Incidence and severity of root rot disease complex of field pea in northeastern Alberta in 1988

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Twenty-nine pea fields in northeastern Alberta were surveyed in 1988 for the presence and severity of root rot disease complex. Mean disease incidence and severity were 31% and 0.57 (on a scale of 0-4), respectively. Populations of ***Fusarium*** spp. and ***Pythium*** spp. in these pea fields averaged 58 x 10^2 and 6.0 x 10^2 propagules/g soil, respectively. ***Fusarium*** was the most frequently isolated genus from root-rot lesions of diseased pea plants. ***Rbizoctonia solani*** and ***Pythium*** spp. were isolated only occasionally. The ratio of *F. **solani*** :F. ***oxysporum*** :other ***Fusarium*** spp. was 1:3:8.

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En 1988, on a examine vingt-neuf champs de pois du nord-est de l'Alberta afin de déceler la présence des différents agents pathogènes responsables du pourridié et d'evaluer la gravite des foyers d'infection. L'incidence moyenne de la maladie et l'indice de gravité étaient respectivement de 31 % et de 0,57 (selon une échelle de 0 à 4). On a relevé en moyenne 58 x 10^2 propagules de ***Fusarium*** spp. par gramme de sol et 6,0 x 10^2 propagules de ***Pytbium*** spp. par gramme de sol dans ces champs de pois. C'est le genre Fusarium que l'on a isolé le plus fréquemment des lésions des racines des pois malades. Ce n'est qu'occasionnellement que l'on a isolé ***Rbizoctonia solaniet Pytbium*** spp. Le ratio ***F. solani*** : ***F. oxysporum*** : autres espèces de ***Fusarium*** était de 1:3:8.

Introduction

Field pea (*Pisum sativum* var. arvense L.) is well-adapted to a cool climate and can withstand considerable frost. In recent years the acreage of field peas in north-central Alberta has dramatically increased due to its value as a cash crop, use in rotation with cereals, high protein content (26%) which is suitable for human and livestock consumption, and atmospheric nitrogen-fixing ability (1).

The root rot disease complex of pea is a worldwide problem which can seriously reduce yield and quality of the crop (5, 6, 11). More than 20 different fungi have been implicated as causal agents in different regions of the world. To obtain more information on root rot of field pea in northeastern Alberta, a survey was carried out to determine the incidence and severity of root rot and to isolate and identify fungi associated with the root rot disease complex.

Materials and methods

Twenty-nine pea fields in northeastern Alberta were surveyed between late May and mid-June in 1988 for root rot (Fig. 1). Ten plants, along a W-pattern transect through each field, were dug up at each of 10 points. All roots were stored in a cooler at 5°C. Roots were washed and the incidence (%) and severity of root rot assessed. Severity ratings were assigned based on a scale of 0 to 4 where 0 = healthy, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, and 4 = 51-100% root discoloration.

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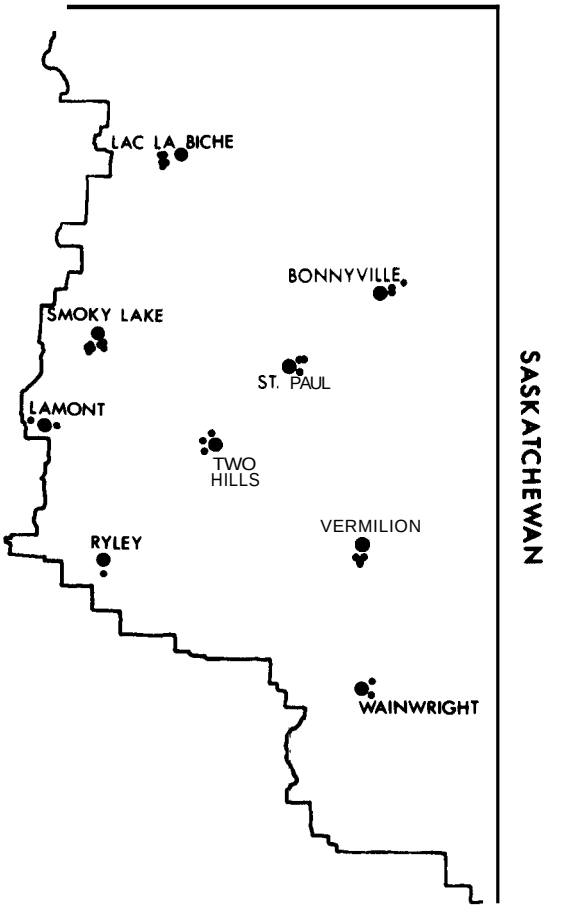

