Cereals / Céréales

Crop / Culture: Barley

Location / Emplacement: Saskatchewan

Title / Titre: Saskatchewan Barley Disease Survey, 1990

Name and Agency / Nom et Organisation:

K.L. Bailey and L.J. Duczek, Agriculture Canada Research Station, 107 Science Crescent, Saskatoon, Saskatchewan S7N 0X2
B. Berkenkamp and C. Kirkham, Agriculture Canada Research Station, P.O. Box 1240, Melfort, Saskatchewan S0E 1A0
R. Knox, Agriculture Canada Research Station, P.O. Box 1030, Swift Current, Saskatchewan S9H 3X2
K. Mortensen, Agriculture Canada Research Station, P.O. Box 440, 5000 Wascana Parkway, Regina, Saskatchewan S4P 3A2

METHODS: A co-operative provincial disease survey was conducted in 110 barley fields between flowering and soft dough growth stages. Barley fields within five areas of the province representing most of the crop districts were surveyed (Fig. 1). The minimum guidelines for surveying methods were to walk 20 paces into a randomly selected field, and assess disease on a sample of 10 plants. Diseases such as smut, ergot, take-all, and viruses were estimated for the percent incidence in either the plant sample or over the entire field. Common root rot was estimated by counting the number of plants in the sample that had lesions covering more than 50% of the sub-crown internode. Foliar diseases were assessed on a 0-9 scale (Couture 1980) that reflects the impression of disease levels in the lower, middle, and upper leaf canopies. Some diseased samples were plated on media to determine which pathogen was present although most diseases were identified by visual symptoms in the field.

RESULTS AND COMMENTS: Of the fields surveyed, 40 were 2-rowed, 21 were 6-rowed, and 49 were not classified as to type. The distribution, severity, and prevalence of the diseases found on barley are shown for each crop district in Table 1.

Net blotch, mostly the netted-form, was found in 86% of the fields at moderate severity levels. Scald and spot blotch were found in one third of the fields at slight levels of infection. Twenty percent of the fields were described as having unidentified leaf spots which reflected the difficulty in visually distinguishing among the spotted-form of net blotch, spot blotch, and physiological leaf spot. Septoria leaf blotch occurred in 15% of the fields at trace levels. All foliar diseases were most prevalent in the north and east-central crop districts which coincided with the areas having more moisture. The exception was the most northern half of crop district 9B where very dry conditions caused stunting, premature senescence, and head sterilty. Traces of stem rust of barley occurred in 12% of the fields. However, one field of 2-row barley in the south-east corner of the province had moderate levels of stem rust on all plants. Common root rot was observed in almost all fields with an average of 28% of the plants showing severe disease symptoms on the sub-crown internodes. Loose and covered smut, powdery mildew, BYDV, ergot, take-all, and bacterial blight were noted in the occasional field and barley stripe (1%) was found in one field in the south-west corner of the province.

REFERENCE:

Couture, L. 1980. Assessment of severity of foliage diseases of cereals in cooperative evaluation tests. Can. Plant Dis. Surv. 1:8-10

Figure 1. Crop districts and boundaries of barley fields surveyed in Saskatchewan,1990.

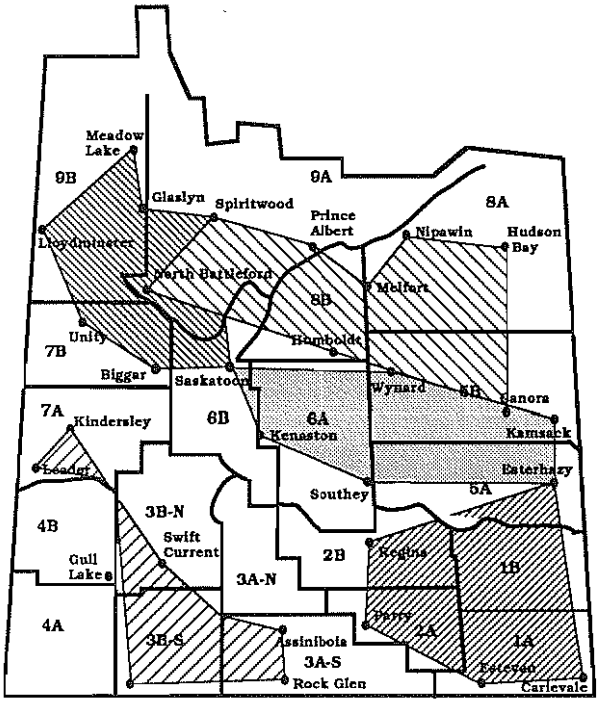


Table 1. Distribution, severity, and prevalence of barley diseases in Saskatchewan fields surveyed between flowering and soft dough stages, 1990.

Crop District	No. Fields	Leaf spot	Net blotch	Scald	Septoria	Spot blotch	Common root rot %	Smut %	Stem rust	Powdery mildew	BYDV %	Ergot %	Take all %	Bacterial blight
1A	3	1/1*	7/2	-**	-	-	20	1.1/3	TR/2	-	-	-	-	-
1B	2	3/1	5.5/2	2/1	-	-	30	-	SL/2	-	-	0.1/1	-	-
2A	1	-	-	-	-	-	90	-	-	-	-	-	-	-
2B	1	-	7/1	-	-	-	9	-	-	3/1	-	-	-	-
3A-N	0	-	-	-	-	-	-	-	-	-	-	-	-	-
3A-S	0	-	-	-	-	-	-	-	-	-	-	-	-	-
3B-N	2	-	3/2	-	-	-	45	-	-	-	1/1	-	-	-
3B-S	1	3/1	-	-	-	-	-	-	-	-	-	-	-	-
4A	0	-	-	-	-	-	-	-	-	-	-	-	-	-
4B	0	-	-	-	-	-	-	-	-	-	-	-	-	-
5A	5	2/1	6/4	6/1	2/1	-	37	-	TR/2	-	-	0.1/1	-	-
5B	15	1.6/4	4.6/15	0.8/3	0.8/3	1.6/5	19	-	TR/1	-	-	-	-	-
6A	2	4.5/1	-	1.3/2	-	-	25	-	-	-	-	-	-	-
6B	3	1/1	1/1	1/1	-	-	7	-	-	-	-	-	-	-
7A	4	1/4	1/1	1/1	-	-	27	-	-	-	1/1-	-	-	-
7B	2	8/1	5/2	1/1	-	-	53	-	-	-	5/2	-	-	-
8A	21	-	3.3/19	1.6/11	0.1/3	1.2/11	16	-	TR/3	-	-	-	-	-
8B	15	0.1/1	2.8/15	0.4/5	0.2/2	1.7/8	16	-	TR/3	-	-	-	-	-
9A	24	3/4	4.4/22	2.6/10	0.5/4	1.3/6	8	0.1/1	-	-	-	-	6/1	-
9B	9	4.5/2	3.9/8	5/3	5/1	-	24	2/1	-	-	-	-	-	1/2
Average or total	110	2.7/22	4.2/94	2.1/39	1.4/14	1.5/30	28	1.1/5	TR/13	3/1	2.3/3	0.1/2	1/1	1/2

* average disease rating (0-9 scale after Couture 1980) / number of fields affected
** not observed or not recorded

