Oilseeds and Special Crops / Oleagineux et cultures speciales

CROP: Canola

LOCATION: Manitoba

NAME AND AGENCY:

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TITLE: DISTRIBUTION, PREVALENCE AND INCIDENCE OF CANOLA DISEASES IN MANITOBA 1993

METHODS: Two surveys were conducted in Manitoba. During the first week of September 64 crops of *Brassica napus* and seven of *B. rapa* (syn. *B. campestris)* were surveyed in the western and northern crop districts. During the second, 18 crops of *B. napus* were surveyed in the eastern and Interlake crop districts. The presence of various diseases was noted in each field and disease incidence was determined from a sample of 50 plants. The route taken in the surveys is shown in Figure 1. In addition 113 samples of canola were submitted for analysis to the Manitoba Agriculture Crop Diagnostic Centre.

RESULTS AND COMMENTS: Sclerotinia stem rot caused by *Sclerotinia sclerotiorum* was observed in 84 of 89 crops (94.4%). The percentage of infested crops ranged from 81.8% in crop district 11 to 100% in crop districts 1, 2, 4, 6, 7 and 9 (Table 1). Mean disease incidence ranged from 21% in crop district 1 to 41.4% in crop district 5 (Table 2). On an overall province-wide basis the mean incidence of sclerotinia was 29.1% (Table 2). This level of infection would likely result in about a 15% yield loss based on research conducted by Morrall *et al.* The estimated yield loss in 1993 of 15% was higher than the estimated yield loss in 1992 of between 2 and 8% depending on crop region (C. G.J. van den Berg and R.G. Platford, 1993).

Blackleg caused by *Leptosphaeria maculans* was observed in 37 of 89 crops (41.6%) (Table 1). The mean incidence of infected plants ranged from 0 in crop districts 4 and 9 to 17.5% in crop district 8 (Table 2). Blackleg was not found in every crop district surveyed, unlike 1992 (C.G.J. van den Berg and R.G. Platford, 1993). However, the incidence in the districts where it was detected was generally higher in 1993 than in to 1992. The mean incidence of blackleg-infected plants on a province-wide basis was 6.2% (Table 2) which would likely have caused an average yield reduction of less than 3%.

Foot rot was observed in 23 of 89 crops surveyed (25.8%) (Table 1). The mean disease incidence ranged from 0 in crop districts 4 & 5 to 3.5% in crop district 2 and 3.1% in crop district 11 (Table 2). The incidence of foot rot was higher in 1993 than 1992. A contributing factor was the excess soil moisture and below normal temperatures. Another disease detected was staghead (caused by *Albugo candida*) in three crops of *B. rapa* in crop district 3. Black spot (caused by *Alternaria* spp.) was found at trace to moderate level in almost all crops surveyed. The estimated yield loss from black spot was less than 1%. Aster yellows was observed in the survey but could not be accurately measured as most crops surveyed were already swathed. Grey stem caused by *Pseudocercosporella capsellae* was observed in five crops of *B. rapa* in crop districts 3, 4, 5 and 6 but was not considered to have caused any loss in yield.

In Manitoba, the 1993 growing season was cooler than normal, as in 1992, and most regions except the extreme southwest received a higher than normal amount of precipitation. Several fields in crop districts 8 & 11 were observed to have high levels of plants that died prematurely due to suffocation from excessively high soil moisture levels.

Despite the disease loss, notably from sclerotinia stem rot, canola yields on a province wide basis were close to normal and most of the crop graded No. 1. The cool, wet weather favoured the growth of canola and improved growth compensated somewhat for disease loss.

Of the 113 samples submitted to the Manitoba Agriculture Crop Diagnostic Centre, 18 showed sclerotinia stem rot, 11 showed root rot, six showed downy mildew, four showed blackspot, four showed blackleg and one showed staghead. In addition to diseases, 46 samples showed evidence of herbicide injury, 18 of sulphur deficiency and five environmental stress, primarily from excess water. Several samples of seedlings were affected by a severe late May frost.

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Table 1. Prevalence of diseases of canola in Manitoba - 1993.

CROP DISTRICT	NO. OF CROPS	PERCENT CROPS INFECTED			
		SCLEROTINIA	BLACKLEG	FOOT ROT	STAGHEAD
1	4	100	100	50	
2	4	100	100	50	
3	13	92	39	31	15
4	6	100			
5	12	92	58		
6	10	100	30	30	
7	8	100	25	38	
8	14	93	71	36	
9	7	100		14	
11	11	82	18	27	
Manitoba Average	89	94	42	26	2

Table 2. Mean percentage incidence of diseases of canola in Manitoba in 1993.

CROP DISTRICT	SCLEROTINIA	BLACKLEG	FOOT ROT
1	21.0	13.0	1.5
2	25.5	10.0	3.5
3	26.8	4.6	1.7
4	34.7	0	0
5	41.4	4.4	0
6	34.0	1.6	1.8
7	27.0	6.5	1.0
8	30.9	17.5	2.9
9	28.6	0	0.6
11	21.6	4.5	3.1
Manitoba Average	29.1	6.2	1.7

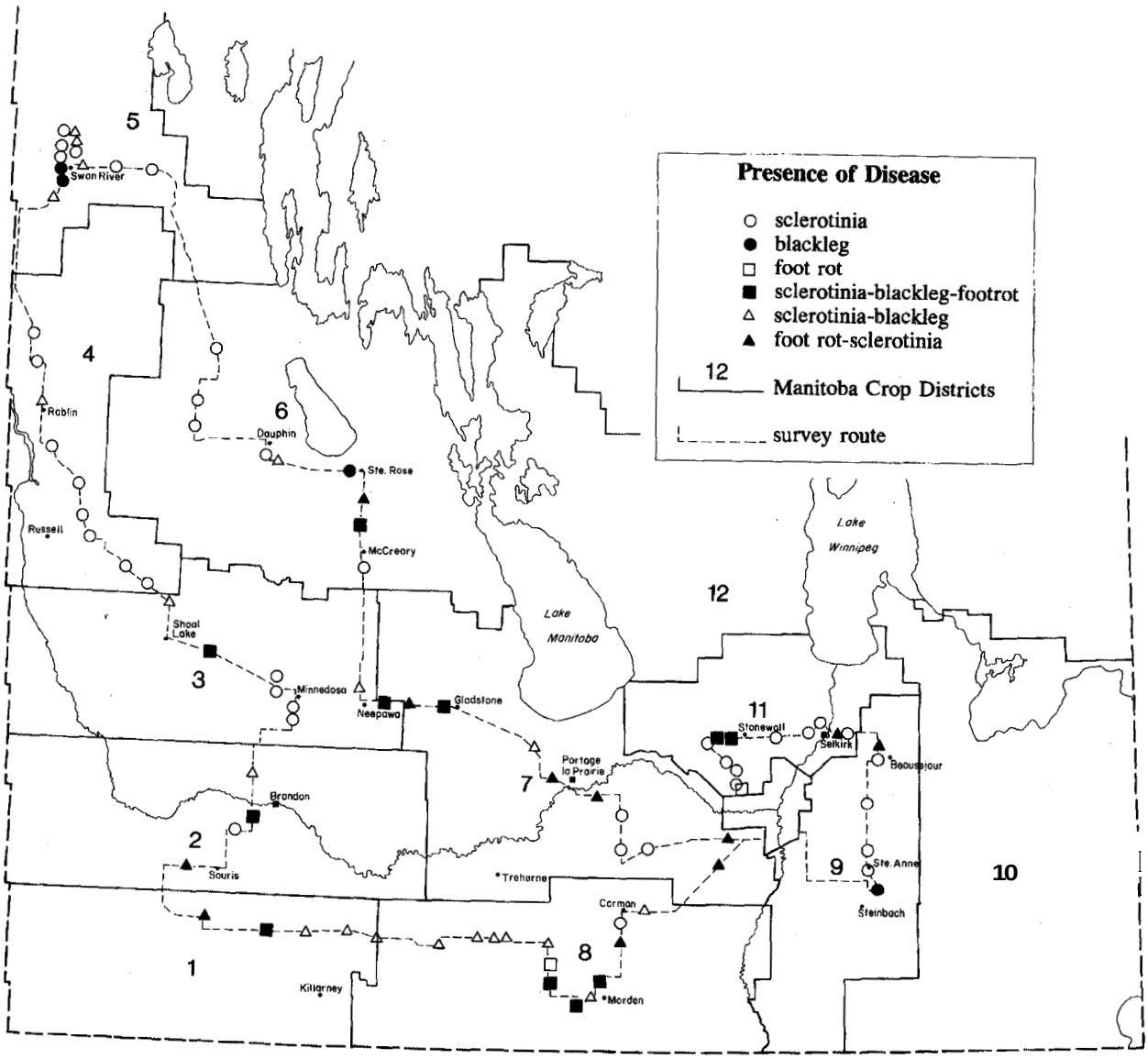

Figure 1. Distribution of fields included in Manitoba canola survey, 1993.

