Diseases of pulse crops in Alberta, 1978-79

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Selected fields of processing (*Pisum sativum*) and dry peas (*P. safivum* and *P. safivum* var. *arvense),* processing and dry beans (*Phaseolus* vulgaris), fababeans (*Vicia faba),* soybeans (*Glycine max*) and lentils *(Lens culinaris)* in Alberta were examined for diseases over a two-year period. Overall, root rot *(Fusarium* spp. and *Rhizoctonia solani)* was the most common disease in pea and bean crops. Other prevalent diseases recorded on peas were powdery mildew (*Erysiphe pis!),* Alternaria leaf spot (*Alternaria alternata),* bacterial blight *(Pseudomonas pisi)* and downy mildew (*Peronospora viciae*). Bacterial blights *(Pseudomonas phaseolicola* and *Xanthomonas phaseoli)* were prevalent in processing beans, while white mold (*Sclerotinia sclerotiorum*) was common in dry beans. In fababeans, Alternaria leaf spot *(Alternaria alternata),* powdery mildew (*Microsphaera penicillata* var. ludens) and chocolate spot (*Botrytis cinerea*) were the most common diseases. Fusarium root rot *(Fusarium oxysporum)* in lentils and bacterial blight *(Pseudomonas glycinea)* in soybeans were the only infectious diseases recorded on these crops.

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Des champs selectionnes de pois de transformation (*Pisum* safivum), de pois secs (*P. safivum* et **P.** safivum var. *arvense),* de haricots secs et de transformation *(Phaseolus vulgaris),* de fdves des marais (*Vicia faba),* de fdves soja (*Glycine max*) et de lentilles (Lens *culinaris)* situes en Alberta furent examines sur une periode de deux ans afin d'evaluer l'importance des maladies presentes. En general, la pourriture des racines causée par *Fusarium* spp. et *Rhizoctonia solani* était la maladie la plus répandue dans les champs de pois et de haricots. Le blanc *(Erysiphe pisi),* la brûlure bacterienne (*Pseudomonnas pisi*) et le mildiou (*Peronospora viciae*) furent souvent observes sur les pois. La tache aérolée *(Pseudomonas phaseolicola*) et la brûlure bacterienne (*Xanthomonas phaseoli*) etaient repandues chez les haricots de transformation alors que la pourriture sclerotique (*Sclerotinia sclerotiorum*) était commune chez les haricots secs. Chez la fève des marais on a souvent retrouve la brûlure alternarienne *(Alternaria alternata),* le blanc (*Microsphaera penicillata* var. *ludens*) et la tache chocolat (*Botrytis cinerea*) tandis que l'on n'a detecte que la pourriture fusarienne des racines *(Fusarium oxysporum)* chez les lentilles et la brûlure bacterienne *(Pseudomonas glycinea)* chez les fdves soja.

Introduction

The area of land devoted to pulse crop production in Alberta has steadily increased in recent years (Table 1). Most of this increase has come about as the result of the introduction and acceptance of "new" pulse crops such as fababeans and lentils. In view of the increased importance of pulse crops to Alberta's agricultural industry, comprehensive surveys were conducted during 1978 and 1979 to identify prevalent and potentially serious diseases. Diseases of pulse crops have been appraised similarly in Saskatchewan (9, 10, 11, 12) and Manitoba (14, 15).

Surveys were carried out in commercial fields in southern and central Alberta. Fewer fields were surveyed in 1979 compared to 1978, but more detailed disease assessments were made in 1979. The crops surveyed in 1978 were processing peas (garden peas, ***Pisum sativum*** L.), dry peas (garden peas grown for seed and field peas, ***P. safivum*** var. ***arvense*** L.), dry beans (field beans, ***Phaseolus vulgaris*** L.) and fababeans (*Vicia* faba L.) The 1979 survey also included processing beans (snap beans, ***P. vulgaris*** L.), soybeans (*Glycine max* (L.) Merr.) and lentils *(Lens culinaris* Medik.).

