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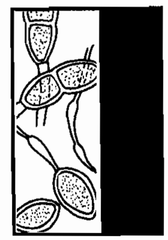
CANADIAN PLANT DISEASE SURVEY



EDITOR: D.W. CREELMAN

RESEARCH BRANCH CANADA DEPARTMENT OF AGRICULTURE

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CANADIAN PLANT DISEASE SURVEY

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(continued inside back cover)

"The Canadian Plant Disease Survey is a periodical of information and record on the occurrence and severity of plant diseases in Canada. It will also accept other original information such as the development of methods of investigation and control, including the evaluation of new materials. Review papers and compilations of practical value to phytopathologists will be included from time to time. It will not accept results of original research suitable for publication in more formal scientific journals".

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RESISTANCE OF ONION VARIETIES TO FUSARIUM BASAL ROT AND TO PINK ROOT[1]

G. E. Woolliams [2]

Abstract

Field tests with 23 hybrid and 23 open-pollinated onion varieties indicated that (a) open-pollinated varieties are, in general, more resistant to fusarium basal rot, and (b) individual hybrid and open-pollinated varieties vary widely in their susceptibility to the rot. The results also indicate that both types of onion are less resistant to pink root than to fusarium basal rot and that, in general, resistance of an individual variety to fusarium basal rot is converse to its resistance to pink root.

Introduction

The choice of onion varieties for commercial production in the Interior dry belt of British Columbia has been strongly influenced by the need for providing resistance to several serious diseases. Within the last five years onion production has been confined almost exclusively to the hybrid varieties 'Autumn Spice', 'Autumn Splendor', 'Premier', 'Epoch', and 'Brown Beauty'. These have replaced open-pollinated onions including 'Yellow Globe Danvers', 'Mountain Danvers', and 'Yellow Globe'. The change to hybrids was especially prompted by the need to utilize their greater resistance to neck-rot, Botrytis allii Munn, which was causing serious losses in the open-pollinated varieties, especially during winter storage.

The change to hybrid varieties has been followed by increased concern with losses from fusarium basal rot, Fusarium oxysporum Schlecht. f. cepae (Hanz.) Snyd. & Hans. This disease, introduced to the region over 40 years ago (4), has been responsible for varying amounts of rot in growing and stored onion bulbs. However, the losses in open-pollinated varieties were seldom sufficient to cause concern among growers. Since the industry has replaced these with hybrid onions, growers have suffered losses as high as 50% rotted bulbs at harvest.

Pink root, Pyrenochaeta terrestris (Hans.) Gorenz, J. C. Walker & Larson, appeared in the B. C. Interior at about the same time as basal rot (4). Although less is known of the extent of actual loss from this disease, and the relative susceptibility of varieties, it is recognized as a common disease on practically all farms.

Because of the increased importance of fusarium basal rot, tests have been made of the comparative resistance of a number of hybrid and open-pollinated varieties to this disease. The reactions of the same varieties to pink root have been included in the comparisons.

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[2] Plant Pathologist.

Materials and methods

The relative degrees of disease resistance of 23 hybrid and 23 open-pollinated varieties or strains were compared in field plantings. Seed of nearly all the hybrids tested and also some of the open-pollinated varieties was supplied by one firm that specializes in seed production of hybrid onions. Seed of the rest of the varieties tested was supplied by several seed firms (Table 1) and included onions of different colors and uses including pickling and bunching onions. The seed of each variety was pelleted with 25% Trithion for onion maggot control, and sown in single 40-foot rows in a field in which basal bulb rot had been severe and pink root present the previous year. The entire field was fertilized by the owner prior to seeding, and a side dressing of ammonium phosphate was applied to the test plots during June to promote growth of the plants and to minimize losses (1). The dates of sowing and of lifting the bulbs were those selected by the grower for his commercial onion crop that was growing adjacent in the same field. Readings of basal bulb rot and pink root were made at the time of lifting.

Results and discussion

The percentages of fusarium basal rot infection (Table 1) ranged from 58.0% to 6.0% among the hybrids, and from 42.2% to 1.7% among the open-pollinated varieties. The most susceptible of the hybrids tested, with over 50% of the bulbs affected, were 'Experimental No. 6', 'Experimental No. 16', 'Fiesta', and 'Brown Beauty'; the most resistant, with less than 10% of the bulbs affected, were 'Hickory', 'Spartan Era', 'Experimental No. 14', and 'Experimental No. 11'.

Among the open-pollinated varieties, only two had more than 20% basal rot infection. These were a strain of 'Yellow Globe Danvers', with 42.2% rotted bulbs, and 'Sweet Spanish Large Utah', with 24.5% rot. The most resistant of these varieties, with less than 5% infection, were 'Silver Queen', Mountain Danvers', and 'Annual Bunching'.

There was a wide range of susceptibility between the three tested strains of 'Yellow Globe Danvers'. Although the one strain proved unusually susceptible, with 42.2% rotted bulbs, the other two strains from commercial sources (Table 1) had only 20.0% and 7.1% loss.

Table 1. Resistance of onion varieties to fusarium basal rot and pink root at harvest.

Variety	Total bulbs	% Healthy	% Basal rot	% Pink root only	*Source of seed	Variety	Total bulbs	% Healthy	% Basal rot	% Pink root only	*Source of seed
Hybrid varieties						Open pollinated varieties					
Exp. No. 6	162	15.5	58.0	26.5	A	Danvers Yellow Globe	206	4.9	42.2	52.9	A
Exp. No. 16	134	9.7	56.0	34.3	A	Sweet Spanish Large Utah	151	10.6	24.5	64.9	C
Fiesta 61	114	15.8	55.3	28.9	A	Yellow Globe Danvers	220	4.1	20.0	75.9	C
Brown Beauty	127	4.8	53.5	41.7	A	White Globe	118	0.8	19.5	79.7	C
Magnifico	128	8.6	35.9	55.5	A	Yellow Ebenezer	167	2.4	18.6	79.0	E
Exp. No. 4	214	12.1	31.8	56.1	A	Southport White Globe	178	2.4	13.5	84.3	E
Abundance	198	3.5	29.8	66.7	A	Sw. Span. Early Imperial	240	15.0	12.5	72.5	C
Exp. No. 9	158	5.7	28.5	65.8	A	Iowa 44 Yellow Globe	116	6.0	12.1	81.9	E
Exp. No. 15	165	10.9	28.5	60.6	A	White Ebenezer	167	3.6	11.4	85.0	E
Encore	195	8.2	23.1	68.7	A	Early Yellow Globe	137	7.3	10.9	81.8	C
Exp. No. 10	149	19.5	20.1	60.4	A	Yellow Sweet Spanish	212	6.6	10.4	83.0	A
Elite	136	7.4	19.1	73.5	A	Early Yellow Globe	188	8.5	10.1	81.4	A
Exp. No. 8	183	2.2	18.6	79.2	A	Silverskin Pickling	180	0.0	10.0	90.0	C
Autumn Spice	146	8.9	17.1	74.0	A	Red Weathersfield	121	6.6	9.1	84.3	C
Exp. No. 12	156	1.9	14.1	84.0	A	Stuttgarter	161	31.7	7.5	88.8	E
Early Harvest	169	1.8	13.6	84.6	B	White Portugal	196	3.6	7.1	89.3	E
Nugget	200	6.5	13.0	80.5	A	Yellow Globe Danvers	155	20.0	7.1	72.9	D
Spartan Gem	194	5.1	12.9	82.0	A	Giant Prizetaker	156	4.5	7.0	88.5	C
Autumn Splendor	161	7.4	12.5	80.1	A	Southport Red Globe	196	1.6	6.6	91.8	E
Hickory	211	5.7	9.0	85.3	A	Walla Walla Sw. Span.	167	7.8	6.6	85.6	D
Spartan Era	186	1.6	8.6	89.8	A	Annual Bunching	184	4.3	4.9	90.8	C
Exp. No. 14	185	28.1	7.0	64.9	A	Mountain Danvers	219	10.9	2.3	86.8	C
Exp. No. 11	167	26.9	6.0	67.1	A	Silver Queen	118	2.5	1.7	95.8	E

*Supplier of seed

A - Crookham Co., Caldwell, Ida.

B - Roy A. Nicholson Ltd., Burlington, Ont.

C - A. E. McKenzie Co. Ltd., Brandon, Man.

D - Gill Bros. Seed Co., Portland, Ore.

E - Stokes Seeds Ltd., St. Catharines, Ont.

Fusarium basal rot infection on individual bulbs at harvest varied from slight, following recent bulb infection, to severe, following infection earlier in the growing season. The rot was normally quite extensive on bulbs that had been infested by onion maggots.

Only four of the 46 onion varieties and strains had less than 50% pink root infection. Twenty-seven had over 75% root infection. The four most resistant varieties were 'Experimental No. 6' (26.5% infection), 'Fiesta 61' (28.9% infection), 'Experimental No. 16' (34.3% infection), and 'Brown Beauty' (41.7% infection).

The degree of pink root infection on individual bulbs at harvest varied from as few as two or three pink-colored, turgid, and still functioning roots to root systems that were totally wilted, desiccated, and functionless. Lightly infected bulbs were well sized for the variety, but severly affected bulbs were smaller than normal. Most diseased bulbs had pink root symptoms on 50% or more of the roots. No distinction in severity of infection was made in the records of disease incidence.

Discussion

The results indicate that hybrid onion varieties are characteristically much less resistant than open-pollinated sorts to fusarium basal rot. Nevertheless, four hybrid varieties suffered less than 10% infection, and five others less than 15%. This suggests that hybrid onions with satisfactory resistance to the disease can be found, either among varieties already released, or through breeding programmes using the more resistant varieties as parents.

Obviously there is a much wider selection of resistant material among the open-pollinated varieties. Where production is satisfactory in other respects, their susceptibility to botrytis neck rot can be minimized if facilities are available for quick drying and proper storage after harvesting. However, the demonstrated variations in susceptibility of the tested strains of 'Yellow Globe Danvers' indicates that their resistance to basal rot cannot be taken for granted. The strain of this variety that was selected and propagated in the Okanagan valley, and widely grown over 30 years ago, was tested at that time for basal rot resistance and, under experimental conditions comparable to those imposed in the recent tests, developed basal rot on only 10 to 13% of the bulbs (2, 3). Thus the resistance of this strain approximated that of the most resistant of the three strains used in these tests, whereas the other two strains developed infection in 42.2% and 20.0% respectively.

Obviously resistance to pink root is much more rare among both hybrid and open-pollinated varieties. Unfortunately, the highest levels of resistance were displayed by the four hybrids that were most susceptible to basal rot, and conversely, the open-pollinated varieties such as 'Silver Queen', that showed the highest level of resistance to basal rot, were among the most susceptible to pink root. Indeed there is justification for speculating that pink root infection may in some manner reduce the susceptibility of bulbs to basal rot infection.

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BACTERIAL LEAF SPOT OF PEACH IN SOUTHWESTERN ONTARIO

B. N. Dhanvantari [1]

In recent years bacterial leaf spot of peach caused by Xanthomonas pruni (E. F. Smith) Dowson has become prevalent in southwestern Ontario. Consequently, to obtain more information on this important disease, peach orchards in Essex county were under frequent observation before and during the growing season of 1966.

A survey to determine the incidence of this disease was made in September in 3 orchards in Harrow-Leamington area. 20 to 40 trees of each of several varieties selected at random in each orchard were inspected and checked for symptoms on foliage and twigs. Summer cankers on current year's twigs as described by Anderson (1) were not found even on trees showing an abundance of foliage symptoms. However, dead terminal parts of current year's twigs resembling the "black tip" type of canker were fairly common, but it is unlikely that these were bacterial cankers because isolations from them did not show the presence of X. pruni. Deep purple and black leaf spots of irregular outline, chlorosis of leaf tissue adjacent to areas where such leaf spots coalesced, ragged shot holes left by dehiscence of leaf spots and defoliation were consequently the symptoms used in assessing disease severity.

Table 1. Incidence of and defoliation caused by bacterial leaf spot of peach in 3 orchards in Harrow-Leamington area of southwestern Ontario in 1966.

Orchard	Variety and year planted		No. trees inspected	% infection	% severe infection	Defoliation
No. 1, Harrow	Sunhaven	1962	39	71.5	12.5	
	Dixired	1962	40	100.0	77.5	
	Kalhaven	1962	40	100.0	97.5	Severe
	Envoy	1962	40	100.0	80.0	Severe
	Redskin	1962	40	100.0	45.0	
	Cardinal	1960	40	100.0	47.5	
	Redhaven	1960	40	87.5	20.0	
No. 2, Harrow	Jubilee	1961	40	80.0	32.7	
	Cardinal	1961	20	100.0	75.0	
	Redhaven	1961	20	85.0	60.0	Severe
	Loring	1961	20	80.0	40.0	Severe
	Kalhaven	1961	20	100.0	100.0	
	Early Elberta	1961	20	100.0	30.0	
	Envoy	1961	20	100.0	70.0	Severe
No. 3, Ruthven	Loring	1961	30	63.3	23.3	
	Garnet Beauty	1961	30	93.3	60.0	Severe
	Keystone	1962	20	35.0	20.0	
	Envoy	1962	20	45.0	10.0	
	Redhaven	1963	30	96.6	40.0	Severe
	Dixired	1958	10	100.0	80.0	
	Babygold-5	1965	30	80.0	50.0	Severe
	Babygold-6	1965	20	55.0	10.0	
	Babygold-7	1965	20	80.0	25.0	

Disease severity ranged from light to severe (Table 1). From survey data as well as from general observations made in several other orchards it was concluded that the incidence of this disease in the major peach growing area of southwestern Ontario is relatively high and that it has become established in many young orchards. Varieties like 'Kalhaven', 'Envoy', 'Dixired', and 'Garnet Beauty' were most severely affected and among the 'Babygold' varieties, new to this area, 'Babygold-5' was similarly severely affected. It was noted that infection was generally not uniform throughout a tree; while the southwestern part showed severe infection, the north and western parts usually did not. Varietal differences in the degree of defoliation were also noted; severity of foliage infection and degree of defoliation were not always in agreement. For example, the 'Dixired' variety showed very little defoliation even though heavily infected.

The general impression gained from these surveys was that the more severely affected trees were definitely lacking in vigour.

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[1] Plant Pathologist, Research Station, Canada Department of Agriculture, Harrow, Ontario.

THE INFLUENCE OF DISEASE INCIDENCE AND HOST TOLERANCE ON OAT YIELDS[1]

R. V. Clark[2]

Abstract

Field comparisons over a three-year period have indicated that oat varieties differ in their tolerance to such diseases as stem and crown rust and the septoria disease. Tolerance could be important in areas and years where these diseases are not initiated too early. However, when they develop early and severely, yields of all varieties are considerably reduced. This situation would not occur frequently. Strains from the current Ontario oat-breeding program showed more tolerance than did introduced material accumulated at Ottawa. More emphasis should be placed on early selection for high yield in developing improved cereal varieties, keeping in mind the possible value of host tolerance.

Introduction

In most oat-growing areas the crop is subjected to numerous diseases that often reduce yields. The diseases of major concern in Eastern Canada include stem rust, Puccinia graminis Pers. f. sp. avenae Erikss. & Henn., crown rust Puccinia coronata Cda., septoria leaf blotch, Septoria avenae Frank f. sp. avenae and barley yellow dwarf virus. The production of resistant varieties is the logical means of controlling these and other cereal diseases and, over the years, pathologists and breeders have had considerable success in producing such varieties (6). This has been especially true for diseases like the rusts (9, 10). These varieties, however, have provided only temporary control as they have not retained their resistance for any length of time. Furthermore, recently licensed oat varieties have shown no improvement in resistance over earlier-released varieties (11). In practically all instances, resistant varieties have been developed with genes specific for certain rust races and new races, to which these varieties were not resistant, have subsequently appeared. This problem has been extremely critical in areas where the varieties have been grown in close proximity to the alternate hosts of the oat rusts, because in these areas new races have been produced continually. Even in areas where the alternate hosts have been eradicated the problem is almost as acute. Moore (5) recently reviewed the oat stem rust situation in the north central United States and concluded that it was extremely critical. Because of shifts in rust race populations in recent years, all oat varieties being grown in that area were susceptible. Furthermore, there were only a few possible sources of resistance available and these would probably be attacked by new races in the near future. He suggested that control measures other than major gene resistance have to be considered.