CROP: Canola
LOCATION: Central Saskatchewan

NAME AND AGENCY:
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TITLE: CHANGES IN BLACKLEG INCIDENCE, 1991-93, WITH NOTES ON OTHER DISEASES

METHODS: Eleven rural municipalities (RM's) around Saskatoon (Fig. 1) were visited in 1991, 1992, and 1993, and standing stubble from at least five canola (*Brassica napus* [BN] or *B. rapa* [BR]) crops sampled annually in each one. Seventy crops were sampled in 1991, 55 in 1992, and 73 in 1993. Results of a 1991 survey of 25 crops in five RM's in the Prince Albert area, and some of the other 1991 data, were part of an earlier report (3). In 1993, an additional survey of 10 crops was conducted in the Watrous area, 100 km S.E. of Saskatoon (Fig. 1). This survey was principally in RM's 281 and 310. In 1993, the 83 crops surveyed were identified to species using swathed material or small groups of standing plants that had been missed during harvesting operations. There were 59 fields of BN and 24 of BR.

All the surveys were primarily for blackleg (*Leptosphaeria* maculans), but disease incidence (DI) and severity also were recorded for other pathogens. Records were made of overall blackleg incidence (any infections on the stubble) and of severe cankers. The latter were those that visibly weakened or destroyed the structural integrity of tissues at the stem base. Methods of sampling and identifying strains of *L.* maculans were as previously described (3).

RESULTS AND DISCUSSION: The virulent strain of *L.* maculans was the predominant one in central Saskatchewan in all three years. Mean DI in the 11 RM's in 1991, 1992, and 1993, was 97, 32, and 75%, respectively. Mean incidence of severe basal stem canker was 12% in 1991; it was 1% or less in each of the other two years (Table 1). Mean DI in the Watrous area in 1993 was 58%. In 1993 the highest concentrations of BR were in the northeastern RM's 401, 403, and 431 (Fig. 1). Mean DI in the 24 BR fields over seven RM's was 83%. Twenty BN crops from the same seven RM's had a mean DI of 73%; that in the remaining 39 BN crops was 67%. Mean DI in four BR crops near Watrous was 78%, whereas that for four BN crops in the same two RM's was 43%.

June is the critical month for ascospore discharge and infection of young canola plants by *L.* maculans (Petrie, unpublished data). June precipitation at Saskatoon totalled 136, 15 and 58 mm in 1991, 1992, and 1993, respectively (Table 2). Average precipitation for the 11 RM's from late May to early July, 1991-93, was 159, 24, and 168 mm (Table 1). Low rainfall in June was a major factor contributing to low blackleg levels in 1992. Temperature also has a profound effect on the rate of blackleg development in infected plants (1). In 1992 and 1993, cool, wet conditions in July and August (Table 2) favored prolonged flowering and vegetative growth of canola. In both years, the "latent" (symptomless) phase of the disease (2) was also prolonged. External stem symptoms developed slowly, and stem lesions often remained small in late September. Conversely, above normal temperatures in August, 1991 (Table 2), promoted conspicuous premature ripening of many canola plants infected at the stem base.

Improved blackleg resistance in currently grown *B. napus* cultivars also reduced the blackleg severity level. In 1991, the highly susceptible cultivar, Westar, made up 17.5% of the canola hectarage in Saskatchewan, or 243, 667 ha. In 1992, Westar took up only 3.7% of the hectarage, or 50,911 ha. (Data from 1991 and 1992 Prairie Grain Variety Surveys prepared by the three Prairie Wheat Pools.) Lenghtened rotations out of canola also contributed to the reduced blackleg incidences. Despite very high incidence of blackleg in 1991, the average basal stem canker incidence was 12%. Four percent of the 1991 fields had an incidence of severe stem canker of 50% or higher, and 13% had an incidence of 25% or higher. The relatively high stem canker levels in RM's 373 and 402 (Table 1) were directly related to short intervals between canola crops in some of the fields sampled.

OTHER DISEASES: In May, 1992, snow mould (*Typhula* sp.) was observed in several canola stubble fields, particularly between Grandora and Vanscoy in RM 345. Stubble-born *Typhula* sclerotia were especially noticeable in a field of the BN cultivar Global near Grandora that had long stubble and considerable snow retention in the winter of 1991-92. Sclerotinia stem rot *(Sclerotinia sclerotiorum*) was prevalent only in 1993. The mean stem rot DI varied from 1% in RM 344 to 9% in RM's 345 and 373. The average for the 11 RM's was 5%. Thirty percent of the plants in one field in RM 345 were infected, and 39% in a field in RM 373. Stubble crops of BR were often discolored by grey stem (*Pseudocercosporella capsellae*) in 1993, particularly in RM 401. Also in 1993, high incidences of alternaria black spot (*A. brassicae* and *A. raphani*) were observed on swathed plants in many fields throughout the area. Pod spotting was general, but surface area affected rarely exceeded 5%.

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Table 1. Blackleg infection on stubble of canola crops in eleven rural municipalities in central Saskatchewan, 1991-93.*

Rural municipality	Av. % incidence & range of stem infections			Av. % incidence of severe basal stem cankers			Total rainfall (mm)**		
	1991	1992	1993	1991	1992	1993	1991	1992	1993
343 Blucher	100	20 (2-55)	63 (53-76)	12 (0-44)	0.0	0.3	156	21	148
344 Corman Park	80 (40-100)	72 (0-97)	80 (59-100)	4 (0-12)	1.6	0.9	150	11	221
345 Vanscoy	99 (91-100)	51 (26-74)	70 (8-100)	18 (3-60)	0.0	1.6	215	26	121
372 Grant	99 (96-100)	25 (4-49)	85 (63-100)	10 (0-26)	0.0	2.1	232	30	150
373 Aberdeen	97 (93-100)	22 (4-48)	62 (52-78)	29 (6-75)	0.0	0.0	173	36	124
401 Hoodoo	100 (99-100)	40 (7-67)	81 (67-90)	15 (0-63)	0.0	0.0	154	6	187
402 Fish Creek	100	6 (2-8)	89 (85-92)	23 (1-46)	0.0	0.3	157	38	157
403 Rosthern	98 (86-100)	25 (2-87)	80 (54-100)	4 (0-24)	0.7	2.8	128	26	168
404 Laird	100	56 (5-89)	68 (58-77)	9 (0-24)	0.7	0.9	139	14	210
405 Great Bend	98 (92-100)	29 (2-56)	57 (32-80)	7 (1-16)	0.0	0.3	123	22	171
431 St. Louis	100	7 (2-21)	85 (63-97)	3 (0-16)	0.0	0.0	125	38	189
Averages (ranges)	97 (40-100)	32 (0-97)	75 (8-100)	12 (0-75)	0.3	0.8	159	24	168

* Blackleg was assessed on 50 stubble plants from each of 5-7 fields per rural municipality per year.

** Precipitation data (late May to early July annually) from weekly Crop and Weather Report, Saskatchewan Agriculture and Food, Statistics Branch, Regina, Sask.

Table 2. Total monthly precipitation and monthly mean temperature at Saskatoon, May-August, 1991-93.*

Year	Precipitation (mm)				Mean temperature (°C)			
	May	June	July	August	May	June	July	August
Normal**	44.2	59.0	54.2	36.8	11.5	15.7	18.5	17.4
1991	72.4	136.0	49.2	14.0	11.7	16.7	18.7	21.0
1992	46.6	14.6	66.2	47.4	10.4	15.1	16.8	15.5
1993	36.8	58.4	75.3	64.3	11.3	13.7	15.2	15.9

* From Environment Canada, Atmospheric Environment Service, Monthly Meteorological Summary, Saskatoon 'A', Saskatchewan.

