

## Relationship of *Rhizoctonia solani* and *Colletotrichum coccodes* to Basal Stem Canker of Tomato

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### ABSTRACT

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*Rhizoctonia solani* and *Colletotrichum coccodes* were associated with a basal stem canker of field-grown tomatoes in Massachusetts. *R. solani* was most frequently isolated from the early stages of canker development, whereas frequency of isolation of *C. coccodes* increased with canker age. Under experimental conditions, cortical wounds were necessary for *R. solani* to cause cankers on stems of tomato transplants. Isolates of *R. solani* from stem cankers, root lesions, and root surfaces varied in ability to cause cankers, those from stem cankers being most virulent. *C. coccodes* isolates caused limited canker development. Susceptibility of 16 tomato cultivars to *R. solani* varied according to cultivar and origin of isolate.

Basal stem canker is a persistent problem in fresh market tomato (*Lycopersicon esculentum* Mill.) production in Massachusetts. Symptoms are noted

when the first clusters ripen. Severely affected plants are stunted, with yellowed older leaves. These plants often decline and die, and growers sometimes confuse the condition with *Fusarium* and *Verticillium* wilt. Large girdling stem cankers are found at or below the soil line. Lesions begin as a soft, black decay of the

cortex and change to a dry, brown to gray, sunken, often zonate canker with age. Stems are hollow, with internal discoloration. Small black sclerotia are often abundant in old cankers. Adventitious roots may form above and around cankers. Evidence of previous mechanical injury may be visible in the canker.

*Rhizoctonia solani* Kühn has been reported to cause damping-off, "foot rot," and stem canker in greenhouse and field-grown tomatoes (2,10-13). Direct penetration of stems by *R. solani* has been described (10,12); others reported that entrance through senescing plant parts or wounds was necessary for infection (2,11). *Colletotrichum coccodes* (Wallr.) Hughes, a common soilborne fungus, causes black-dot root rot of potato and occasionally of tomato (1,3-5,9,13). Limited stem invasion in the field has also been reported (5). *C.*

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*coccodes* was previously thought to be the cause of brown root rot or "corky root" of tomato (1,3) but is now known to be a secondary colonizer that can obscure the primary cause, *Pyrenochaeta lycopersici* (6).

## METHODS AND RESULTS

Affected plants were collected and isolations were made by plating surface-sterilized (1:9 Clorox solution for 10 min) pieces of canker margins on potato-dextrose agar acidified with lactic acid (50%) to pH 4.0 (PDAL). Two predominant fungi were isolated. A sterile fungus with all the features ascribed by Parmeter and Whitney (8) to *R. solani* was most frequently isolated from the early stages of canker development. The other fungus was most frequently isolated from later stages of canker development, where small black sclerotia were often present. This fungus fits the description of *C. coccodes* (1,9). Roots of young tomato plants, with and without stem cankers, were examined and occasional small (4–5 mm), limited, red-brown to brown lesions were found on some major roots. Isolations from these yielded *R. solani*. Root segments without symptoms were washed 10 times in sterile water and plated on PDAL without surface sterilization. *R. solani* was isolated from 10–20% of the samples.

Twenty isolates of *R. solani* from stem cankers, root lesions, and root surfaces and five isolates of *C. coccodes* were used separately and in combination in tests in the greenhouse. Discs were cut from the edges of PDAL colonies of *R. solani* and *C. coccodes* and applied with Scotch Magic Tape singly or in combination to the surfaces of stems at the soil line of Bonny Best tomato plants at the four-leaf stage. Plain PDAL discs were used for

controls. Plants were examined after a month, and only a few superficial infections were noted. Reisolation attempts were not successful. This test was repeated in the same way, except that 1-cm wounds were made in the cortex of stems before inoculum was applied. Eleven of the *R. solani* isolates, mostly from stem cankers, caused stem cankers ranging from slight to severe and resembling those seen in the field (Fig. 1); the other nine isolates were from root lesions and root surfaces and caused either limited cortical decay or no symptoms. The five *C. coccodes* isolates caused limited cortical decay and occasional limited expansion of wounds. Both fungi were readily reisolated where cortical decay and cankers occurred.

