Symptomless Carriers of the Chickpea Wilt *Fusarium*

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ABSTRACT

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Lentil, pea, and pigeonpea were identified as symptomless carriers of the chickpea wilt fungus, *Fusarium oxysporum* f. sp. *ciceri*.

Chickpea (*Cicer arietinum* L.) is grown as a grain legume crop in the Indian subcontinent, the Middle East, eastern and northern Africa, and South and Central America. Chickpea wilt caused by *Fusarium oxysporum* Schlecht emend. Snyd. & Hans. f. sp. *ciceri* (Padwick) Snyd. & Hans. occurs in several countries (7). In India, it causes an annual yield loss of 10% (10). Soilborne pathogens are known to persist in field soils long after a susceptible crop has been removed. It is also known that many *Fusarium* spp. persist in soil by means of chlamydospores (9). *F. oxysporum* f. sp. *ciceri* can survive in debris from wilted plants for more than 2 yr (Haware and Nene, *unpublished*).

Several cultivated plants and weeds have been shown to be symptomless carriers of *Fusarium* spp. (1,3,5,6,12). However, *F. oxysporum* f. sp. *ciceri* produces wilt symptoms only in *Cicer* spp. (8), and it is not known whether other hosts could be symptomless carriers.

MATERIALS AND METHODS

Field screening. At the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), uniform disease nurseries have been developed (8). These are used for growing crop plants as well as for collecting naturally growing weeds. After the rainy seasons (October–March) of 1977–1978 and 1978–1979, breeding materials of chickpea were planted in the disease nurseries for normal screening of wilt caused by *F. oxysporum* f. sp. *ciceri*. The susceptible cultivar JG-62 showed 100% mortality. It was from such plots that the naturally growing weed species were collected for isolation of the fungus. Crop species were planted in these plots, as well as in pots (45-cm, earthen pots containing wilt-sick soil) for screening. In each pot, along with the crop species, 10 seedlings of chickpea cultivar JG-62 were also planted as susceptible checks. Because *F. oxysporum* f. sp. *ciceri* can be internally seedborne (4), seeds of JG-62 used in plantings were collected only from healthy plants grown in *Fusarium*-free plots.

Pot screening. A pot-screening procedure was used to verify the results of field screening. The pot-screening procedure has already been described (8).

Weed screening. Species of weed genera belonging to 14 families were collected from the uniform disease nurseries for fungus isolations: *Amaranthus* L., *Argemone* L., *Cardiospermum* L., *Cassia* L., *Commelina* L., *Convolvulus* L., *Corchorus* L., *Cyanotis* D. Don, *Cyperus* (Mich.) L., *Desmodium* Desv., *Digera* Forsk., *Eragrostis* Wolf., *Euphorbia* L., Heliotropium L., *Hibiscus* L., *Indigofera* L., *Launea* Cass., *Paspalum* L., *Phyllanthus* L., *Tribulus* L., and *Xanthium* L.

Crop screening. Crop species belonging to six families were grown both in the disease nurseries and in pots prepared for screening: *Arachis hypogaea* L. (cv. TMV-2); *Cajanus cajan* (L.) Millsp. [cvs. NP(WR)-15, ICP-6997]; *Citrullus vulgaris* Schrad.; *Cucumis sativus* L.; *Glycine max* (L.) Merr.; *Hibiscus esculentus* L.; *Lens esculentus* Moench.; *Lycopersicum esculentum* Mill. (cv. Pusa Ruby); *Medicago sativa* L.; *Pennisetum typhoides* Rich. (cvs. NHB-3, HB-3); *Phaseolus vulgaris* L.; *Pisum sativum* L.; *Raphanus sativus* L.; *Solanum melongena* L.; *Sorghum vulgare* Pers. (cvs. CSH-1, CSH-6); *Vigna mungo* (L.); *V. radiata* (L.) Wilczek.; *V. unguiculata* (L.) Walp. (cv. var. 57); and *Zea mays* L. (cv. SB-22).

Isolations. Roots and stems of test plants were washed under running water for 10 min and then air-dried. Roots were cut into small pieces (5 mm) and surface-disinfected with 2.5% sodium hypochlorite for 2 min. For each test species, 25 pieces were plated out on potato-dextrose agar (PDA) and on modified Czapek-Dox agar (11). The plates were incubated at 25 C for 7–10 days, and the *Fusarium* sp. isolated was transferred separately to PDA for pathogenicity tests. Crop species isolations were made every month for 5 mo.

Pathogenicity testing. Twelve isolates were tested. The isolates on PDA were multiplied on a 9:1 sand:maize meal medium, and pathogenicity tests were carried out on the susceptible chickpea cultivar JG-62 by the pot screening procedure (8).

RESULTS

Of the weed species tested, only *Cardiospermum halicacabum* L., *Convolvulus arvensis* L., *Cyperus rotundus* L., and *Tribulus terrastris* L. yielded *F. oxysporum*; however, all four of these isolates were nonpathogenic to chickpea. None of the weed species tested showed symptoms of wilting in the disease nursery.

Of the crop species tested, none showed wilting either in the disease nursery plots or in the pots for screening. Species that yielded *Fusarium* spp. were *Arachis hypogaea, Cajanus cajan, Lens esculentus, Phaseolus vulgaris, Pisum sativum, Vigna mungo, V. radiata,* and *V. unguiculata.* Of these, however, only the *Fusarium* isolates from *Cajanus cajan* (pigeonpea), *Lens esculentus* (lentil), and *Pisum sativum* (pea) were found to be pathogenic to chickpea. Subsequent study of the cultural and morphological characters of these three isolates confirmed that they were *F. oxysporum* f. sp. *ciceri*. Repeated pathogenicity tests with pea, pigeonpea, and lentil confirmed that the roots of these three crop species were colonized only by this chickpea *Fusarium*. We could not isolate any other *Fusarium* sp. from these three crop species.

We have not yet attempted to isolate the chickpea *Fusarium* from farmers' fields that are naturally infested.

DISCUSSION

Management of soilborne pathogens requires that the level of inoculum in the soil, including new or different races, be reduced significantly. Such a reduction in inoculum level, which is important for the durability of the resistant cultivars, can be achieved with crop rotation (2).

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Sources of resistance in chickpea to the wilt fungus have already been identified (8). To achieve durability of resistance to *F. oxysporum* f. sp. *ciceri*, researchers should conduct detailed studies of pathogen survival and should develop methods for reducing inoculum levels in the soil.

Soilborne pathogens specific to a few hosts survive in soil either in the debris of their specific hosts or of symptomless carriers. *F. oxysporum* f. sp. *ciceri* is pathogenic only to *Cicer* spp., but in our study it also colonized roots of lentil, pea, and pigeonpea. These three species are considered symptomless carriers because the pathogen was isolated from their roots, colonization of their roots by *F. oxysporum* f. sp. *ciceri* could be artificially demonstrated, and no symptoms were seen on the three species. This information can be useful in planning crop rotations involving chickpea. Planting crops that do not allow colonization by *F. oxysporum* f. sp. *ciceri* in rotation with chickpea is expected to reduce the inoculum level in the soil.

The chickpea wilt *Fusarium* is internally seedborne (4). We did not check the seeds of lentil, pea, or pigeonpea for seed transmission because we found that *F. oxysporum* f. sp. *ciceri* was confined to their root systems.

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