In recent years more attention has been paid to the possible development of varieties with generalized resistance. Polygenic resistance, minor gene resistance, field resistance and tolerance (4, 5, 6, 7) have been included in this category. These types of resistance have been referred to as "horizontal" resistance by Van der Plank (8). Multiline or composite varieties (1), although made up of lines with specific resistance, could be included in this category since they would be expected to be effective against a wide spectrum of races. Tolerance would be expressed by varieties through good yield even though they may be severely diseased. It has been observed that some varieties suffer much less than others when exposed to the same severe levels of infection (6). Varieties with disease tolerance would be very useful in a crop such as oats because of the difficulty in locating resistance to the septoria disease and because of the rapid change in the race picture for both stem and crown rust, especially in Eastern Canada, and the subsequent failure of specific gene resistance to retain its effectiveness for any length of time.

An excellent opportunity to investigate tolerance in oat varieties, especially to the rusts, was available in the Ottawa area because concentrated populations of the alternate hosts of both stem rust (barberry: Berberis vulgaris L.) and crown rust (buckthorn: Rhamnus cathartica L.) occur at Merrickville some 35 miles southwest of Ottawa. These hosts are not found at Ottawa. Numerous varieties were grown in the two areas in combined disease and yield tests in 1962, 1963 and 1964 to determine whether some of them showed more tolerance to diseases than others. This paper summarizes the results obtained.

Materials and methods

All the oat varieties and strains were grown at the Central Experimental Farm, Ottawa and at Merrickville, Ontario. Each entry was planted as a clump of 20 seeds, evenly distributed over an area approximately one foot in diameter. The centres of the clumps were two feet apart. In 1962, a separate test made up of 15 replicates of the check varieties Russell, Garry and Victory, was planted in a randomized block. When yields of replicates were com-

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pared good agreement was obtained indicating that this was a reasonably reliable method of obtaining yield comparisons. At both locations soil variation was kept at a minimum by planting the clumps so that they occupied an area approximately square in shape. Check varieties were arranged so that one of the three was planted at every tenth clump.

Approximately 1300 oat introductions accumulated at Ottawa over the years were planted at Ottawa and Merrickville in 1962. The 48 highest-yielding entries in the Ottawa test were planted in four replicates at both locations in 1963. In addition, one replicate of all of the entries in the 1962 Ontario oat-breeding program, 75 entries from the Eastern Co-operative, Ontario Preliminary and Screening Tests, was planted. In 1964, four replicates of the 20 highest-yielding introductions and of the 20 highest-yielding strains from the breeding material at both Ottawa and Merrickville in 1963 were planted. Each year disease notes were recorded at least twice during the growing season. Harvesting was done over a considerable period of time in 1962 because of the large numbers of and range in maturity of the entries. However, in 1963 and 1964 only minor differences in maturity were evident. Seed yields expressed as grams per clump were obtained and these, as well as the percent increase or decrease in yield obtained at Ottawa, compared with that at Merrickville, were used for comparisons.

Results and discussion

The prevalent diseases at Ottawa, especially the rusts, appear and develop fairly late and they usually do not influence yields to any extent. At Merrickville, however, where barberry and buckthorn are present, the rusts are initiated early, develop rapidly, reach epidemic proportions, and affect yields considerably. Disease tolerance in varieties would be indicated by those that were able to maintain a reasonable yield of oats when exposed to severe disease conditions, especially if they showed little or no resistance.

The disease picture was similar in the three years of the tests (Table 1). Stem and crown rust and septoria were the diseases of principal concern with barley yellow dwarf virus and manganese deficiency (grey speck) present in trace amounts. Stem and crown rust were present at both Ottawa and Merrickville but infection was earlier and heavier in the latter area (Table 1). If only the degree of infection at maturity was compared then the difference in rust development at the two locations did not appear too great. However, when the duration of exposure of the crop to these diseases at Ottawa and Merrickville was considered, then the differences became more significant. The overall influence of the rusts on yields would be expected to be considerably greater at Merrickville than Ottawa. No entries were completely free from rust infection in the tests and at Merrickville most were quite susceptible. The septoria disease was present at both locations to about the same degree each year (Table 1). However, because of the heavy rust infection in most cases at Merrickville, there was less leaf area available for the fungus to become established.

There were no notable differences in environmental conditions, other than disease severity, between the two locations. Oat yields at Ottawa were reasonably good in 1962 and 1964 (Table 2). However, they were very poor in 1963 because the early part of the growing season was hot and dry and the latter part, cool and wet. The poor yields obtained at Merrickville in 1962 and 1963 (Table 2) resulted mainly from early stem and crown rust infections. The 1962 test was located in an area that limited

Table 1. Kind and prevalence of diseases on oat varieties grown at Ottawa and Merrickville from 1962 to 1964.

	Introductions					
	Stem rust		Crown rust		Septoria	
Year	Ott.	Mer.	Ott.	Mer.	Ott.	Mer.
1962	L*	H	M	H	M-H	M-H
1963	Tr-L	L-M	L	H	M-H	M-H
1964	L-M	M-H	L	M-H	H	H
	Breeding Material					
1962	—**	—	—	—	—	—
1963	M	H	L	M	M-H	M-H
1964	L	M-H	L	M	H	H

* Disease scale Tr - trace, L - light, M - moderate, H - heavy
** Not grown

Table 2. Average yield in grams per plot of varieties of oats grown at Ottawa and Merrickville from 1962 to 1964.

	Introductions	
	Ottawa	Merrickville
1962	87.6*	—**
1963	26.3	6.3
1964	119.7	92.1
	Breeding Material	
1962	—***	—***
1963	31.4	19.3
1964	95.2	82.9

* This figure includes the same entries that were grown in 1963.
** Not harvested
*** Not grown

early growth. This, combined with the heavy rust infection produced such a poor crop that it was not worth harvesting. In 1963, plant growth was reasonably good but seed yields were poor, particularly from the introductions. Stem and crown rust developed later at Merrickville in 1964 and consequently there was a smaller reduction in yields when compared with those obtained at Ottawa.

It is generally believed that stem rust is responsible for greater reductions in yield than crown rust. Stem rust was heavy on the breeding material at Merrickville in 1963 and light on the introductions. Crown rust was heavy on the introductions and light on the breeding material (Table 1). This suggested that, on the average, the introductions had good resistance to stem rust and the breeding material good resistance to crown rust. However, the 1963 data for Merrickville (Table 2) indicate that the yields of the introductions were reduced considerably more than were those of the breeding material.

No tolerance comparisons could be made between yields at Ottawa and those at Merrickville in 1962. There was, however, a wide variation in the yields of the various entries grown at Ottawa. At maturity many of the high yielding ones were heavily infected by the rusts and septoria diseases indicating that these varieties had some degree of tolerance. Comparisons could be made in 1963, although yields at both locations were low. Some of the entries were able to maintain their yield at Merrickville much better than others, although it would appear that, in a year when the rusts are initiated early, yields of all entries are greatly reduced. In general, entries included in the breeding material showed more tolerance than those in the introductions. This fact was substantiated when the yields of the check varieties were compared with those in the two groups. All three checks outyielded any of the introductions at Merrickville in 1963 but several entries in the breeding material outyielded even the best check and none of these entries showed an appreciable degree of resistance, especially to stem rust.

There was again evidence of tolerance in a number of the entries compared in 1964 (Fig. 1) and, as before, primarily in the breeding material. The rusts developed later than usual and as a result five of the entries showed slightly higher yields at Merrickville than at Ottawa. The introductions outyielded the breeding material at both locations (Table 2). The average percent reduction in yield at Merrickville was greater for the introductions (27.6) than for the breeding material (12.3). The introductions, therefore, as a group had the potential at Ottawa to outyield the breeding material but they did not have the disease tolerance to maintain their superiority in yield at Merrickville. Six of the introductions showed less than a 10 percent increase or decrease in yield at Ottawa when compared with Merrickville, but 15 of the entries in the breeding material could be included in this category (Fig. 1). The two top yielding entries in the breeding material were included in this group and, in both cases, they were quite susceptible to stem rust at Merrickville. A general observation was made that entries in both groups that gave high yields were susceptible to the rusts and those that gave low yields showed some resistance. This would indicate that resistance and high yields are negatively associated and that continual selection for resistance would favor low yields.

Date of maturity may have had an influence on the yield of some of the entries as early maturing strains would be expected to have an advantage as they would suffer less from severe disease infections. In 1963 and 1964 yield comparisons of the individual varieties at the two locations were used to show the presence of tolerance and entries that were early or late maturing at Ottawa were also early or late maturing at Merrickville. However, in these two years the range in maturity was relatively small amounting to a difference of approximately one week. Maturity did not appear to be an important factor in these tests as both early and late maturing entries showed varying degrees of tolerance. In 1964, entries 'OA 90-3', 'OA 94-1', 'OA 18-28' and 'Dorval' in the breeding material group (Fig. 1) were moderately late to late in maturity and showed good tolerance while 'OA 34-9' was early but showed poor tolerance. The same picture was true in the group of introduced varieties. The introduced varieties were, on the average, earlier in maturity than the breeding material and this might account for their high yield in 1964 compared to the breeding material (Table 2) since diseases were not as severe that year.

The development of oat varieties with good tolerance to the rusts and septoria is feasible and the presence of this character should considerably increase yields in oat-growing areas in most years. The results presented here were obtained in an area where stem and crown rust occur very early and are severe every year. Similar epidemics would be found consistently only in areas where the alternate hosts of the rusts are present to the same extent. It has been noted previously (2) that oat varieties show a considerable range in tolerance to ascosporic inoculum of the fungus causing the septoria disease. The increased yields obtained with the recently released variety Russell (10) is thought to be due to the fact that this variety has shown better tolerance to septoria disease than those developed previously (3).

The fact that entries from the current Ontario oat breeding program have more tolerance than the introduced varieties is not surprising. These entries have been selected for many factors including high yields, often under reasonably severe disease epidemics, hence those with tolerance would be retained automatically. The introduced varieties no doubt have not been subjected to such intensive selective processes. Most breeding programs involved in the search for improved varieties of cereals have as their primary objective the finding of genes for disease resistance and selection for improved yields usually takes place in advanced generations. By the time yield selections are made, lines with genes

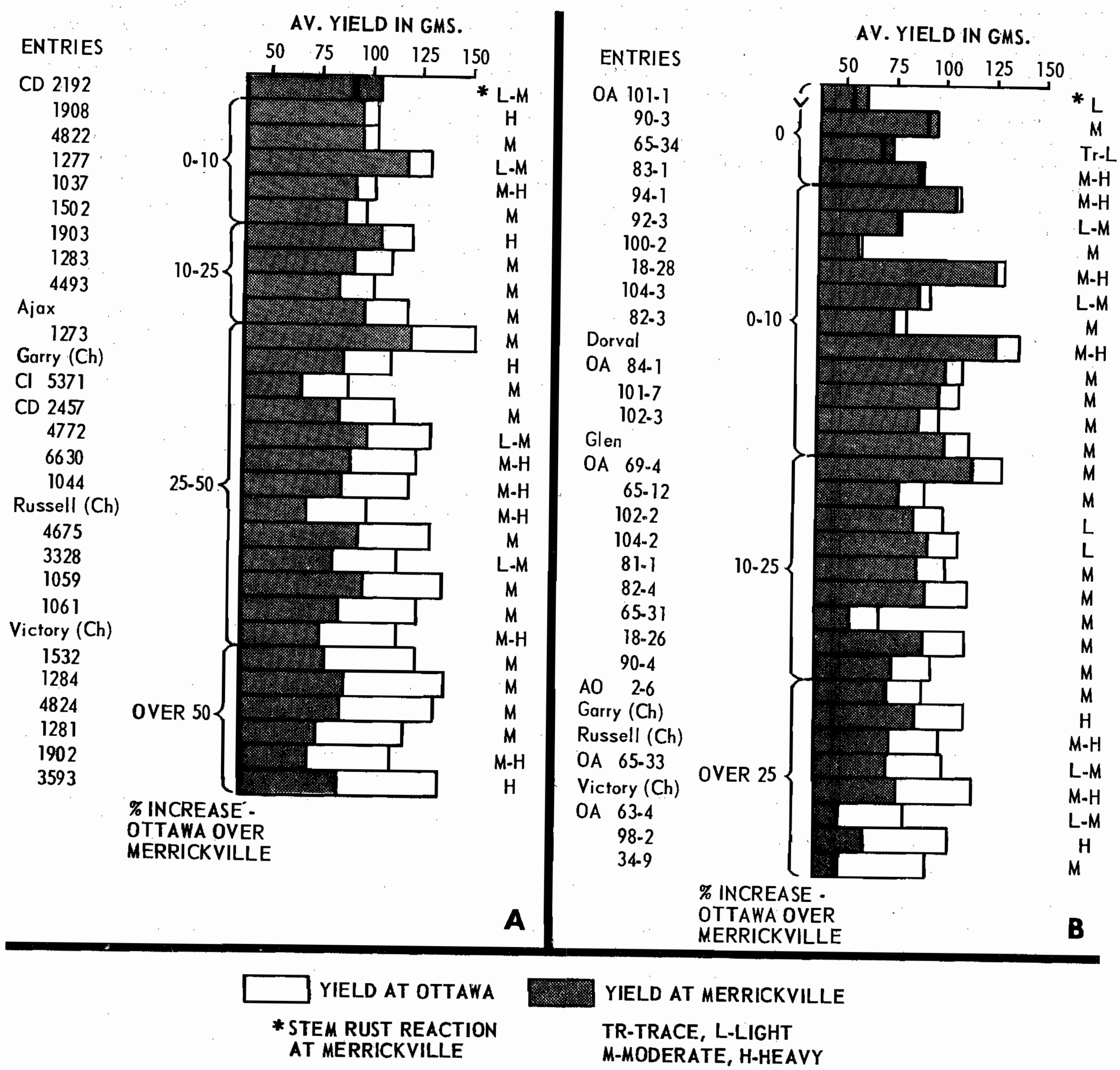

Figure 1. The average yield in grams per plot of varieties of oats grown at Ottawa and Merrickville, Ontario, in 1964. (A) Introduced varieties. (B) Ontario Breeding program Material. Entries in both groups arranged according to the percent increase in yield at Ottawa over Merrickville.

that would improve yield may have been discarded because of susceptibility to *diseases*. A more advantageous approach might be to have improved yields as the primary objective of the breeding program. Disease resistant lines could possibly be selected from or genes for resistance could be added to advanced generations. In this way the high-yielding ability of certain lines would not be lost. Host tolerance could be used to provide protection under disease conditions.

Acknowledgment

The technical assistance of K.B. Last is greatly appreciated.

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VIRUS DISEASES OF CEREALS IN THE EASTERN PART OF THE CANADIAN PRAIRIES IN 1966[1]

C. C. Gill and P. H. Westdal [2]

Introduction

These observations are based mainly on weekly surveys during spring and summer in south-central Manitoba. A more extensive survey, which included other areas of Manitoba and the eastern part of Saskatchewan was made in the last week of July.

Aster yellows

The incidence of aster yellows virus (AYV) infection in barley in 1966 was the highest on record for commercial barley fields in Manitoba. The amount of infection, based on the number of sterile heads, ranged from a trace to 6.5%, with a mean of 3.2% for 25 fields. There was less virus infection in early fields than in late fields.

The six-spotted leafhopper, Macrosteles fascifrons (Stål), the main vector of AYV, was more abundant than usual. The leafhopper migrated into Manitoba in late May in about the usual numbers but the population increased rapidly due to favorable weather conditions. Three percent of the leafhoppers tested in late May and early June were carrying AYV. In late June the figure was 2.6%.

High temperature, which favors development of the leafhopper and shortens the incubation period of the plant (3), appeared to be the most important factor contributing to the high incidence of AYV in 1966. From June 17 to 30, the daily mean temperature was 22° C compared with the long-term mean for this period of 18° C. Above-normal temperatures continued throughout July. Much of the barley in Manitoba was sown late and had just emerged by the latter half of June. At this stage barley is highly attractive to leafhoppers and probably most susceptible to AYV infection.