Methods

Varying numbers of fields of each pulse crop were selected for survey (Tables 2 and 3) so as to include the main cultivars currently being grown and to fairly represent the geographical areas of production. Between June and September of each year, efforts were made to visit each field at least twice and, where possible, three times at approximately 4 to 5 week intervals. Second visits to a few fields were not possible in 1979 because of early crop maturity. Soybean and lentil fields surveyed in 1979 were examined only once.

Fields were traversed in a large semi-circle and at ten equally spaced sites, ten plants (in 1978) or all plants (in 1979) within three metres of row length were examined. At each of the sites, various plant parts were examined. Roots were carefully dug up and checked for disease. Counts were made of the total number of plants/3 m in 1979, and disease incidence was recorded as a percentage of the total plants examined. No attempt was made to rate severity. Field diagnoses of infectious diseases were confirmed by laboratory isolation and identification of the pathogens. In some cases, attempts were made to reinfect healthy plants to reproduce the diseases under greenhouse conditons.

Results

Several diseases were found in each crop (Tables 2 and 3). Of these, Fusarium and Rhizoctonia root rots, powdery mildew, fungal leaf spots and bacterial blights were the most prevalent. Besides the diseases mentioned in Tables 2 and 3, several others were recorded at very low incidence levels (< 1%); these are mentioned in the text.

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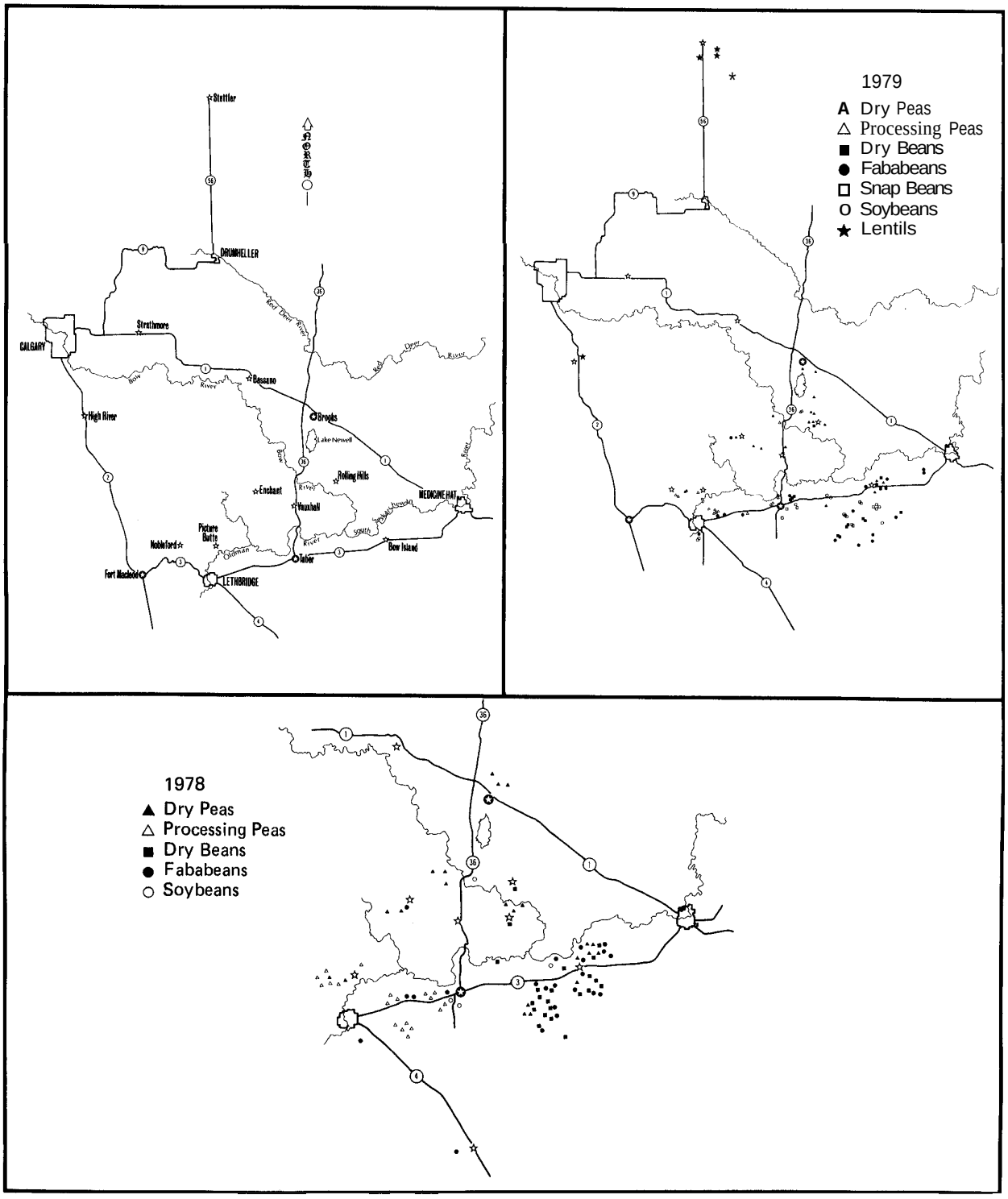