** Averages determined by Environment Canada.

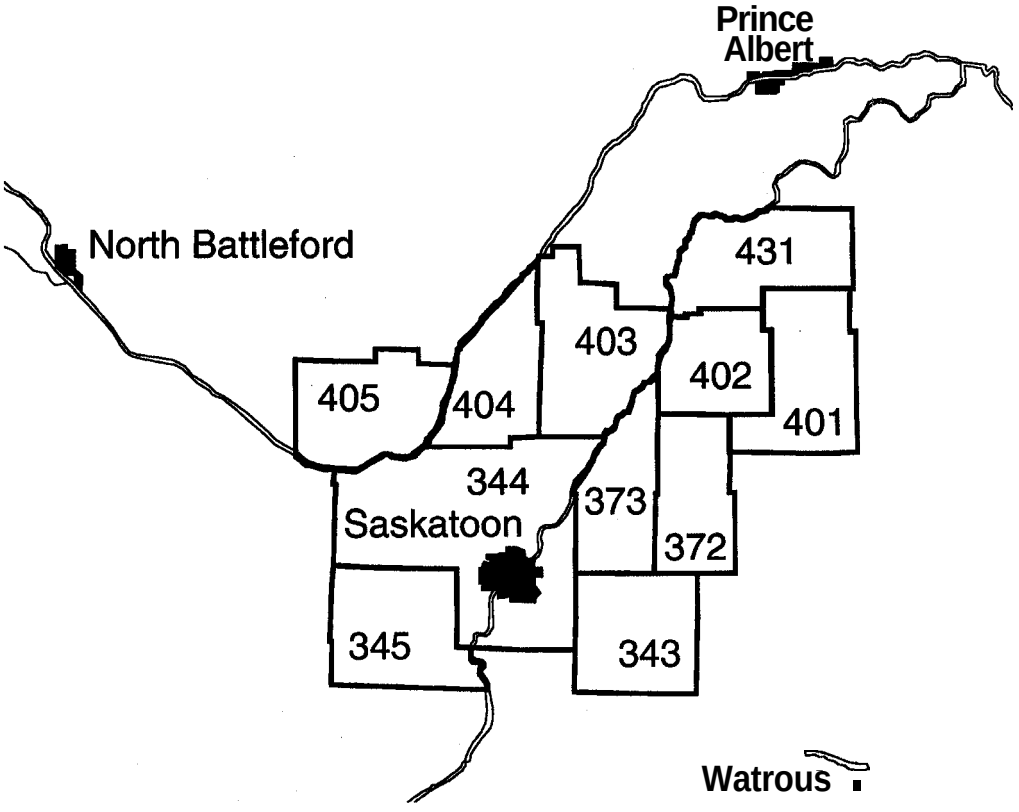

Figure 1. Eleven Saskatchewan rural municipalities in which blackleg surveys were conducted in canola stubble crops, 1991-93.

CROP: Canola

LOCATION: Alberta

NAME AND AGENCY:

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TITLE: BLACKLEG OF CANOLA SURVEY IN ALBERTA - 1993

INTRODUCTION AND METHODS: A province-wide survey, now in its sixth year, was carried out for virulent blackleg of canola (*Leptosphaeria maculans*). The cooperative survey was done by fieldmen in each of Alberta's 67 municipalities. In addition Agriculture Canada seed inspectors reported on the presence of virulent blackleg in seed crops in the province during their annual inspections in July. Diagnostic confirmation for the disease was available in laboratories at Fairview, Brooks, and at the Environmental Centre in Vegreville.

The survey by the fieldman was based on inspecting one crop of canola for every 2,000 ha of canola grown in each municipality. Fieldmen randomly checked crops for virulent blackleg, particularly in areas or regions where they suspected shortened crop rotations, i.e., continuous canola or canola every second year. Crops were sampled as previously described (1, 3).

RESULTS AND COMMENTS: In the east and east-central regions of Alberta, canola yields were at record levels. Nevertheless virulent blackleg was diagnosed in a third of all crops surveyed. Infection levels were usually less than 5% but a few exceptions were as high as 100%. In the Peace Region of Alberta comprising almost one third of the provincial canola acreage, infestation levels went from one crop in 1992 to 102 crops with virulent blackleg in 1993. A detailed report has been published in this issue of the *Can. Plant Dis. Surv.* (2). The virulent blackleg infestation level represents around 8% of the crops surveyed in this region.

Agriculture Canada seed inspectors reported 36 crops and plots totalling 800 ha with trace levels of virulent blackleg in the Vermilion region. Infections were all on lower leaves implicating ascospores from infected stubble in nearby fields as the likely source. One 14 ha seed crop of Horizon canola at Grande Prairie was also confirmed with a trace leaf infection of this disease. The seed inspectors surveyed 494 crops for a total of 9,892 ha province wide.

Testing of Alberta canola seed up to April 1993 by private laboratories demonstrated 13 instances of blackleg infected lots out of 1,315 *seed* lots examined. Infestation levels in the seed samples were usually at 0.1 to 0.2% of seeds examined.

Virulent blackleg was not detected in crops in Census Divisions divisions 1 and 2, in southern Alberta where 20% of the provincial canola acreage was grown this year. In total not including seed crops 1770 crops were inspected province-wide, and 192 were found to be positive for virulent blackleg, giving an average percent infestation level of 10.8% of crops surveyed.

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CROP: Canola

LOCATION: Alberta

NAME AND AGENCY:

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TITLE: THE FIRST REPORT ON EXTENSIVE SPREAD AND DISTRIBUTION OF VIRULENT BLACKLEG OF CANOLA IN THE PEACE RIVER REGION OF ALBERTA, 1993

INTRODUCTION AND METHODS: The annual survey for virulent blackleg (*Leptosphaeria maculans*) of canola in the Peace River region of Alberta was conducted in July and August, 1993 with the cooperation of agricultural fieldmen in all 13 provincial municipalities. Canola crops were randomly selected; however, fields with shortened or no crop rotation were given priority. All canola crops within an 8 km radius of one field in the Municipal District (MD) of Smoky River where Alto canola (*Brassica napus*) was confirmed with trace levels of virulent blackleg in 1992 (1), were included in the survey. Combined with other canola crops randomly selected, a total of 350 crops were surveyed in the MD of Smoky River. In the County of Grande Prairie, over 600 crops were checked. All samples were tested to confirm virulent blackleg at the Regional Crops Laboratory, Fairview or the Pest Diagnostic Clinic, Alberta Environmental Centre, Vegreville (3). Crops were sampled as previously described (4).

RESULTS AND COMMENTS: A total of 1273 crops was surveyed in the Peace region (Figure 1). Of the 600 surveyed in the County of Grande Prairie, and 350 surveyed in the MD of Smoky River, 52 and 45, respectively, were confirmed with virulent blackleg. There were 5 other crops in two other municipalities where virulent blackleg was confirmed. The Regional Crops Laboratory in Fairview received canola specimens from 241 locations and confirmed 54 with virulent blackleg. The Diagnostic Clinic in Vegreville received canola specimens from 162 locations and identified 48 with positive virulent blackleg. Most of the canola crops had disease incidence at low or trace levels. Several had higher levels, ranging from 20-44%. One of the crops in the county of Grande Prairie was found to have infestation levels as high as 84% at some spots (2). Some of the cultivars surveyed were *B. napus* cvs, Alto, Excel, and Westar, and *B. rapa* cvs, Horizon, Parkland and Tobin which are all susceptible to blackleg. In all cases where a high disease incidence was recorded, farmers had grown canola in the same field more than once in the past four years, and several of them had grown it in both 1992 and 1993.

ACKNOWLEDGEMENTS: Thanks to the agricultural fieldmen and weed inspectors involved in surveying the fields, to the Canola Council of Canada agronomist, Brad Dowell for support and participation in the survey, to Rita Stevens, senior technician, Alberta Environmental Centre, Vegreville, and Ellen Dalke and JoAnne Loland, laboratory assistants, Regional Crops Laboratory, Fairview for their assistance with isolating and testing for virulence of blackleg from canola specimens.