Barley stripe mosaic

Barley stripe mosaic was found in one of 32 commercial fields examined. The diseased barley was a two-row variety, and was located near Kamsack, Saskatchewan. Approximately 50% of the plants exhibited symptoms and the density of diseased plants was relatively uniform throughout the field. The virus was readily transmitted by mechanical means, from diseased plants to 'Selkirk' and 'Rescue' wheat, 'Herta' and a black, hulless barley and 'Golden Bantam' sweet corn. Twelve seedlings each of 'Clintland' and 'Letoria' oats were also inoculated, but only one of the 'Clintland' plants became infected. This disease was also observed on barley in experimental plots near Winnipeg.

Barley yellow dwarf

Sweeping by net and visual examinations of cereals in fields for the aphid vectors of barley yellow dwarf virus (BYDV), began on May 6.

As in 1965, the English grain aphid, Macrosiphum avenae (Fabricius), was the first vector species to be found in the spring. There is strong evidence that the first English grain aphids in 1966 were migrants. No aphids were found in fields of winter rye near Carman and Elm Creek by May 20. Strong southerly winds prevailed in southern Manitoba on May 21 and 22. When the same rye fields were reexamined on May 24, six English grain aphids were collected in 100 sweeps. Only winged adult forms were present. By June 22, the counts for this aphid were 20 per 100 sweeps on rye and 6 per 100 sweeps on spring cereals, which indicated that there were few additional migrants during this 4-week period. Only by late July was there a marked increase in the numbers of English grain aphids. Figures then rose to an average of 250 aphids per 100 sweeps on spring cereals.

One cherry-oat aphid, Rhopalosiphum padi (L.), was found on spring barley on June 8, but this species was not seen again until August 3 when 50 were collected in 100 sweeps on wheat. This was the largest population of the species found during the season.

One greenbug, Schizaphis graminum (Rondani), and one corn leaf aphid, Rhopalosiphum maidis (Fitch), were found in 300 sweeps on rye on June 15. Populations of the greenbug became prominent (18 per 100 sweeps on spring cereals) only by the middle of July, and then it rapidly increased in numbers and finally competed with the English grain aphid as the dominant species on cereals. The corn leaf aphid was never abundant on barley, its favored host among the cereals. The highest count on barley was 4 per 100 sweeps. The first rose-grass aphids, Metopolophium dirhodum (Walker), were found on oats on August 4. This species remained rare throughout the season.

The efficiency of sweeping for different aphid species was tested in one field of green, headed oats on August 11. In 50 sweeps, 464 English grain aphids and 129 greenbugs were collected. The ratio of English grain aphids to greenbugs was thus 3.6 to 1. Visual inspection of the field appeared to indicate that populations of the greenbug were higher than those of the English grain aphid. Forty plants, adjacent to the area swept, were pulled at random and aphids found on these plants were counted. The totals were 429 greenbugs and 118 English grain aphids. The ratio of greenbugs to English grain aphids was thus 3.6 to 1. The number of greenbugs was higher than the number of English grain aphids on all except five of the forty plants.

It would appear, therefore, that sweeping for the greenbug is much less efficient than for the Eng-

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lish grain aphid. One reason for this may be that adults of the English grain aphid are more easily dislodged in sweeping than those of the greenbug, since the former drop readily to the ground when disturbed. Also, it has been our experience that adults are usually more easily disturbed and dislodged than nymphs. Since nymphs of the greenbug appeared to be more numerous on these plants than those of the English grain aphid, this may explain the smaller number of greenbugs collected by sweeping.

The proportion of aphids caught in the field throughout the season, that transmitted virus when allowed to feed on oat seedlings in the greenhouse, was very low. The number of aphids that transmitted out of the number tested was as follows: English grain aphid, 4 out of 5653; greenbug, 1 out of 484; rose-grass, cherry-oat and corn leaf aphids, each 0 out of 4. These results contrast strongly with those for 1964, when at least 25% of each of the five species collected in the first week of August transmitted BYDV to test seedlings (1). The small proportion of aphids that was found to transmit BYDV agreed with the low incidence of this disease in commercial fields. Disease ratings were as follows: Wheat, trace in 13 fields and nil in 34; oats, 1% in 1 field, trace in 15 and nil in 13; barley, 1% in 1 field, trace in 3 and nil in 28.

Oat necrotic mottle

This disease was first observed in 1965 and was described as a new virus disease of oats in Manitoba (2). Studies were subsequently made on host range, transmission and stability of the virus (4). In 1966, the disease was not observed on oats and the field where the disease was originally seen was sown with flax.

Host range studies revealed that quackgrass, Agropyron repens (L.) Beauv. and bromegrass, Bromus inermis Leyss. could not be infected mechanically, but that Canada bluegrass, Poa compressa L. and Kentucky bluegrass, Poa pratensis L. were susceptible (4). These grasses, with the exception of Canada bluegrass, were the chief components of the grassy sward alongside the field where the disease was found. On June 8, 26 samples of Kentucky bluegrass were collected from the area. Partially developed flower heads were present on most samples. When sap from each sample was rubbed on 'Clintland' oat seedlings, infection resulted, with symptoms typical of oat necrotic mottle.

Slight chlorotic mottle was observed on the youngest leaves of only two of the 26 samples of bluegrass. No symptoms were seen on the other samples. Transmission occurred readily. Each sample of grass was assayed on about 10 oat seedlings, and the average proportion of test plants infected was 93%. When sap from samples of quackgrass, collected in the same area, was rubbed on oat seedlings, no infection resulted.

Specimens of thrips found in the partially developed flower heads of the bluegrass were allowed to feed on 'Clintland' oats, but no infection resulted. Later in the season, eriophyid mites were observed on the leaves of the bluegrass in the same area. Some of these were transferred to caged oat seedlings, but again no infection developed. Up to now, therefore, the natural vector for oat necrotic mottle virus has not been found.

Other diseases

Wheat striate mosaic was observed in two out of about 50 commercial wheatfields. There was less than 1% infection in both cases. Oat blue dwarf was not seen in commercial fields of oats, but was present in experimental plots near Winnipeg.

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ESTIMATES OF CROP LOSSES FROM DISEASES IN THE LOWER FRASER VALLEY OF BRITISH COLUMBIA, 1965[1]

H. N. W. Toms[2]

Introduction

The Lower Fraser Valley from Chilliwack to the islands of the Fraser River delta is the most concentrated vegetable growing area in B.C. and grows approximately one-third of the produce required to supply the wholesale market of metropolitan Vancouver throughout the year. Although there is some overlapping, the local produce is replaced in winter, spring and early summer by comparatively low-priced imports from Texas, California and Mexico and in the late spring by earlier crops from adjacent Washington and Oregon. For individual crops the percentages produced in the Lower Fraser Valley or elsewhere in B.C. reaching the Vancouver market naturally vary considerably, but for the principal crops they are 20-40% of the total. The Vancouver market also receives substantial quantities of potatoes, field onions and tomatoes, and cucumbers from elsewhere in B.C. The remainder is imported.

Farms with large acreages of one crop, whether grown for processing or the fresh market are found mainly at a distance of 40 to 75 miles from Vancouver while the market gardens with more intensive cultivation are located within 25 miles of the metropolitan area. Such vegetables as beans, peas, cauliflower and broccoli for canning and freezing, beets, corn, potatoes and turnips, are grown as rotation crops on mixed farms rather than in market gardens.

Market gardens are situated almost entirely on flat terrain adjacent to the present channels of the river or in old channels long since silted up. Soils in use are predominantly clays or loam clays (Ladner and Monroe types) or peat (muck soils of partially decomposed sphagnum moss) with an occasional garden extending up loam slopes. Since the war there has been a noticeable decrease in local vegetable production on the periphery of the metropolitan area owing both to the rising cost of land and to the conversion of farm and market garden land to residential and industrial uses. Their most noticeable feature, especially in those operated by Chinese tenant farmers, is their intensive cultivation. Crops are interplanted and, as one crop reaches maturity and is harvested, the other is already well established.

The growing season is considerably longer than in other parts of Canada. In favored locations the first crop of lettuce is transplanted in late March and cut early in June, spinach in early March and cut in mid-May, and bunching onions in mid-March and pulled in early June. In one district early potatoes are planted in mid-March and dug in mid-June. Some cole crops can be harvested into December in years when the fall is mild.

Raspberry and strawberry plantings are located mainly on clay and clay loam land, almost entirely on flat terrain. The larger plantings of highbush blueberry and all cranberry acreage are situated in bogs of semi-decomposed peat, being land for which no other use exists at the present time. A small percentage of the blueberry crop is grown on clay loam. Italian prunes are mainly grown on hilly terrain.

The 1965 growing season was relatively warm and dry and rainfall was so distributed that the optimum conditions for a build-up of diseases in general did not take place. There was a very low incidence of foliar diseases such as blights, molds, rusts and mildews.

Acknowledgment

Grateful acknowledgement is made to horticulturists of the British Columbia and Canada Departments of Agriculture, to an officer of the Plant Protection Division, and to an official of the B.C. Coast Vegetable Co-operative Association for supplying data. R. B. Porth, graduate student, Division of Plant Science, University of British Columbia, provided useful information on the incidence of disease in vegetables grown in muck soils.

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Table 1. Estimated losses by crop and disease.

	Acres	Crop Value	Estimated Loss	
VEGETABLES				
BEANS - Includes processing:	1,777	$ 500,000		
Gray Mold (Botrytis cinerea)			2%	$ 10,000
Root Rots (Sclerotinia etc.)			5%	25,000
Boron Deficiency			2%	10,000
BROCCOLI - Includes processing:	325	210,300		
Bacterial Soft Rot			5%	10,500
Downy Mildew (Peronospora parasitica)			5%	10,500
Club Root (Plasmodiophora brassicae)			8%	27,300
Boron Deficiency			1%	2,400
BRUSSELS SPROUTS - Includes processing:	160	111,700		
Bacterial Soft Rot			25%	27,900
Downy Mildew (Peronospora parasitica)			5%	5,580
Club Root (Plasmodiophora brassicae)			2%	2,200
Boron Deficiency			3%	3,300
CABBAGE	400	249,000		
Club Root (P. brassicae)			3%	7,500
CAULIFLOWER - Includes processing:	425	311,600		
Bacterial Curd Rot			5%	15,600
Downy Mildew (Peronospora parasitica)			5%	15,600
Club Root (Plasmodiophora brassicae)			2%	6,300
Boron Deficiency			1%	3,100
Seedling troubles (Rhizoctonia etc.)			5%	15,600
CUCUMBERS				
Field:	315	200,000		
Root Rot (Fusarium sp.)			5%	10,000
Scab (Cladosporium cucumerinum)			5%	10,000
Leaf Spot (Alternaria cucumerina and A. tenuis)			2%	4,000
Greenhouse:	---	185,000		
Misc. Soil Fungi			10%	18,500
LETTUCE (450 acres)		340,000		
Sclerotinia Rot, Drop - Spring crop:	125		15%	14,100
Bottom Rot (Rhizoctonia complex) - Summer:	175		10%	13,200
Bacterial Soft Rot - Late crop:	150		10%	11,340
ONIONS				
Bunching:	50	54,000		
Smut (Urocystis magica)			5%	2,700
Downy Mildew (Peronospora destructor)			5%	2,700
Bulb Crop:	145	170,000		
Neck Rot (Botrytis spp.)			15%	25,500
PEAS - Table and Processing:	5,280	985,800		
Downy Mildew (Peronospora viciae)			1%	9,850
Root Rot (Fusarium complex)			5%	49,300

Table 1. Estimated losses by crop and disease. (continued)

	Acres	Crop Value	Estimated Loss	
POTATOES	5,000	1,800,000		
Black Leg (*Erwinia phytophthora*)			2%	5,950
Common Scab (*Streptomyces scabies*)			arbitrary	1,500
Bacterial Soft Rot (*Erwinia carotovora*)			"	15,000
Bacterial Ring Rot (*Corynebacterium sepidonicum*)			.3%	500
Storage Dry Rots (*Fusarium* spp.)			1.6%	30,000
Tuber Net Necrosis (Leafroll virus, developed in storage)			4%	75,000
Misshapen Tubers (Various causes)			15%	270,000
SPINACH - Spring crop:	12	7,500		
Downy Mildew (*Peronospora farinosa*)			20%	1,500
SQUASH - Winter stored:	100	40,000		
Black Rot (*Mycosphaerella melonis*)			20%	8,000
TOMATOES				
Field:	15	15,000		
Early and Late Blights			20%	3,000
Blossom-end Rot			5%	750
Greenhouse:	---	200,000		
Leaf Mold (*Cladosporium fulvum*)			5%	10,000
Tobacco Mosaic Virus			10%	20,000
Verticillium Wilt (*V. dahliae*)			5%	10,000
TURNIPS AND RUTABAGAS	90	55,000		
Boron Deficiency			2%	1,100
TREE FRUITS				
ITALIAN PRUNE	300	60,000		
Black Knot (*Apiosporina morbosa*)			20%	12,000
SMALL FRUITS				
BLUEBERRY	1,300	600,000		
Cane Canker(*Godronia cassandrae* f.)			15%	90,000
Blossom Blight and Mummy Berry (*Sclerotinia vaccinii-corymbosi*)			10%	60,000
Nursery Propagation Beds (Misc. Twig and Root Rots)			1.6%	10,000
CRANBERRY	500	255,000		
Cotton Ball (*Sclerotinia oxycocci*)			trace	50
Fruit Rots (Misc. organisms)			1%	2,550
RASPBERRY	1,700	2,520,000		
Fruit Rot (*Botrytis cinerea*)			2%	50,400
Root Rots (after December 1964 freeze injury)			10%	214,200
STRAWBERRY	300	300,000		
Fruit Rot (*Botrytis cinerea*)			10%	30,000
Red Stele (*Phytophthora fragariae*)			10%	30,000
Powdery Mildew (*Sphaerotheca macularis*)			2%	6,000
Root Rot Complex			5%	15,000

Estimated total losses $ 1,342,070

SCREENING OF POTATO FUNGICIDES IN 1966[1]

L. C. Callbeck [2]

Introduction

For the second consecutive year the potato fields of Prince Edward Island escaped attack by late blight, Phytophthora infestans (Mont.) de Bary, making 1966 the sixth such year in the past 45 years. Rainfalls were both light and scattered during the July-September period and, most of them being immediately followed by dry winds, there was insufficient moisture for the development of the fungus. In addition, the complete absence of the disease in 1965 suggested that probably no inoculum was present.

Materials and methods

Thirteen fungicides, most of which were repeated from the previous blightless season, were included in the 1966 Screening Test at Charlottetown. These products were as briefly described below.

1. Brestan 60. American Hoechst Corporation, California. A mixture of triphenyltin acetate (60%) and maneb (20%). 5 oz./80 gal.
2. Daconil 2787. Diamond Alkali Company, Painsville, Ohio. Tetrachloroisophthalonitrile. 1.0 lb./80 gal.
3. Difolatan 80W. Chevron Chemical (Canada) Limited, Oakville, Ontario. Cis-N-((1, 1, 2, 2-tetrachloroethyl) thio)-4-cyclohexene-1, 2-dicarboximide. 1.0 lb./80 gal.
4. Dithane M-45. Rohm and Haas Company of Canada Limited, West Hill, Ontario. Zinc coordinated manganese ethylenebis (dithiocarbamate). Mn, 16%; Zn, 2%. 1.0 lb./80 gal.
5. DuTer. Philips-Duphar, Amsterdam, Holland. Triphenyltin hydroxide (20%). 0.75 lb./80 gal.
6. Hortocritt. S.I.A.P.A., Rome, Italy. Ethylene thiuram monosulfide. 2.5 lb./80 gal.
7. M100. DuPont of Canada Limited, Montreal. Disodium cyclohexane-1, 2-dithiocarbamate and disodium hexamethylene bisdithiocarbamate. 3.3 lb. + 1.0 lb. zinc sulphate/80 gal.
8. Manzate D. DuPont of Canada Limited, Montreal. Maneb powder containing zinc sulphate in physical mix. 1.0 lb./80 gal.
9. Micene. Green Cross Products, Montreal. Zinc complex salt of dithiocarbamate acid. 1.0 lb./80 gal.
10. Organil 66. Procida, Neuilly sur Seine, France. A confidential product. 1.0 lb./80 gal.
11. Polyram 80W. Niagara Brand Chemicals, Burlington, Ontario. Zinc activated polyethylene thiuram disulfide. 1.0 lb./80 gal.
12. RH-90. Rohm and Haas Company of Canada Limited, West Hill, Ontario. A confidential product. 1.6 lb./80 gal.
13. Z.M.C.5 80W. Niagara Brand Chemicals, Burlington, Ontario. A complex containing Zn, Mn, and Cu. 1.0 lb./80 gal.

