be considered in pathogenesis.

SUMMARY

The fungus *Pythium ultimum* Trow. was found the causal agent of a soft rot disease of taniers [*Xanthosoma sagittaefolium* (L.) Schott.] and taros [*Colocasia esculenta* (L.) Schott.]. A yellow pigmented bacterium occasionally associated with the rot turned out to be a saprophyte.

Roots of diseased plants became mucilaginous and decayed rapidly. The infected rhizomes were soft and cheesy. The base of infected petioles were water-soaked and the leaves collapsed.

The fungus was isolated in pure culture and grew well in most culture agar media, producing abundant sporangia at 20–30° C., but failed to grow at temperatures below 12° C. or above 36° C.

Varieties of taniers and taro inoculated with *P. ultimum* showed differential degrees of susceptibility to infection when kept in an environment of 90-percent relative humidity and a temperature of 20° C.

Definitive measures to control the disease effectively are not known. Use of clean "seed", planting in well drained soils, and crop rotation practices, however, have been recommended.

RESUMEN

Al estudiarse una enfermedad (Currutaca) de las yautías [*Xanthosoma sagittaefolium* (L.) Schott.] y de las malangas [*Colocasia esculenta* (L.) Schott.], se determinó que el agente causal es el hongo *Pythium ultimum* Trow. Asociada a esta enfermedad se halló ocasionalmente una bacteria que produce colonias amarillentas, pero resultó ser un mero saprófito.

La Currutaca se caracteriza por el deterioro y podredumbre de las raíces, las rizomas y los pecíolos, con la consiguiente marchitez de las plantas. Las raíces y la base de los pecíolos enfermas tienen un aspecto gelatinoso y las rizomas afectadas se ablandan.

El patógeno se aisló del material infectado. Se desarrolló bien en substratos nutritivos a temperaturas entre los 12° C. y los 36° C. A temperaturas menores de 12° C. o superiores a 36° C., el hongo apenas creció o no creció del todo. A temperaturas entre los 20° C. y los 30° C. produjo esporangios abundantemente.

Cuando se inocularon algunas variedades de yautías y malangas con el *P. ultimum* se comprobó que la yautía Viequera y la malanga eran las más

susceptibles. Para combatir la enfermedad, se recomienda usar terrenos friables, bien desaguados y sembrar en rotación otros cultivos que no sean hospedantes del *P. ultimum*.

LITERATURE CITED

1. Alvarez-García, L. A., A new disease of orchids in Puerto Rico: *Pythium* black rot, *J. Agr. Univ. P.R.* *35*(4): 126-35, 1951.
2. Ashby, S. F., Report of the Microbiologist, Ann. Rep. Dept. Agric. Jamaica for 1920, pp. 24-5, 1921.
3. Cook, M. T., Ann. Rept. Univ. P. R. Agr. Exp. Sta. 1935-36, p. 135, 1937.
4. Díaz, M. and Busó, J. B., Resultados de una demostración para reprimir el mal de la yautía por selección de semilla, *Rev. Agr. P.R.* *14*(5): 313-4, 1925.
5. Parris, G. K., Diseases of taro in Hawaii, Hawaii Agr. Exp. Sta. Circ. 18, 29 pp., 5 figs., 1941.
6. Plant Pathology: Rep. Hawaii Agr. Exp. Sta., 1937, pp. 35-45, 1938.
7. Poole, R. F., Sweet potato ring rot caused by *Pythium ultimum*, *Phytopathology* *24*: 807, 1934.
8. Posnette, A. E., Root of Cocoyams (*Xanthosoma sagittaefolium* Schott.), *Trop. Agric. Trinidad* *22*(9): 164-70, 1945.
9. Shepherd, E. F. S., Cocoyam root rot in the Gold Coast, Rep. Third W. Afr. Agr. Conf., 1938 (Gold Coast Sect.) pp. 83-6, 1940.
10. Wright, J., Root rot of Coco-yams, Gold Coast Dept. Agr. Year-Book 1930 (Bull. 23), pp. 184-97, 3 pl., 1931.