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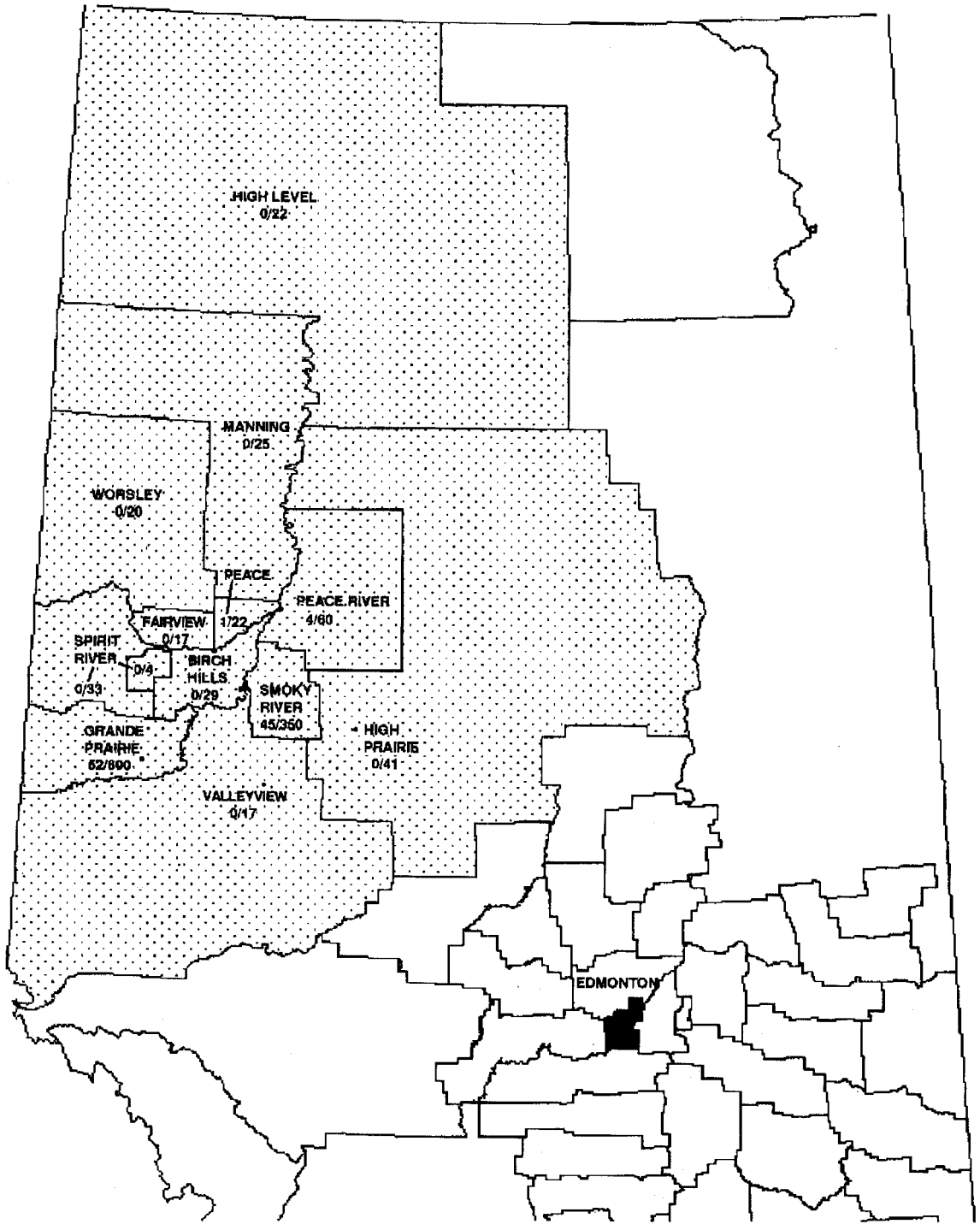

Numbers in municipalities indicate Blackleg infested crops over number **of** crops surveyed.

Figure 1. Prevalence of virulent blackleg of canola in Peace River region of Alberta in 1993.

CROP: Canola

LOCATION: Alberta

NAME AND AGENCY:

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TITLE: SURVEY OF CANOLA DISEASES IN THE PEACE RIVER REGION OF ALBERTA, 1993

METHODS: Commercial crops of canola were surveyed in the Beaverlodge and Fairview areas of the Peace River region of Alberta. In July and early August 12 canola crops (growth stage 4.3-4.4[1]) were sampled for brown girdling root rot (BGRR, *Rhizoctonia solani*, *Fusarium* spp., *Pythium* spp.) in the Beaverlodge area. Five plants were collected nonselectively at each of five sites per crop for a total of 25 plants per crop. The sampling sites were at least 25 m from the edge of the crop and >50 m apart. At Fairview, in mid August, 18 crops (growth stage 5.1-5.2 [1]) were sampled by nonselectively collecting ten plants at each of five sites along a W-shaped path, normally for a total of 50 plants per crop. However, in two crops only 45 plants were collected. The first site was 100 paces from the edge of each crop. Plants collected in both areas were assessed for BGRR using a 0-4 scale, where 0 = no lesions on the taproot, 1 = light brown lesions on taproot but no girdling, 2 = coalesced brown lesions on taproot but no girdling, 3 = dark brown lesions girdling taproot above main laterals (wirestem appearance), 4 = severe necrotic lesions on taproots, roots roted off and plant dead. The incidence of sclerotinia stem rot *(Sclerotinia sclerotiorum*), staghead (*Albugo candida*), and black spot (*Alternaria* spp.) recorded were also from samples collected in the Fairview area.

RESULTS AND COMMENTS: In 1993, BGRR remained the most common canola disease in the crops surveyed (Table 1). All crops were affected by BGRR; average incidence and severity of BGRR were slightly higher at Beaverlodge than in the Fairview area. Black spot and staghead were present in over 60% of the crops surveyed. However, the average incidence of black spot was higher than the average incidence of staghead. Sclerotinia stem rot was the least prevalent of the diseases surveyed at Fairview. The highest incidence of stem rot was 14%. Thus, for all crops stem rot remained below the level at which fungicide application would have been justified.

In three crops at Beaverlodge plants sampled for the assessment of BGRR were suspected to be infected with virulent blackleg (*Leptosphaeria maculans*). Plant samples were collected and sent to either the Alberta Environmental Centre at Vegreville, the Alberta Agriculture Regional Crops Laboratory at Fairview, or to the Agriculture Canada Research Station at Saskatoon to be tested. Plant samples from all three crops were confirmed to be infected with virulent blackleg. Trace levels of virulent blackleg were found in two crops. In the third crop the incidence ranged from 34-84%, based on a total of 10 sites distributed throughout the entire crop. At each site, disease incidence was assessed by starting on one side of a 1 m^2 quadrat placed on the soil surface, counting a total of 50 plants, and recording the number that were infected with blackleg. Disease severity was not assessed; however, severe basal stem cankers were present and resulted in significant premature ripening and crop lodging. This is the first report of significant levels of virulent blackleg in the County of Grande-Prairie.

ACKNOWLEDGEMENTS: The authors would like to thank P.D. Kharbanda and R. Stevens, Alberta Environmental Centre, Vegreville, Alberta, and R.K. Gugel and G.A. Petrie, Agriculture Canada Research Station, Saskatoon, Sask. for their assistance with the isolation and identification of virulent blackleg from plant samples.

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Table 1. Survey data for various canola diseases, Beaverlodge and Fairview, Alberta, 1993.

AREA & DISEASE	PREVALENCE (% OF CROPS INFECTED)	MEAN DISEASE INCIDENCE (%)			MEAN DISEASE SEVERITY		
		AVG	MIN	MAX	AVG	MIN	MAX
Beaverlodge							
BGRR*	100	98	92	100	1.9	1.1	2.6
Fairview							
BGRR	100	86	38	100	1.8	0.4	2.9
Sclerotinia	44	3	0	14			
Staghead	61	8	0	38			
Black spot	67	37	0	100			

* BGRR = brown girdling root rot.