Figure 1. Distribution of pulse crop fields in southern Alberta which were surveyed for diseases in 1978 and 1979.

Table 1. Hectares of pulse crops grown in Alberta, 1974–79.

Pulse	1974	1975	1976	1977	1978	1979
Processing peas	1,996	2,119	1,681	1,501	2,400	1,900
Dry peas	6,478	5,162	2,632	4,049	4,049	4,049
Processing beans	262	240	229	272	300	300
Dry beans	972	1,538	2,105	2,429	2,591	2,834
Fababeans	400	1,215	810	1,619	1,923	3,644
Soybeans	0	0	0	0	0	150
Lentils	-	-	-	-	50	486
Total	10,108	10,274	7,457	9,870	11,313	13,363

Processing and dry peas

The predominant disease in processing peas in both years was root rot (*Fusarium* spp. *Rhizoctonia solani* Kuhn, and *Pythium ultimum* Trow.) (Tables 2 and 3). In 1979, it occurred in all the fields visited. By contrast, dry pea crops had a relatively low root rot incidence and fewer fields were infested. *Fusarium* was the most frequently isolated pathogen in the pea root rot complex, and the species included *F. avenaceum* Schlecht., *F. culmorum* (W.G. Smith) Sacc., *F. equiseti* (Corda.) Sacc., *F. oxysporum* Schlecht., *F. oxysporum* var. *redolens* (Wr.) Gordon, and *F. solani* (Mart.) Sacc. In processing peas, powdery mildew (*Erysiphe pisi* DC.), Alternaria leaf spot (*Alternaria alternata* (Fr.) Keissl.) (Fig. 2) and Ascochyta blight (*Ascochyta pinodes* L.K. Jones) were encountered only in 1978. Bacterial blight (*Pseudomonas pisi* Sackett.) was present in processing pea fields during both years, but was more common during 1979. Conversely, Fusarium wilt (*F. oxysporum*) incidence was somewhat higher in 1978 (0.5% incidence in 1979).

In dry peas, powdery mildew incidence was invariably high towards the later part of the season (Tables 2 and 3). In 1979, all 11 fields visited in mid-August had powdery mildew with five fields having disease incidence levels of 100%. Ascochyta blight and Alternaria leaf spot were also more prevalent late in the season. In most cases, these occurred in mixed infections (Fig. 3) along with powdery mildew. Downy mildew (0.6% late season incidence in 1978), Ascochyta foot rot (*Ascochyta pinodella* L.K. Jones) and bacterial blight, in particular, were higher in incidence during 1979. Low levels of Sclerotinia stem rot (*Sclerotinia sclerotiorum* (Lib.) de Bary) and gray mold (*Botrytis cinerea* Pers. ex Fr.) infections on stems and pods were observed in dry peas surveyed in 1979. Very low levels (< 1% incidence) of Fusarium wilt were recorded in dry pea crops during both surveys.