Crop / Culture: Barley

Location / Emplacement: Manitoba

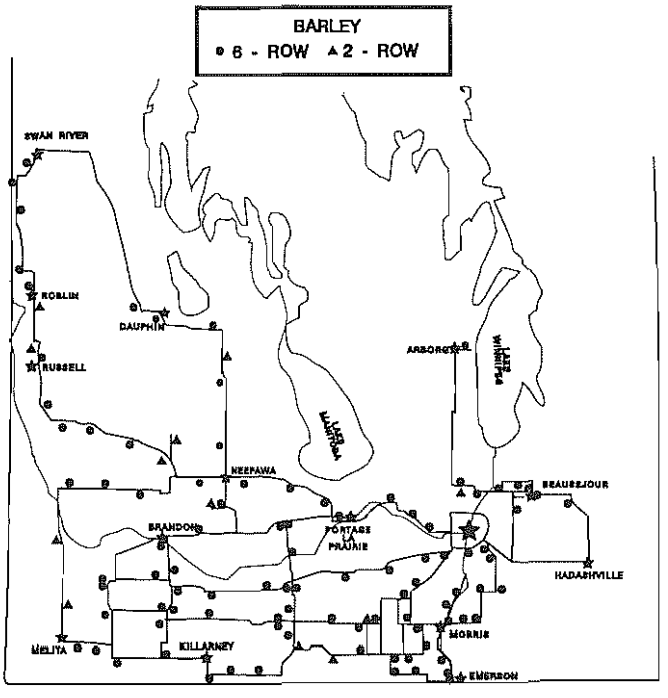
Title / Titre: SURVEY FOR BARLEY LEAF DISEASES IN MANITOBA IN 1990

Name and Agency / Nom et Organisation:
A. Tekauz, J. Gilbert and E. Mueller
Agriculture Canada
Research Station
195 Dafoe Road
Winnipeg, Manitoba
R3T 2M9

METHODS: Leaf disease incidence and severity levels were assessed by sampling 106 Manitoba barley fields between 11 July and 8 August. Fields were selected at random every 10-20 kms along the survey routes depeuding on crop frequency. Plants were examined along an inverted V transect approximately 50 m long per side. Disease levels were rated visually in both the upper (top 2 leaves) and lower canopies nsing a four-point scale: trace (<5% leaf area affected); slight (5-15%); moderate (16-40%); and severe (41-100%). Infected leaves were collected and kept in paper envelopes for subsequent pathogen identification and disease confirmation. Snrface-sterilized tissue pieces were placed in moist chambers to promote pathogen sporulaton.

RESULTS AND COMMENTS: The location of the 95 six-rowed and 11 two-rowed fields surveyed is shown in Fig. 1. Growth stage at sampling ranged from 55 to 83 (Zadoks et al. scale). Disease level on upper leaves were generally trace or slight (a few moderate) and on lower leaves was largely moderate with 20% rated as moderate to severe. Pyrenophora teres (net blotch pathogen) was isolated from 92% of fields, and Cochliobolus sativus (spot blotch pathogen) from 71%. Most of the more severely diseased fields were of six-rowed barley infected with the net-form of net blotch. This may be a reflection of the susceptibility of Argyle barley (24% of acreage in 1990) to this form. Scald was detected in three fields and was moderate to severe in one field of six-rowed barley 25 km west of Shoal Lake. Overall, leaf diseases likely caused relatively little damage to the Mauitoba barley crop in 1990. The general lack of rain after the first week of July preveuted the spread and intensification of infection in the upper crop canopy. However, in some early-planted fields (of Argyle barley?), yield losses of about 25% are estimated, based on the disease severity observed.

Figure 1. Location of barley fields sampled for leaf diseases in Manitoba in 1990.



Crop / Culture: Barley, Oat and Wheat

Location / Emplacement: Central Alberta

Title / Titre: CEREAL DISEASE SURVEY IN CENTRAL ALBERTA - 1990

Name and Agency / Nom et Organisation:
D.D. Orr
Agriculture Cauada
Research Station
Bag Service 5000
Lacombe, Alberta
TOC 1S0

METHODS: The cereal fields surveyed in central Alberta were selected at random in early August. Fields were traversed in an inverted V and plants were examined every 10 paces for root, leaf, and head diseases. Leaf diseases were rated as the percent leaf area affected. Head and systemic diseases were rated as the percent of plants affected in square metre samples. Root diseases were rated as the average severity of the disease in 10 plant samples.

RESULTS AND COMMENTS:

Weather Conditions: The 1990 growing season in central Alberta was characterized by heavier than normal rainfall in April, May and June. Many farmers had to delay seeding until the end of June. Continuing good growing ccnditions resulted in higher than average yields, however quality was reduced slightly, probably as a result of the elevated levels of leaf disease.

Two-Row Barley: Leaf diseases were once again prevalent in two-row barley, although at lower levels than in 1989. Approximately 60% of the fields with symptoms had penultimate leaves rating 10% or more for leaf disease. Net blotch (Pyrenophora teres) was present in all 18 fields examined, with one-third rating 10% or more damage on the flag leaf. Scald (Rhynchosporium secalis) occurred in two-thirds of fields with 50% of these rating 10% or more disease on the flag leaf. Loose smut (Ustilago nuda) occurred in 4 of the fields examined at levels of $\leq$ 1%. Covered smut (U. hordei) was noticed in only one field and barley yellow dwarf in 2 fields, both at levels of $\leq$1%. Fourteen of the fields showed common root rot symptoms (Cochliobolus sativus and Fusarium spp.) with 60% of these exhibiting disease levels of 10%.

Six-Row Barley: Leaf disease incidence was lower and less severe in the 19 fields of six-row barley examined. Only 36% of the fields infected with net blotch had disease ratings of 10% or more on the penultimate and no fields had more than 5% disease ou the flag leaf. Scald occurred less frequently but the levels were higher. Ratings of 10% or more scald were found on 54% of the penultimate and 33% of the flag leaves. Covered smut was not found, but one-third of the fields had loose smut ratings of $\leq$1%. Common root rot was detected in 10 fields, with 7 having 5% and 1 field with 25% disease. Bacterial blight was present in three fielcs at very low levels. An interesting aud unusual observation was that of two plants infected with barley leaf stripe (Pyrenophora graminea) in a field near Delburne. This is one of the few occurrences of leaf stripe iu a commercial field in this area.

Oats: The four fields of oats surveyed all had very low disease levels. Septoria leaf blotch (Septoria avenae) was found in the lower leaf canopy in amounts of 5%. Blast symptoms were evident in three fields at 1% or less severity, which is about average. Barley yellow dwarf was seen at low levels in one field.

Wheat: Septoria leaf blotch (Septoria spp. complex) was the most prevalent disease and was found in 12 of the 14 fields surveyed. Disease severity was moderate with 80% of the pennltimate and 8% of the flag leaves rating $\geq$ 10% disease. Take all (Gaeumannomyces graminis) occurred in half of the fields, with three having levels of 1%. Less than half of the fields surveyed had common root rot, all of them with $\geq$ 5% disease levels. Half the fields had leaf rnst (Puccinia recondita) at very low levels and powderly mildew (Erysiphe graminis) in moderate amounts in the lower leaf canopy.

Crop / Culture: Barley, Oat, and Wheat

Location / Emplacement: Manitoba and Saskatchewan

Title / Titre: CEREAL SMUT SURVEY, 1990

Name and Agency / Nom et Organisation:
P.L. Thomas
Agriculture Canada
Research Station
195 Dafoe Road
Winnipeg, Manitoba
R3T 2M9

METHODS: In July, 1990 cereal crops were surveyed for Ustilago hordei, U. nigra, U. nuda, U. tritici, U. avenae, and U. kolleri in Manitoba and Saskatchewan. The northern area was covered by a route from Winnipeg-Saskatoon-Prince Albert-Swan River-Winnipeg and the sonthern area by trips north and south of Winnipeg and a route from Winnipeg-Weyburn-Indian Head-Yorkton-Winnipeg. Fields were selected at random at approximately 15 km intervals, depending on the frequency of the crops in the area. An estimate of the percentage of infected plants (i.e. plants with sori) was made while walking an ovoid path of approximately 100 m in each field. Levels of smut greater than trace were estimated by counting plants in a 1 m^2 area at at least two sites on the path. U. nuda and U. nigra were differentiated by observing germinating teliospores with a microscope.

RESULTS: See Table 1. Smut was found in 72% of the fields of barley, 15% of the common wheat, 68% of the durum and 8% of the oat. The average levels were 0.6% for barley, 0.3% for dnrum wheat and trace for common wheat and oat. Noteable high incidences of smut observed were 10% U. nuda in fields of barley near Lucky Lake, SK and Grandview, MB, and 10% U. tritici in a durum field near Francis, SK.