CROP: Canola

LOCATION: British Columbia

NAME AND AGENCY:
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TITLE: 1993 CANOLA BLACKLEG SURVEY IN THE BRITISH COLUMBIA PEACE RIVER REGION

METHODS: The purpose of the survey was to determine whether the virulent strain of blackleg (*Leptosphaeria maculans*) had been introduced into the Peace River region of British Columbia. The survey was conducted from September 20 to 23, 1993 by 14 B.C.M.A.F.F. staff and one Canola Council representative. Every *Brassica napus* and every second *B. campestris* crop encountered was surveyed. Crops were sampled in an inverted W pattern starting 30 m from the field entry point. Ten plants were pulled and examined for blackleg every 30 m for a total of 50 stems per crop. A minimum of 50 additional plants were also examined for blackleg along the edge of the field. Stems with blackleg-like lesions or pycnidia were collected and retained for culturing at the provincial plant diagnostic lab. Blackleg cultures were forwarded to Dr. P. Ellis, Agriculture Canada Research Station, Vancouver, for ELISA testing using monoclonal antibodies.

RESULTS AND COMMENTS: Virulent blackleg was not detected in this survey. A total of 178 crops was surveyed comprising 11,525 ha out of 44,500 ha grown in 1993. Only three crops of *B. napus* were found. Samples from 56 crops were retained for culturing and ELISA testing. None of the samples had girdling lesions, and very few had basal stem cankers. Non-virulent blackleg was detected on samples from 50 crops. Virulent blackleg has not yet been detected in British Columbia.

ACKNOWLEDGEMENTS: Many thanks to the following for assisting with the survey: L. MacDonald, K. Murphy, K. Nickel, G. Carter, J. Dobb, J. Forbes, L. Bowd, K. Tosczak, A. Blair, T. Pittman, J. Moore, D. Coates, B. Greenhalgh, D. Scott, V. Joshi, B. Dowell.

CROP: Field Bean

LOCATION: Ontario

NAME AND AGENCY:
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TITLE: RECURRENCE OF ANTHRACNOSE DISEASE ON FIELD BEAN IN SOUTHWESTERN ONTARIO IN 1993

METHODS: In 1993, the field trials of field beans organized by the Ontario Pulse Committee were inspected by committee members on August 25 and a subsequent visit was made a week later. Forty-two lines of white beans and 39 lines of coloured beans at all nine locations (i.e. Ailsa Craig, Brussels, Elora, Exeter, Kippen, Mitchell, Shetland and Kemptville) were inspected for anthracnose. Disease samples were collected and sent to Harrow for examination, isolation and tests of pathogenicity.

RESULTS AND COMMENTS: Anthracnose was found in samples from six of nine Ontario field trial locations in southwestern Ontario. This was the first time since 1983 that anthracnose had been observed in Ontario. The six fields where anthracnose was present were at Kippen, Mitchell, Woodstock, Shetland, Exeter and Brussels. The three fields with no anthracnose were at Ailsa Craig, Elora and Kemptville. On August 25, several bean lines, including those carrying the Are gene (i.e. cvs. Centralia, OAC Sprint and Shetland), showed signs of the disease.

Examination of disease samples indicated the presence of anthracnose spores. Ten isolations were made from 12 plant samples collected from the six locations. The 10 pure cultures were inoculated on susceptible bean plants. Koch's postulates were fulfilled and the isolates were positively identified as *Colletotrichum lindemuthianum.*

Ontario field bean has been free of anthracnose for the past 10 years because of a strict program of seed treatment with benzimidazoles, a pedigree seed program and a breeding program which transferred a resistance gene (Are) to major commercial cultivars.

The occurrence of anthracnose in bean lines carrying the Are gene indicates two possibilities. One is that the Are lines are not homogenous and are segregating and the other is that the causal agent may be a new race of *C. lindemuthianum.* At present, an intensive investigation is being undertaken to resolve these questions.

CROP: Field Bean and Field Pea

LOCATION: MANITOBA

NAME AND AGENCY:
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TITLE: DISEASES OF FIELD PEA AND FIELD BEAN IN MANITOBA IN 1993 FIELD PEA

METHODS: A total of 21 crops were surveyed in the principal pea growing area in southern Manitoba in 1993. The survey was conducted during the last week of August. Crops were selected at random in different regions. Each crop was sampled by one person walking 100 m in the field following an inverted V pattern. Diseases were identified by symptoms and the incidence and severity of each disease were recorded. In addition, 27 samples of field pea were submitted for analysis to the Manitoba Agriculture Crop Diagnostic Centre by agricultural representatives and growers.

RESULTS AND COMMENTS: Crop emergence was good and stand was excellent in most of the crops surveyed. The above normal rainfall resulted in high soil moisture contents and excellent crop vigour. Such conditions created favourable microclimates for high levels of infection by *Mycosphaerella pinodes* and other foliar pathogens. A combination of unfavourable growing conditions due to excess soil moisture, various levels of flooding, and the high incidence of mycosphaerella blight weakened the root systems and resulted in premature ripening and severe losses, particularly in eastern and central Manitoba.

Mycosphaerella blight was observed as early as the middle of July and progressed very rapidly. By the last week in August, mycosphaerella blight was widespread on leaves, stems and pods in all the crops surveyed. The severity ranges were 20-80% leaf area infected, 5-50% stem area infected, and 10-40% pods infected in most crops surveyed.

Anthracnose (*Colletotrichum* spp.) was observed at trace levels in some crops. Traces of bacterial blight infections were observed early in the season but did not develop into high levels of severity later in the season. Powdery mildew (*Erysiphe polygoni*) was not observed until the last week in August, at the time when the crop was prematurely ripening, and the severity of this disease remained at low levels. Traces to 1% of downy mildew (*Peronospora viciae*) infections were observed in most crops surveyed.

Root rot (*Fusarium* spp.) was common in most crops surveyed and resulted in complete loss of several crops in the Carman Area. The excess soil moisture contributed to the root rot complex. Infections by *Sclerotinia sclerotiorum* were observed in most crops especially if they were heavily lodged and severity ranged from trace to 5% infected plants.

Of the 27 samples submitted to the Manitoba Agriculture Crop Diagnostic Centre, 11 showed mycosphaerella blight, four rhizoctonia and pythium seedling blight, two each bacterial blight downy mildew, or root rot (*Fusarium* spp.), and one each powdery mildew, anthracnose or sclerotinia. In addition, three samples were found to be affected by environmental stress and three by herbicide injury.

FIELD BEAN

METHODS: Eight crops of field bean in southern Manitoba were monitored on a weekly basis in 1993, from June 1 to August 31. In addition 26 samples of field bean submitted by agricutlural representatives and growers were examined by the Crop Diagnostic Centre.

RESULTS AND COMMENTS: The lack of heat units due to the exceptionally cool weather throughout the entire growing season delayed growth and reduced the yield in all crops. Bacterial infections including common blight *(Xanthomonas campestris* pv. *phaseoli*), halo blight *(Pseudomonassyringae* pv. *phaseolicola),* and brown spot *(P. syringae* pv. *syringae)* were predominant in July. Excess moisture in August resulted in flooding of fields in the central region causing extensive crop losses. By mid August, white mould (*Sclerotinia sclerotiorum)* was found in all crops surveyed with high disease severity in several crops in the Portage la Prairie area.

Twenty six samples of field bean submitted by agricultural representatives and growers were examined by the Crop Diagnostic Centre. Bacterial blight infections were identified in 13 samples, fusarium root rot in six, sclerotinia white mould in two, and alternaria leaf spot in one. In addition to diseases five samples were found to be affected by environmental stress and three samples affected by herbicide injury.

CROP: Dry Bean

LOCATION: Southern Alberta

NAME AND AGENCY:
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TITLE: SURVEY OF DISEASES OF DRY BEAN IN SOUTHERN ALBERTA IN 1993

METHODS: Thirty-one irrigated dry bean crops were surveyed during late August 1993 for white mold *(Sclerotiniasclerotiorum),* gray mold (*Botrytis cinerea)* and bacterial blights *(Xanthomonas campestris, Pseudomonas syringae)* in the area surrounding Bow Island, Alberta. Each field was sampled by selecting ten sites in a U-shaped pattern, approximately 20 m apart, with each site consisting of a 3 m long section of row (Howard and Huang, 1983). The number of plants with white mold symptoms, and the number of healthy plants were recorded at each site. The percentage of plants with white mold for the entire field was then calculated as the average of the ten sites. The incidence of gray mold and bacterial blights was estimated visually according to the following scale: (1) none (0% of plants infected), (2) trace (<1%), (3) light (1-10%), (4) moderate (11-25%), (5) severe (26-50%), (6) very severe (>50%).

