Plantago Wilt

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ABSTRACT

Fusarium oxysporum is reported here as a pathogen of the mucilage plant, *Plantago ovata*. Symptoms may be a pre-emergence damping-off, or a rapid wilting of 120- to 150-day-old plants. Discoloration of the tap root (commencing at the tip) is also evident, and is accompanied by the presence of large quantities of hyphae in xylem elements, vascular discoloration, and a cortical root rot.

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Plantago ovata Forsk (blond psyllium seed) is currently being grown in arid regions of the United States for its seed, a source of mucilage for pharmaceuticals such as stabilizers and laxatives. The mucilage is contained in the outer epidermal layer of the seed, and is removed by mechanical abrasion. As a commercial crop, *P. ovata* is a winter annual in lower desert areas where temperatures rarely fall below −6.0 C. Planting occurs in late October and early November and the seeds are harvested by combining in May. *P. ovata* plants are grass-like in appearance, but are really classed as stemless herbs. Leaves are in rosettes, and seed scapes are produced which grow to a height of 20-30 cm.

First-year losses due to the wilt-type disease have not been observed. However, with successive years of monoculture, circular areas of wilted and dying plants appear with a resulting decline in yields. The disease is manifested either as a pre-emergence damping-off, or as a late-season wilt of plants as they start to produce seed scapes. Wilting, which first occurs in the outer leaves, is preceded by a change in leaf color from green to silver. Wilting of the whole plant is rapid; leaves may become prostrate within 36-48 hours after incipient wilting. Roots of wilting plants always show a black discoloration which gradually progresses from the root tip towards the crown. A cortical root rot accompanies the discoloration, and the internal tissues take on a very woody consistency.

A number of diseases have been reported on other *Plantago* spp. in this country (5), but only downy mildew (which is incited by *Peronospora plantaginis)* has been reported on *P. ovata* in India (1). This is the first-known report of a disease of *P. ovata* in North America.

Isolation of *F. oxysporum* Schlecht. emend. Snyd. & Hans. was initially made by soaking roots and aboveground parts of affected plants in 0.5% NaOCl for periods up to 30 minutes then plating them on potato-dextrose agar (Difco) + 100 ppm streptomycin, 2% water agar + 100 ppm streptomycin, or on peptone-PCNB-agar (4). Nonsterile samples of 1,000 each of nonabraded, single-abraded, and double-abraded seeds grown in East India, Mexico, and Arizona were cultured on peptone-PCNB.

The most frequently isolated fungi were grown on steam-pasterurized seeds of oats or *P. ovata,* then introduced into steam pasteurized U.C. Mix (3) either prior to planting or when plants were 120-150 days old and starting to produce seed scapes. Inoculum was distributed at the rate of 20 g of seed and fungus per 15.24-cm diameter pot. The soils of similar plants also were infested with suspensions prepared by removing the surface growth from a 10-day-old PDA plate-culture, suspending the resulting material in 100 ml of sterile distilled water, and then distributing this volume over five pots. The infection studies were replicated and utilized three generations of plants (one each year for 3 years) in the greenhouse. Soil temperatures were maintained over a range of 15-20 C.

Histological studies were made using plant parts cleared by Herr's procedure (2), then sectioned with a Hooker microtome. Sections were stained in 1% acid fuchsin, and mounted in the clearing agent.

The predominant organism isolated from the vascular tissues of roots, crowns, leaves, and seed scapes of naturally infected *P. ovata* plants showing incipient wilt and progressive root tip discoloration was *F. oxysporum.*

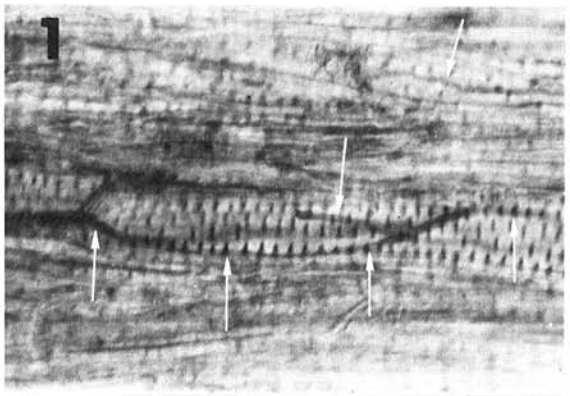

Fig. 1-2. 1) Hyphae in xylem elements (arrows) of a *Plantago ovata* root which showed symptoms of wilt and vascular discoloration and from which *Fusarium oxysporum* Schlecht., was isolated (× 600). **2)** *Plantago ovata* growing in soil infested with *F. oxysporum* Schlecht., cultured on *P. ovata* seed (A) and potato-dextrose agar (B), and growing in non-infested soil (C).

Isolates were most easily obtained from surface-disinfested roots, and to a lesser extent from above-ground parts. Isolation from twice-abraded, single-abraded, nonabraded Indian, Mexican, and Arizona seeds showed the fungus to be mainly associated with nonabraded and single-abraded seeds from all three areas. The mean percentage of all isolations of this fungus from 1,000 each of nonabraded and single-abraded seeds from each of the three areas was 2.6%, while the mean percentage recovery from all three 1,000-seed lots of double-abraded seed was 0.1%. This would indicate a more superficial association of the fungus to the seed. Therefore, control measures involving seed treatment, or complete removal of the mucilage layer, may be possible.

Preplant introduction into steam-pasteurized U.C. Mix of *F. oxysporum* always caused at least a 90% loss of stand from the seed-rot and pre-emergence damping-off. The various other isolated fungi effected only minor stand losses following similar infestations. Of the fungi tested, only *F. oxysporum* induced typical symptoms in 120- to 150-day-old *P. ovata* plants when the U.C. Mix was infested during this period of time. The earliest symptoms (incipient wilt) were generally noted within 2 weeks following soil infestation at a soil temperature of 15-20 C. Under our greenhouse conditions, complete wilt and death of plants occurred within another 2 weeks, Fig. 2. Routine isolation from plants grown in artificially infested soil resulted in the recovery of the fungus from the vascular tissues of roots, crowns, and leaves, as well as from root cortical tissue and decayed seeds.

Hyphae were also observed in xylem elements of sectioned roots (Fig. 1) obtained from greenhouse studies and naturally infected field-grown plants. The consistent finding of hyphae in the xylem of plants showing root discoloration and wilt, and the isolation of *F. oxysporum* from vascular tissues, implicates the hyphae as being that of the suspect pathogen.

Attempts are presently being made to determine where the fungus is located within the seed, its host range for *formae specialis* determination, and effective control procedures.

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