COMMENTS: The average level of infection for barley was lower than for any year in the last decade. It is noteable that the incidence of the two seedling infecting smnts appears to have been reduced more by the drought of recent years than was the incidence of the floral infecting loose smut. The reason for this is not apparent. Most of the smut in common wheat was in fields that appeared to be sown to semi-dwarf types. The resistance in most of our wheat cultivars, and the drought, appears to be keeping the level of smut low. The 0.3% infection in durum wheat reflects resistance that is no better than fair in many cultivars. The trace level of infection in oat reflects good varietal resistance and the drought conditions of previous years.

TABLE 1. Incidence of smut in cereals in Manitoba and Saskatchewan in 1990

Crop	No. fields	Smut species	% Fields affected		Mean % infected plants	
			MB	SK	MB	SK
Common wheat	213	U. tritici	19	10	tr*	tr
Durum wheat	41	U. tritici	62	70	tr	0.7
Oat	39	U. avenae, U. kolleri	0	27	0	tr
Barley	202	U. nuda	77	51	0.5	0.4
		U. hordei	10	18	0.1	0.2
		U. nigra	14	1	0.1	tr

*tr = less than 0.1%

Crop / Culture: Cereals

Location / Emplacement: Maritime Provinces

Title / Titre: CEREAL DISEASE PROFILE IN THE MARITIME PROVINCES - 1990

Name and Agency / Nom et Organisation:

Martin, R.A. and Johnston, H.W.
Agriculture Canada, Research Station
P.O. Box 1210, Charlottetown
Prince Edward Island C1A 7M8

Weather Conditions: Cereal production in the Maritimes was not adversely effected by fungal pathogens in 1990 as a result of the generally favorable weather patterns. The early portion of the planting season was relatively wet which delayed some seeding operations. Mid season conditions were dry in some areas and moisture may have limited yields. While post heading conditions were conducive to disease development in most of New Brunswick and Prince Edward Island, the stage of growth and rates of disease progression were slow and had little limiting effects on yield. Late season rains, particularly in New Brunswick, did have an impact on quantity and quality of the harvest. Western Nova Scotia was hot and dry and fungal diseases did not develop to significant severities.

Barley: Weather conditions during early and midseason were not conducive to the development of foliar disease. Foliar diseases of barley were not a serious problem in Nova Scotia or New Brunswick. Net blotch and scald, incited by Pyrenophora teres and Rhynchosporium secalis, respectively, were the primary barley diseases of concern in the Maritime Provinces. Scald was not a problem except on some early seeded fields. Net blotch was more severe than scald although relatively dry weather prior to heading resulted in little lesioning until late in the season. The lateness of the on-set of lesioning resulted in the yield losses from net blotch which were lower than normally expected for the region. Fusarium head blight of barley was uot reported as being a problem although symptoms were identified at very low levels. Common root rot was observed in all areas but was not reported as being of any greater significance than in previous years. Loose smut remains a recurring problem in barley but at low levels. Excessive moisture at harvest time adversely effected the barley harvest in New Brunswick. Warm dry weather in Nova Scotia was not conducive to the development of disease outbreaks.

Wheat: In New Brunswick weather conditions were favourable for wheat production and fungal diseases were less severe than in most years. Late season storms caused some lowering of quality when harvests were delayed and through an increase in lodging. Fusarium head blight was not severe and septoria leaf and glume blotch were severe only with late harvested crops. On Prince Edward Island wheat had few disease problems with lower than normal levels of both fusarium head blight and septoria diseases. In only a few instances did the septoria leaf blotch reach a stage of severity that warranted use of a foliar fungicide. Wheat crops planted prior to mid-May rains were healthier than those planted after a 10-day period of wet weather. Tan spot incited by Pyrenophora tritici-repentis was commonly observed in research plots in Charlottetown. This pathogen forms a complex with Septoria nodorum on wheat leaves but no information is available on relative frequency of each from non-research fields. The severity of powdery mildew was low on both winter and spring wheats and varied in severity according to the resistance of the cultivar and N fertilization. Nova Scotia experienced a warm dry summer and fungal diseases did not develop on either winter or spring wheat to appreciable levels.

Oats: Diseases recorded on oats in the three Provinces were limited to Septoria avenae incited speckled leaf blotch which was less severe than usually found in the Maritime Provinces. A slight increase in BYDV may have occurred in New Brunswick.

Triticale: No fields of triticale were surveyed but research plots were healthy with no disease problems. Fusarium head blight was less severe than encountered with triticale in previous years.

Summary: The dry weather reduced the significance of diseases in 1990; however, this dry warm weather at heading and flowering was considered the cause of lowered grain yields in 1990.

Crop / Culture: Cereal Crops

Location / Emplacement: Manitoba

Title / Titre: Diseases diagnosed on wheat, barley and oat samples submitted to the Manitoba Agriculture Plant Pathology Lahoratory in 1990.

Name and Agency / Nom et Organisation:

PLATFORD, R. G.
Manitoba Agriculture
Plant Pathology Laboratory
Agricultural Services Complex
201-545 University Crescent
WINNIPEG, Manitoba
R3T 5S6

Methods: There were 222 samples of wheat, 173 of barley and 24 of oat sent to the Manitoba Agriculture Plant Pathology Laboratory in 1990. Samples were examined for disease symptoms, and where necessary, isolations were made onto Potato Dextrose Agar.

Results: Wheat - The results of the wheat snbmissions are shown in Table 1. Tan spot (Pyrenophora tritici-repentis) was the most commonly diagnosed disease. The samples were mainly submitted in June in which time the weather was very moist. Dry weather in July and August reduced the impact of tan spot and septoria blotch (Septoria spp.). Wheat streak mosaic virus disease was detected in 8 samples of spring wheat originating from McCauley and Minto in westhern Manitoba. In all cases these were of spring wheat that had been planted adjacent to winter wheat.

Barley - The results of the 173 barley submissions are presented in Table 2. Net blotch (Pyrenophora teres) was diagnosed in 53 samples. Its development was favoured by moist weather in June but dry conditions in July and August limited its further development. Barley yellow dwarf was severe in 1990, particularly on late planted barley. A flame chlorosis survey was conducted and 2 samples were sent into the laboratory. Tbe results of the survey are presented separately. Stem rust (Puccinia graminis f. sp. tritici) was severe on 5 samples of late planted barley.

Oats - The results of the oat submissions are sbown in Table 3. While only a single sample with crown rot (Puccinia coronata) was submitted crown rust of oats was the most prominent disease on the crops in 1990. The single sample submitted was from Vita in southeastern Manitoba and sbowed a rust severity greater than 50%. Barley yellow dwarf was also prominent on late planted oats as it was in barley and wheat.

TABLE 1. Diseases diagnosed on wheat samples submitted to the Manitoba Agriculture Plant Pathology Laboratory in 1990

Disease	Causal Agent(s)	Number of Samples
Tan spot	*Pyrenophora tritici - repentis*	72
Common root rot	*Cochliobolus sativus*, *Fusarium* spp.	29
Septoria	*Septoria* spp.	24
Glume blotch	*Septoria* spp.	11
Barley yellow dwarf	Barley Yellow Dwarf Virus	10
Wheat streak mosaic	Wheat Streak Mosaic Virus	8
Leaf rust	*Puccinia recondita* f. sp. *tritici*	6
Black chaff	*Alternaria* spp., *Cochliobolus* spp. *Cladosporium* spp.	3
Flame chlorosis	Flame Chlorosis Virus Like Agent	2
Take all root rot	*Gaeumannomyces graminis* var. *tritici*	1
Environmental stress	drought	33
Nutrient deficiencies		3
Herbicide injury		23

TABLE 2. Diseases diagnosed on barley samples submitted to the Manitoba Agriculture Plant Pathology Laboratory in 1990

Disease	Causal Agent(s)	Number of Samples
Net blotch	*Pyrenophora teres*	53
Barley yellow dwarf	Barley Yellow Dwarf Virus	37
Flame chlorosis	Flame Chlorosis Virus Like Agent	26
Common root rot	*Cochliobolus sativus*, *Fusarium* spp.	14
Stem rust	*Puccinia graminis* f. sp. *tritici*	5
Smut	*Ustilago* spp.	1
Environmental stress, Seeding problems		24
Herbicide		13