RESULTS: White mold was present in all of the 31 dry bean crops surveyed (Table 1). The frequency of crops with moderate, severe, and very severe incidence of white mold was 42%, 19%, and 29% respectively. Six crops with very severe disease had more than 82% of plants infected or killed by the pathogen. The disease was widespread in the area surrounding Bow Island (Figure 1).

Gray mold was present in 19 of the 31 crops. The frequency of crops with moderate and severe incidence of gray mold was 16% and 3%, respectively. The disease was found throughout the survey area.

Bacterial blights were present in 24 of the crops. The frequency with moderate, severe, and very severe incidence of bacterial blights was 6%, 6%, and 3%, respectively. All the crops with severe and very severe disease were associated with injury of plants by hail. Bacterial blights were found mainly in the area south and southwest of Bow Island.

Table **1.** Diseases of dry bean in southern Alberta in **1993.**

Disease incidence (% of plants infected)	Number of crops		
	White mold	Gray mold	Bacterial blight
None (0%)	*0*	**12**	**7**
Trace (<1%)	*0*	**10**	**12**
Light **(1-10%)**	**3**	**3**	**7**
Moderate **(11-25%)**	**13**	**5**	**2**
Severe **(26-50%)**	**6**	**1**	**2**
Very Severe (>50%)	**9**	*0*	**1**

DISCUSSION: White mold was reported as a serious disease of dry beans in southern Alberta (Huang *et al.*, **1988).** The disease was both widespread and severe in **1993.** The exceptionally high incidence of white mold observed in many crops may be due to extended periods of cool, wet weather during the **1993** growing season. Although gray mold and bacterial blights were widespread, the incidence of these diseases was generally low in most fields in southern Alberta in **1993.**

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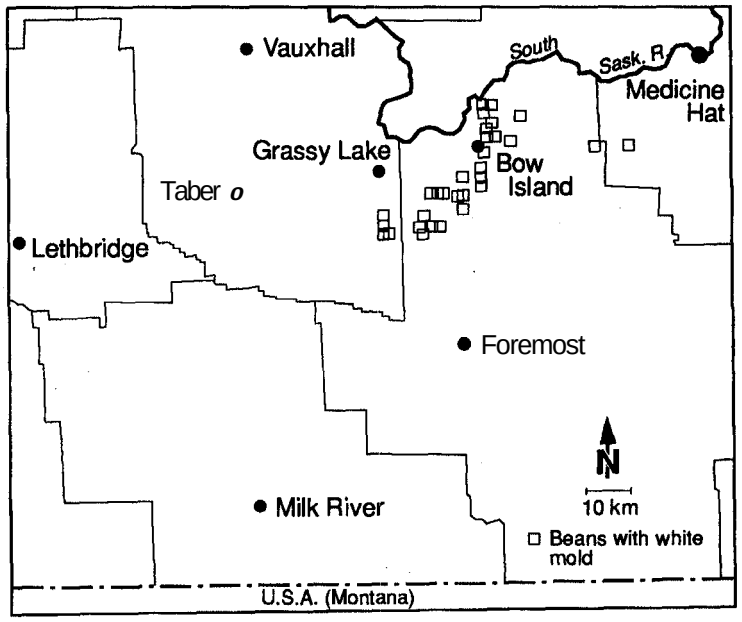

Figure **1.** White mold of dry bean in southern Alberta in **1993.**

CROP: Flax

LOCATION: MANITOBA

NAME AND AGENCY:

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TITLE: DISEASES OF FLAX IN MANITOBA IN 1993

METHODS: A total of 42 flax crops in Southern Manitoba and 11 in southeastern Saskatchewan were surveyed in 1993. Thirty-eight crops were surveyed on August 23-25, and 15 crops on September 9-10. Crops were selected at random in different regions. Each crop was sampled by two persons walking 100 m in opposite directions in the field following an "M" pattern. Diseases were identified by symptoms and the incidence and severity of each disease were recorded. In addition, 12 samples of flax were submitted for analysis to the Manitoba Agriculture Crop Diagnostic Centre by agricultural representatives and growers.

RESULTS AND COMMENTS: Crop emergence was good and stand was excellent in most of the crops surveyed. The above normal rainfall resulted in high soil moisture contents and excellent crop vigour. Such conditions caused various levels of lodging in 12 flax crops thus creating a favourable microclimate for high levels of infection by *Septoria linicola* and other saprophytic fungi.

Pasmo *(Septorialinicola)* was observed in 51 crops (96% of crops surveyed), and the disease developed very rapidly during the month of September (Table 1). The incidence of pasmo ranged from trace to 40% infected plants in crops surveyed in August, and from 30% to 100% infected plants in crops surveyed in September. Similarly, the severity ranged from trace to 50% of stem and leaf area infected in August and from 10-80% stem and leaf area infected in September.

Traces of aster yellows (mycoplasma-like organism) were observed in only four crops. No typical symptoms of fusarium wilt (*Fusarium oxysporum* f.sp. *lini*) were observed in any of the surveyed crops; however, the prolonged high soil moisture conditions must have weakened the root system towards the end of the season. Rust (*Melampsora lini*) was not observed in any of the crops surveyed, nor on the 30 rust differential lines planted at Morden and Portage la Prairie.

Of the 12 samples submitted to the Manitoba Agriculture Crop Diagnostic Centre, three showed pasmo, two alternaria leaf spot, *6* environmental stress, and two nutrient deficiency.

Table 1. Incidence and severity of pasmo on flax in Manitoba in 1993.

NO. OF CROPS	% OF CROPS	INCIDENCE*	SEVERITY**
2	4	0	0
15	28	Trace	1%
7	13	1-5%	1-5%
11	20	5-20%	5-10%
4	8	20-40%	5-20%
3	*6*	20-40%	10-40%
4	8	40-60%	20-50%
7	13	100%	20-50

* Incidence is the percentage of infected plants in each field.

** Severity is estimated as the percentage of stem and leaf area infected.

CROP: Lentil

LOCATION: Saskatchewan

NAME AND AGENCY:

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TITLE: SEED-BORNE DISEASES OF LENTIL IN SASKATCHEWAN IN 1993

METHODS, RESULTS AND COMMENTS: No organized survey of lentil crops was conducted in Saskatchewan in 1993. However, anecdotal reports and telephone inquiries from farmers and agricultural representatives indicated that foliar diseases were a major problem. The weather was marked by well-below normal temperatures throughout the growing season and above-average precipitation in July and August in most areas of production. This resulted in dense vegetative growth, poor pod set, late maturity, extensive development of ascochyta *(Ascochytafabae* f. sp. *lentis*) and botrytis stem and pod rot *(Botrytis cinerea),* and low yields of very poor quality seed. Although botrytis rots have always been common in lentil crops, die-back was at unprecedented levels in crops and experimental plots in 1993. Farmers reported that extensive clouds of botrytis spores were stirred up from infected tissues by harvesting machinery and they expressed concern about potential allergenic reactions.

Seed-borne *Botrytis* was at record levels in samples from experimental plots at Saskatoon and Melfort. Seed-borne *Botrytis* can cause seedling blight and was responsible for about 20% seedling death in late June in one lentil crop in central Saskatchewan. In view of this, there is concern about seed to be planted in 1994; very little high-quality seed with low levels of seed-borne pathogens is available.

By early December 874 samples of lentil seed had been tested at two commercial laboratories in Saskatchewan. Only about ***6%*** of these samples showed 0% *Ascochyta* infection. The overall mean level of infection was 5.2%. This compares with levels over the previous six years of 2.4% (1987), 1.4% (1988), **1.6%** (1989), 2.1% (1990), 5.0% (1991) and 4.0% (1992) (1, 2). In 175 samples tested for seed-borne *Botrytis*, levels ranged up to 15.3% with a mean of 3.4%.

Anthracnose caused by *Colletotrichum truncatum* was found in samples at only very low levels. This disease is not highly seed-borne (2) and is favored by warm weather.

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CROP: Field pea

LOCATION: Central Alberta

NAME AND AGENCY:
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TITLE: DISEASES OF FIELD PEA IN CENTRAL ALBERTA IN 1993

METHODS: Thirty-one crops of field pea were surveyed in central Alberta for diseases during the 1993 growing season. Of these crops, 14 were surveyed July 26-28, and 17 were surveyed August 25-27. Five crops were examined in both surveys. The first survey was conducted during flowering and the second survey during pod filling. The crops were distributed across 11 counties (Figure **1).** Incidence and severity of various diseases were determined by rating ten plants at four random sampling sites in each crop. The diseases were identified by symptoms and the severity of each disease was estimated using a scale of 0 (no disease) to 9 (most or all of the plant severely diseased).