Processing and dry beans

Root rot was by far the most prevalent disease during both years (Tables 2 and 3). In laboratory isolations, *F. acuminatum* Ell. & Ev., *F. oxysporum, F. solani* and *Rhizoctonia solani* were found associated with diseased roots, but no *Pythium* spp. were present. White mold (*S. sclerotiorum*) occurred on dry beans each year with the highest incidence recorded in 1978. Late season visits revealed that bacterial blight was present in several fields of both kinds of beans. In dry beans, halo blight (*Pseudomonas phaseolicola* (Burkh.) Dows.) was more common during 1978, whereas common blight (*Xanthomonas phaseoli* (E.F. Sm.) Dows.) was more prevalent in 1979 (late season incidence = 1.6%). During 1979, in one field of late-planted processing beans, frequent irrigation resulted in an epidemic of bacterial blight with clearly visible foci of infection (Fig. 4). Though both bacterial blight pathogens were present in this field, *X. phaseoli* appeared to cause greater damage. Herbicide injury from drift of 2,4-D or MCPA was observed in several dry bean crops surveyed in 1978. A similar case was recorded in 1979 on processing beans. In 1979, a few dry bean fields exhibited trifluralin- or dinitramine-type herbicide damage on roots. Low levels of Botrytis gray mold were present each year in the dry bean crops.

Fababeans

Foliar diseases, developing mostly later in the season, were the most prevalent problems during both years (Tables 2 and 3). Of these, Alternaria leaf spot (*A. alternata*) (Fig. 5) was encountered in all fababean fields. Leaf infections by *Ascochyta fabae* Speg. were recorded in a few fields in 1978, but were not found during the 1979 survey. Chocolate leaf spot incidence was markedly higher in 1979. Isolations from chocolate leaf spot lesions yielded B. *cinerea*. Several such isolates of B. *cinerea* were subsequently used in attempts to re-infect fababean seedlings in the greenhouse but were non-aggressive (sensu Jarvis, 1977) and failed to reproduce the disease. Powdery mildew was found to be caused by *Microsphaera penicillata* (Wallr. ex Fr.) Lev. var. *ludens* (Salmon) Cooke. Root rot (*Fusarium oxysporum, F. avenaceum* and *R. solani*) incidence was higher in 1978 (2.3%) than in 1979 (0.7%). In 1979, the disease was recorded in 40% and 22% of the fababeans surveyed during early and late season, respectively.

Table 2. Diseases of pulse crops in Alberta in 1978.

Pulses	No. fields visited*	Diseases;	Percent fields diseased		Mean disease incidence (%)	
			Early season	Late season	Early season	Late season
Processing peas	20	Root rot	55.0	75.0	26.5	35.8
		Powdery mildew	0.0	45.0	0.0	24.4
		Alternaria leaf spot	0.0	45.0	0.0	22.6
		Ascochyta blight	0.0	25.0	0.0	11.6
		Downy mildew	0.0	30.0	0.0	7.2
		Edema	0.0	15.0	0.0	2.4
		Fusarium wilt	15.0	25.0	0.2	1.2
		Bacterial blight	0.0	20.0	0.0	1.0
Dry peas	22	Powdery mildew	0.0	81.8	0.0	59.0
		Alternaria leaf spot	0.0	45.5	0.0	22.0
		Ascochyta blight	0.0	45.5	0.0	21.8
		Bacterial blight	9.1	4.5	0.2	3.1
		Root rot	36.4	4.5	4.6	2.6
		Ascochyta foot rot	0.0	9.1	0.0	1.2
		Low temperature injury	27.3	-	2.4	-
Dry beans	22	Herbicide injury	0.0	11.4	0.0	17.0
		White mold	0.0	59.1	0.0	4.6
		Root rot	81.8	11.4	14.2	4.6
		Halo blight	4.5	13.7	0.6	4.6
		Gray mold	0.0	11.4	0.0	1.6
Fababeans	21	Alternaria leaf spot	0.0	100.0	0.0	32.0
		Powdery mildew	0.0	57.1	0.0	20"1
		Ascochyta blight	0.0	19.0	0.0	6.8
		Edema on pods	0.0	47.6	0.0	4.5
		Chocolate leaf spot	0.0	42.9	0.0	2.6
		Root rot	71.4	61.9	3.5	1.1

* Early and late season visits were made to the same fields.