TABLE 3. Diseases diagnosed on oat samples submitted to the Manitoba Agriculture Plant Pathology Laboratory in 1990

Disease	Causal Agent(s)	Number of Samples
Barley yellow dwarf	Barley Yellow Dwarf Virus	7
Septoria blotch	*Septoria* spp.	4
Root rot	*Fusarium* spp., *Pythium* spp.	3
Bacterial blight	*Xanthomonas translucens*	2
Crown rust	*Puccinia coronata* f. sp. *avenae*	1
Wheat streak mosaic	Wheat Streak Mosaic Virus	1
Environmental stress		4
Herbicide injuty		2

Crop / Culture: Oat

Location / Emplacement: Manitoba and eastern Saskatchewan

Name and Agency / Nom et Organisation:
J. Chong and D.E. Harder
Agriculture Canada
Research Station
195 Dafoe Road
Winnipeg, MB., R3T 2M9

Title / Titre: OCCURRENCE OF OAT RUSTS IN WESTERN CANADA IN 1990

METHODS: The occurrence of oat crown rust (causal agent Puccinia coronata f. sp. avenae) and oat stem rust (causal agent P. graminis f. sp. tritici) in Manitoba and eastern Saskatchewan was determined by frequent examination of farm fields or stands of wild oat (Avena fatua L.) from early July to late August. Rust samples were collected from wild oat, cultivated oat, and rust nurseries located near Woodmore, Brandon, Morden, Dauphin, in Manitoba, and near Indian Head and Regina, in Saskatchewan.

RESULTS AND COMMENTS: Crown rust was first observed in trace amounts on wild oat in southern Manitoba on July 10. In the past several years crown rust was not observed in commercial fields, due to the widespread use of oat cultivars with both resistant genes Pc38 and Pc39 (Dumont, Riel, and Robert). In 1990 crown rust severities of 5% to 10% were commonly observed in commercial fields, indicating the widespread occurrence of crown rust races that can attack these resistant cultivars. To date 63 of the 147 isolates isolated from the 1990 field collections were races with virulences to both genes Pc38 and Pc39 and other Pc genes. Races with these virulences, first isolated in 1987, were more prevalent in 1990 than in 1989. If these races become established in Manitoba, significant crop losses are likely in future. Efforts are underway to incorporate additional resistance into well adapted cultivars such as Dumont and Robert.

Oat stem rust was first observed in trace amounts on wild oat in Manitoba on August 2, and did not develop significantly in Manitoba through to late August. All the oat cultivars currently grown in the eastern prairies are highly resistant to the predominant races of the stem rust population.

Crop / Culture: Oat

Location / Emplacement: Quebec

Title / Titre: A SUMMARY OF DISEASES OF OATS IN QUEBEC IN 1990

Name and Agency / Nom et Organisation:

Rioux, Sylvie
Station de recherches
Agriculture Canada
2560 boul. Hochelaga
Ste. Foy, Quebec G1V 2J3

The incidence of oat diseases was examined in six different regions of Quebec in late July and early August in 1990. Growth stages at the time of assessments ranged from medium milk to soft dough. Speckled leaf blotch (Septoria avenae f.sp. avenae) occurred as usual throughout the province. It was severe on the most susceptible cultivars and moderate on the others. Crown rust caused by Puccinia coronata was present in trace amounts on the most susceptible cultivar at St-Hyacinthe and was moderate at LaPocatiere (Lower St. Lawrence). At Deschambault (central Quebec) it was the most severe disease on the crop and all cultivars except one suffered very severe damage. The cultivar not affected by crown rust was affected severely by speckled leaf blotch. Yellow dwarf virus (BYDV) was observed in light quantities at Pintendre (Quebec City district) and at Lennoxville (Eastern Townships). Stem rust (Puccinia graminis f.sp. avenae) and fusarium head blight (Fusarium graminearum) were not detected at any significant level.

Crop / Culture: Spring Wheat

Location / Emplacement: Region of St-Hyacinthe, Quebec

Title / Titre: SURVEY OF SPRING WHEAT DISEASES IN 1990

Name and Agency / Nom et Organisation:

Devaux, A.
Service de la phytotechnie
St-Hyacinthe, M.A.P.A.Q.
C.P. 480, St-Hyacinthe, Quebec J2S 7B8

METHODS: Three fields of the cultivar Max, and one of the cultivars Casavant, Katepwa, Laura, Laval 19, Messier, Mondor, Opal, and Robin were surveyed for leaf, root, stem, and head diseases at Zadoks et al.[1] growth stages 47, 59, and 77. The intensity of foliar diseases was assessed on 10-20 plants at 10 sites along a W transect in the fields. Samples of 10 plants were pulled out at each site at ZGS 77 to note stem and root diseases. Leaf diseases were evaluated before and at heading as a percentage leaf area affected on the whole plant using the Horsfall & Barratt grading system[2]. After heading, only the flag leaves were assessed. Head blight was measured on the percentage heads and spikelets affected on 50 heads chosen at random at four different sites in each field.

RESULTS AND COMMENTS: Table 1 shows the minimum-maximum percentage disease intensity recorded at growth stages 47, 59, and 77. At heading, tan spot (Pyrenophora tritici-repentis) was observed in all the fields with a maximum intensity of 4.0% leaf area affected on cultivar Casavant. Powdery mildew was observed on susceptible cultivars with a maximum intensity of 3.3 to 3.5% infected leaf area. After heading, tan spot was mixed with Septoria nodorum and affected a maximum of 10.6% of flag leaves of cultivar Casavant and from 2.6 to 5.9% of flag leaves of the other cultivars. Powdery mildew (Erysiphe graminis) affected up to 3.5% of cultivar Casavant and leaf rust (Puccinia recondita) up to 3.8% of cultivar Mondor. Slight stem necrosis on basal portion of stems affected up to 19.7% of the stems of cultivar Max and 11.1% of Roblin. Other cultivars had a maximum of 2.1% affected stems caused mainly by Bipolaris sorokiniana and some Fusarium sp. Fusarium head blight (F. graminearum) was noted on all cultivars with a maximum of 5.2% infected spikelets on cultivar Max and a minimum of 0.2% infected spikelets on Laura. Take-all was not observed in the nine fields surveyed.

Table 1. Prevalence and intensity of spring wheat diseases in the St-Hyacinthe region in 1990.

Growth stages[1]		spots	mildew	rust	necrosis	heads	spikelets
Before heading:	47*	0-3.3	0-3.3	0	-	-	-
Heading:	59*	2.3-4.0	0-3.5	0	-	-	-
After heading:	77**	2.6-10.6	0-3.5	0-3.8	0-19.7	1.9-18.9	0.2-5.2

[1]Zadoks et al. growth stages of cereals. 1974. Weed Res. 14(6): 415-421.
[2]Horsfall & Barratt grading system. 1945. Phytopathology 35(8): 655 (Abstr.).
*Disease assessment on all leaves.
**Disease assessment on flag leaves only.