Plots of the blight-susceptible variety Green Mountain were planted on May 31, exactly 50 seed pieces being dropped in each 50-foot row. Each plot was 50 feet long by 4 rows wide and 14 plots — one for each fungicide and an unsprayed control — were set out in each of 4 ranges. Single rows of the same variety were planted as buffers between plots and as borders for the area. These rows were not sprayed.

No insecticides were included in the spray mixtures, insect pests being controlled by spraying all rows with Thiodan at appropriate times. The fungicides were applied on July 14, 25, August 2, 11, 22, 31, September 9, 19, the mean interval being 9.6 days, by means of a tractor-sprayer unit which delivered approximately 120 gallons per acre. The boom carried 4 nozzles per potato row, 2 being above the plants and 2 on drop pipes. The test was terminated on September 26, 118 days after planting, by the application of diquat top killer. Harvesting was performed at mid-October.

The weather being generally unfavourable for the blight fungus, it was necessary to introduce the disease by sprinkling the buffer rows with water suspensions of spores. Several disseminations were made between July 19 and September 6. Even with these inoculations the disease built up very slowly and by September 14 the defoliation of the control plots showed a mean of only 24 per cent. After that date, night dews and higher relative humidities caused a more rapid advance in the controls, these plots reaching complete defoliation by September 26. On that date, eleven of the fungicides had allowed but slight infections to develop, making it exceedingly difficult to accurately record differences among them (Table 1). The fungicide Micene, which allowed 20 per cent defoliation to occur, was relatively ineffectual; M100 was of no value.

Data on yield and tuber rot are given in Table 2. The gradual defoliation of the plants caused a marked reduction in the yield of the unsprayed control plots but, because of the lack of heavy rain, tuber rot caused a further reduction of only 4.9 per cent of the volume. Differences among the yields of the treatments were not statistically significant and losses from tuber rot were small, ranging from zero to 1.1 per cent.

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Table 1. Percentage defoliation.

Treatment	Sept. 14	Sept. 19	Sept. 26
Brestan	T	1	2
Daconil 2787	O	T	1
Difolatan 80W	T	2	4
Dithane M-45	O	1	3
DuTer	T	2	3
Hortocritt	T	1	2
Manzate D	T	2	3
Micene	3	10	20
M100	8	36	70
Organil 66	T	1	2
Polyram 80W	T	3	4
RH-90	1	2	3
Z.M.C.5 80W	T	2	4
Check	24	85	100

Table 2. Effect of treatments on yield and rot.

Treatment	Total bu./ac.	Smalls bu./ac.	Rot bu./ac.	No. 1 bu./ac.	Rot %
Brestan	499.4	56.1	0.0	443.3	0.0
Daconil 2787	532.4	56.8	0.0	475.6	0.0
Difolatan 80W	521.0	63.4	0.0	457.6	0.0
Dithane M-45	512.6	51.7	1.1	459.8	0.2
DuTer	516.8	57.2	0.9	458.7	0.2
Hortocritt	526.9	59.4	3.3	464.2	0.6
Manzate D	517.2	63.8	0.9	452.5	0.2
Micene	508.2	57.6	0.7	449.9	0.1
M100	490.8	64.9	4.2	421.7	0.9
Organil 66	510.6	50.6	3.5	456.5	0.7
Polyram 80W	541.2	57.9	2.6	480.7	0.5
RH-90	518.5	51.7	2.2	464.6	0.4
Z.M.C.5 80W	517.0	55.0	5.5	456.5	1.1
Check	462.9	76.6	22.9	363.4	4.9

DISEASES OF RAPE, MUSTARD AND CRUCIFEROUS WEEDS IN THE PRAIRIE PROVINCES

G. Allan Petrie[1] and T. C. Vanterpool[2]

Introduction

Rape acreage in the Prairie Provinces in 1966 was 3% lower than in 1965. However, due to an 11% increase in yield, to 17.4 bushels per acre the estimated total seed production is 24.1 million bushels, greater than in 1965 by 1.5 million bushels. In Saskatchewan, a record 620,000 acres were sown to rape which has now replaced flax as most extensively grown oilseed crop in the province. Saskatchewan rapeseed production is expected to be 12 million bushels in 1966 (2).

Precipitation in early spring was generally below average. However, from June to August most centers visited during the main disease surveys received above-normal rainfall, particularly during August. Slightly subnormal temperatures were recorded during July and August over much of the rape-growing area (1).

Materials and methods

Several disease surveys were made during the period from June to mid-October. The area included in the main surveys made in August extended from north-central Alberta through Saskatchewan into northwestern Manitoba. Sixty fields of crucifers, including 52 of rape and eight of yellow mustard were rated for disease. Routine isolation of fungi and tests for pathogenicity were made in the same manner as in previous years (3).

Table 1. Rape disease Survey, 1966. Disease rating for 52 fields. (The 1965 figures are given in brackets for comparison.)

Disease organism	Tr.	Sl.	Mod.	Sev.	% of total fields infected
Albugo cruciferarum	15* (25)	25 (25)	29 (10)	10 (5)	79 (65)
Peronospora parasitica	2 (2.5)	8 (2.5)	10 (0)	2 (5)	22 (10)
Sclerotinia sclerotiorum	13 (12.5)	12 (5)	10 (5)	4 (5)	39 (27.5)
Alternaria spp. (A. brassicae & A. raphani)	13 (--)	38 (--)	17 (--)	4 (-)	72 (--)
Mycosphaerella brassicicola	27 (10)	27 (12.5)	15 (35)	0 (7.5)	69 (65)
Yellows (aster yellows virus)	33 (22.5)	6 (5)	6 (2.5)	0 (0)	45 (30)

*Figures in each category are % of fields sampled.

Results and discussion

Ratings for the major diseases found on rape during the general survey are presented in Table 1 in which comparisons with 1965 figures have been made.

Leaf, stem and pod spots caused mainly by Alternaria brassicae (Berk.) Sacc. were much more in evidence than in 1965. In late June and early July the lower leaves of rape in many fields in the Humboldt-Melfort area bore numerous greyish spots. In August, black stem and pod spots were plentiful, particularly in fields in the Swan River area of Manitoba, where seed infestation is likely to be considerable. Yellows (aster yellows virus) was again noticeable, especially in some rape plots at Saskatoon. Mycosphaerella brassicicola (Duby) Lind., the cause of ringspot of rape, while occurring in a larger number of fields, was generally less severe than in the previous summer. Many fields across the Prairies were seeded late in 1966, and fields of widely varying maturity could be found in most districts. A strong impression was obtained that ringspot attacks older, senescent plants to a greater extent than younger ones. This is why the earlier-maturing Polish rape varieties such as 'Arlo' and 'Echo' appear to be more susceptible than the later-maturing Argentine varieties such as 'Golden', Nugget' and 'Tanka'.

Albugo cruciferarum S. F. Gray, the cause of white rust and staghead, was again one of the most destructive pathogens encountered. Some plots near Saskatoon, as well as fields near Duck Lake and Wakaw in Saskatchewan, and Morinville, Redwater and Vermilion in Alberta were particularly badly infested. Slightly raised, brown stem lesions about two centimeters long containing typical Albugo oospores were frequently found on rape, especially in a few Alberta fields. In several instances where these occurred on some of the larger stems it appeared that they may have been responsible for a greater reduction in yield than that attributable to individual medium-sized hypertrophies at the tops of inflorescences. A variety of pathogens, of which Peronospora parasitica (Pers. ex Fr.) Fr., Fusar-

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ium spp., Alternaria brassicae, and A. raphani Groves and Skolko were the main ones were found in association with Albugo on rape hypertrophies. The conidial stage of Peronospora was more conspicuous than it has been for several years.

Although relatively few fields of yellow mustard (Brassica hirta Moench) could be examined, some interesting observations were made. Sclerotinia stem rot (Sclerotinia sclerotiorum (Lib.) de Bary) was by far the most noticeable disease. In the August surveys it occurred in 63% of the fields, with 38 % of these being rated "moderate" to "severe". In a few fields near Annaheim and Middle Lake, Sask., at least 75% of the stems were severely rotted in low-lying areas. Ascospore infection was suspected in many instances where lesions had started high up on the stems. The staghead disease (Albugo cruciferarum) was not found in any mustard fields examined. Yellows (aster yellows virus) and Alternaria (A. brassicae and A. raphani) occurred in trace amounts in about 25% of these fields. A basal stem rot caused by Fusarium spp. in association with Rhizoctonia solani Kühn was recorded on B. hirta collected near Cudworth, Sask., also in trace amounts. Fusarium acuminatum (Ell. & Ev.) Wr. and F. poae (Pk.) Wr. were isolated. Fusarium acuminatum was also found causing a foot rot of rape near Saskatoon. In former years, F. acuminatum, F. poae, F. equisiti (Cda.) Sacc. and F. solani (Mart.) App. & Wr. emend. Snyder & Hansen have been isolated from rape in Saskatchewan.

Pycnidia of the blackleg fungus Plenodomus lingam (Tode ex Fr.) Höhn. (=Phoma lingam (Tode ex Fr.) Desm.) were extremely abundant on overwintered zero erucic acid rape stubble (Brassica napus L.) at Saskatoon in May of this year. Both the "rape" and "Sisymbrium" types (3) were obtained in culture. The fungus still persisted on surface trash in October. Blackleg was found once again in 1966 experimental plots at several sites near Saskatoon. The yearly field survey for P. lingam was centered in the Annaheim-Lake Lenore area of Saskatchewan, the region in which it continues to be most prevalent on cruciferous crops. Blackleg was, however, less prevalent on stubble than it was last fall, perhaps due to drier conditions in September of this year. Although it was found in 71% of the fields examined, including all five fields of B. hirta from which samples were taken, ratings were only in the order of "trace" to "slight". On the other hand, the "Thlaspi" type (3) was again found on stems of T. arvense in most centers of rape production in Saskatchewan and Alberta. In addition, plants with prominent leaf spots from which the "Thlaspi" strain was isolated were collected in late June and early July at Saskatoon and several locations near Melfort. This is the first time that conspicuous leaf symptoms have been observed in the field. The whitish-brown lesions, dotted with numerous small black pycnidia, were commonly a centimeter or two in length, oval or irregular in shape, and without sharply-defined borders. With age they enlarge to destroy entire leaves, the withered remains of which often clasped the stems, frequently giving rise to further lesions there.

Many miscellaneous collections of cruciferous plants yielded rape parasites. These observations have been brought together in Table 2. Of special note are the severe infestation of yellows (aster yellows virus) on Brassica kaber var. pinnatifida and the occurrence of Alternaria brassicae and A. raphani as moderately severe pod and stem spots of Thlaspi arvense.

Damage caused by 2, 4-D drift was of two types (Fig. 1), the particular symptom observed depending upon the degree of development of the rape crop at the time the spraying was carried out. Proliferation of tissue at the stem base, the most common type of damage, often results from spraying of nearby cereal fields in June when the rape plants are still quite young. This symptom was observed at several locations in the course of the summer. In addition, young plants with basal and apical stem enlargements were received from a field near Lloydminster in July. At flowering time the upper portions of the flower stalks may be rendered sterile by 2, 4-D drift which may result from spraying for brush control. This was observed in a field near Margo, Sask., in which about 40 % of the plants had their potential seed yield reduced by one- to two-thirds. It was also observed in a field near Swan River, Manitoba.

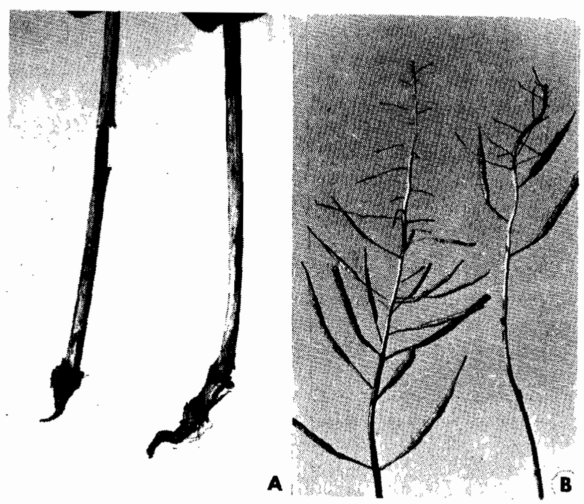

Figure 1. Two types of 2, 4-D damage on rape. Left – Proliferation of tissue at the stem base. Right – Sterility of upper portions of flower stalks.

In many fields a much milder form of sterility at the apices of rape plants was attributed to heat and lack of moisture at a critical stage in development.

Small whitish-grey raised areas uniformly distributed over the leaves of rape plants appeared in the Humboldt area in June (Fig. 2). They appeared to occur at the bases of epidermal hairs and were believed to be intumescences resulting from water congestion of the tissue. Sections prepared from affected leaves did not reveal tissue alteration sim-

Table 2. Miscellaneous disease observations, 1966.

Host	Disease	Severity	Location
Brassica kaber (DC.) L. C. Wheeler var. pinnatifida (Stokes) L. C. Wheeler.	Yellows (aster yellows virus)	Sev.	Rape field, near Margo, Sask.
	Albugo cruciferarum	Tr.	Mustard field, near Annaheim, Sask.
Capsella bursapastoris (L.) Medic.	Peronospora parasitica	Mod.	Margo, Sask.
Thlaspi arvense L.	Sclerotinia sclerotiorum	Tr.	Rape field, Warspite, Alta.
	Yellows (aster yellows virus)	Tr.	Mustard field, Cudworth, Sask.
	Alternaria brassicae and A. raphani	Mod.	Pod and stem spot, near Melfort, Sask.
Lepidium sp.	Alternaria brassicae	Tr.	
Chinese cabbage (Brassica pekinensis (Lour.) Rupr.)	Yellows (aster yellows virus)	Sev.	Saskatoon.
Radish (Raphanus sativus L.)	Alternaria raphani	Sl.	Irrigation plots, Saskatoon.

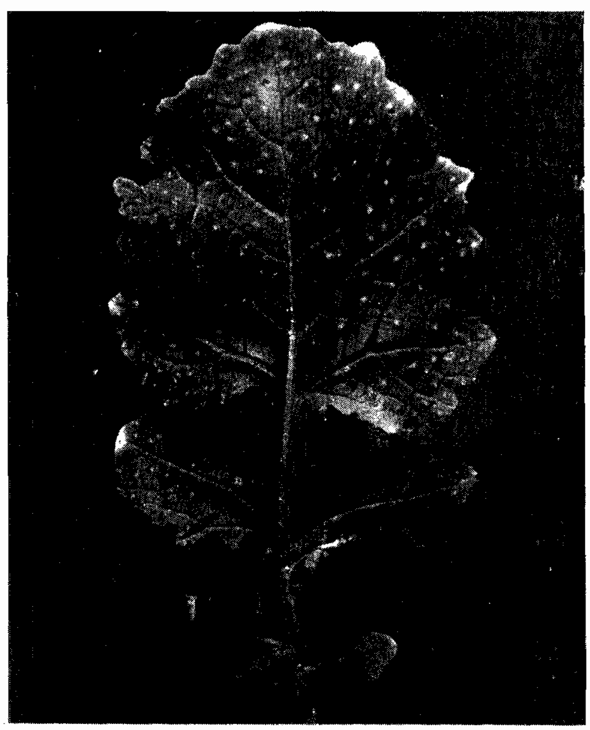

Figure 2. Intumescences on a rape leaf.

ilar to that described by Wolf (4) and further studies of them are being made.