A field test was done to determine the role of *R. solani* and *C. coccodes* in invasion of stem-wounded tomato transplants at planting. Plants in the four-leaf stage were wounded and inoculated. Six plants each of 16 cultivars (Table 1) were inoculated for each of four fungal isolates. Three isolates of *R. solani* were used, one each from a stem canker, a root lesion, and a root surface. One isolate of *C. coccodes*, from a stem canker, was also used. Isolates were chosen on the basis of previous pathogenic activity in greenhouse tests. When fruit began to ripen, plants were dug and evaluated for decline symptoms and canker formation. Isolations were made on PDAL. The stem canker isolate of *R. solani* caused moderate to severe cankers and obvious decline symptoms on 10 of the 16 cultivars, the root lesion isolate caused slight to moderate cankers on 11 cultivars, and the root surface isolate caused slight to moderate cankers on seven cultivars. *C. coccodes* caused slight increases in wound size, with some dark

cortical decay, to occasional moderate cortical decay areas on 14 cultivars. Fungi that caused infections were consistently reisolated (Table 1). In some cases, both *R. solani* and *C. coccodes* were isolated from the same plant. Each was isolated from control plants of two cultivars apiece. Stem cankers did not occur on tomato cultivars Heinz 1350, Manalucie, Trellis 22, and VF-Hybrid inoculated with *R. solani* isolates. Limited wound colonization by *C. coccodes* did occur on these four cultivars.

## DISCUSSION

Wounding was necessary for *R. solani* and *C. coccodes* to invade the stems of young tomato plants. This confirms Strong's conclusions (11) but is contrary to other reports (10,12) of direct penetra-

Table 1. Recovery of *Rhizoctonia solani* or *Colletotrichum coccodes* from wound-inoculated field-grown tomatoes

Tomato cultivars <sup>a</sup>	Origin of isolates used as inoculum					Control <sup>b</sup>
	<i>R. solani</i>			<i>C. coccodes</i>		
	Stem canker	Root lesion	Root surface	Stem canker		
Better Boy	R	R,C	R	C	...	
CRT	R,C <sup>c</sup>	R	R	C,R	...	
Heinz 1350	...	...	...	C	...	
Indian River	R	R	...	...	...	
Manalucie	...	...	...	C	...	
Manapal	...	R	R	...	C	
Ramapo	R	R	...	C	...	
Setmore	R,C	R,C	R	C	R	
Stakeless	...	R	...	C	...	
Super Red	R,C	...	...	C	C	
Supersonic	R	R	...	C	...	
Terrific	R	R	R,C	C	...	
Trellis 22	...	...	...	C	...	
Tropic	R,C	R	R	C	...	
VF-Hybrid	...	...	...	C	...	
Wonder Boy	R,C	R	R,C	C	R	

<sup>a</sup>Six plants per cultivar per fungal isolate; agar discs of fungal inoculum applied to cortical stem wounds at transplanting.

<sup>b</sup>Plants wounded but not inoculated with agar discs.

<sup>c</sup>R = *R. solani*, C = *C. coccodes*, recovered from all plants.