Crop / Culture: Wheat

Location / Emplacement: Saskatchewan

Title / Titre: Saskatchewan Wheat Disease Survey, 1990

Name and Agency / Nom et Organisation:

K.L. Bailey and L.J. Duczek, Agriculture Canada Research Station, 107 Science Crescent, Saskatoon, Saskatchewan S7N 0X2
B. Berkenkamp and C. Kirkham, Agriculture Canada Research Station, P.O. Box 1240, Melfort, Saskatchewan S0E 1A0
R. Knox, Agriculture Canada Research Station, P.O. Box 1030, Swift Current, Saskatchewan S9H 3X2
K. Mortensen, Agriculture Canada Research Station, P.O. Box 440, 5000 Wascana Parkway, Regina, Saskatchewan S4P 3A2

METHODS: A co-operative provincial disease survey was conducted in 254 wheat fields between flowering and soft dough growth stages. Most of the crop districts in the province were surveyed (Fig. 1). The minimum guidelines were to walk 20 paces into randomly selected fields, and assess disease on a sample of 10 plants. Diseases such as smut, ergot, take-all, and viruses were estimated for the percent incidence in either the plant sample or over the entire field. Common root rot was estimated by counting the number of plants in the sample that had lesions covering more than 50% of the sub-crown internode. Foliar diseases were assessed on a 0-9 scale (Couture 1980) that reflects the impression of disease levels in the lower, middle, and upper leaf canopies. Although most diseases were identified by visual symptoms in the field, some cooperators plated diseased samples on media to determine which pathogens were present. Leaves were stored dry and later washed for 1 h, surface disinfected for 1 min in 0.6% sodium hypochlorite (Javex), then rinsed three times with sterile distilled water. Leaf pieces 6 cm long were put on water agar (1.6%) containing 100 mg/L streptomycin sulfate and 50 mg/L vancomycin hydrochloride and incubated uuder blacklight (BL) light for 12 h alternating with 12 h dark at 20 C. Sporulation was observed after about one week.

RESULTS AND COMMENTS: Of the fields surveyed, there were 219 spring wheat, 34 durum, and one winter wheat. The distribution, severity, and prevalence of the diseases are shown by crop districts in the province (Table 1).

The most prevalent diseases were leaf spots (particularly tan spot and *Septoria* spp.) and leaf rust which occurred in 50% of the fields. The severity of leaf spots was moderate whereas leaf rust occurred in trace to slight amounts. Fifteen leaf samples collected from crop districts 5A, 5B, and 6A were plated and the major foliar pathogens were *Pyrenophora tritici-repentis* in 10 samples, *Septoria nodorum* in 6, and *S. tritici* in 6. Five of the 15 fields had combinations of 2 or all 3 pathogens present where as only *P. tritici-repentis* was found in 5, *S. nodorum* in 3, and *S. tritici* in 2. *P. tritici-repentis* and *S. nodorum* were found throughout these districts but *S. tritici* was found only in the eastern half.

Common root rot was present in most fields with an average of 14% of the plants showing severe symptoms on the sub-crown internode. Powdery mildew and glume blotch were observed in 15% of the fields and occurred at a low disease severity. These two diseases were most frequently observed in the northern part of the province. About 5% of the fields showed infections of wheat streak mosaic virus (south), loose smut (south-west), and BYDV (south-west and west-central). The incidence of loose smut ranged from 0.1% to 6% whereas the incidence of the viral diseases ranged from 0.3% to 2%. Other diseases noted were ergot, stem rust, and bacterial blight. In one isolated area in crop district 2B, 3% of the heads inspected in the sample had ergot. In this same area, 50% of the wheat samples brought to the Saskatchewan Wheat Pool elevators were downgraded due to ergot.

Heat and moisture stress affected 24% of the fields surveyed in crop districts 3, 4, and 7A to the point of causing stunting, premature leaf senescence, and floret abortion. An unusual condition found in 14% of the fields in these same districts was plants with stems bent at 90 degrees to the vertical and the cause was unknown. Generally insect problems were not noted but in crop districts 3, 4, and 7A white heads due to wheat stem maggots were observed in 41% of the fields and in crop district 8A grasshoppers and green bugs appeared to be especially severe.

REFERENCE:

Couture, L. 1980. Assessment of severity of foliage diseases of cereals in cooperative evaluation tests. Can. Plant Dis. Surv. 1:8-10

Figure 1. Crop districts and boundaries of wheat fields surveyed in Saskatchewan, 1990.

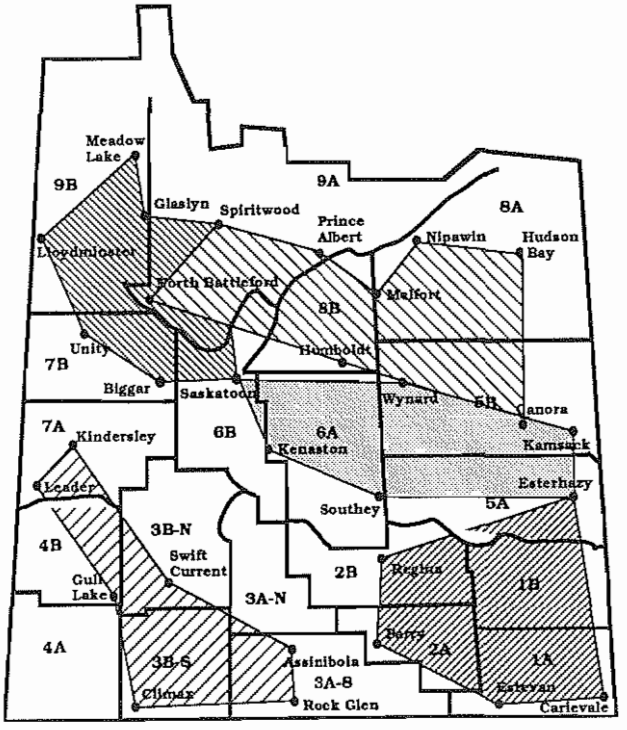


Table 1. Distribution, severity, and prevalence of wheat diseases in Saskatchewan fields surveyed between flowering and soft dough stages, 1990.

Crop District	No. Fields	Leaf spot	Tan spot	Septoria	Leaf rust	Common root rot %	Powdery mildew	Glume blotch%	Stem rust	WSMV	Ergot %	Smut %	BYDV %	Bacterial blight
		*	**											
1A	6	-	4.5/6	3/1	1/3	26	-	1/1	TR/1	1/3	0.5/2	-	-	-
1B	8	-	5.4/8	3.5/2	2/8	16	-	-	-	1/3	0.1/2	0.1/1	-	-
2A	5	-	3.4/5	2/2	2/4	18	-	1/1	TR/1	-	-	-	-	-
2B	3	-	4.5/4	2.6/3	2/2	12	-	-	-	1/3	3/1	-	-	1.5/2
3A-N	0	-	-	-	-	-	-	-	-	-	-	-	-	-
3A-S	7	2.7/7	-	-	1/2	10	1/1	-	-	-	-	0.1/3	-	-
3B-N	24	3.2/22	-	-	-	8	-	-	-	-	-	0.1/7	1/7	-
3B-S	13	2.5/11	-	-	1/2	9	4/2	-	-	-	-	0.1/2	2/5	-
4A	0	-	-	-	-	-	-	-	-	-	-	-	-	-
4B	14	1.4/9	-	-	-	26	-	-	-	-	-	3/2	2/3	-
5A	21	4/8	4.9/7	4.3/8	1/20	22	-	1/5	-	1/3	0.1/1	0.1/1	-	-
5B	33	3.7/10	4/19	5.1/23	1/10	12	0.7/5	-	-	-	-	-		
6A	18	2.8/18	-	-	1/16	20	-	-	-	-	-	-	1/1	-
6B	4	1/1	4/2	7/1	-	8	-	-	-	-	-	-	-	-
7A	7	2.2/5	-	-	1/1	20	-	-	-	-	-	-	0.3/4	-
7B	3	4/2	2/3	1/1	-	3	1/1	-	-	-	-	-	-	-
8A	18	-	3/17	3.2/15	0.9/10	10	2.5/12	1/6	-	-	-	-	-	-
8B	29	-	3.2/29	2.8/29	1.9/21	11	0.5/7	1/6	-	-	-	-	-	-
9A	32	5/2	3.4/28	4/28	0.2/4	6	1.2/12	1/10	-	-	-	-	-	-
9B	10	4.3/3	3.6/8	3.2/9	-	12	1/1	2/7	-	-	-	-	-	-
Aver. or total	254	3.1/98	3.8/136	3.5/122	1.2/103	14	1.4/41	0.8/36	TR/3	1/12	1/6	0.6/16	1.3/20	1.5/2

* not observed or not recorded

** average disease rating (0-9 scale after Couture 1980) / number of fields affected

Crop / Culture: Wheat

Location / Emplacement: Province of Quebec

Title / Titre: OCCURRENCE OF WHEAT DISEASES IN QUEBEC IN 1990

Name and Agency / Nom et Organisation:

Devaux, A.
Service de la phytotechnie de
St-Hyacinthe, M.A.P.A.Q.
C.P. 480, St-Hyacinthe, Quebec J2S 7B8

In 1990, the incidence of wheat diseases was recorded at nine locations in the six regions surveyed. Fusarium head blight (F. graminearum) was low to moderate in most regions but was most severe at Ste-Rosalie, Pintendre, and La Pocatiere. Leaf rust (Puccinia recondita) was severe on susceptible cultivars, late in the season, except at Lennoxville. Mixed leaf spot infections (Pyrenophora tritici-repentis and Septoria nodorum) were widespread in all regiona but were less severe than usual this year. Powdery mildew (Erysiphe graminis) was present on susceptible cultivars in all regions except La Pocatiere, but milder at Normandin, Pintendre, and Deschambault. Glume blotch (Septoria nodorum) occurred in low intensities only at Lennoxville, (Ustilago nuda) and ergot (Claviceps purpurea) were observed only in trace quantities in southwestern Quebec.