It may be clearly seen from the survey results that the majority of the common rape diseases have increased in severity since 1965, which was itself a year very favorable for disease development. The persistence and spread of rape diseases on weeds, although perhaps not yet a major factor in the disease situation, should nevertheless be mentioned once again, as it appears to be definitely increasing on the Prairies. All the important rape pathogens have been collected on at least one common weed species during the last two years. White rust, blackleg, sclerotinia stem rot, and alternaria black spot are good examples of diseases having wide host ranges on weeds.

Acknowledgment

The junior author is grateful to the National Research Council of Canada and the Saskatchewan Research Foundation for grants in aid of research on the various diseases of rape.

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ASTER YELLOWS OF POTATO IN BRITISH COLUMBIA[1]

N. S. Wright [2]

Introduction

A disease of potato, known locally as haywire (3), has been observed on occasional plants in the Pemberton and Cariboo districts of British Columbia for several years. The symptoms agree with the published descriptions of aster yellows (1, 2). In 1966 the disease occurred to a greater extent than in any previous year on record. In a few fields as many as 25% of the plants were infected. The disease occurred also on several weeds and other cultivated species. Typical aster yellows symptoms were observed on common plantain (Plantago major L.), pineapple weed (Matricaria matricarioides (Less.) Porter), wild buckwheat (Polygonum convolvulus L.), carrot (Daucus carota L.), China aster (Callistephus chinensis (L.) Nees), zinnia (Zinnia elegans Jacq.), cosmos (Cosmos bipinnatus Cav.) and poppy (Papaver rhoeas L.) Infection was common in plants of the above species which were growing in or near the seriously affected potato fields. The aster leafhopper, Macrosteles fascifrons (Stål) was present in large numbers and presumably was responsible for spreading the virus.

The observations and experiments which are reported here were made several years ago but until 1966, the identity of the disease was uncertain.

Figure 1. Primary symptoms of aster yellows on potato.

Symptoms

Primary symptoms (Figure 1) consist of an upward rolling of the uppermost leaves, an intensification of pigment in the rolled leaves, aerial tubers, general stunting and premature death. Immature tubers from diseased plants are often soft or spongy. Primary symptoms of aster yellows cannot be distinguished with certainty from those of leaf roll or witches' broom, but secondary symptoms of leaf roll and witches' broom are distinctive and diagnostic. Plants with secondary symptoms of aster yellows simply lack vigour. Tuber seed pieces from the same diseased plant may produce plants which have normal vigour, others which are weak, and still others which have no growth above ground.

Graft transmission

Scions taken from a field-grown potato plant with early primary symptoms were grafted to the stems of 4 healthy 'Netted Gem' potatoes in the greenhouse. After 4 weeks the inoculated plants became chlorotic and developed axillary branches and aerial tubers. Control plants grafted with healthy scions remained normal. Several 1- to 4-ounce tubers were produced by each plant. These were held 5 months in cold storage and then planted. The difference in vigor between the plants produced by tubers from inoculated and control plants was not significant. However, aster yellows virus does not always reduce the vigor of tubers (1) and since none of the plants had leaf roll or witches' broom symptoms it seems probable that the virus transmitted by grafting was aster yellows. Similar grafts with scions from field-grown plants with secondary symptoms have failed to indicate the presence of aster yellows virus.

Effect on vigor

Observations were made on the vigor of plants produced by tubers from aster yellows-infected potatoes from the field. Forty-eight tubers, 4 ounces or more in weight, were harvested from 13 plants which showed primary symptoms. Varieties tested were 'Warba' and 'Netted Gem'. The following spring the tubers were each cut into 2 or 4 seed pieces and planted so that the seed pieces from each tuber were in a unit. Controls were 42 tubers of the same size and varieties taken from 12 plants which were free of aster yellows symptoms. The 48 tubers from diseased plants and the 42 control tubers were cut into 180 and 168 seed pieces respectively.

By the end of July when most of the plants were 18 inches high the vigor of each was rated "good", "poor" or "none". Those given the last rating had failed to produce any aerial growth. The uniformity of the plants produced by each tuber was also noted. The results, which are given in Table 1, show that the effect of the virus on vigor was approximately the same for each variety. One-third of the seed

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Table 1. The effect of aster yellows virus on potato plant vigor the year after infection

Variety		Plants with vigor rated			Units in which vigor of plants was		
		Good	Poor	None	Good	Poor	Variable
Warba	- Aster yellows	80	8	16	19	5	5
Netted Gem	- " "	40	22	14	5	5	9
Totals		120	30	30	24	10	14
Warba	- Control	72	0	0	18	0	0
Netted Gem	- "	96	0	0	24	0	0
Totals		168	0	0	42	0	0

Table 2. The marketable and total yield of 'Netted Gem' potato clones recovered from aster yellows

Clone	Kind of plants			Yield[1] (1955)	
	1953	1954	1955	Marketable	Total
I	Aster yellows	Weak	Normal	29.0	46.0
II	Aster yellows	Normal	Normal	30.2	46.2
III		Aster yellows	Normal	30.5	44.2
IV	Normal	Normal	Normal	26.7	44.2
		Significance (P=0.05)		NIL	NIL

[1]Mean of 4 replicates expressed in pounds/plot.

pieces from the infected plants either failed to germinate or produced plants of poor vigor. Only one-half of the 48 tubers from diseased plants produced units in which the vigor of the plants was uniformly good. Fourteen of the 48 tubers produced some plants which had good vigor and others which had poor vigor. The remaining 10 all produced plants of uniformly poor vigor. All seed pieces from control plants produced plants of good vigor.

The effect of aster yellows virus on the vigor of potato clones was temporary. The tuber progeny of plants with very low vigor produced some normal and some slightly dwarfed plants but all others produced plants of normal vigor. The yields were compared among 4 clones of 'Netted Gem', 3 of which had recovered from aster yellows. One clone was derived from plants which were weak the first year and normal the second year after infection; the second clone was derived from plants which were normal for two successive years after infection; the third clone was derived from normal plants one year after infection; the fourth clone was a control. Results are shown in Table 2. The total and marketable yields of the 4 clones were the same.

Summary and discussion

Aster yellows virus was diagnosed as the cause of a minor potato disease which has occurred for several years in the Pemberton and Cariboo districts of British Columbia. Diagnosis was facilitated in 1966 because, in addition to potato, the virus had spread on a few farms to clearly diagnostic weed, vegetable, and ornamental hosts.

Observations from previous years on the performance of tubers from individual plants indicated that about one third of the seed pieces derived from infected plants produced weak plants or missing hills. The effect on vigor, however, is temproary and the yield of tubers from recovered plants was not affected.

Isolation of potato fields from areas where the virus may overwinter in weeds or other hosts coupled with the eradication of these hosts is expected to keep the disease incidence at a low level on farms in these areas.

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DISEASES OF BROMEGRASS IN SASKATCHEWAN IN 1966[1]

J. Drew Smith[2]

Introduction

Surveys for the two major leaf spots of Bromus inermis Leyss. caused by Selenophoma bromigena (Sacc.) Sprague and Johnson and Pyrenophora bromi (Died.) Drechsler were made in 233 pastures, seed and hay crops and road verges in the provinces between 19 May and 24 September.

The distribution of the two diseases was similar to that reported by Smith (1). Selenophoma leaf spot was more widespread than pyrenophora leaf blotch but the latter was more common and more severe on the black parkland and black and grey/black parkland/forest soil zones than on the brown prairie soils. With some very localized exceptions, notably in the bottoms of roadside ditches and on irrigated areas, severe pyrenophora leaf blotch was not seen on bromegrass in the brown or dark-brown prairie soil zones. Neither leaf spot was severe on short, grazed pasture.

Both leaf spots appeared earlier than in 1965. In the Unity seed-growing area, selenophoma leaf spot was first seen on young leaves on 19 May. In the Nipawin/Melfort seed-production districts, lesions of pyrenophora leaf blotch on new leaves were recorded on 26 May. Peak severity for selenophoma leaf spot was in mid-July at Saskatoon and Indian Head. Pyrenophora leaf blotch was most severe at Nipawin/Melfort in mid-August and at Big River and Leask at the end of August. There were indications by mid-June of an imminent epiphytotic of pyrenophora leaf blotch on seed crops of registered varieties of bromegrass in the Nipawin/Melfort area and the below-average yields of seed there may be a reflection of the high incidence of this and other diseases. However, wet weather at the time of seed set may also have contributed to poorer seed yields. Seed yields of bromegrass in the Unity district, where common brome predominates, was only slightly below normal and leaf spots were only slightly more severe than in 1965.

Ecology of S. bromigena and P. bromi in road allowances

The material for road making is often taken from the road allowances or ditches. Often the soil is thin at the lowest position and thicker along the road edge and field side bank of the allowance. On the moister soils in Saskatchewan, road allowances are often sown with common brome which is susceptible to both diseases. Most commonly, growth is more dense on the shoulders of the allowance where

Table 1. Severity of two major bromegrass leaf spots throughout the season (233 localities)

Survey Periods	Leaf spot	Severity* rating 4	3	2	1	0
19 May to 31 May	Selenophoma	0	0	0	10	13
	Pyrenophora	0	1	8	6	8
2 June to 23 June	Selenophoma	0	10	22	65	47
	Pyrenophora	0	20	39	28	57
13 July to 22 July	Selenophoma	2	4	5	3	2
	Pyrenophora	0	5	4	0	7
10 August to 31 August	Selenophoma	1	2	7	5	21
	Pyrenophora	7	8	10	7	4
1 September to 24 September	Selenophoma	0	0	0	5	9
	Pyrenophora	0	1	7	6	0
Total						
19 May to 24 September	Selenophoma	3	16	34	88	92
	Pyrenophora	7	35	68	47	76

*Where 4 is severe disease and 0 no symptoms seen.

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there is greater top soil depth or higher soil fertility than at its base. In spring, following snow melt, and in wet weather, water often stands in the allowance base.

In the dark brown and brown prairie soil zones the lowest portion of the road allowance is usually the place where P. bromi may be found, sometimes with S. bromigena. On the darker soils of the parkland and parkland forest belt it is often necessary to search the road allowance shoulder in the longer grass to find S. bromigena. Rarely is P. bromi absent from bromegrass in the road allowance bottom on darker soils during the summer. Verge trimming operations expose almost the whole profile of bromegrass stands and it is noticeable that where patches of lush growth occur there selenophoma leaf spot is usually more severe than where growth is sparse and open.

Results of infection studies with S. bromigena show that following inoculation with conidial suspensions, a 4- to 5-day moist chamber incubation is required to establish infection. Heavy watering of inoculated plants reduces the amount of infection as the inoculum is largely washed off. On the other hand, infection with P. bromi may be apparent 48 hours after inoculation. One of the factors affecting distribution of the two diseases on bromegrass in road allowances may be differences in density of stand. The denser growth at the edges favours the maintenance of high humidity around the lower leaves for the longer infection period required by S. bromigena. At the allowance base, although there may be more moisture, with sparser growth there is less protection from spore "wash off" during prolonged rainy periods.

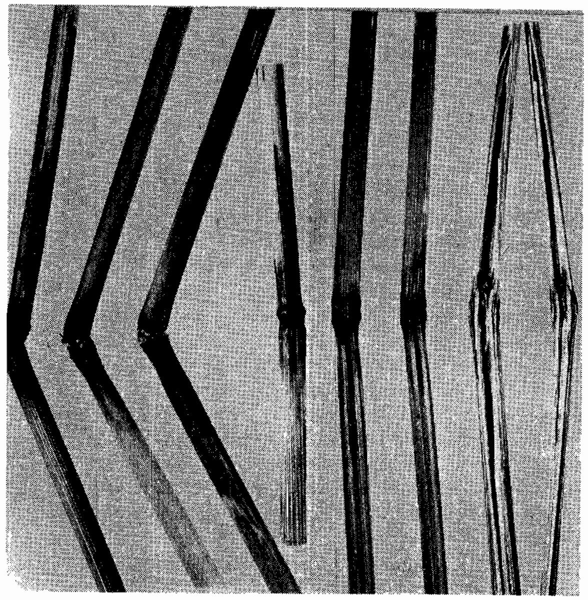

Figure 2. Black node on brome grass culms
Left – Stem fracture
Centre – External appearance
Right – Internal blackening

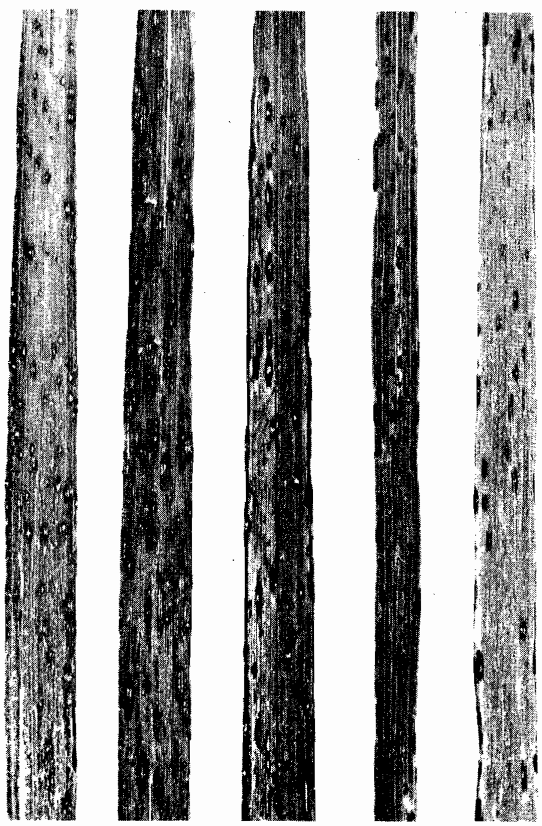

Figure 1. Sporotrichium leaf spot on bromus inermis.

Effect of burning on P. bromi

The severity of leaf spots was found to have been reduced by burning plant debris. At Leslie, a strip of an 80-acre field of commercial brome grown for seed failed to catch fire in the fall of 1965. In July 1966, 100 plants taken at random from the unburnt strip had an average rating of 2.06 for pyrenophora leaf spot, on the 0-4 scale, and 100 plants from the burnt area had an average rating of 0.20. At Nipawin, 100 plants from an area in a seed crop of 'Carlton' which did not burn in the spring of 1966 had an average rating of 1.82 for pyrenophora leaf spot and 100 from the surrounding burnt area had an average rating of 0.43.

Other diseases

Scald (Rhynchosporium secalis (Oud.) J. J. Davis) was first noted at the end of May and become severe in several locations by mid-August. The disease was as common and severe on brome on light prairie soils as on the black soils of the parkland.

Figure 3. Selective herbicide damage on brome grass.

The Sporotrichium isolated in 1965 in Saskatoon was associated with leaf spot symptoms (Fig. 1) in 13 locations widely scattered over the province from mid-August 1966. The spotting was severe on a seed crop of the variety 'Saratoga' at Melfort on 18 August and moderately severe on a seed crop of the variety 'Carlton' at Leask on 31 August.

A condition referred to as "black node" became apparent in July at Saskatoon (Fig. 2). It was associated with abnormally thick and brittle culms in some varieties. The disease appeared in seed crops in the Melfort area in August. Isolates from blackened nodes yielded principally Septoria and Fusarium spp. The condition had no significant effect on stem or seed weight in the varieties 'Red Patch' and 'S-6733', but increased lodging. Although it was not possible to relate the condition to cultural or climatic factors in commercial crops, at Saskatoon thick tillers and abnormally brittle stems were associated in experimental plantings with selective herbicide damage. The herbicide concerned was a low volatility 2, 4-DB. This was severe (Fig. 3) in all 5 varieties in replicated field experiment.

