Pea Root Rot Development and Associated Pathogens in Ontario Fields

ANDRES A. REYES, Research Scientist, Agriculture Canada, Vineland Station, Ontario, Canada L0R 2E0

ABSTRACT

REYES, A. A. 1980. Pea root rot development and associated pathogens in Ontario fields. Plant Disease 64:392-393.

The severity of pea root rot in five fields in central Ontario increased as the season progressed. *Fusarium solani* f. sp. *pisi* was the fungus isolated most frequently from diseased roots and rhizospere soil, and its population density in the root tissues was directly related to disease severity. *Pythium* spp. were also isolated frequently (from plants sampled at the flowering stage) but were less abundant than *F. solani* f. sp. *pisi*. *F. oxysporum* f. sp. *pisi* and *Rhizoctonia solani* were encountered least from diseased roots. These fungi caused root rot on inoculated pea seedlings.

Additional key words: *Pisum sativum*

In the most recent survey of pea (*Pisum sativum* L.) diseases in Ontario, Canada, (3) root rot characterized by dark brown lesions around the area of the cotyledonary node was the predominant disease. *Fusarium solani* (Mart.) App. & Wr. f. sp. *pisi* (F. R. Jones) Snyd. & Hansen was consistently isolated from plants with this symptom. *F. oxysporum* Schlecht. f. sp. *pisi* (Linford) Snyd. & Hansen was isolated from wilted plants less frequently, but the symptoms were difficult to distinguish from those caused by *F. solani* f. sp. *pisi*.

Other fungi are also involved in the pea root rot complex. In 1976, Blume and Harman (4) reported that *F. solani* f. sp. *pisi*, *Pythium* spp., and *Aphanomyces euteiches* Drechs. were the important fungi causing pea root rot in New York. Hampton and Ford (6) observed that *F. solani* f. sp. *pisi*, *Pythium* spp., *A. euteiches*, and *Rhizoctonia* spp. caused pea root rot in the coastal area of Washington and Oregon in 1964. Kaiser et al (7) isolated *Pythium* spp., *F. oxysporum*, *F. solani*, and *Rhizoctonia solani* Kuhn from diseased pea roots in Iran in 1969.

The objectives of the present study were to determine the severity of pea root rot, the pathogenic microorganisms associated with the disease, and their population levels at different times during the season in central Ontario.

MATERIALS AND METHODS

Sampling. Five fields in central Ontario were seeded on 15 April 1977 to the pea cultivar Little Marvel and sampled every 3 wk from 25 April to 27 June 1977. The 2–10 ha fields were 31–230 km apart and had various crop histories (Table 1).

Sixty plants selected at random were dug from each field on each sampling date. Rhizosphere soil adhering to the root was collected for estimating microorganism populations. Rhizosphere soil and root samples were stored separately in 46 × 81 cm polyethylene bags at 5 C for a maximum of 3 wk.

Roots were washed in running tap water and blotted dry on paper towels, and the severity of root rot was recorded. Root rot symptoms were rated on a 0–5 scale, and the sum of the ratings was divided by the number of plants graded to obtain the disease index.

Isolation. Attempts were made to isolate the various pathogens reported to cause pea root rots in Ontario (5). To isolate *F. solani* f. sp. *pisi*, *F. oxysporum* f. sp. *pisi*, and *Phoma medicaginis* Malbr. & Roum. var. *pinodella* (L. K. Jones) Boerema (syn. *Ascochyta pinodella* L. K. Jones), each sample of 10 roots or 5 g of rhizosphere soil was homogenized in a Waring Blendor (10). One milliliter of each of five dilutions (w/v) (1:100, 1:500, 1:1,000, 1:5,000, 1:10,000) of the homogenate was poured onto plates (100 × 15 mm) of differential medium (10). Controls were identified cultures of these

Table 1. Root rot on and fungi isolated from roots and rhizosphere soil of Little Marvel peas