‡ Includes infectious and noninfectious diseases.

A pod and seed spot disease similar to one described on fababeans in Germany by Griesbach (6) was found in three fields in 1978. The main disease symptom was sunken black spots on pods and seeds. These yielded a Pseudomonas-like bacterium in culture and symptoms were reproduced by culating detached fababean pods in petri dishes (Fig. 6). Physiological edema on pods, seen as small black warts (Fig. 7), was observed in several fields each year of the survey (Tables 2 and 3). In 1978, 2,4-D herbicide damage was seen along the margins of several fields. Trace levels of Sclerotinia stem rot and bean yellow mosaic were recorded during the 1979 survey. Bean yellow mosaic was the only virus disease observed in all of the pulse crops inspected over the two seasons.

Soybeans

Bacterial blight (Pseudomonas *glycinea* Coerper) was the only infectious disease observed (Table 3). In one field, over 75% of the plants had foliar infections. Dicamba-type injury was observed in two fields located side by side. Damage from over-irrigation was seen in one field.

Lentils

All fields had a low incidence of root disease (Table 3) which was characterized by cortical rot and sloughing-off. Diseased plants appeared chlorotic, somewhat wilted and were killed when infection was severe. *Fusarium solani, F.* oxysporum and *F.* oxysporum var. *redolens* were isolated from the necrotic root tissue.

Discussion

Root rot was a major disease on virtually all of the pulses surveyed, particularly on processing peas and beans. Our

observation of its high incidence in all processing pea producing areas in Alberta are parallel with those made in an extensive nationwide survey by Basu *et. al.* (1). *Fusarium* spp. were, by far, the most prevalent and serious root rot pathogens, except in processing beans where *R. solani* was equally damaging. In peas, *F. oxysporum* was frequently isolated from plants with root rot and appeared to be more important in promoting root decay than in inciting the near wilt disease. Dry peas were not affected by root rot as frequently as processing peas. The reasons for this difference are not completely understood, though two possible explanations can be offered. Processing pea growers, most of whom have grown canning or freezer peas for many years, often quickly return the same fields back to pea production. By contrast, dry peas are usually grown by different growers who do not crop their land to peas as frequently. Another conducive factor may be the comparatively higher frequency with which processing pea crops are irrigated, thus giving higher incidences of root rot especially where *Pythium* spp. may be present. As in Saskatchewan (9, 10, 12), our surveys of dry pea fields in Alberta have shown that, while root rot is present, other diseases are relatively more serious. In fababeans, root rot incidence was somewhat higher in 1978. In part, this may be due to different cropping patterns, since a large number of fababean fields surveyed during 1978 had had other pulse crops grown in them in previous years.

Powdery' mildew was more abundant in dry pea and fababean crops during 1979, probably due to the drier, warmer weather conditions in that year. On *Vicia* spp., *Erysiphe polygoni* DC. ex Merat as well as *Microsphaera penicillata* have been reported as causes of powdery mildew (4, 17). In Alberta, our studies revealed that only *M.*

Table 3. Diseases of pulse crops in Alberta in 1979.