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A COMPARISON OF DICHLOROFLUANID, DICHLORAN AND DAC 2787 WITH CAPTAN FOR FRUIT ROT CONTROL IN STRAWBERRIES

Jack A. Freeman[1]

Abstract

Continuing the spraying of captan through the picking period (8 sprays) gave increased yields of sound fruit over plots sprayed 5 times. Results with dichlofluanid were the same though the 8 sprays were not significantly different from 5 sprays. Two sprays of dichlofluanid, 2 lb./acre applied when the first flowers opened and again at full bloom, gave as good control as five sprays of the 1-lb. rate. The possibility that three sprays (6 lb./acre) during blossom to early fruit formation would give adequate protection is suggested. Five sprays of DAC 2787 at $1\frac{1}{2}$ lb./acre proved as effective as eight sprays of captan or dichlofluanid. Dichloran was the least effective of the fungicides. Fruit size was not affected by captan, dichloran or DAC 2787. Dichlofluanid, on the other hand, caused a significant reduction in fruit size. It is suggested that this is a possible reason for lack of increase in total weight of sound fruits over that from captan-treated plants. The field sprays of dichlofluanid were slightly more effective than captan or DAC 2787 for postharvest control of fruit rot. Dichloran proved more effective in controlling latent infection of fruit than in reducing rot incidence in the field.

Introduction

A major concern of strawberry growers in coastal British Columbia is the high incidence of gray mold (Botrytis cinerea Pers.) which causes a serious fruit rot in most years.

On the basis of earlier research conducted at the Small Fruits Substation, Abbotsford, British Columbia, captan was recommended control of gray mold in strawberries (3). A schedule consisting of at least four sprays of captan at $1\frac{1}{2}$ lb./acre applied at intervals of 7 to 10 days, starting when the first blooms open was recommended. Even though this spray schedule results in a marked increase of sound fruit (50 to 100%) there are still many rotted berries in the field (up to 15% of total yield).

In work conducted at the East Malling Research Station (4), dichlofluanid (N-(dichlorofluoromethylthio-N', N'-dimethyl-N-phenylsulfamide) was shown to be clearly superior to thiram, captan, DDCB and dichloran in reducing the amount of botrytis infection on two varieties of strawberry. The plants were sprayed first when 5% of the flowers were open and again at full bloom. These results suggested that even in seasons when botrytis infection is heavy, good commercial control of fruit rot might be achieved by using only two fungicidal sprays, provided they are applied thoroughly.

Clark et al. (2) found that the application of dichloran (2, 6-dichloro-4-nitroaniline) resulted in outstanding control of Botrytis cinerea on lettuce and that no check to the growth of the crop resulted.

Thus, an experiment was conducted in 1966 to obtain information on the effectiveness of various spray schedules with captan, DAC 2787 (tetrachloroisophthalonitrile), dichloran and dichlofluanid for field and postharvest fruit rot of strawberries.

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Methods

'Northwest' strawberries were planted in a silt loam at the Small Fruits Substation, Abbotsford, British Columbia in 1965. The experiment was laid out in a randomized block design with six replications. Each plot consisted of a single 30-foot row. The plants were grown by the matted row system and good grower practices were followed in establishing the plantation. The planting was sprinkler-irrigated when necessary. In the spring of 1966 the entire planting was cleaned up by removing the dead leaves and cultivating lightly. On May 9, the planting received an application of 6-30-15 fertilizer at 500 pounds per acre. All fungicide treatments were begun at first bloom on May 7. Concentrate sprays (blossom application at high rate) of captan 3 lb./acre and dichlofluanid 2 lb./acre were tested by applying them on May 7 and again on May 12 when the strawberry plants were about in full bloom with some fruit forming. Captan $1\frac{1}{2}$ lb./acre, DAC 2787 $1\frac{1}{2}$ lb./acre and dichlofluanid 1 lb./acre were begun May 7 and continued through the picking period, with the last spray being applied on June 30 for a total of 8 sprays.

Control of preharvest infection was determined by weighing all infected berries from each plot at each picking. The crop was picked 6 times between June 18 and July 11.

In addition to weighing the infected fruit, the weights of marketable and cull fruit were also recorded. The size index of sound berries from each plot was determined at each picking. The effect of treatment on postharvest fruit rot was determined from a random sample of at least 7 pounds of sound berries picked on June 20, 26, July 4 and July 11 from each plot in each replicate. The berries were transported in shipping crates to Agassiz, 40 miles distant, and were placed in common storage. The percentage of sound berries was determined at 24, 48, and 72 hours after harvest.

Table 1. Influence of various treatment schedules on preharvest fruit rot of 'Northwest' strawberries

Treatment (active ingredient) (sprays in 100 gal. water)	Number of sprays*	Rotted fruit lb./plot	Sound fruit lb./plot	Increase over unsprayed %
Unsprayed	-	17.56 a**	26.12 e	0
Captan 1½ lb./acre	8	6.47 d	44.72 a	71
Dichlofluanid 1 "	8	2.51 f	44.65 a	71
DAC 2787 1½ "	5	5.33 de	43.10 ab	65
Captan 1½ "	5	7.70 cd	38.56 bc	48
Dichlofluanid 1 "	5	3.43 ef	39.43 abc	51
Dichloran 2 "	5	9.72 bc	31.25 de	20
Concentrate sprays at blossom				
Captan 3 lb./acre	2	11.99 b	35.19 cd	35
Dichlofluanid 2 "	2	7.67 cd	38.33 bc	47
Mean		8.04	37.93	
S.E. Mean		0.88	1.84	

*1st spray - May 7 (first bloom); 2nd spray - May 12 (about full bloom, some fruit forming); 3rd spray - May 20; 4th spray - May 30; 5th spray - June 9 (last spray before harvest); 6th spray - June 18; 7th spray - June 24; 8th spray - June 30.

**Means not followed by the same letter are significantly different at the 5% level (Duncan's Multiple Range Test).

Results and discussion

The incidence of fruit rot in the unsprayed plots was 40% or more, apparently due to the unusually wet season. Rainfall was recorded on 39 days from May 7, at the beginning of flowering, to July 11, at the end of harvest. The results of past tests showed little advantage in carrying the spray programme through the picking period. However, in this test, continuing the spraying of captan through the picking period was definitely beneficial (Table 1). The results with dichlofluanid were the same though the 8 sprays were not significantly different from the 5 sprays.

The two sprays of dichlofluanid at 2 lb./acre gave as good control as five sprays at the 1-lb. rate. From these results it appears quite possible that three sprays (6 lb.) at blossom time would give adequate protection. This still would be considerably less than the amount used by Moore et al. (4) who used applications of up to 8 lb. active ingredient per acre. It is doubtful whether this amount would be tolerated by the 'Northwest' variety, since some leaf injury occured at the 2-lb. rate. The five sprays of DAC 2787 at 1½ lb./acre proved as effective as the eight sprays of captan or dichlofluanid. Dichloran was the least effective of the fungicides.

Dichlofluanid resulted in a significant reduction in the amount of rotted fruit produced per plot, yet the weight of sound fruit was not increased correspondingly over that from captan-sprayed plants. Similar results were reported by Moore et al. (4) who found that dichlofluanid was clearly superior to other treatments in reducing botrytis infection, but that in one test there was no increase in the total weight of sound fruits over that from thiram-sprayed plants and in another test there was only a slight increase.

Table 2. Influence of various treatment schedules on berry size and postharvest fruit rot of 'Northwest' strawberries

Treatment lb. a.i./acre with times sprayed	Size index gm/25 fruit	Percent sound fruit after picking 24 hr.	48 hr.	72 hr.
Unsprayed	212.5 a*	91	65	35
Captan 3 (2X)	210.3 a	92	74	55
Captan $1\frac{1}{2}$ (8X)	206.5 a	96	89	70
Captan $1\frac{1}{2}$ (5X)	203.7 ab	96	85	65
Dichloran 2 (5X)	201.8 abc	94	82	63
DAC 2787 $1\frac{1}{2}$ (5X)	201.2 abc	96	87	66
Dichlofluanid 1 (8X)	185.8 bc	98	93	74
Dichlofluanid 2 (2X)	185.2 bc	94	84	68
Dichlofluanid 1 (5X)	184.2 c	97	90	75
Mean	199.0			
S.E. Mean	6.03			

*Means not followed by the same letter are significantly different at the 5% level (Duncan's Multiple Range Test).

In previous tests (3) fruit size was affected by treatment. Fruit tended to be larger from plots treated with the more efficient fungicides. In this test fruit size was not significantly affected by captan, dichloran or DAC 2787 (Table 2). However, dichlofluanid caused a significant reduction in fruit size. This may explain in part why there was little or no increase in the total weight of sound fruits over that from captan- or thiram-sprayed plots. In other words, there were more sound berries produced on the dichlofluanid-sprayed plants but they were smaller than those produced on captan- or thiram-treated plants. Powell (5) reported that strawberry plants benefitted nutritionally from captan and that fruit size was increased. The benefit is evidently lacking with dichlofluanid.

The data on postharvest control of fruit rot again showed the beneficial effect of the fungicide field sprays after 48 hours storage. Dichlofluanid was slightly more effective than captan or DAC 2787. Dichloran proved much more effective in controlling latent infection of fruit than reducing rot incidence in the field.

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THE RELATIONSHIP BETWEEN CLIMATE AND FOLIAR DISEASES OF MUCK GROWN VEGETABLES IN 1966[1]

T. Simard[2], R. Crête[3] and L. M. Tartier[2]

Abstract

In 1966, foliar diseases of muck-grown vegetables developed more extensively than during the four previous years. This is attributed to the fact that the June rainfall approximated the 29-year average and favoured the establishment of early primary disease foci. Subsequent dryer weather particulary during the second part of June and the month of July apparently prevented the development of serious leaf blight epidemics.

Résumé

En 1966, les maladies foliaires des légumes de sol organique prirent une extension plus considérable que durant les quatre années précédentes. On attribue ce phénomène au fait que la précipitation du mois de juin se rapprochant de la moyenne de 29 ans aurait favorisé le développement précoce de foyers initiaux de maladies. Une pluviosité peu abondante, surtout durant la seconde moitié de juin et le mois de juillet, aurait empêché, par la suite, toute épidémie grave de se développer.

Introduction

The first aim of this annual survey initiated in 1959 is to record the annual occurrence and severity of diseases of the main vegetable crops in the muck soil district south of Montreal. In 1962 (2), it was noticed that a relationship seemed to exist between the amount of June rainfall and the development of such foliar diseases as blights of carrot, onion and potato. Thereafter, the annual evaluation of this relationship became the main purpose of the survey.

In 1966, the climatic conditions at the beginning of the season indicated the desireability of surveying fields for diseases during July. However, due to circumstances beyond our control, the survey was not carried until the second part of August. The diseases were recorded according to an index devised in 1961 (1) and since modified as follows:

Disease Intensity	Percent Affected Plants or Leaf Area (1)
Trace	1-10
Slight	10-30
Moderate	30-60
Severe	60-100

(1) Percent affected plants used for virus and soil borne diseases; leaf area used for leaf blights.

The meteorological data recorded at Ste. Clotilde were obtained from Mr. C. Peron, of the Research Station at St. Jean, Qué. These data for 1966 appear in Table 1 and a summary of the survey in Table 2.

Table 1. Total rainfall in inches at Ste. Clotilde (Châteauguay)

Year	June	July	August
1965	0.78	4.37	6.00
1966	3.10	2.88	3.33
29-year average	3.39	3.52	3.48

Results

Table 2 shows that in the second part of August leaf blights of carrot (Alternaria dauci and Cercospora carotae), leaf blight of onion (Botrytis squamosa) and early blight of potato (Alternaria solani) were present in most of the fields surveyed. In accordance with Hyre's forecasting criteria, late blight of potato (Phytophthora infestans) appeared only in the second part of August and afterwards developed slowly in fields as well as in check plots of 'Green Mountain' at Ste. Clotilde. On celery, bacterial blight (Pseudomonas apii) was more prevalent than usual, one field showing a general infection of moderate intensity. As expected from the high populations of six-spotted leafhoppers, aster yellows was commonly found in carrot and celery fields, as well as in lettuce fields according to observations made in July by Mr. R. Crête. Fusarium bulb rot (Fusarium oxysporum f. cepae) and smut (Urocystis magica) of onion appeared to be more prevalent than during the previous year. Only a trace of white rot of onion (Sclerotium cepivorum) was found in one field. This is in contrast to the years 1962 and 1965, when July mean temperatures

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Table 2. Diseases in the muck soil area south of Montreal, Quebec, in 1966

Crop	Diseases	Disease intensity
CARROT	Alternaria leaf blight (*Alternaria dauci*)	7-tr. 9-sl. 4-mod. 1 sev./22 fields
	Cercospora leaf blight (*Cercospora carotae*)	9-tr. 9-sl. 2-mod./22 fields
	Aster yellows (callistephus virus 1)	12-tr./22 fields
CELERY	Bacterial blight (*Pseudomonas apii*)	5-tr. 1-mod./12 fields
	Early blight (*Cercospora apii*)	3-tr./12 fields
	Late blight (*Septoria apiicola*)	1-tr./12 fields
	Aster yellows (callistephus virus 1)	9-tr./12 fields
	Manganese deficiency	7-tr./12 fields
	Boron deficiency	1-tr./12 fields
	Mosaic	5-tr./12 fields
	Pink rot (*Sclerotinia sclerotiorum*)	2-tr./12 fields
	Nematode root knot (*Meloidogyne hapla*)	1-tr./12 fields
LETTUCE	Aster yellows (callistephus virus 1)	1-tr./1 field
ONION	Leaf blight (*Botrytis squamosa*), may include an undetermined amount of leaf fleck (*B. cinerea*)	6-tr. 8-sl. 1-mod. 1-sev./22 fields
	White rot (*Sclerotium cepivorum*)	1-tr./22 fields
	Purple blotch (*Alternaria porri*)	4-tr. 3-mod./22 fields
	Pink root (*Pyrenochaeta terrestris*)	1-tr./22 fields
	Fusarium bulb rot (*Fusarium oxysporum* f. *cepae*)	7-tr./22 fields
	Smut (*Urocystis magica*)	6-tr./22 fields
POTATO	Black leg (*Erwinia atroseptica*)	6-tr./15 fields
	Early blight (*Alternaria solani*)	8-tr. 2-sl./15 fields
	Late blight (*Phytophthora infestans*)	1-tr. 2-sl. 1-sev./15 fields
	Rhizoctonia (*Rhizoctonia solani*)	6-tr./15 fields
	Verticillium wilt (*Verticillium albo-atrum*)	2-tr./15 fields
RADISH	Downy mildew (*Peronospora parasitica*)	1-tr./1 field

lower than normal seemed to favour outbreaks of this disease (4). Unfamiliar lesions attributed to the wilt organism (*Verticillium albo-atrum*) were observed on tubers in two potato fields.

Discussion

It was generally observed that foliar diseases developed more extensively in 1966 than in the four previous years, particularly in 1965 when rainfall in July and August was much higher than during the corresponding months of 1966 (4). This year extensive leaf disease development was expected, since the June rainfall approximated the 29-year average. This was interpreted earlier as a factor favoring the early establishment of primary disease foci (2, 3, 4). Three instances of early disease development were observed in 1966. The first one involved the detection of alternaria blight in four carrot fields at the early date of June 23. The second involved a field of 'Copper Gem' onion well protected from wind where leaf blight was detected on July 10 and later developed to a moderate intensity. In the third instance, an early planted field of 'Irish Cobbler' potato was severely affected by late blight in mid-August, when the disease was just starting to show on late varieties. However, leaf disease severity generally remained at a low level. This is attributed to the fact that the below-normal rainfall in the second part of June and during July prevented leaf diseases from reaching an epidemic stage except possibly in localized areas favorable to the establishment of the required microclimate.

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CO-OPERATIVE SEED TREATMENT TRIALS - 1966[1]

H. A. H. Wallace[2]

Introduction

Forty-nine seed treatment chemicals were tested in 1966 against common bunt of wheat (Tilletia foetida (Wallr.) Liro), covered smut of oats (Ustilago kolleri Wille), covered smut of barley, (U. hordei (Pers.) Lagerh.), and seed rots of flax and rye caused by a complex of soil-borne and seed-borne microorganisms.

The object of these experiments was to determine the effectiveness of new formulations of chemicals for use as seed treatments.