Field[a] (1974, 1975, 1976 crops) 1977 Sampling date	Root rot[b]	*Fusarium solani* f. sp. *pisi* Root cpg[c]	*Fusarium solani* f. sp. *pisi* Soil cpg[c]	*Pythium* Root %[d]	*Pythium* Soil cpg[c]	*Rhizoctonia solani* Root %[d]
Huttonville (bean, carrot, pea)						
April 25	0.0	19	488	0	11	0
May 16	2.1	206	1,098	64	8	27
June 6	3.0	920	880	90	9	4
June 27	3.8	14,500	1,423	14	16	19
Inglewood (potato, bean, cucumber)						
April 25	0.0	0	397	0	13	0
May 16	0.9	410	473	76	18	0
June 6	2.6	1,490	880	79	19	12
June 27	3.6	13,450	1,068	7	100	11
Jordan (grass, grass, tomato)						
April 25	0.0	0	0	0	6	0
May 16	1.5	0	0	72	22	0
June 6	1.7	34	0	90	25	12
June 27	1.8	825	305	57	19	8
Millgrove (onion, grass, pea)						
April 25	0.0	0	200	0	5	0
May 16	1.5	115	244	27	1	0
June 6	2.3	326	1,203	56	6	4
June 27	3.1	6,600	1,423	22	8	0
Stouffville (pea, pepper, tomato)						
April 25	0.0	0	587	0	2	0
May 16	0.9	0	564	0	3	0
June 6	1.1	1,200	1,017	50	10	0
June 27	3.2	6,700	3,253	43	7	12

[a] Seeded on 25 April 1977.

[b] Disease index: 0 = no root rot symptoms, 1 (trace) = flecklike brown lesions at cotyledonary node, 2 (light) = flecklike lesions scattered around cotyledonary node and on some lateral roots, 3 (moderate) = coalesced lesions extending to 2 cm above or below cotyledonary node and several lesions on lateral roots, 4 (severe) = extensively discolored root system, and 5 = dead plant.

[c] cpg = colonies per gram of root tissue or soil rhizosphere.

[d] Percentage of plated roots (cotyledonary node pieces) yielding fungus.

pathogens used to infest previously steamed soil, which was plated similarly. The differential media used for isolating *F. solani* f. sp. *pisi*, *F. oxysporum* f. sp. *pisi*, and *P. medicaginis* var. *pinodella* were modified peptone-PCNB (9), modified Martin's rose bengal (1), and modified peptone-dextrose agar (12), respectively.

The colonies of *F. solani* f. sp. *pisi* and *F. oxysporum* f. sp. *pisi* were counted after 5 days of incubation (23 C), and those of *P. medicaginis* var. *pinodella* were counted after 28 days of incubation. Colonies were examined microscopically (2,11) and identified by comparisons with the controls.

Plates of 2% water agar were used to isolate *Pythium* spp. and *R. solani*. A 1-cm section of the cotyledonary node from each of 50 plants from each field on each date was placed in the center of a water agar plate (60 × 15 mm). Before plating, root sections were washed in running tap water. Correspondingly, 0.5 g of each soil sample was placed carefully at five spots in each of 10 water agar plates (100 × 15 mm). Identified cultures of *P. irregulare* Buism. and *R. solani*, in soil handled similarly, served as controls.

Colonies of *Pythium* spp. and *R. solani* in the plates were counted after 24–48 hr of incubation at 23 C. *Pythium* colonies were recognized by their somewhat straight line growth and *R. solani* by dense growth of coarse brown mycelium. Identifications were verified microscopically.

The population densities of the microorganisms were expressed either as number of colonies per gram of sample or percentage of cotyledonary node pieces yielding the fungus.

RESULTS AND DISCUSSION

During the four sampling dates in a 9-wk period, 1,200 plants were collected. The severity of root rot increased as the season progressed but varied among fields (Table 1).

During the 1977 season, the plants emerged on about 25 April, were 5–8 cm high on 16 May, flowered on 6 June, and were mature by 27 June. No root rot was observed on the earliest sampling date (25 April). The severity of root rot progressed from trace to light (16 May) to trace to moderate (6 June), and finally to light to severe (27 June).

A high pea root rot index occurred in fields previously cropped to beans or peas, and a low index was associated with one field (Jordan) with no history of either crop. Apparently, beans or peas maintained the pathogens at high levels in the soil.

F. solani f. sp. *pisi*, *F. oxysporum* f. sp. *pisi*, and *Pythium* spp. were isolated from pea roots and rhizosphere soil; *P. medicaginis* var. *pinodella* was not detected (Table 1). *F. solani* f. sp. *pisi* and *Pythium* spp. were isolated as early as 25 April, but *F. oxysporum* f. sp. *pisi* was not encountered until 6 June. *R. solani* was not isolated until 16 May and was associated only with root samples.

Representative cultures (1,280 of *F. solani* f. sp. *pisi*, 220 of *F. oxysporum* f. sp. *pisi*, 400 of *Pythium* spp., and 50 of *R. solani*) were maintained on potato-dextrose agar. When these were later tested for pathogenicity on Little Marvel pea seedlings in steamed and artificially infested soil, 65, 60, 90, and 100%, respectively, of the cultures were virulent. These values were used to extrapolate the probable population levels of each pathogen in the plant and rhizosphere soil samples.

