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Wilt of Radish Caused by *Fusarium oxysporum* f. sp. *raphani* in Washington State

L. J. du Toit, Washington State University, Mount Vernon Research & Extension Unit, 16650 State Route 536, Mount Vernon, WA 98273; and **G. Q. Pelter,** Washington State University Cooperative Extension, Courthouse, P.O. Box 37, Ephrata, WA 98823

Corresponding author: L. J. du Toit. dutoit@wsu.edu

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Radish (*Raphanus sativus* L.) seed crops in Washington may annually produce up to 70% of the US and up to 40% of the world supply of radish seed (11). In May and June 2002, severe symptoms of wilting and dieback were observed in a radish stock seed crop in the Columbia Basin of central Washington. Examination of the roots revealed a dark vascular discoloration and root rot, as well as cabbage maggot (*Delia radicum* L.) larvae with associated feeding injury. Isolations from the symptomatic root tissue onto acidified potato dextrose agar (PDA) revealed the presence of *Fusarium oxysporum*, identified according to Nelson et al. (8) on the basis of colony morphology and the presence of chlamydospores, microconidia produced in false heads on short monophialides, and abundant macroconidia.

The pathogenicity of two of the isolates of *F. oxysporum* was evaluated in the greenhouse using 2-week-old seedlings of the radish cultivar Champion. For each isolate, 6 seedlings were wounded by tearing the sides and lower end of each transplant plug. The roots were inoculated by soaking the plug in a suspension of approximately 10^5 spores/ml for 60 s, and individually transplanting each seedling into potting medium (Sunshine Mix #1) in a 10-cm-diameter pot. For the control treatment, 6 seedlings were treated in the same manner except the plugs were soaked in sterile deionized water for 60 s. In addition, 6 seedlings were inoculated as described above with a spore suspension of an isolate of *F. oxysporum* obtained from bean seedlings in central Washington. The seedlings were maintained on a greenhouse bench at 20±2°C (14-h/10-h day/night cycle). For both radish isolates of *F. oxysporum*, symptoms of wilt were observed on all inoculated seedlings, but not on control seedlings nor on seedlings inoculated with the bean isolate of *F. oxysporum*. Symptoms progressed from yellowing of a single leaf (Fig. 1) to general wilting and dieback of plants over the course of four weeks. Four plants inoculated with *F. oxysporum* (two plants per radish isolate) were dead within 24 days of inoculation (Fig. 2). Twenty-nine days after inoculation, the roots of each plant were washed under running water, cut longitudinally, and assessed for discoloration. Plants inoculated with the radish isolates of *F. oxysporum* displayed 15 to 100% discoloration of the vascular and cortical tissues (Fig. 3 and Fig. 4). None of the control plants, nor the plants inoculated with the bean isolate of *F. oxysporum*, had discolored roots (Fig. 4). *Fusarium oxysporum* was reisolated onto acidified PDA from roots inoculated with the radish isolates of *F. oxysporum*. A sample of the seed from which this proprietary stock seed crop was grown was not available to assay for *F. oxysporum*.

Fig. 1. One-sided yellowing of a radish leaf three weeks after inoculation of the plant roots with *Fusarium oxysporum*.

Fig. 2. Non-inoculated (left) and inoculated (right) radish plants four weeks after inoculation of the latter with *Fusarium oxysporum* isolated from a radish seed crop.

Fig. 3. Discoloration of the vascular and cortical tissues of a radish root 29 days after inoculation with *Fusarium oxysporum*.

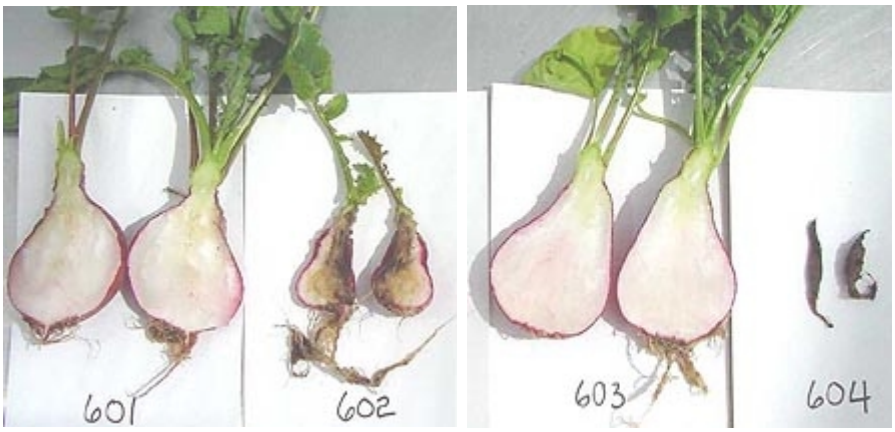

Fig. 4. Symptoms of Fusarium wilt on radish plants inoculated with *Fusarium oxysporum* isolated from a radish seed crop. 601 = non-inoculated control; 602 and 604 = inoculation with two different radish isolates of *F. oxysporum*; and 603 = inoculation with a bean isolate of *F. oxysporum*.

The host range of *F. oxysporum* f. sp. *raphani* is limited to radish (3,5,6). In the US, Fusarium wilt of radish has previously been reported in California (1,5), Colorado (2), and Wisconsin (9). The disease has also been observed in Brazil (7). *Fusarium oxysporum* f. sp. *conglutinans*, causal agent of cabbage yellows, is pathogenic on many *Brassica* spp. but not on radish (3,6). This is the first report

of Fusarium wilt of radish caused by *F. oxysporum* f. sp. *raphani* in Washington, an important region for radish seed production in the US (11). By the end of the growing season, the combination of Fusarium wilt and cabbage maggot injury resulted in a stand loss of about 90% in the stock seed crop, which was abandoned. Radish stock seed crops are estimated to be three times the value of commercial radish seed crops (4). Given that *F. oxysporum* f. sp. *conglutinans* can be seedborne in *Brassica* spp. (10), and because of the potential for widespread dissemination of seedborne pathogens, research is needed to determine whether *F. oxysporum* f. sp. *raphani* can be seedborne in radish.

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