RESULTS AND COMMENTS: The results are presented in Table **1.** Seven diseases were observed in each survey. Of these diseases, downy mildew *(Peronosporaviciae*) was the most prominent in the first survey. This disease occurred at trace to moderately severe levels in 12 of 14 crops examined in the first survey. The severity of this disease was reduced three fold and it was observed in only 8 of 22 crops examined during the second survey. Ascochyta blight *(Ascochyta* spp.) was the most severe disease observed in the second survey. **It** was present at moderate to severe levels in all 22 crops examined in this survey. The severity of this disease increased over three fold during the 4-week interval between the two surveys. Sclerotinia stem rot *(Sclerotinia sclerotiorum*) was found at trace to moderate levels and it was ranked as the third or the second most severe disease in the two surveys. Trace amounts of infection by foot rot *(Phoma medicaginis* var. *pinodella*), septoria leaf blotch (*Septoria pisi*) and gray mold (*Botrytis cinerea*) were found in both surveys. Powdery mildew (*Erysiphe polygon4* was observed in one crop in the first survey and bacterial blight (*Pseudomonas pisi*) was observed in one crop in the second survey. The severities of the two diseases were slight.

This is the first time that downy mildew has been reported as the most prominent disease on pea in central Alberta although it was commonly observed during 1992. The abnormally cool and moist weather that occurred throughout the summer of 1993 may have contributed to the levels of downy mildew. The effect of this disease on yield of field pea in Alberta has not been determined. Ascochyta blight and sclerotinia stem rot have been commonly observed on field pea in central Alberta. The severities of these diseases vary from year to year and field to field. Because both diseases may cause great reductions in yield and seed quality, it is important to prevent epidemics of them.

ACKNOWLEDGMENT: Financial support from the Natural Sciences and Engineering Research Council of Canada through Visiting Fellowships in Canadian Government Laboratories is gratefully acknowledged. Thanks are also due to Mr. W.E. Davis for his assistance in locating pea crops.

Table 1. Presence, incidence and severity of field pea diseases in central Alberta in 1993.

DISEAESE	SURVEYED JULY 26-28				SURVEYED AUGUST 25-27			
	NO CROPS SURVEYED	NO CROP AFFECTED	INCIDENCE %	SEVERITY (0-9)	NO CROPS SURVEYED	NO CROPS AFFECTED	INCIDENCE %	SEVERITY (0-9)
Ascochyta blight	14	10	46	1.5	22	22	98	4.6
Sclerotinia stem rot	14	64	3	1.4	22	18	41	1.1
Downy mildew	14	12	75	2.1	22	8	18	0.6
Foot rot	14	2	12	0.5	22	7	13	0.5
Septoria leaf blotch	14	5	50	1.3	22	7	15	0.4
Gray mold	14	1	7	0.3	22	2	7	0.3
Bacterial blight	14	0	0	0.0	22	1	3	0.1
Powdery mildew	14	1	2	0.1	22	0	0	*0.0*

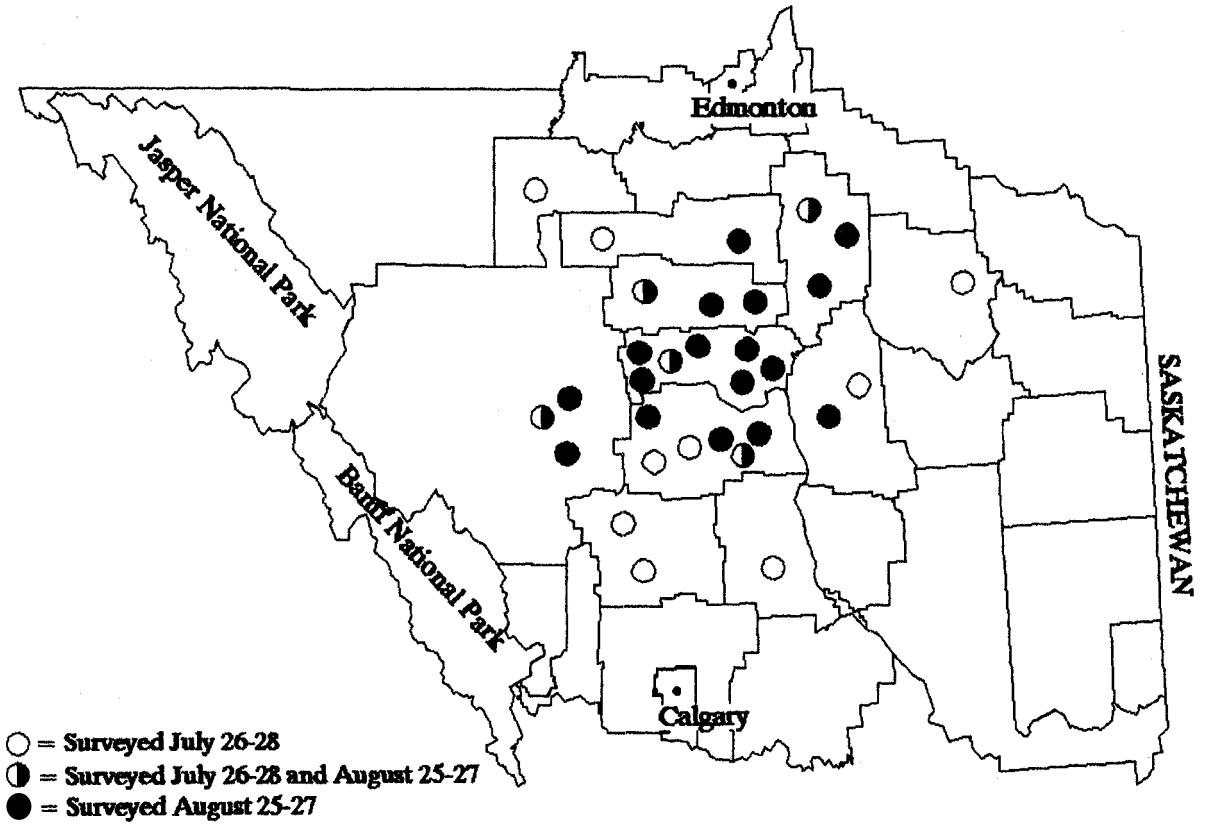

Figure 1. Locations of pea crops surveyed for diseases in central Alberta in 1993.

CROP: Sunflower

LOCATION: Manitoba

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TITLE: DISEASES OF SUNFLOWER IN MANITOBA IN 1993

METHODS: A total of 50 sunflower crops in southern Manitoba and **6** crops in southeastern Saskatchewan were surveyed in 1993. Twenty-six crops were surveyed on August 23-25, 17 on September 9-10, and 13 on October 5. Crops were selected at random in different regions. Each crop was sampled by two persons walking 100 m in opposite directions in the field following an M pattern (3,4). Diseases were identified by symptoms and the incidence of downy mildew (*Plasmopara halstedii*), sclerotinia wilt or head and stem infections *(Sclerotinia sclerotiorum*), and verticillium wilt (*verticillium dahliae*) were recorded. Disease severity for rust (*Puccinia helianthi*) and leaf spots (*Septoria helianthi* and *Alternaria* spp.) were measured as percent leaf area affected. Disease severity for phoma (*Phoma* spp.) was measured as percent stem area affected. All **56** crops were assessed for sclerotinia wilt, however, only the 30 fields surveyed in September-October were assessed for sclerotinia headrot and mid-stem infections due to the lack of symptoms in crops surveyed early (Table 1). Similarly due to an early frost which killed the leaves, only the 43 crops surveyed up to September 15 were assessed for all other diseases. A disease index was calculated for each disease in every crop based on disease incidence or disease severity (Table 1). In addition, 17 samples of sunflower were submitted for analysis to the Manitoba Agriculture Crop Diagnostic Centre by agricultural representatives and growers.

RESULTS AND COMMENTS: The crop conditions were generally good during the first half of the growing season. The above normal rainfall created high soil moisture content and waterlogging in the low spots of many sunflower fields in Manitoba, and that resulted in poor stand and vigour in such spots. The crop was 2-3 weeks later than normal and the early frost must have contributed to low yield and quality at harvest.