F. solani f. sp. *pisi* was the most prevalent fungus isolated (Table 1). Samples from Huttonville had the highest density of *F. solani* f. sp. *pisi* and those from Jordan the lowest. *F. solani* f. sp. *pisi* increased in the root tissues as the season advanced. *F. oxysporum* f. sp. *pisi* (data not presented) and *R. solani* were the least isolated fungi from diseased roots.

The *Pythium* spp. isolated were *P. hypogynum* Middleton, *P. irregulare*, *P. oligandrum* Drechs., *P. sylvaticum* Campbell & Hendrix, *P. ultimum* Trow., *P. vexans* de Bary, and several unidentified species. *Pythium* spp. were recorded from root samples most frequently on 6 June when the peas were at the flowering stage.

Only *F. solani* f. sp. *pisi* populations appeared to be correlated with disease severity (Table 1). This relationship and the predominance of the fungus suggest that *F. solani* f. sp. *pisi* played the most important role in the etiology of pea root rot in these fields. This pathogen also was reported as the primary cause of the pea root rot complex in michigan in 1956 (8) and in eastern Washington and Oregon in 1964 (6).

ACKNOWLEDGMENTS

I thank H. W. Neufeld for technical assistance; P. K. Basu (Agriculture Canada Research Station, Ottawa) and J. M. Kraft (USDA/ARS, Prosser, WA) for cultures of *Fusarium solani* f. sp. *pisi* and *Phoma medicaginis* var. *pinodella* and *F. oxysporum* f. sp. *pisi*, respectively; and D. J. S. Barr (Agriculture Canada Biosystematics Research Institute, Ottawa) for identification of *Pythium* species level.

LITERATURE CITED

1. ABAWI, G. S., and J. W. LORBEER. 1971. Populations of *Fusarium oxysporum* f. sp. *cepae* in organic soils in New York. Phytopathology 61:1042-1048.
2. BARNETT, H. L. 1960. Illustrated genera of imperfect fungi. 2nd ed. Burgess Publishing Co., Minneapolis, MN. 225 pp.
3. BASU, P. K., R. CRETE, A. G. DONALDSON, C. O. GOURLEY, J. H. HAAS, F. R. HARPER, C. H. LAWRENCE, W. L. SEAMAN, H. N. W. TOMS, S. I. WONG, and R. C. ZIMMER. 1973. Prevalence and severity of diseases of processing peas in Canada, 1970-71. Can. Plant Dis. Surv. 53:49-57.
4. BLUME, M., and G. E. HARMAN. 1976. Distribution of pea root rot pathogens in commercial plantings in New York. (Abstr.) Proc. Am. Phytopathol. Soc. 3:301.
5. CONNERS, I. L. 1967. An annotated index of plant diseases in Canada. Can. Dep. Agric. Pub. 1251. 381 pp.
6. HAMPTON, R. O., and R. E. FORD. 1965. Pea diseases in Washington and Oregon, 1964. Plant Dis. Rep. 49:235-238.
7. KAISER, W. J., M. OKHOVAT, and G. H. MOSSAHEBI. 1971. Etiology and control of damping-off and root rot of pea (*Pisum sativum*) in Iran. Plant Dis. Rep. 55:244-248.
8. LOCKWOOD, J. L., D. J. DEZEEUW, A. L. ANDERSEN, and D. J. HAGEDORN. 1957. Pea diseases in Michigan, 1955 and 1956. Plant Dis. Rep. 41:478-480.
9. PAPAVIZAS, G. C. 1967. Evaluation of various media and antimicrobial agents for isolation of *Fusarium* from soil. Phytopathology 57:848-852.
10. REYES, A. A. 1979. Populations of the spinach wilt pathogen, *Fusarium oxysporum* f. sp. *spinaciae*, in the root tissues, rhizosphere, and soil in the field. Can. J. Microbiol. 25:227-229.
11. TOUSSOUN, T. A., and P. E. NELSON. 1976. A pictorial guide to the identification of *Fusarium* species. 2nd ed. Pennsylvania State University Press, University Park. 43 pp.
12. WALLEN, V. R., S. I. WONG, and J. JEUN. 1967. Isolation, incidence, and virulence of *Ascochyta* spp. of peas from the soil. Can. J. Bot. 45:2243-2247.