Pulses	No. fields visited*	Diseases;	Percent fields diseased		Mean disease incidence (%)	
			Early season	Late season	Early season	Late season
Processing peas	15, 14	Root rot	100.0	100.0	16.1	30.1
		Downy mildew	0.0	57.1	0.0	9.5
		Bacterial blight	13.3	92.9	1.4	7.5
Dry peas	15, 11	Powdery mildew	0.0	100.0	0.0†	85.5
		Ascochyta blight	6.7	63.6	trace	34.8
		Alternaria leaf spot	0.0	63.6	0.0	26.4
		Downy mildew	0.0	63.6	0.0	16.7
		Bacterial blight	73.3	90.9	3.5	14.2
		Root rot	100.0	72.7	8.3	8.2
		Hail injury	0.0	18.2	0.0	7.2
		Ascochyta foot rot	0.0	36.4	0.0	5.3
		Sclerotinia stem rot	0.0	45.5	0.0	2.5
Processing beans	15, 10	Root rot	100.0	‡	16.6	-
		Common blight	0.0	60.0†	0.0	22.9
		Halo blight	0.0	60.0	0.0	5.3
Dry beans	15, 15	Root rot	86.7	-	3.6	-
		White mold	0.0	66.7	0.0	3.3
Fababeans	15, 9	Chocolate leaf spot	0.0	100.0	0.0	50.0
		Powdery mildew	13.3	88.9	3.1	43.4
		Alternaria leaf spot	0.0	100.0	0.0	19.5
		Edema on pods	6.7	77.8	0.8	4.5
Soybeans	5	Bacterial blight	40.0	-	14.8	-
		Herbicide injury	40.0	-	3.1	-
Lentils	5	Fusarium root rot	100.0	-	2.7	-

* Number of fields visited, early season and late season, respectively. Soybean and lentil crops were visited just once.

‡ Includes infectious and non-infectious diseases.

† Incidence 0.01%.

‡ No disease assessments were made.

penicillata var. ***ludens*** was present, as has been shown elsewhere in Western Canada (7, 11, 13). In processing peas, crops are harvested several weeks earlier than peas grown for seed and thus escape high powdery mildew infection. The practice of less frequent irrigations in dry pea crops may also explain the higher powdery mildew incidence (3).

In spite of a very dry summer during 1979, incidence of chocolate leaf spot on fababeans was surprisingly high and was markedly greater than that recorded in 1978. Favorable conditions for infection may have occurred during periods of high humidity following irrigation. Though both ***Botrytis fabae*** Sard. and ***B. cinerea*** have been reported as pathogens on ***Vicia faba*** (4, 11, 16), the former, a more aggressive and damaging species, was not encountered either during field surveys or in laboratory isolations. Also, ***B. fabae*** infections were not observed in fababean fields during extension visits and in seed tests done in 1979 (S. P. Sumar, unpubl. data) on samples from commercial fababean seed lots. Seed tests also revealed that Alberta-grown seed stocks were essentially free of infection by ***A. fabae,*** which was reflected by the very low field incidence of ***Ascochyfa*** blight. This disease was found only in 1978, likely resulting from a single infected seed lot. At the present time, ***A. fabae,*** like ***B. fabae,*** is thought not to be established in Alberta. ***Ascochyfa fabae,*** however, is known to occur elsewhere in Western Canada (2, 9, 11 and P.D. Kharbanda, pers. comm). Isolates of ***Alternaria alternata*** from diseased fababean leaf tissue did not reinfect young fababean plants in greenhouse tests. Though this fungus was frequently isolated from fababean seed in laboratory tests (unpubl. data), its mild pathogenicity and predominance in the late season, especially on senescing leaves, lead us to conclude that the fungus is a relatively unimportant pathogen.

The frequent occurrence of bacterial blights in pea and bean crops in Alberta suggests that infected seed provides most of the primary inoculum. Sprinkler irrigation was observed to be a major means of spread within fields. In soybeans, contaminated seed lots (S. P. Sumar, unpubl. data) resulted in a very high field incidence of bacterial blight (***P. glycinea***).

Lentils have become a well-established crop in Alberta. Although Fusarium root rot was present in all lentil fields surveyed, its incidence was low and neither yields nor stands appeared to be significantly affected. Although lentils grown in Alberta do not appear, at the present time, to be as seriously affected by diseases as elsewhere on the Prairies (9, 10, 12), diseases will likely become more important as production becomes more intensive.

