Fusarium equiseti—A New Cause of Cumin Spice Plant Wilt in Israel

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ABSTRACT

Reuveni, R. 1982. *Fusarium equiseti*—A new cause of cumin spice plant wilt in Israel. Plant Disease 66:498-499.

Fusarium equiseti was isolated from wilted cumin (*Cuminum cyminum*) spice plants grown in infested soils. The incidence and number of fungus propagules in field soil, determined by plating, was related to the number of plants wilted and killed by the pathogen.

Cumin (*Cuminum cyminum* L.) is grown in semiarid areas of Israel as a nonirrigated winter spice crop (200–300 mm annual rainfall). Plant wilt, at the seedling and mature stages of growth, caused a decrease in plant population that severely lowered yield. Wilting occurred mainly in fields with poor drainage.

The objectives of this study were to identify the cause of wilting and the factors resulting in wilt severity.

MATERIALS AND METHODS

Plants and soils. During the winter of 1979, infested cumin plants and propagule-infested soil samples were collected from fields previously cropped to wheat (*Triticum aestivum* L.) and onion (*Allium cepa* L.). The former field contained severely and moderately diseased plants; the latter had a low incidence of diseased cumin plants. Five soil and 50 plant samples were taken from each field 45 days after seeding.

In other commercial cumin fields, plant and soil samples were taken from early and late sowings (mid-January and mid-February). These fields showed different infection rates. The mortality rate was high in fields sown early and low in fields sown late.

Soil samples and sample preparation. After the upper layer was removed, soil samples were taken at a depth of 10 cm. From each of the composite field samples, 10 g of soil was taken at random for laboratory plating. The samples were placed in sterile flasks and diluted (1:10, w/w) with sterilized tap water. The soil-water suspension was thoroughly mixed with a magnetic stirrer. After 10 min of mixing, the suspension was diluted to 1:1,000, and 0.1 ml of the final dilution of each soil sample was placed in a petri dish containing 10 ml of potato-dextrose agar (PDA) or pentachloronitrobenzene (PCNB) medium (4). There were five replications of each plating. After 10 days of incubation in the dark at 25 C, the number of propagules was counted and identifications and microscopic observations were performed.

Isolation studies. Roots and stems of plants were thoroughly washed in tap water. Segments were surface disinfected in a 1% solution of sodium hypochloride for 2 min. The segments were then plated either on acidified PDA or PCNB medium. Plates were incubated for 10 days in the dark at 25 C before identification and frequency of isolated fungi were determined.

Inoculation tests. A fungal isolate identified as *Fusarium equiseti* (Cda.) Sacc. derived from cumin roots was used. Propagules from 10-day-old cultures of each isolate were brushed off and suspended in sterilized tap water.

Four-week-old cumin plants grown in sterilized loam soil (500 g) were used in inoculation tests. Furrows 2 cm deep were made near the plants and filled with 10 ml of inoculum suspension (3×10^3 propagules per milliliter) and covered with soil. The pots were then incubated at 20 ± 1 C in growth chambers with a 12-hr day length provided by Gro-Lux cool white fluorescent tubes (10,000 lux). *F. equiseti* was recovered from roots of wilted plants 45 days after inoculation.

Infection potential of soils. One-hundred cumin seeds were sown in 500 g of soil (three replications). The pots were incubated at 20 ± 1 C in the growth chambers with a 12-hr day length. The number of wilted seedlings was recorded daily.

Contribution 113-E, 1981 series, from the Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel.

Accepted for publication 9 September 1981.

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0191-2917/82/06049802/$03.00/0

Table 1. Incidence of *Fusarium equiseti* in different fields of cumin

Preceding crop in rotation	Incidence (%) of Wilted cumin plants[a]	*F. equiseti* isolated from plants[b]	*F. equiseti* propagules ($\times 10^3$/g of soil)[c]
Wheat	46.0 ± 1.4	90	19.6 ± 0.8
Wheat	22.0 ± 2.1	95	11.4 ± 1.1
Onion	2.4 ± 0.9	92	10.6 ± 0.7

[a] In field 1 m^2, average of five replications.
[b] Ten plants from each of five replications were tested.
[c] Ten grams of soil sampled from each of five replicated plots of each field were plated. Numbers are averages of five plots for each replication.

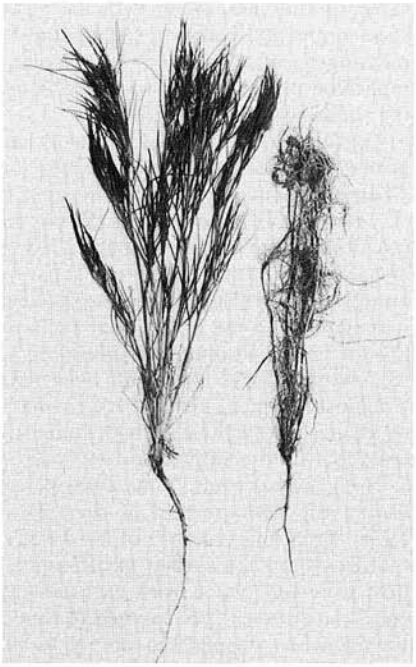

Fig. 1. Cumin plants: **(Left)** Uninoculated control. **(Right)** Inoculated with *Fusarium equiseti*.

RESULTS AND DISCUSSION

The main fungus isolated from roots of affected plants was *F. equiseti,* according to Gordon's concept (1). In addition, this identification was confirmed by W. Gerlach, Berlin. Infected plants were wilted 45 days after inoculation (Fig. 1), demonstrating the pathogenicity of the fungus.

F. oxysporum (Schl.) emend Syn. et Hans. f. sp. *cumini*, reported to be the causal organism of Fusarium wilt of cumin (3,5), was not isolated from wilted plants. *F. equiseti* has been reported to be widely distributed in soils, seeds, and plants in Israel (2). Our results suggest that *F. equiseti* is pathogenic to cumin plants in Israel.

Incidence of *F. equiseti*. The number of *F. equiseti* propagules (Table 1) was greatest (19.6×10^3/g) in soils with a high incidence of diseased plants (46.0%) and lowest (10.6×10^3/g) in soils with a low incidence (2.4%). The pathogen was isolated from 92 to 95% of affected plants whether plants were from fields with heavily or slightly diseased plants. Visual estimates indicated that the fields sown in mid-January were more severely affected than those sown later. The number of *F. equiseti* propagules was directly related to the number of wilted plants in the field. In fields sown early, the number of *F. equiseti* propagules was higher ($22.2 \pm 1.2 \times 10^3$/g of soil) than in fields sown later ($0.6 \pm 0.4 \times 10^3$/g of soil).

Infection potential studies of these soils showed that 95% of cumin plants were wilted when seeded (mid-January) in soil that was highly infested. Only 35% of cumin plants wilted in soils with a low incidence of *F. equiseti* propagules.

The pathogen that was isolated from plants and soils from all fields studied indicated that *F. equiseti* is pathogenic to cumin plants in Israel.

ACKNOWLEDGMENTS

I thank M. Diab and Yunit Harlev at Newe Ya'ar, the Extension Service team at the Jenin Agricultural Station, and J. Palti, Agricultural Research Organization, Israel. I gratefully acknowledge the help of W. Gerlach, Director of the Federal Biological Institute, Berlin.

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