Materials and methods

One gram of smut spores of T. foetida, U. kolleri and U. hordei were dusted on 200 grams of clean 'Red Bobs' wheat, naturally smutted 'Vanguard' oats, and naturally smutted 'Plush' barley, respectively. 'Prolific' spring rye, hand-picked to remove broken kernels, and 'Marine' flax were used for emergence tests.

The source, formulation, and composition of the seed treatment materials used in the 1966 tests are given in Table 1. About half of the unidentified materials were drillbox formulations and non-mercurials. Each chemical was applied to the 200 grams of seed at the indicated dosage (Table 2) in a sealer and well shaken. Two days later 200 seeds were packaged in envelopes, placed in polyethylene bags and stored at a cool temperature until seeded (27 to 41 days later). The slurries were prepared by adding 4.2 cc of water to each gram of wettable powder.

All crops were sown at Brandon, Morden and except the 'bunt' test, at Winnipeg. The plots, which were 12 feet long and 9 inches apart were replicated 4 times at each station. Two hundred seeds were sown in each plot and all seedlings of flax and rye counted. The percentage of smutty heads (Table 2) is based on counts of all heads in the row.

Results and discussion

The barley test at Winnipeg failed to head, possibly because the soil was waterlogged. Hence, the values in Table 2 for bunt and barley smut are for two stations, and for the other tests three stations. As indicated by the non-treated checks, bunt infection was good (13-20 percent); barley smut was erratic as shown by 4.3 percent smutty heads for the first check and 10.4 percent for the second; oat smut was higher than in 1965 (8.1 to 11.4 percent compared to 2.4 percent in 1965). Flax and rye emergence was not improved by the seed treatments, and both crops showed toxic effects from several of the test materials. Generally, all the chemical treatments gave fair to good control of smut diseases.

Several materials warrant additional comment:

Co-op Liquid Wireworm Treatment (#35) is not designed to control plant diseases. Emergence of flax and rye was not affected.

Although the higher dosages used of materials 279 (#3) and 279A (#5) reduced smut infection, they also reduced emergence of flax and rye. A dosage that can control smut without affecting germination may be difficult to obtain.

The 2- and 3-ounce dosage of Chemagro 4497 controlled smut infection, but all three dosages reduced the percentage emergence of flax and rye seedlings.

In the 1966 Co-operative Seed Treatment Trials, Tillex gave good control of barley smut. However, in the 1965 test (2) Tillex failed to control barley smut, although good control of other smuts was obtained. Since samples of all treated seed were kept for subsequent storage effects, samples from the 1965 test were plated using Machacek's agar-sheet test (1). This test indicated that the barley had not been treated.

Acknowledgment

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[1] Contribution No. 236 from Canada Department of Agriculture Research Station, Winnipeg, Manitoba.

[2] Plant Pathologist

Table 1. Source, formulation and composition of seed treatment materials

Treatment No.	Source	Formulation		Composition
1	---	---		Untreated check
2-3	Morton	EP-279	WP	Identity not available
4-5	"	EP-279A	L	"
6	"	EP-301-B	D	"
7	"	EP-301-C	D	"
8	"	EP-301-D	D	"
9	"	EP-301-E	D	"
10-12	"	EP-308	D	"
13	Niagara	Me C 791	L	Phenylmercuric acetate 2.40% + aldrin 30.86%
14	"	Niadual MP	L	Identity not available
15	"	" MC Conc.	L	"
16	"	Puraseed	L	"
17	Merck (Metasol)	124A	L	"
18-19	" "	124B	L	"
20	" "	124C	L	"
21-22	" "	124D	L	"
23	" "	124E	L	"
24-25	" "	124F	L	"
26-28	Chemagro	4497 (50%)	WP	Bis (1, 2, 2-trichloroethyl) sulfide 50%
29	Diamond Alkali	2787 + Captan	WP	Tetrachloroisophthalonitrile 35% + captan 35%
30	" "	2787-W75	WP	" 75%
31	Green Cross	Tillex	L	Alkoxy-alkyl-mercury hydroxide 5%
32	" "	"	L	" 3.3%
33	Co-op	Liquid Mercury	L	Oxine-methylmercury 2.25%
34	"	XL Dual Purpose	L	" 1.36 oz./gal. + heptachlor 2.5 lb./gal.
35	"	Wireworm	Sn	Heptachlor 2.5 lb./gal.
36	Green Cross	KMC 324	D	Identity not available
37	" "	MHC 324	D	"
38	" "	PHC 324	D	"
39	" "	XHC 324	D	"
40	" "	BHC 324	D	"
41	" "	DHC 324	D	"
42	" "	THC 324	D	"
43	" "	MHC 223	D	"
44	" "	TMHC 175	D	"
45	" "	TMHC 2222	D	"
46	Chipman	Agrosol-B29	L	Methylmercury dicyandiamide (2.36 oz./gal. Hg)
47	"	Mergamma B-33	L	" " (0.89 oz./gal. Hg) and heptachlor 2.5 lb./gal.
48	"	65-S-1	D	Identity not available
49	"	65-S-7	D	"
50	"	66-S-1	D	"
51	"	66-S-2	D	"
52	"	66-S-3	D	"
53	"	66-S-4	D	"
54	"	66-S-5	D	"
55	Niagara	Polyram 7D	D	Polyram 7% mixture
56	"	" 80	WP	" 80% mixture
57	"	ZMC5-80	WP	Identity not available
58	Morton	Panogen 15B		Methylmercury dicyandiamide (2.5 oz./gal. Hg)
59	Du Pont	Ceresan M		Ethyl mercury-p-toluene sufonanilide (3.2% Hg)
60	---	---		Untreated check

Table 2. Co-operative seed treatment trials - 1966

Treatment No.	Dosage Cereals oz./bu.	Dosage Flax oz./bu.	Disease rating (%) Bunt	Barley Smut	Oat Smut	Flax Emergence	Rye Emergence
1	CHECK		20.13	4.30	11.40	69.0	58.3
2	*1.00	*2.00	0.00	4.84	0.42	49.7	57.8
3	*2.00	*4.00	0.00	0.06	0.00	41.0	41.3
4	1.30	2.60	0.13	5.56	0.98	49.1	56.4
5	2.60	5.20	0.00	1.88	0.04	29.0	48.3
6	2.12	4.24	0.00	0.00	0.17	68.4	63.4
7	1.41	2.82	0.13	0.31	0.87	71.4	68.3
8	2.00	4.00	0.00	1.81	1.08	70.0	67.4
9	2.00	4.00	0.63	1.56	1.58	67.6	67.3
10	1.42	2.84	0.00	0.00	0.12	72.5	57.0
11	0.71	1.42	0.00	0.19	0.21	66.6	60.1
12	0.35	0.70	0.06	0.50	0.50	72.0	60.6
13	2.00	4.00	0.13	1.56	0.43	66.7	66.8
14	2.00	4.00	2.88	1.50	0.08	71.3	65.3
15	0.75	1.50	0.25	1.45	0.05	67.0	67.5
16	0.75	1.50	0.06	4.38	0.38	73.0	65.1
17	0.50	1.00	0.61	2.00	0.00	72.0	65.9
18	0.50	1.00	0.69	3.25	0.33	70.9	61.3
19	0.75	1.50	0.06	1.88	0.17	72.9	57.8
20	2.00	4.00	2.00	0.74	0.12	69.5	68.1
21	0.50	1.00	0.13	0.88	0.00	67.0	62.9
22	0.75	1.50	0.13	1.94	0.04	69.0	62.1
23	2.00	4.00	2.00	1.44	0.26	70.3	66.3
24	0.50	1.00	0.06	2.81	2.17	68.8	62.8
25	0.75	1.50	0.19	3.44	1.17	68.7	64.3
26	*1.00	*2.00	2.19	4.19	0.42	49.4	53.3
27	*2.00	*4.00	0.25	0.13	0.00	48.2	53.4
28	*3.00	*6.00	0.00	0.00	0.00	48.2	48.7
29	*2.00	*4.00	0.38	1.95	0.67	66.3	55.8
30	*1.00	*2.00	0.13	1.75	2.12	64.7	60.9
31	0.50	1.00	0.13	0.88	0.46	67.4	63.6
32	0.75	1.50	0.00	0.69	0.42	72.3	60.8
33	0.75	1.50	0.25	3.03	0.25	72.4	63.2
34	2.00	4.00	1.31	1.94	0.33	72.1	69.8
35	2.00	4.00	18.06	7.73	11.43	62.8	64.5
36	2.00	4.00	0.00	7.48	1.85	66.8	57.5
37	2.00	4.00	0.06	0.56	0.34	67.5	61.9
38	2.00	4.00	0.19	3.19	0.87	67.0	60.3
39	2.00	4.00	0.00	6.39	1.76	70.9	59.5
40	2.00	4.00	0.06	7.06	0.79	74.1	61.7
41	2.00	4.00	0.00	3.98	1.89	68.3	62.3
42	2.00	4.00	0.00	5.31	0.47	64.0	64.2
43	2.00	4.00	0.19	0.94	1.01	67.7	60.3
44	2.00	4.00	0.00	1.44	0.58	68.0	64.0
45	2.00	4.00	0.06	1.69	0.33	67.0	60.0
46	0.75	1.50	0.25	1.63	0.12	64.2	63.1
47	2.00	4.00	1.31	0.60	0.00	66.0	66.1
48	2.00	4.00	0.00	0.06	0.09	72.4	58.4
49	2.00	4.00	0.00	0.06	0.17	68.4	58.3
50	2.00	4.00	0.00	0.00	0.04	72.6	65.3
51	2.00	4.00	0.00	0.06	0.38	71.9	65.9
52	2.00	4.00	2.00	3.13	0.39	66.7	60.8
53	2.00	4.00	0.06	2.63	1.66	71.0	63.5
54	2.00	4.00	0.00	4.31	1.95	73.5	65.4
55	9.60	19.20	0.06	2.75	3.23	67.9	56.9
56	*2.00	*4.00	0.00	1.19	0.37	63.6	59.6
57	2.00	4.00	0.00	0.50	0.21	60.2	61.6
58	0.75	1.50	0.00	1.63	0.08	65.5	65.8
59	0.50	1.00	0.25	1.69	0.00	64.9	59.9
60	CHECK		13.19	10.46	8.16	65.8	61.3
Least Significant Difference			2.97	4.25	2.22	7.0	8.0

***Applied as a slurry.**

A COMPARISON OF STANDARD AND DRILLBOX SEED TREATMENT CHEMICALS FOR COVERED SMUT OF OATS AND BARLEY[1]

H. A. H. Wallace[2]

Introduction

Standard seed treatment chemicals may be applied at any time from early fall to the day of seeding the following spring. In contrast, drillbox seed-treatment chemicals are applied within an hour or two of seeding. Since the amount of active ingredient per bushel is the same for the two types of treatment any variation in disease control is a reflection of the contact time between seed and chemical. Although tests in 1965 (1) showed no significant differences in control effected by standard and drillbox treatment chemicals or between seed treated prior to the day of seeding and that treated and sown the same day, the incidence of smut in untreated oats was only 2 percent and that in untreated barley 8 percent. In 1966, eight standard and seventeen drillbox seed treatment chemicals were tested against oats and barley artificially infected with the covered smuts, Ustilago kolleri Wille and U. hordei Lagerh., respectively.

Materials and methods

The pesticides used and the P. C. P. No. (Pesticide Control Product Number) of each are shown in Table 1, together with the formulations and active ingredients. Chemicals 2 to 19 are mercurials, and 20 to 25 non-mercurials. "Non-mercurial" does not necessarily mean "non-poisonous", however, for of the products tested only Drillbox Bunt-No-More does not carry the "poison" symbol on the label.

The pesticides were obtained from Morton Chemical Co., 11710 Lake Ave., Woodstock, Ill., U. S. A.; Dupont Co. of Canada Ltd., P. O. Box 660, Montreal, Quebec; Sherwin-Williams Co. of Canada Ltd., (Green Cross Products), 2875 Centre Street, Montreal, Quebec; Chipman Chemicals Ltd., 519 Parkdale Ave., N. Hamilton, Ontario; Interprovincial Co-operatives Ltd., 1700 Portage Ave., Winnipeg, Manitoba and Niagara Brand Chemicals, 1274 Plains Rd. E., Burlington, Ontario.

One gram of spores of U. kolleri and U. hordei were applied to the 200 grams of naturally smutty oats and barley seed, respectively.

The treatment procedure consisted of adding the required amount of chemical to the 200 grams of smutty seed in a one-quart sealer and shaking well. The storage periods between date of treatment and date of seeding for series "A" treatments ranged from 27 to 41 days. The "B" treatments were made an hour or two before seeding.

The plots, which were 12 feet long and 9 inches apart were replicated 4 times at each of three stations. Two hundred seeds per plot were sown. The percentage of smutty heads (Tables 2 and 3) is based on counts of all heads in the row.

Results

The barley test at Winnipeg failed to head, possibly because the soil was waterlogged. Hence, the values presented in Table 2 for oats are overall averages of the three stations, whereas those for barley are based on results from the Morden and Brandon nurseries only.

The mercurials gave good control of oat and barley smuts, but the non-mercurials were less effective.

The mean disease rating (%) of seven standard mercurial seed treatments (#2, 4, 6, 8, 10, 12, 14) and seven similar drillbox treatments (#3, 5, 7, 9, 11, 13, 15) are shown in Table 3. Comparable average disease ratings for 1965 after treatment with six of the mercurials are shown in brackets.

Table 3. Mean disease rating of some standard and drillbox formulations applied 3 or 4 weeks prior to seeding (Series A) and immediately before seeding (Series B).

	Disease Rating (%)			
	Oat Smut		Barley Smut	
Series A				
Untreated check	8.64	(1.91)*	6.50	(8.39)
Standard treatments	0.03	(0.00)	0.80	(3.12)
Drillbox treatments	0.07	(0.00)	1.10	(1.98)
Series B				
Untreated check	8.66	(2.09)	9.00	(7.43)
Standard treatments	0.47	(0.55)	1.29	(2.62)
Drillbox treatments	0.52	(0.37)	1.01	(2.46)

*Mean disease ratings 1965

Results obtained in 1965 and 1966 were similar, except for higher oat smut infection in the check in 1966. There was no significant difference between standard and drillbox treatments when the chemicals were applied at the same time. However, treatment of seed four weeks or more prior to seeding (Series A) improved the control of oat smut slightly, but did not alter control of barley smut relative to the one-or-two hour post-treatment period before seeding (Series B).

1 Contribution No. 235 from the Canada Department of Agriculture Research Station, Winnipeg, Manitoba

2 Plant Pathologist

Table 1. P.C.P. No., source and formulations of pesticides

Exp. No.	P.C.P. No.	Source		Form		Active Ingredients Fungicide	HGE	Insecticide
1			Untreated Check					
			Mercurials					
2	8448	Morton	Panogen 15B	Sn*	MMD**	3.7 oz./gal.	2.5 oz./gal.	
3	9201	"	Panogen PX	Du	MMD	0.9%	0.6%	
4	2521	Dupont	Ceresan M	WP	EMS	7.7%	3.2%	
5	9134	"	Ceresan M-DB	Du	EMS	1.93%	0.8%	
6	8754	Green Cross	San	Du	MMO	7.3%	3.0%	
7	9229	" "	San DB	Du	MMO	1.83%	0.75%	
8	3633	Chipman	Agrox C	Du	PMA	7.15% EMC 1.00%	5.00%	
9	9209	"	Agrox DB	Du	PMA	1.79% EMC 0.25%	1.25%	
10	6595	"	Mergamma C Dual Purpose	WP	PMA	2.86% EMC 0.40%	2.00%	LIN 30.0%
11	9219	"	Mergamma DB Dual Purpose	PD	PMA	1.79% EMC 0.25%	1.25%	LIN 18.75%
12	9128	Co-op	MMH Liquid Mercury	Li	MMH	2.25%	1.25%	
13	9458	"	Metasol MMH-DB	Du	MMH	1.43%	0.80%	
14	9424	Morton	Pandrinox A	Sn	MMD	1.32 oz./gal.	0.88 oz./gal.	ALD 2.5 lb./gal.
15	9472	"	Pandrinox A-PX	Du	MMD	0.72%	0.48%	ALD 20.0%
16	9325	"	Pandrinox PX	Wp	MMD	0.72%	0.48%	HEP 20.0%
17	9421	Niagara	Puraseed DB	Pd	PAC	1.55% PMF 1.55% CDE 0.44	0.95%	
18	9451	"	Puradrin DB	Du	PAC	1.55% PMF 1.55% CDE 0.44	0.95%	ALD 25.0%
19	---	Green Cross	Drillbox Merlane	Du	MMO	1.83%	0.75%	
			Non-Mercurials					
20	9480	Morton	Pentadrin A	Sn	PCN	1.6 lb./gal.		ALD 2.6 lb./gal.
21	9489	"	Pentadrin A PX	Du	PCN	13.2%		ALD 20.0%
22	9432	"	Pentadrin PX	Du	PCN	13.2%		HEP 20.0%
23	9429	Green Cross	Drillbox Bunt-No-More	Pd	HCB	10.0% CAP 20%		
24	9205	" "	Drillbox Dual Purpose Bunt-No-More	Pd	HCB	10.0% CAP 20%		ALD 25.0%
25	6337	" "	Dual Purpose Bunt-No-More	Pd	HCB	16.0%		ALD 40.0%

*Formulation Code: Du = dust; Li = liquid; Pd = powder; Sn = solution; WP = wettable powder.