Fig. 1. Map of northeastern Alberta showing the approximate locations of the fields surveyed in 1988.

Five pieces (0.2x 0.2 cm) of discolored root tissue were taken from each of five randomly selected plants from each of the 29 fields sampled. The root tissue was surface sterilized in 0.6% sodium hypochlorite for 2 min, rinsed in sterile water, blotted dry, and placed on acidified potato dextrose agar (PDA). Five pieces of tissue were plated in each petri plate and incubated 5 days at room temperature. Hyphal tips growing out from the tissue were cut off and transferred to PDA slants for further growth and identification.

Five surface soil sub-samples were collected at random from each of the 29 naturally infested pea fields one month after planting to estimate the numbers of *Fusarium* and *fythium* propagules. All soil sub-samples from the same field were passed through a 1.68 mm screen and thoroughly mixed together. Soil dilution series of 1:10 and 1:200 (w/v) were prepared for each air-dried sample with 0.2% sterile water agar, then 1 mL of the soil dilution was spread onto a pentachloronitrobenzene (PCNB) medium plate, which is selective for *Fusarium* (9), and onto a pimaricin-vancomycin agar plate (MPVM) with rose bengal (0.02 g/L), which is selective for *fythium* (8). Five plates were prepared for each sample. The PCNB plates were incubated under fluorescent light at room temperature and the number of *Fusarium* colonies recorded after 7 days. The MPVM plates were incubated for 48 h in darkness at room temperature, then washed under a slow stream of water to remove materials other than *fythium* colonies which had grown into the medium. The number of *fythium* colonies was then recorded.

Results and discussion

Peas with root rot were found in all fields surveyed. Average disease incidence and severity of root rot were 31% and 0.57 (on a scale of 0-4), respectively (Table 1). Populations of *Fusarium* spp. and *fythium* spp. averaged 58 x 10^2 and 6 x 10^2 propagules/g soil, respectively. *Fusarium* was the most frequently isolated genus from root rot affected pea plants; *Rhizoctonia solani* and *fythium* spp. were isolated only occasionally. Of the total *Fusarium* cultures recovered, the ratio of *F. solani* : *F. oxysporum* : other *Fusarium* was 1:3:8.

Previous studies have indicated that *F. solani* f. sp. *pisi* is the primary causal agent of root rot of green pea in Canada (2, 10). However, in our study, the high frequency of isolation of *F. oxysporum* indicates that it is a major fungal component of the root rot disease complex in northeastern Alberta. The unidentified *Fusarium* spp. are probably of little importance in causing root rot of field pea (11).

Several *fythium* spp. have been reported as the major incitants of seed decay and preemergence damping-off of pea in other countries (4, 5). Although the frequency of isolation of *fythium* spp. from root tissues was very low, the populations of *fythium* spp. varied considerably between fields. In addition, a few isolates of *fythium* spp. obtained from infected peas were found to be highly pathogenic on the pea cultivar Tipu (Hwang, unpublished). It has been reported that *fythium* spp. may play a significant role in the pea root rot disease complex in the early growth stage of pea plants and when the soil is poorly drained and cold (3, 5).