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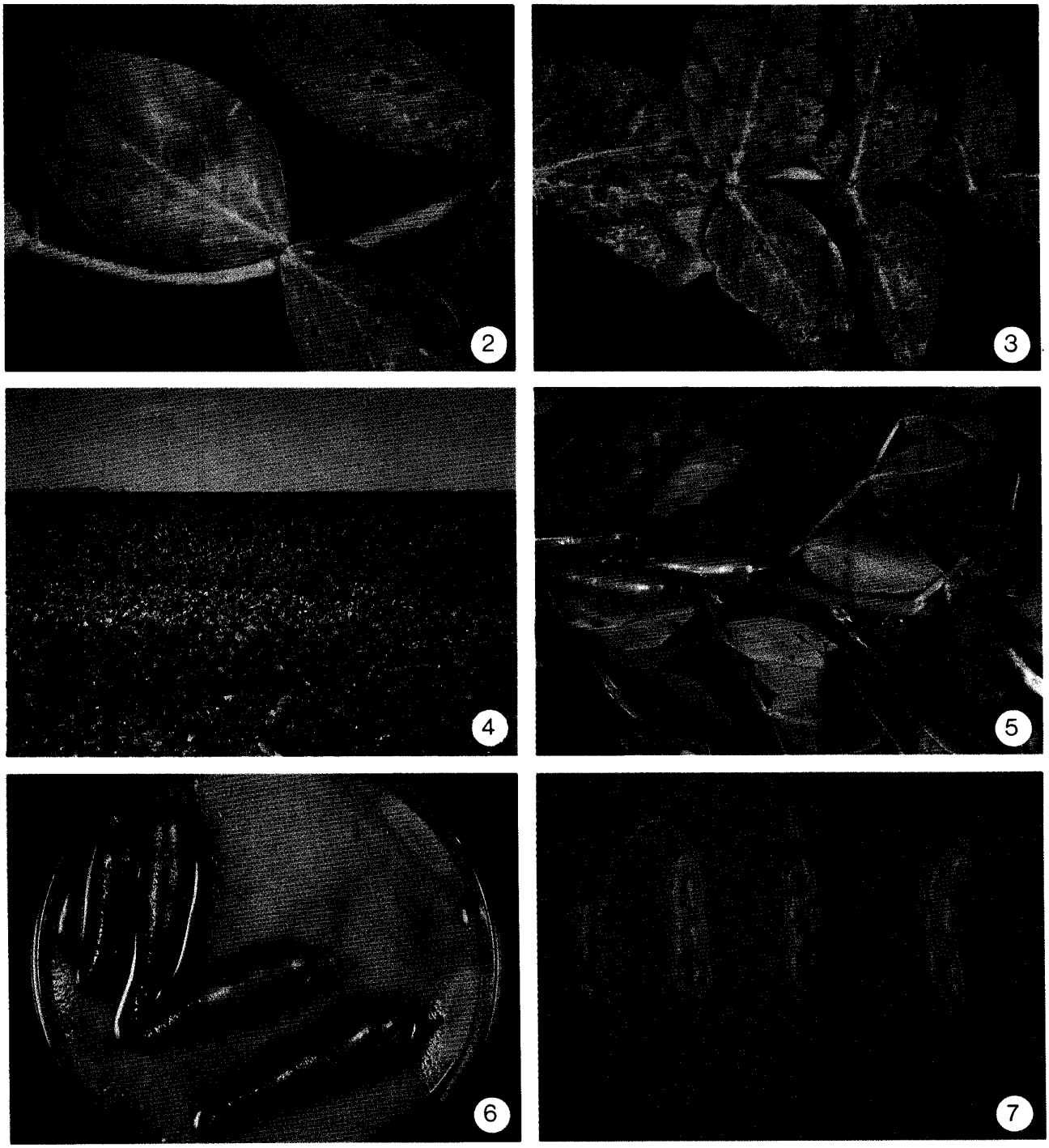

Figure **2** Alternaria leaf spot *(Alternaria alternata)* on the leaves of processing pea. Figure **3** Mixed infections of *Alternaria alternata* and *Ascochyta pinodes* on pea leaves. Figure **4** Foci of infection by *Xanthomonas phaseoli* and *Pseudomonas phaseolicola* in a field of processing beans. Figure ***5*** Alternaria leaf spot *(Alternaria alternata)* on fababean. Figure ***6*** Bacterial pod spot *(Pseudomonas* sp.) on fababean. Figure **7** Black wart – like growths (edema) on fababean pods.