Occurrence of Stem Necrosis on Field-Grown Tomatoes Incited by *Pseudomonas corrugata* in Florida

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ABSTRACT

Jones, J. B., Jones, J. P., Stall, R. E., and Miller, J. W. 1983. Occurrence of stem necrosis on field-grown tomatoes incited by *Pseudomonas corrugata* in Florida. Plant Disease 67:425-426.

Pith necrosis and hollowing of tomato stems was observed in 20 fields of tomatoes. A yellowish bacterium was consistently isolated. Based on biochemical, physiological, and pathogenicity tests, the bacterium was identified as *Pseudomonas corrugata*.

For many years, pith necrosis of field-grown tomatoes in Florida was thought to be incited by *Erwinia carotovora*. In the spring of 1982, two fields in central Florida and 18 fields in northern Florida were affected with a pith necrosis in which the interior of the stem was hollowed out (Figs. 1–3). A Gram-negative bacterium that formed yellowish brown colonies on nutrient agar was isolated.

Pith necrosis of greenhouse-grown tomatoes caused by the bacterium *Pseudomonas corrugata* Roberts & Scarlett has been reported in England (9). Lukezic (7) reported the bacterium in the United States but only in association with symptomless alfalfa roots. This report provides evidence that the bacterial strains isolated from the field-grown tomatoes are *P. corrugata*.

MATERIALS AND METHODS

Bacterial strains. The tomato strains from Florida were isolated from chips at the margins of infected stem tissue by grinding the chips in sterile distilled water and plating on nutrient yeast-dextrose agar (NYDA, 23 g nutrient agar, 5 g yeast extract, 10 g dextrose, 1 L deionized water, pH 6.8). Five cultures were used in physiological tests. Three strains of *P. corrugata* were obtained from F. L. Lukezic (Pennsylvania State University, University Park 16802).

The strains were tested for arginine dihydrolase activity (12), oxidase reaction (4), starch hydrolysis (10), and anaerobic growth, using Hugh and Leifson's (3) medium supplemented with glucose and covered with sterile mineral oil. The strains were also tested for DL-phenylalanine deamination (11), nitrate reduction (8), lipase activity using Tween 20 (6), gelatin hydrolysis (8), levan production (6), and pectate degradation (2). The bacterial cells were checked for pattern of flagellation (1), for Gram strain (10), and for accumulation of poly-β-hydroxybutyric acid (10).

Biochemical and physiological tests. Nutritional tests were conducted as described by Lukezic (7) except Noble agar was used in place of Bacto purified agar. All test compounds were filter-sterilized except geraniol. All compounds were added to make a final concentration of 0.2% (w/v) except geraniol, which was added by placing one drop on the underside of the petri dish top. A suspension of bacterial cells grown on NYDA for 48 hr was adjusted to 10^8 cells per milliliter. A loopful of each strain was streaked on duplicate plates of each medium. Plates were incubated at 25 C for 7 days and evaluated for extensive growth on the medium. Slight growth was considered negative.

Pathogenicity tests. Five-week-old Campbell 28 tomato plants were inoculated with an insect mounting needle laden with a 48-hr culture of the bacteria grown on NYDA. The plants were placed in clear polyethylene bags for 72 hr at 28 C in a growth chamber and then unbagged. The plants were rated for external browning and pith necrosis after 5 days.

Fig. 1. Tomato stem infected with *Pseudomonas corrugata* showing brown discolored stem lesion.

Fig. 2. Internal pith degradation of a tomato stem infected with *Pseudomonas corrugata*.

Florida Agricultural Experiment Stations Journal Series No. 4104.

Accepted for publication 15 November 1982.

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Table 1. Utilization of nitrogenous compounds, carbohydrates, alcohols, glycols, and organic acids by three known strains of *Pseudomonas corrugata* and the tomato strains from Florida

	Nomenspecies	
	P. corrugata	Tomato strains
Compound	(3)[a]	(5)[a]
D-Saccharate	3[b]	5
Levulinate	0	0
D-Gluconiate	3	5
Glutarate	3	5
meso-Tartrate	0	5
D-(−)-Tartrate	0	0
L-Tartrate	2	0
Citraconate	0	0
Lactate	3	5
Glycolate	0	0
Asparagine	3	5
Alanine	3	5
L-Threonine	1	0
DL-Threonine	0	0
Arginine	3	5
L-Lysine	0	1
Tryptamine	0	0
Homoserine	0	0
L-Histidine	3	5
Betaine	3	5
Nicotinate	0	0
σ-Amino-N valeric acid	3	5
Putrescine	3	5
Adonitol	0	0
Geraniol	0	0
Arabitol	0	0
Sorbitol	0	0
meso-Inositol	3	5
Mannitol	3	5
Erythritol	0	0
Ethanol	1	5
D-Arabinose	0	0
L-Arabinose	3	5
Glucose	3	5
Rhamnose	0	0
Sucrose	3	5
Maltose	3	5
Trehalose	3	5
D-Galactose	3	5
β-Lactose	0	0

[a] Number of strains tested.
[b] Number of strains positive for growth on that medium.

Potato and onion sections were checked for soft rot as described by Lukezic (7). A suspension of about 10^8 cells per milliliter was injected into leaves of *Nicotiana glutinosa* L. by the method of Klement et al (5). The leaves were evaluated at 24 hr for a hypersensitive reaction.

RESULTS AND DISCUSSION

The isolates of pith necrosis of tomato from Florida caused extensive browning of the pith and vascular browning of tomato plants. In some instances, a breakdown or hollowing of the pith occurred. No browning or pith necrosis occurred in control plants. None of the strains tested caused a rotting of potato or onion. All strains induced a hypersensitive reaction in tobacco after 24 hr of incubation.

Fig. 3. Proliferation of adventitious rooting on stems infected with *Pseudomonas corrugata*.

All strains tested accumulated poly-β-hydroxybutyric acid, were Gram-negative, and had one or more polar flagella. The strains were positive for nitrate reduction, oxidase, gelatin liquifaction, and lipolysis of Tween 20. The strains tested negative for starch hydrolysis, arginine dihydrolase, levan production, phenylalanine deaminase, and anaerobic utilization of glucose. With arginine dihydrolase, the Florida strains gave a weak positive reaction after 24 hr, whereas the *P. corrugata* strains gave a positive reaction after 7–10 days of incubation.

Utilization of the 41 substrates tested by the known strains of *P. corrugata* and the tomato strains from Florida was nearly identical with the exception of *meso*-tartrate, L-tartrate, and ethanol (Table 1).

The strains from field-grown tomatoes were very similar to the known strains of *P. corrugata*. Based on field symptoms and physiological, biochemical, and pathogenicity tests, this bacterium was identified as *P. corrugata*. This appears to be the first report of *P. corrugata* on field-grown tomatoes. A similar or, perhaps, the same disease (known locally as Erwinia stalk rot) has occurred sporadically in Florida for several years; however, the disease was rare and unimportant. Consequently, no effort was expended to properly determine the cause of the stalk rot until recently when its occurrence appeared to be on the increase. It is not clear whether there is a complex of two diseases with overlapping symptoms or just one disease. It is clear that *P. corrugata* does incite pith necrosis and vascular browning of field-grown tomatoes in Florida.

ACKNOWLEDGMENTS

We are grateful to L. C. Barnhill, C. S. Bell, and R. W. Owens for technical assistance.

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