Crop / Culture: Wheat

Location / Emplacement: Manitoba

Title / Titre: FOLIAR PATHOGENS OF WHEAT IN MANITOBA IN 1990

Name and Agency / Nom et Organisation:
J. Gilbert, A. Tekauz and E. Mueller
Agriculture Canada
Research Station
195 Dafoe Road
Winnipeg, Manitoba
R3T 2M9

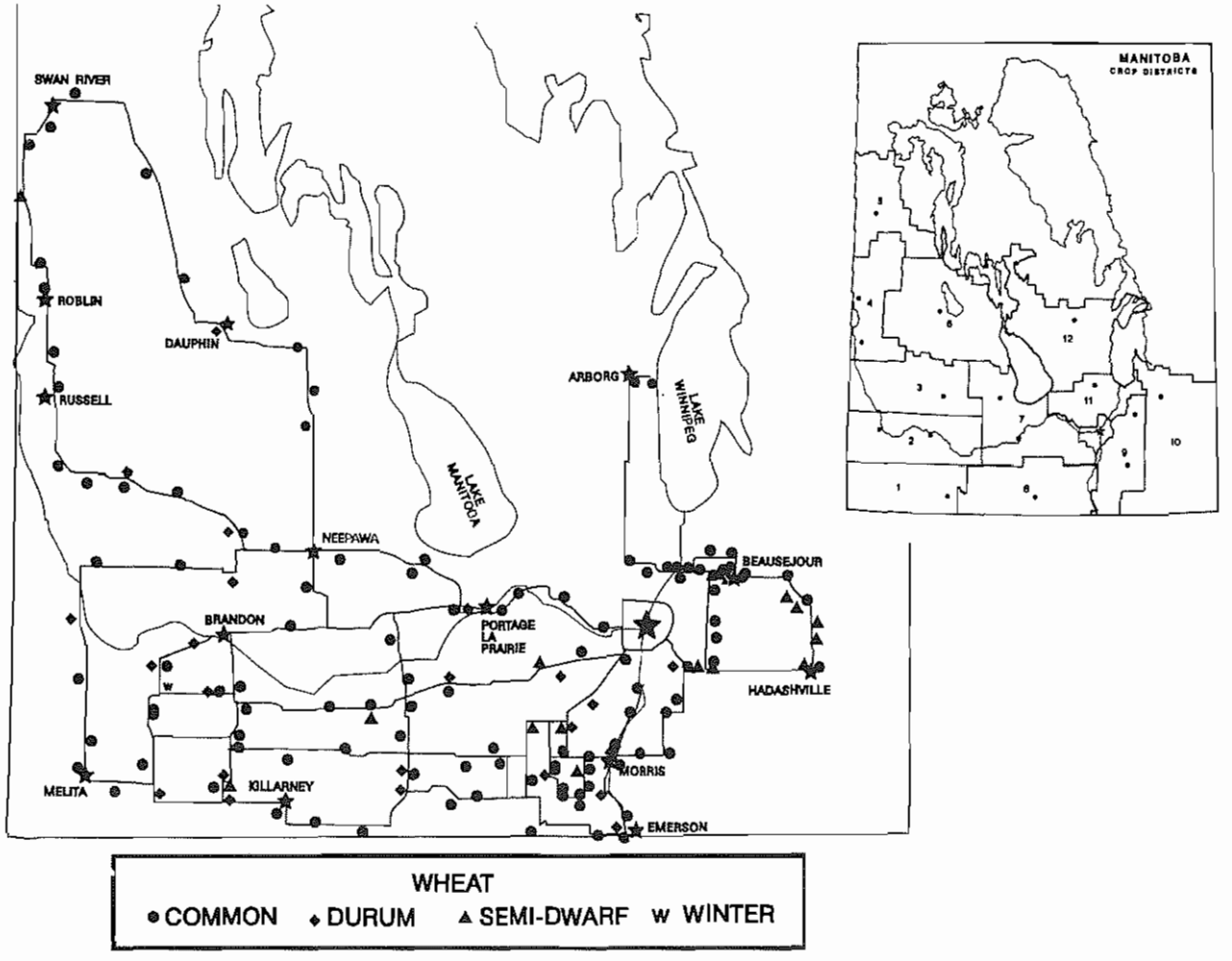
METHODS: One hundred and fifty-five fields of wheat (116 common, 22 durum, 16 semi-dwarf, and 1 winter) throughout the cereal-growing areas of Manitoba were surveyed for foliar pathogens from 11 July to 8 August 1990. Crop developmental stages were recorded at time of sampling and severity of disease on upper and lower leaves were categorized as 0, TR, 1, 2, 3, or 4, with 4 describing dead leaves and 1 lightly affected. Infected leaf samples were collected at each site for subsequent pathogen/disease determination. Lesions from leaf tissue were surface sterilized and placed in moisture chambers for 5-7 days to induce sporulation to facilitate pathogen identification.

RESULTS AND COMMENTS: Maturity of plants at sampling ranged from G.S. 57-83 (Zadoks et al. scale) with the majority between G.S. 65-75. The relatively wet spring caused more leaf-spotting in 1990 than in 1989 in Manitoba. Disease severity levels ranged from 0-2 on flag leaves and from 1-4 on lower leaves; in 36% of fields the latter were moderately to severely affected, or dead. *Pyrenophora tritici-repentis* (tan spot) was isolated from 83.9% of fields throughout the province (Table 1). *Cochliobolus sativus* (spot blotch), isolated from 72.3% of fields, was also widespread except in crop reporting district 5 (Swan River Region). Septoria leaf blotch (*Septoria* spp.) was found in 57.5% of fields, with the causal agent identified as *S. nodorum* in 46.5%, *S. avenae* f. sp. *tritici* in 9.7%, and *S. tritici* in 1.3%. Septoria was more common in crop reporting districts 7-11 in the south and east, and 5-6 in the north-west, than in other areas of the province. Leaf rust (*Puccinia recondita*) was evident in 33.5% of fields. Of these, 48.1% were moderately or severely affected. Infection levels were generally light in the south and the south-west, but moderate to severe in fields east of Winnipeg. *Ascochyta tritici*, causal agent of *Ascochyta* blight or leaf spot was isolated from 9.7% of fields. As was the case for most lesions of tan spot and Septoria, those of *Ascochyta* leaf spot could not be distinguished with certainty from the general "leaf spot complex".

Table 1. Frequency of diseases identified in 155 wheat fields in Manitoba in 1990.

Wheat Class	Disease						
	Septoria leaf blotch			Tan spot	Spot blotch	Leaf rust	*Ascochyta* blight
	"nodorum"	"avenae"	"tritici"				
Common	55	11	2	96	85	44	10
Durum	7	3	0	20	15	5	4
Semi-dwarf	9	1	0	13	12	3	1
Winter	1	0	0	1	0	0	0
Total	72	15	2	130	112	52	15
% Fields	46.5	9.7	1.3	83.9	72.3	33.5	9.7

Fig. 1. Wheat fields surveyed for foliar pathogens in 1990.