Fusarium wilt disease is a potentially serious threat to field pea production in that area. Since both *Fusarium* and *fythium* are soil-inhabitants and may survive for a long time, a four-year crop rotation is recommended (6, 7, 11). Unfortunately, some Alberta pea growers continue to grow pea year after year in the same field because of its high value as a cash crop. This practice will likely increase the prevalence and severity of the root rot disease complex, which could become a major limiting factor in pea production. Therefore, to assess the potential for root rot, a large-scale screening and isolation of pathogens based on a more extensive field survey is needed in order to identify the race(s) of *F. oxysporum* f. sp. *pisi* and the other pathogens associated with root rot. Since the use of wilt- and root rot-resistant pea cultivars offers the

Table 1. Incidence and severity of pea root rot and populations of *Fusarium* spp. and *Pythium* spp. in pea fields surveyed in northeastern Alberta in 1988.

Location	No. of fields	Incidence (%)		Severity*		Propagules/g air-dried soil	
		Mean	Range	Mean	Range	*Fusarium* (x10^2)	*Pythium* (x10^2)
Bonnyville	3	38	15-53	0.76	0.29-1.29	40	4.6
Lac La Biche	5	48	31-59	1.07	0.54-1.50	43	5.2
Lamont	2	28	28-28	0.48	0.38-0.57	29	6.4
Ryley	1	22	-	0.26	-	70	6.6
Smoky Lake	7	29	2-76	0.55	0.02-1.94	59	10.1
St. Paul	3	20	1-31	0.27	0.03-0.37	62	4.5
Two Hills	3	57	39-87	1.05	0.62-1.81	64	3.6
Vermilion	3	22	15-30	0.43	0.36-0.53	82	7.2
Wainwright	2	14	2-26	0.24	0.02-0.46	71	5.6
Total/Average	29	31	-	0.57	-	58	6.0

*Root rot severity rating scale: 0 = clean; 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, and 4 = 51-100% of the root discolored.

best possibility for controlling the diseases, greater efforts are also needed to develop pea cultivars, not only with specific resistance to the *Fusarium* wilt pathogen, but also with nonspecific resistance to *Fusarium, **Pythium,*** and other root rot pathogens.

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Literature cited

1. Alberta Agriculture. 1980. Dry pea production in Alberta. Agri-fax Agdex 142/20-6.
2. 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.
3. Benedict, W.G. 1969. Influence of soil temperature on the development of pea root rot. Can. J. Bot. 47:567-574.
4. Hendrix, F.F. Jr., and W.A. Campbell. 1973. *Pythium* as plant pathogens. Ann. Rev. Phytopathol. 11:77-98.
5. Kraft, J.M., and D.D. Roberts. 1969. Influence of soil water and temperature on the pea root rot complex caused by Pythium *ultimum* and *Fusarium solani* f. sp. *pisi*. Phytopathology 59:149-152.
6. Kraft, J.M., and D.W. Burke. 1971. *Pythium ultimum* as a root pathogen of beans and peas in Washington. Plant Dis. Rep. 55:1056-1060.
7. Lumsden, R.D., W.A. Ayers, P.B. Adams, R.L. Dow, J.A. Lewis, G.C. Papavizas, and J.G. Kantzes. 1976. Ecology and epidemiology of Pythium species in field soil. Phytopathology 66:1203-1209.
8. Mircetich, S.M. 1971. The role of *Pythium* in feeder roots of diseased symptomless peach trees and in orchard soils in peach tree decline. Phytopathology 61:357-360.
9. Nash, S.M., and W.C. Snyder. 1962. Quantitative estimations by plate counts of propagules of the bean root rot Fusarium in field soils. Phytopathology 52:567-572.
10. Swanson, T.A., R.J. Howard, G.H.A. Flores, and S.P. Sumar. 1984. Incidence of root rot in pulse crops in southern Alberta, 1978-1983. Can. Plant Dis. Surv. 64:39-41.
11. Tu, J.C. 1987. Integrated control of the pea root rot disease complex in Ontario. Plant Dis. 71:9-13.