Sclerotinia wilt/basal stem infection was prevalent in 68% of all fields surveyed but the incidence was very low and ranged from traces to 5% infected plants. However, the incidence and severity of headrot and mid-stem breakage from ascospore infections were much higher in 1993 than in previous years (1,3,4). Twenty-nine crops, out of 30 surveyed towards the end of the season, showed prevalent headrot/mid-stem infections, with incidence ranging from 5% to 60% infected plants. The ratio of headrot to mid-stem infections varied among fields but was relatively equal in individual crops. Seven of the 13 crops surveyed in October had 40-50% mid-stem infections which resulted in stem breakage and total yield loss in the infected plants.

Verticillium wilt was prevalent in 27 crops (63% of those surveyed in August-September) with incidence ranging from traces to 5% infected plants in oilseed hybrids, and from 5% to 50% in confectionery hybrids. The high disease incidence in confectionery types is due to the lack of resistance to this disease in most of these hybrids.

Downy mildew was observed in 9 crops (21% of those surveyed in August-September) with incidence ranging from trace to 5% in all infested crops.

Rust was the least prevalent disease in 1993, and was observed in *8* crops (19% of craps surveyed in August-September) with disease severity of traces to <1% leaf area affected. The incidence and severity of rust in 1993 in Manitoba were the lowest recorded in the last ten years due to the exceptionally low temperatures during the 1993 growing season (1,2,3,4).

Leaf spots were common in 40% of crops surveyed in August-September with severity ranging from traces to 10% leaf area affected. Stem lesions caused by *Phoma* spp. were observed in 23% of crops with severity ranging from traces to 10% infected plants.

Leaf damage from the sunflower beetle *(Zygogrammaexclamtionis*) was observed in all crops surveyed, with severity ranging from 5% to 50% leaf area consumed by the beetles.

Of the 17 samples submitted to the Manitoba Agriculture Crop Diagnostic Centre, two showed sclerotinia headrot, and one each of fusarium rot and botrytis. In addition to diseases, 14 of the samples were found to be affected by herbicide drift and one affected by insect damage.

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Table 1. Prevalence and severity of sunflower diseases in Manitoba and southeastern Saskatchewan in 1993.

DISEASE	NO. AND % OF FIELDS INFESTED*	DISEASE INDEX**	
		MEAN	RANGE
Sclerotinia wilt	38 (68%)	0.6	T-1
Sclerotinia headrot	29 (97%)	2.3	1-4
Sclerotinia mid-stem	29 (97%)	2.2	1-4
Verticillium wilt	27 (63%)	1.0	T-4
Downy mildew	9 (21%)	0.7	T-1
Rust	8 (19%)	0.5	Traces
Leaf spots	17 (40%)	1.1	T-2
Phoma stem lesions	10 (23%)	1.0	T-2
Stand	56	1.3	1-3
Vigour	56	1.6	1-3

* Sclerotinia wilt was assessed on all 56 fields surveyed; sclerotinia headrot/mid-stem infections were assessed on 30 fields surveyed in September-October; while rust, downy mildew, and verticillium wilt were assessed on 43 fields surveyed in August-September.

** Disease index is based on a scale of 1 to 5: 1= trace to 5% disease, 2= 5% to 20% disease, 3= 20% to 40% disease, 4= 40% to 60% disease and 5= greater than *60%* disease levels. Index is based on disease incidence for downy mildew, sclerotinia wilt and verticillium wilt, and on disease severity measured as percent leaf area infected for leaf spots and rust and percent stem area infected for phoma. Indexes for stand and vigour are based on 1-5 scale (1= very good and 5= very poor).

CROP: Sunola

LOCATION: Saskatchewan

NAME AND AGENCY:
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TITLE: INCIDENCE OF SCLEROTINIA ON SUNOLA IN SASKATCHEWAN IN 1993

INTRODUCTION: Production of sunflower in Saskatchewan increased from 5,400 tonnes (1983-1992 average) to 35,000 tonnes in 1993 (2). The increase can be largely attributed to the production of sunola, a miniature sunflower bred for Saskatchewan's climate (1). Like all sunflowers, sunola is susceptible to *Sclerotinia sclerotiorum*. Symptoms such as bleaching and shattering of the stem base result from myceliogenic germination of sclerotia and invasion of the roots. Upper stem lesions and head rot are caused by air-borne ascospores.

METHODS: Sixty-two sunola crops were surveyed for sclerotinia diseases between September 4 and 27. The majority of the survey was focused on areas of canola production such as Crop Districts (CD) 6B, 8A, 8B, 9A, and 9B (2). Sunola crops in CD 7A, where predominantly cereals are grown, were also surveyed. Crops were sampled at four well-separated sites as in the 1992 survey (1). If 5 % or more of the plants were diseased, 100 plants at each site were scored to determine % disease incidence (DI). If less than 5 % were diseased, DI was recorded as a 'trace'. Disease incidence for basal stem and for aerial (upper stem and head rot) infections were recorded separately. A mean plant density (number plants/m^2) per field was determined by counting the number of plants in a 1 m^2 quadrat at each sample site. Information about crop history and seeding rates was obtained from the growers.

RESULTS AND DISCUSSION: Total DI ranged from zero to 81 % with aerial infection accounting for approximately 75 % of the disease (Table 1). In contrast, in 1992 DI ranged from zero to 14 %, the majority due to basal stem rot (1). The increase in disease, especially aerial infection, was probably due to the above normal precipitation in the 1993 growing season. Most of Saskatchewan received heavy rains beginning in early July and lasting through August (2), making conditions favourable for ascospore production.

Total DI values were greatest in CD 8A, ranging from 20 to 81 % (Table 1). The abundant moisture and inoculum density in this canola-producing area were probably responsible for the high DI. In CD 6B total DI ranged from trace to 27 %, in CD 9B from trace to 26 %, in CD 9A from trace to 19%, and in CD 8B from trace to 17 %. In CD 7A, where only one of the ten fields surveyed had previously been sown to a crop susceptible to S. *sclerotiorum*, DI ranged from absent to trace (Table 1). Aerial infection was evident in all the crops in which the disease occurred, while basal stem rot was evident in only one. In 1992, no sclerotinia diseases were found in CD 7A (1). Above average precipitation in CD 7A probably caused the increase in aerial infection in 1993. Susceptible weeds may have maintained a low inoculum level in previous years or seed containing sclerotia may have been used in 1993.

The mean seeding rate and plant density were similar among CD's and therefore not likely to be a primary factor in determining DI (Table 1). However, the average seeding rate increased from 5.6 kg/ha in 1992 (1) to 10.8 kg/ha in 1993. A higher seeding rate may allow increased contact of roots with sclerotia or a heavier canopy favourable for ascospore production.

In 1992, no correlation was found between DI and crop history (1). In 1993, there was also no significant regression of DI (either total or basal stem rot) on number of years since the previous susceptible crop, although there was a slight trend of less basal stem rot with increasing number of years. Crops with high basal DI occurred in fields with two and three year rotations. However, the majority of crops in CD 9B were in fields with two to four year rotations but showed only trace amounts of basal stem rot.

ACKNOWLEDGEMENTS; The assistance of the sunola growers and **D.S.** Hutcheson is greatly appreciated.

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2. Saskatchewan Agriculture and Food. Final Crop Report - No. **30.** Regina, Saskatchewan. **Nov. 4, 1993.**

Table 1. Summary of % disease incidence, seeding rates, plant densities, and crop rotations for 62 sunola crops in Saskatchewan, 1993.

CD*	No. crops surveyed	Mean seeding rate kg/ha	Mean density pl/m^2	Mean (range) % aerial DI	Mean (range) % basal DI	Rotation (years)***
7A	10	10.7	15.4	t(0-t)**	0(0-t)	>6
66	8	10.4	14.1	5(t-16)	4(t-11)	3
8A		11.7	16.6	36(19-60)	8(t-21)	3
8B	8	10.1	16.7	7(t-13)	2(0-10)	4
9A	7	11.1	14.5	3(t-12)	2(0-7)	4
9B	24	11.2	15.6	3(t-23)	2(0-13)	3

* **Crop Districts**

** **t = trace amount** of **disease (< 5 %) Traces were counted as 1 % when calculating mean** DI.

*** **Mean number** of **years between susceptible host crops.**