Crop / Culture: Wheat

Location / Emplacement: Manitoba

Title / Titre: OCCURRENCE OF FUSARIUM HEAD BLIGHT IN MANITOBA IN 1990

Name and Agency / Nom et Organisation:
L.S.L. Wong, A. Tekauz and J. Gilbert
Agriculture Canada
Research Station
195 Dafoe Road
Winnipeg, Manitoba
R3T 2M9

METHODS: One hundred and nineteen wheat fields throughout Manitoba were surveyed for Fnsarium head blight between July 25 and August 13, 1990 by sampling an area of about 20 x 20 m at the edge of each field. Ten heads were collected from each field to confirm and identify the Fusarium species present.

RESULTS AND COMMENTS: At sampling time the crop developmental stage ranged from late milk to soft dough. Fusarium head blight was found in 74% of wheat fields examined and occurred throughout Manitoba (Fig. 1). It was found in 71% (60 of 85) of common, 100% (13 of 13) of durum and 71% (15 of 21) of semi-dwarf wheat fields. The severity ranged from trace (62 fields) to 20% heads infected. There were more common wheat fields having high severity levels in 1990 than in previous years. The severely infected wheat fields were found primarily in crop district 8 (south-central Manitoba). F. graminearum, F. poae and F. culmorum were the pathogen species isolated most frequently (Table 1).

Table 1. Distribution of Fusarium species in common, durum and semi-dwarf wheats in Manitoba in 1990.

	No. wheat fields			
	Common	Durum	Semi-dwarf	Total
F. graminearum	34	2	8	44
F. culmorum	19	5	2	26
F. poae	18	7	6	31
F. sporotrichioides	6	3	1	10
F. acuminatum	2	0	0	2
F. avenaceum	0	1	1	2

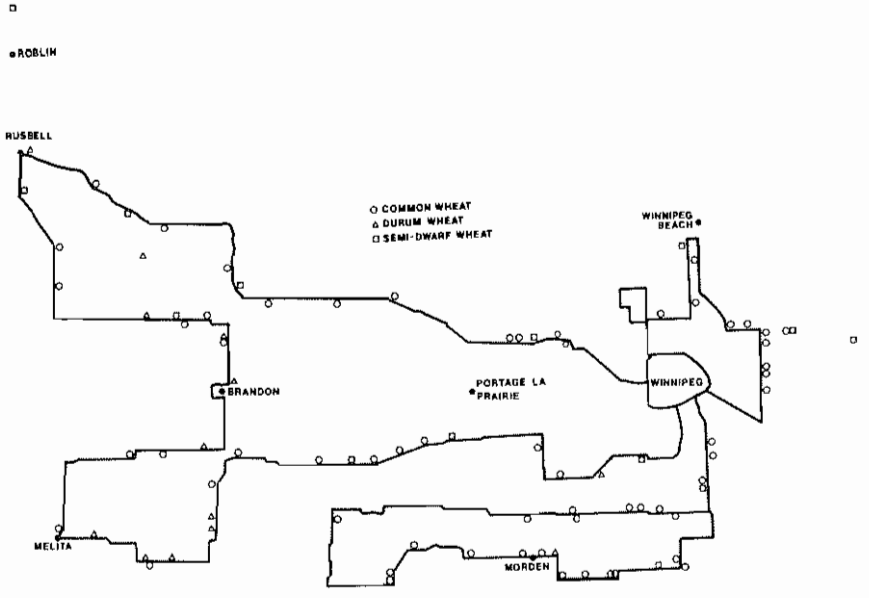


Fig. 1. Survey route and location of wheat fields positive for Fusarium head blight.

Crop / Culture: Wheat and Barley

Location / Emplacement: Manitoba

Title / Titre: 1990 SURVEY OF FLAME CHLOROSIS IN MANITOBA

Name and Agency / Nom et Organisation:

S. Haber
Agriculture Canada
Research Station
195 Dafoe Road
Winnipeg, MB R3T 2M9

G. Platford
Manitoba Agriculture
Plant Pathology Laboratory
201-545 University Cres.
Winnipeg, MB R3T 5S6

BACKGROUND Flame chlorosis (FC) is a novel, soil-borne, virus-like disease of spring cereals that has been reported only in Manitoba (1). Surveys carried out from 1986 to 1989 have indicated that the disease is most common in western Manitoba and appears to be spreading to other regions of the province (1,2). However, the 1986-1989 surveys were limited in their geographic extent, and did not examine systematically the level of FC within the fields that were surveyed. In 1990, a systematic and extensive survey for FC in barley and wheat was carried out with the co-operation of Manitoba Agriculture extension personnel.

METHODS Flame chlorosis is readily diagnosed between the seedling and 4-node stages of growth on the basis of its striking and characteristic symptoms (1). In field workshops held 1990-06-12 and 13 near Brandon and Winnipeg, respectively, personnel were shown how to diagnose FC and record survey data. To estimate efficiently the incidence of FC in the majority of fields where its incidence was likely to be very low, a novel surveying method was used. In a given field, a participant would record the length of time up to 5 min. until the first FC plant was observed in a walk from an arbitrarily selected starting point. If no FC plants were observed after 5 min., it was assumed that FC wes absent; trials had shown that an average surveyor would see at least 10,000 plants in this time. Because FC frequently occurs in a patchy distribution, the number of FC plants among the total number of plants in the surrounding 1 square metre was then counted at the spot where the first FC plant was observed. In each surveyed field four such walks were conducted from 4 different, erbitrarily chosen, starting points. The observations were calibrated to a uniform standard for each surveyed field by estimating the distance walked in 20 sec. and the number of plants seen per metre walked. A typical entry on the survey form looked like this:

SURVEYOR: John PATTERSON
Address: Box 50, Hamiota, MB, ROM 0T0
tel/FAX: 764-2767/764-2759

DATE 90-07-09

LOCATION SE 30-14-21 RM Blanshard

FIELD (type) Virden barley (sample [90-07-09-01]; specimen log number)
Roblin wht -1, Canola -2 (crops in previous years)

	Walk 1	Walk 2	Walk 3	Walk 4
time to 1st FC	002 sec.	001 sec.	014 sec.	003 sec.
FC/plants in $1m^2$	12/216	20/268	12/260	12/228

(mean FC density of 4 'hot spots' = 6%)

distance/time (meters walked/20 sec.) = 15 m
plants/walked meter = 140.

Specimens of FC plants from each field where the disease was observed were forwarded promptly to the Plant Pathology Laboratory of Manitoba Agriculture to confirm the diagnosis (2). Surveyed fields with more than 5% FC plants in the 'hot spots' were defined as "fields with risk of loss due to FC", and fields with FC at lower levels as "fields with FC at subeconomic level". The locations of all surveyed fields were entered on a Manitoba grid map, the basis of the map shown in Fig. 1.

RESULTS AND COMMENTS The survey confirms the findings of earlier surveys (1,2) that FC is centred in western Manitoba in the area north of Brandon. The disease is now so well established in this area that virtually none of the surveyed fields were disease-free in the area roughly bounded by Brandon, Neepawa and Shoal Lake.

