

Fruit Rot of Guava Caused by *Phytophthora citricola*

W. H. KO, Professor, R. K. KUNIMOTO, Research Associate, and W. T. NISHIJIMA, Assistant Extension Plant Pathologist, Department of Plant Pathology, University of Hawaii, Beaumont Agricultural Research Center, Hilo 96720

ABSTRACT

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Grayish brown fruit rot of guava at Waiakea-Uka on the island of Hawaii was found to be caused by *Phytophthora citricola*. Mature fruit appeared to be less susceptible to the pathogen than mature green or green fruit. The pathogen, which produced oospores by self-induction, was capable of inducing oospore formation of A¹ but not A² mating type of *Phytophthora parasitica*.

Additional key words: host range, primitive parasite, *Psidium guajava*

Guava (*Psidium guajava* L.), common in the wild, is becoming an important agricultural crop in Hawaii. Guava fruit is used mainly for processing into puree and beverage juice. Recently, a previously unreported fruit rot of guava was noticed in an orchard at Waiakea-Uka on the island of Hawaii. Fruit hanging close to the soil surface was diseased during rainy periods. The infected areas appeared grayish brown and water-soaked and frequently had a grayish black center. A fungus belonging to the genus *Phytophthora* was consistently isolated from the advancing margin of the diseased fruit. We report here the cause of this new disease.

MATERIALS AND METHODS

Isolation. Diseased fruit tissues (about 5 × 3 × 1 mm) from advancing margins were obtained with a sterilized scalpel after the epidermis was removed. Ten pieces from each diseased fruit were embedded in 2% water agar or a selective medium (14). Three fruits were used for each medium.

Production of zoospores. The cellophane method (8) was used to produce

zoospores. Ten to 15 disks (6 mm in diameter) of agar culture were transferred to a sterilized disk of washed, uncoated cellophane (90 mm in diameter) laid on V-8 agar (10% V-8 juice, 0.02% CaCO₃, and 2% Bacto agar). After incubation for 1 wk at 24 C, the cellophane membrane containing mycelia was removed from the medium and placed in a sterile petri dish into which about 10 ml of sterile distilled water was added. Abundant sporangia were produced after incubation at 24 C for 3 wk. Zoospores were released by washing once with sterile distilled water, chilling at 16 C for 30 min, and then returning to 24 C. Zoospore concentration was determined by the microsyringe method (13).

Pathogenicity tests. Healthy mature (yellow), mature green (light green), and green (dark green) fruit collected from Waiakea Experimental Farm were surface-sterilized in 0.8% NaOCl solution for 20 min. Three spots, about 2–3 cm apart on a fruit, were each inoculated with a drop (about 0.05 ml) of zoospore suspension (17 × 10⁴ spores per milliliter). Inoculated fruit was incubated in a moist chamber at 24 C. Control fruit was treated with distilled water. Ten fruits were used for each treatment, and the experiment was repeated once.

Hormone production. The polycarbonate-membrane technique (10) was used to determine if the guava isolate of *Phytophthora citricola* can also produce hormones stimulatory to oospore formation of cross-inducing ("heterothallic") *Phytophthora*. A piece (15 × 10 × 3 mm) of a 4-day-old V-8 agar culture of an A¹ or A² mating type of

Phytophthora parasitica Dastur placed in the center of a petri dish was covered with a polycarbonate membrane (0.2 μm, 90 mm diameter; Nuclepore Corporation, Pleasanton, CA) and paired with another piece that had just been inoculated with *P. citricola*. The number of oospores produced by *P. parasitica* was determined after 6-day incubation at 24 C in a dark, moist chamber.

RESULTS AND DISCUSSION

Isolations from diseased tissues consistently yielded the same *Phytophthora* species. The fungus is self-inducing ("homothallic"), producing oospores in single culture. Its antheridia are paragnous, applied to the oogonial base. Sporangia are mostly ovoid, but some are conspicuously large and irregular in shape. The morphological characteristics of the fungus are indistinguishable from those of *P. citricola* Sawada (17,18). Sexual reproduction of both cross-inducing and self-inducing species of *Phytophthora* are regulated by sex hormones (10,11). *P. citricola* induced oospore formation of the A¹ but not the A² mating type of *P. parasitica*. The A¹ mating type of *P. parasitica* produced 13–33 oospores per square centimeter. Based on hormone production and reception, 16 types representing three groups of chemically regulated sexuality were postulated (11) for species of *Phytophthora*. The present data show that the guava isolate of *P. citricola*

Table 1. Pathogenicity of *Phytophthora citricola* on guava fruit at various stages of development

Stage of development	Infection rate (%) ^a	
	Inoculated	Control
Mature (yellow)	60	0
Mature green (light green)	93	0
Green (dark green)	100	0

^aA total of 30 sites on 10 fruit per treatment were inoculated.

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belongs to either type 10 or 12 of Group II, which forms oospores by self-induction.

Inoculated guava fruit at all three stages of maturity developed disease symptoms similar to those occurring in nature in 3 days (Table 1). Mature fruit appeared to be less susceptible than mature green or green fruit. None of the control fruit developed disease symptoms. *P. citricola* was reisolated from the advancing margin of all artificially inoculated fruit, thus establishing its pathogenicity. This is also the first record of the fungus in Hawaii. The distribution of the disease appeared to be limited. It was observed only in one orchard and very few fruits were infected.

P. citricola along with *P. citrophthora* are considered advanced parasites (1,2) attacking mainly citrus fruit (9,12). Based on available data, both fungi have relatively wide host ranges (4-6,15,16,18) and can attack roots and aboveground portions of the hosts (3-7,15). Both *P. citricola* and *P. citrophthora*, therefore, should be considered primitive, aerial-

soil parasites similar to *P. cactorum* and *P. parasitica* (12).

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