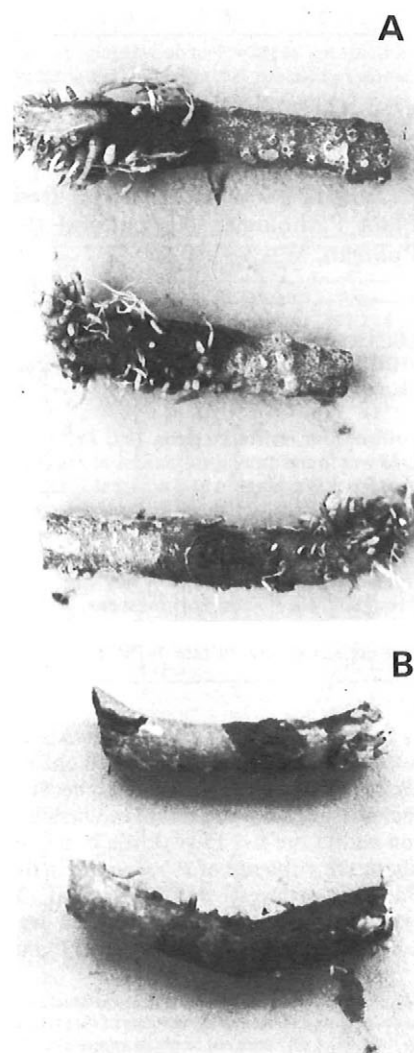


Fig. 1. Basal stem canker of tomato due to wounding and inoculation with either *Rhizoctonia solani* or *Colletotrichum coccodes*: (A) Bottom stem inoculated with *C. coccodes* shows only limited invasion; top and middle stems inoculated with *R. solani* show extensive dark cortical decay. (B) Stems inoculated with *R. solani* show severe, extensive cortical decay (bottom) and moderate limited invasion (top).

tion by *R. solani*. *C. coccodes* was capable of only limited invasion of wounded stems. MacNeill (5) concluded that invasion by *C. coccodes* of stems of field tomatoes is only limited.

Tomato cultivars varied in susceptibility to *R. solani*. Some were resistant, and susceptibility in others varied, depending on the origin of the isolate. Nour El Dein and Sharkas (7) reported that tomato cultivars vary in susceptibility to *R. solani* in relation to root exudation.

Basal stem canker can be expected when tomato transplants are wounded at transplanting or during cultivating. The greater increase in recovery of *R. solani* from young cankers and the increased recovery of *C. coccodes* with canker age, together with results from inoculation tests in greenhouse and field, indicate that

*R. solani* is a primary wound parasite of young tomato stems and that secondary colonization by *C. coccodes* increases with canker age.

#### LITERATURE CITED

1. CHESTERS, C. G. C., and D. HORNBY. 1965. Studies on *Colletotrichum coccodes*. I. The taxonomic significance of variation in isolates from tomato roots. *Trans. Br. Mycol. Soc.* 48: 573-581.
2. CONOVER, R. A. 1949. Rhizoctonia canker of tomato. *Phytopathology* 39:950-951.
3. HORNBY, D. 1968. Studies on *Colletotrichum coccodes*. III. Some properties of the fungus in soil and in tomato roots. *Trans. Br. Mycol. Soc.* 51:541-553.
4. MacNEILL, B. H. 1955. *Colletotrichum* root rot of greenhouse tomatoes. *Plant Dis. Rep.* 39:45-46.
5. MacNEILL, B. H. 1957. *Colletotrichum atramentarium* in field tomatoes. *Plant Dis. Rep.* 41:1032.
6. MANNING, W. J., and P. M. VARDARO. 1974. Brown root rot of tomato in Massachusetts. *Plant Dis. Rep.* 58:483-486.
7. NOUR EL DEIN, M. S., and M. S. SHARKAS. 1964. The pathogenicity of *Rhizoctonia solani* in relation to different tomato root exudates. *Phytopathol. Z.* 51:285-290.
8. PARMETER, J. R., JR., and H. S. WHITNEY. 1970. Taxonomy and nomenclature of the imperfect state. Pages 7-19 in J. R. PARMETER, JR. (ed.). *Rhizoctonia solani*, Biology and Pathology. University of California Press: Berkeley. 255 pp.
9. SCHNEIDER, R. W., R. G. GROGAN, and K. A. KIMBLE. 1978. *Colletotrichum* root rot of greenhouse tomatoes in California. *Plant Dis. Rep.* 62:969-971.
10. SMALL, T. 1927. Rhizoctonia "foot rot" of the tomato. *Ann. Appl. Biol.* 14:290-295.
11. STRONG, M. C. 1961. Rhizoctonia stem canker of tomatoes. *Plant Dis. Rep.* 45:392.
12. VERHOEFF, K. 1963. Footrot of tomatoes, caused by *Rhizoctonia solani*. *Neth. J. Plant Pathol.* 69:265-278.
13. WALKER, J. C. 1952. Diseases of vegetable crops. McGraw-Hill Book Co.: New York. 529 pp.