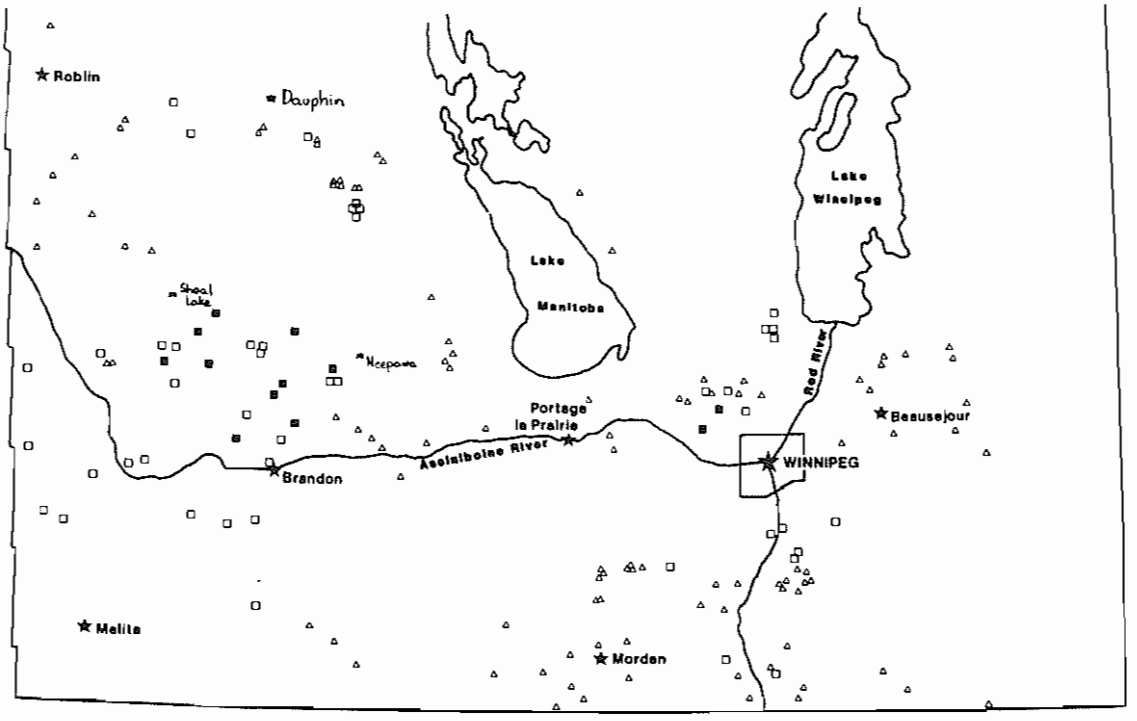


Figure 1. 1990 Manitoba flame chlorosis (FC) survey.
△ sites without FC; □ Sites with FC incidence below 5%; ■ sites with FC incidence above 5%.

This survey also records the first confirmed findings of FC in several new areas, such as the district of Dauphin and areas near the international border south of Brandon and in the southern Red River Valley. Since this is the first FC survey to examine these areas systematically, it is not certain whether these new findings of FC reflect recent spread to these areas or merely that a better search found FC that had been there for some time. Areas with a high proportion of FC sites (Brandon-Neepawa-Shoal Lake triangle, south Interlake) coincide with areas of highest combined frequency of cultivation of barley and wheat in Manitoba. This observation may be consistent with the trend observed elsewhere of increases in soil-borne virus diseases with increasingly intensive cultivation of small-grain cereal crops (1). In areas, such as southeastern Manitoba, where FC has been found at, generally, trace levels, and only since 1988 (1,2) future surveys should track changes in levels of disease intensity.

With several years of data from surveys similar to this one, it should be possible to establish the relationship between disease intensity and cereal cropping cycles, and to chart the future spread of this new disease.

REFERENCES

1) Haber, S., W. Kim, R. Gillespie and A. Tekauz 1990. Flame Chlorosis: a new soil-borne, virus-like disease of barley in Manitoba, Canada. J. Phytopathology 129(3):245-256.
2) Haber, S. 1990. Flame chlorosis: a new, virus-like disease of cereals in Manitoba: 1989 survey. Can. Pl. Dis. Surv. 70(1) p. 50.

Crop / Culture: Wheat, Barley

Location / Emplacement: Manitoba, Saskatchewan

Name and Agency / Nom et Organisation:
J.A. Kolmer and D.E. Harder
Agriculture Canada
Winnipeg, Manitoba
R3T 2M9

Title / Titre: RUST DISEASES ON WHEAT AND BARLEY IN THE EASTERN PRAIRIES IN 1990

METHODS: Fields of cultivated wheat and barley were examined throughout the growing season in Manitoba and Eastern Saskatchewan for wheat leaf rust and stem rust on wheat and barley.

RESULTS AND COMMENTS: Leaf and stem rust of wheat were first observed June 21 in Winter wheat in southwestern Manitoba. By the first week in July, leaf rust was present in light to trace amounts in spring wheat fields throughout southern Manitoba. Leaf rust severities of 20-100% infection on suceptible cultivars were observed throughout southern Manitoba and eastern Saskatchewan (between Regina and Melfort) in the last week of July. Significant yield losses due to leaf rust were expected in winter wheats grown in Manitoba and Saskatchewan, as severities of 50-100% for both rusts were observed on winter wheat at Portage, Minto, Manitoba. The spring wheat and durum cultivars are all resistant to leaf and stem rust, and only trace to light levels of leaf rust were observed, and no stem rust at all was seen in these wheats.

Stem rust on barley was generally observed in trace to light amounts throughout southern Manitoba, and in pockets of southeastern Saskatchewan in the last week of July. However, sten rust severities were very high in fields of late planted barley in southern Manitoba, causing a large reduction in yield. None of the barley cultivars registered in western Canada have good resistance to the predominaut races of stem rust.

Crop / Culture: Winter Wheat

Location / Emplacement: Region of St-Hyacinthe, Quebec

Name and Agency / Nom et Organisation:

Devaux, A.
Service de la phytotechnie de
St-Hyacinthe, M.A.P.A.Q.
C.P. 480, St-Hyacinthe, Quebec J2S 7B8

Title / Titre: SURVEY OF WINTER WHEAT DISEASES IN 1990

METHODS: Nine fields: one of Augusta, two of Monopol, two of Perlo, and four of Karat were surveyed for leaf, root, and head diseases. Foliar diseases were assessed before and after heading on 10-20 plants at 10 sites on a W transect in the field examined. Samples of 10 plants were pulled out at each site to assess for root and basal stem diseases just after heading. Disease intensity of leaves were recorded as a percentage leaf area affected on the whole plant before heading, but on top leaves only after heading using the Horsfall and Barratt grading system[1]. Stem necrosis was assessed as the percentage of stems showing necrosis after removal of the leaf sheath of the basal portion. Head blight was measured as the percentage of heads and spikelets visually infected on 50 heads chosen at random at four different sites in the field.

RESULTS AND COMMENTS: Table 1 shows the minimum-maximum percentage disease intensity for the diseases recorded before and after heading. Before heading, tan spot (Pyrenophora tritici-repentis) was observed in all of the nine fields with a maximum of 7.8% of the leaves affected in the cultivar Karat. Powdery mildew (Erysiphe graminis) was low except in one field of the cultivar Monopol which had 12.3% infection before heading and 11.1% infection of flag leaves at ZGS 80. Leaf rust (Puccinia recondita) was observed only after heading on Monopol with 1.8% of flag leaves infected. Stem necrosis due mostly to Bipolaris sorokiniana and some Fusarium sp. was observed mostly as a slight necrosis in six of the fields with a maximum of 16.9% of the stems examined. Head blight (Fusarium graminearum) was most severe in the cultivar Augusta with a maximum of 2.8% infected spikelets (13.1%). However, all the fields were affected with a minimum of 0.1% infected spikelets. Take-all (Gaeumannomyces graminis) severely infected the cultivars Karat, Perlo, and Monopol with an estimated 40%, 30%, and 25% of plants affected respectively. The other fields showed only traces of infection.

Table 1. Prevalence and intensity of winter wheat diseases in the St-Hyacinthe region in 1990.

Growth stages[2]	% Minimum-Maximum Disease Intensity					
	Leaf spots	Powdery mildew	Leaf rust	Stem necrosis	Head blight heads	Head blight spikelets
Before heading*						
31	0-2.9	0-12.3	0	-	-	-
51	2.3-7.8	0-5.4	0	-	-	-
After heading**						
80	3.8-9.4	0-11.1	0-1.8	0-13.8	1.4-13.1	0.1-2.8

[1]Horsfall & Barratt grading system. 1945 Phytopathology 35(8): 655 (Abstr.).
[2]Zadoks et al. Growth stages of cereals. 1974. Weed Res. 14(6): 415-421.
*Disease assessment on all the leaves.
**Disease assessment on flag leaves only.