**Active ingredients code: ALD = aldrin; CAP = captan; CDE = cadmium equivalent; EMC ethylmercuric chloride; EMS = ethyl mercury p-toluene sulfonanilide; HCB = hexachlorobenzene; HEP = heptachlor; HGE = mercury equivalent; LIN = gamma BHC (from lindane); MMD = Methyl mercuric dicyandiamide; MMH = oxine-methylmercury; MMO = methylmercury pentachlorophenolate; PAC = phenylamino cadmium dilactate; PMA = phenylmercuric acetate; PCN = quintozene (pentachloronitrobenzene).

Table 2. Standard and Drillbox Treatments 1966

Exp. No.	Formulation	Dosage oz./bu.	Disease Rating (%) Oat Smut A	Oat Smut B	Barley Smut A	Barley Smut B
1	Untreated		8.64	8.66	6.50	9.00
	Mercurials					
2	Panogen 15B	0.75	0.00	0.72	0.63	1.81
3	Panogen PX	2.00	0.00	0.63	0.88	2.13
4	Ceresan M	0.50	0.00	0.08	0.50	1.86
5	Ceresan M-DB	2.00	0.33	0.46	0.83	0.75
6	San	0.50	0.00	0.13	1.44	1.13
7	San DB	2.00	0.04	0.13	1.38	0.88
8	Agrox C	0.50	0.00	0.13	0.75	0.56
9	Agrox DB	2.00	0.00	0.58	1.69	0.25
10	Mergamma C Dual Purpose	1.25	0.17	0.33	0.63	1.31
11	Mergamma DB Dual Purpose	2.00	0.00	0.52	0.53	0.75
12	MMH Liquid Mercury	0.75	0.00	1.08	0.94	1.69
13	Metasol MMH-DB	2.00	0.00	0.71	1.00	1.00
14	Pandrinox A	2.00	0.04	0.85	0.74	0.69
15	Pandrinox A-PX	2.50	0.08	1.00	1.38	1.31
16	Pandrinox PX	2.50	0.00	0.29	0.88	0.69
17	Puraseed DB	2.00	0.25	1.83	2.00	3.19
18	Puradrin DB	2.00	0.71	1.82	1.44	3.94
19	Drillbox Merlane	2.00	0.17	1.63	1.00	2.69
	Non-Mercurials					
20	Pentadrin A	2.00	2.50	4.31	3.90	4.94
21	Pentadrin A PX	2.50	5.43	3.92	7.23	9.06
22	Pentadrin PX	2.50	4.58	3.53	6.27	9.31
23	Drillbox Bunt-No-More	2.00	2.75	2.84	5.88	5.81
24	Drillbox Dual Purpose Bunt-No-More	2.00	2.78	3.38	5.88	4.63
25	Dual Purpose Bunt-No-More	1.25	9.12	8.48	7.51	6.41
	Min. Sign. Diff.		2.08	2.11	2.63	2.72

Acknowledgment

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OBSERVATIONS ON STRAWBERRY GREEN PETAL IN PRINCE EDWARD ISLAND

C. B. Willis and L. S. Thompson [1]

Data obtained from replicated strawberry variety trials being conducted at the Experimental Farm, Charlottetown, indicated high levels of green petal infection in 1966 (Table 1). Notes on clonal infections in first-year bearing plots were taken near the end of the fruiting period. A clone was considered infected if any part of the clone displayed symptoms characteristic of the disease. Infections were generally high and there was a wide variation among varieties. The two varieties which are grown widely on a commercial basis in Prince Edward Island, 'Redcoat' and 'Sparkle', were 28 and 60% infected, respectively. These levels of infection were frequently observed by the authors in commercial strawberry plantings in 1966. Higher levels of infection in the 'Sparkle' variety have been observed over the past several years.

In the early spring of 1966 a number of plants were removed from eight of the plots referred to above and transplanted in replicated plots for a future experiment. In early July notes were taken on green petal infections (Table 1). The percentages of infected plants ranged from 0 to 87. No disease symptoms were evident at the time of transplanting.

Surveys of commercial strawberry plantings which had been transplanted in the spring of 1966 showed that the use of granular Di-Syston applied as a sidedressing was much more effective than malathion sprays in controlling green petal infections in strawberry nurseries from which the plants had been obtained (Table 2).

Summary

The incidence of green petal in strawberries was particularly high in Prince Edward Island in 1966. The data obtained provide evidence that spray programs using malathion are not as effective as systemic insecticides, such as Di-Syston, in the control of green petal infections in the year of transplanting. Evidence is provided which substantiates the desirability of planting nursery stock which has been propagated under a proven disease control program. Further evidence also indicates that the variety 'Sparkle' is more susceptible to green petal than the other varieties currently being grown commercially in Prince Edward Island.

Table 1. Green petal infections in strawberry varieties, 1966

	1st-year bearing, 1966		Transplanted, 1966 (a)	
Variety	Infected Clones/ Total	% Infected Clones	Infected Plants/ Total	% Infected Plants
Acadia	12/40 (b)	30		
Agassiz	32/36	92	14/37	38
Fletcher	3/35	8	0/39	0
Frontenac	2/2	100		
K-59-8	2/40	5		
K-59-26	15/38	39		
K-59-28	9/40	23		
Midway	30/40	75		
Molalla	26/40	65	34/39	87
Northwest	22/36	61	10/38	26
Puget Beauty	15/40	38	11/33	33
Redcoat	11/40	28		
Red Gauntlet	25/40	63		
Senga Sengana	16/40	40		
Siletz	4/34	12	0/7	0
Sparkle	24/40	60		
Surecrop	17/40	43	4/39	10
Talisman	25/40	63		
Vesper	15/40	38	3/40	8

(a) Plants were dug in early spring from plots on which no insect control program had been followed the previous year.
(b) Totals for 4 replications.

Table 2. Green petal infections in strawberry nursery stock plants

	Green petal vector control program	
Variety	Foliage spray (a)	Soil systemic (b)
Acadia	8-10 (c)	0
Cavalier	10-12	0
Redcoat	8-10	0
Sparkle	15-20	< 1

(a) Malathion applied at 1 qt./acre from transplanting to late fall at weekly intervals.
(b) Di-Syston applied as a 10% granular formulation at 40 lb./acre immediately following transplanting.
(c) Percentage of nursery stock plants which developed green petal symptoms in 1966.

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IMPORTANCE OF ASTER YELLOWS VIRUS IN FIELD CROPS IN MANITOBA

P. H. Westdal and H. P. Richardson[1]

Aster yellows virus (AYV) is known to cause severe losses in many vegetable crops in Manitoba and in most years is the limiting factor in lettuce production (4). It is difficult to determine accurately losses due to AYV in field crops and, consequently, little direct evidence of loss is available. However, indirect evidence indicates that AYV may be of considerable importance in field crops in some years.

An epidemic of AYV was reported in the Great Plains area of North America in 1957 (2, 3). The epidemic was attributed to an abnormally large population of the insect vector, the six-spotted leafhopper, Macrosteles fascifrons (Stål), and a high incidence of viruliferous individuals within the population.

A comparison of long term mean yields with yields for 1957, for a number of field crops, are shown in Table 1 prepared from the Yearbook of Manitoba Agriculture - 1965 (1). The striking feature of the table is that all crops which are susceptible to AYV had a moderate to marked yield reduction relative to the 30-year mean, whereas, with the exception of field peas, all crops which are highly resistant or immune to AYV yielded crops near or above the 30-year mean. Flax, sunflowers and barley showed the greatest yield reductions.

Although the evidence is purely circumstantial and based on average yields for the province, it seems more than a coincidence that of such a variety of crops only those susceptible to AYV should yield less than the 30-year mean and suggests that the yield reduction may have been due to AYV. If this is assumed, then the monetary loss due to AYV in 1957 was approximately 19.5 million dollars or 11.7% of the total value of field crops produced.

There is probably some crop loss due to AYV in most years. However, on the basis of data such as those compiled for the Yearbook of Manitoba Agriculture only large differences in yield would be evident.

Table 1. Comparison of field crop yields in Manitoba in 1957 with the 30-year means

Crop	30-year mean yield per acre (1936-65)	1957 Yield per acre	1957 Yield as per cent of mean	Estimated loss ($)
Flax	8.8	4.0	45.4*	10,439,000
Sunflowers (23 yr. av.)	604.1	400.0	66.2*	245,000
Barley	25.6	19.4	75.8*	8,323,000
Buckwheat	15.0	13.0	86.7*	52,000
Potatoes	131.2	115.0	87.6*	424,000
Rapeseed (18 yr. av.)	711.3	625.0	87.9*	71,000
Wheat	20.8	22.3	107.2	
Oats	33.2	32.2	97.0	
Rye	17.0	16.5	97.1	
Mixed Grains	29.0	27.7	95.5	
Grain Corn (29 yr. av.)	25.2	25.0	99.2	
Field Peas	18.1	15.0	82.9	
Mustard Seed (14 yr. av.)	696.4	750.0	107.7	
Tame Hay	1.8	1.8	100.0	
Silage Corn	4.7	5.0	106.4	
Sugar Beets (26 yr. av.)	9.0	10.2	113.3	
Total estimated losses				$ 19,554,000
Total value of above field crops in Manitoba in 1957				$167,650,000
Estimated loss as % of total value				11.7

*Crops followed by an asterisk are susceptible to AYV, others highly resistant or immune.

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FIRE BLIGHT OF PEAR AND SOME OTHER HOSTS IN NOVA SCOTIA[1]

C. O. Gourley, C. L. Lockhart[2] and R. E. C. Layne[3]

Abstract

The bacterium, Erwinia amylovora (Burr.) Winslow et al., has been identified as the cause of an infection on pear and Crataegus species in Nova Scotia. In addition to infections of the current season, older cankers found in pear orchards indicated that scattered infections of fire blight had occurred in the Annapolis Valley prior to 1966. More favorable conditions for infection of pear occurred during 1966 than during the preceeding 4 years.

Introduction

Fire blight, caused by the bacterium Erwinia amylovora (Burr.) Winslow et al., has not previously been positively identified in the Annapolis Valley, of Nova Scotia.

In 1938, Hockey reported that a disease of apple nursery stock collected from Annapolis Royal was caused by the fire blight pathogen, but subsequent investigation indicated that it may have been caused by Pseudomonas syringae van Hall (5). Following a survey carried out by the Division of Plant Protection, Canada Department of Agriculture, and by J. F. Hockey in 1953 it was concluded that fire blight was not present in Nova Scotia. The disease has been reported from New Brunswick on apple and pear and from Prince Edward Island on apple, pear, Crataegus and Sorbus (5).

On August 2, 1966 a small block of pear trees of the varieties 'Clapp's Favorite' and 'Bartlett' were inspected at Falmouth in the Annapolis Valley, Nova Scotia. Most of the 60 trees had twigs, water sprouts, fruit spurs and limbs that showed symptoms similar to those associated with fire blight of pear and apple (1).

Isolations made from cankers on pear wood from the Falmouth orchard yielded a bacterium similar to E. amylovora using Dowson's (3) procedure for identification. The identification of the bacterium was confirmed by one of us (Layne) as a virulent strain of E. amylovora.

This paper is a report of the finding and the extent of the fire blight disease on pear and other hosts in the Annapolis Valley, its probable source of entry and its potential effect on fruit production in Nova Scotia.

A survey for fire blight in Annapolis Valley pear orchards

Seventeen of the pear orchards in commercial production in the Annapolis Valley were examined for symptoms of fire blight infection during August, September and October 1966. A dead twig with leaves or blossoms still attached and often with a small canker formed on the branch beneath it was used as the criterion for determining current season infection. Cankers on limbs and trunks which exhibited one or more successive seasonal advances of infection or had obviously died out were determined to be caused by infection in previous years.

Fire blight infections were found in all of the pear orchards examined in the Annapolis Valley (Table 1). Trees were severely cankered in 3 of the 17 orchards and, in one of these, several trees had died as a result of bacterial infection. In the Falmouth orchard (Table 1, orchard 8) severe twig blight had occurred in 1966 and large cankers were present on the main limbs and trunks of most trees (Figs. 2, 3, 4). In the same orchard infected root sprouts were found with the tips curved in the shape of a shepherd's crook (Fig. 5). Cankers resulting from 1966 infections were found in 8 of the orchards. Cankers which had been formed prior to 1966 were found in another 9 orchards. The 4 orchards which had a moderate number or many cankers were all situated at the east end of the Annapolis Valley near the Minas Basin (Fig. 1).

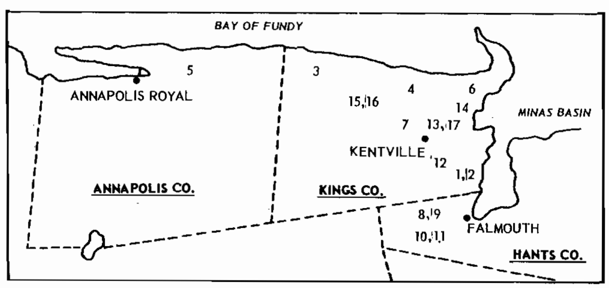

Figure 1. Location of 17 infected pear orchards in the Annapolis Valley of Nova Scotia.

Survey for fire blight on apple and hawthorn

Cankers typical of those formed by E. amylovora were found on apple wood in orchards adjacent to infected pear orchards at locations 2, 3, 6, 7, 9, 11 and 17 (Fig. 1). A few cankers on apple wood at locations 3 and 9 appeared to have been formed in 1966. Cankers were found on hawthorn at locations

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8, 11 and 14 adjacent to infected pear orchards. A few old cankers similar to the one in Fig. 6 were found on a single tree at location 8 and in a hedge row of hawthorn at location 11. A moderate number of cankers were present at location 14 on hawthorn in a hedge row which also contained many wild species of Prunus. A number of these cankers appeared to have been formed in 1966.

Isolation and identification of the bacteria

The isolation procedures were those normally employed for recovering bacterial pathogens from woody tissue. Direct isolations were made from current seasons infections on potato dextrose agar in Petri plates. A small section was excised from the edge of a previous seasons canker and placed in 5 ml of sterile distilled water. After 1 to 3 days a loopfull of the distilled water was streaked on P.D.A. in Petri plates.

Both a white and a yellow colored bacterium were obtained on P.D.A. when isolations were made from wood cankers of apple, pear and hawthorn. The white forms were initially identified by comparing their morphology and growth characteristics on P. D. A. with a known white form of E. amylovora. In a further test to establish the identity of both the white and yellow forms each isolate was inoculated into green pear fruit and succulent pear shoots which are susceptible to E. amylovora and the growing tip of young bean (Phaseolus vulgaris) plants which are susceptible to Pseudomonas syringae. They were inoculated by coating the tip of an inoculating needle with bacteria and inserting the needle about 2 mm into the fruit and into the most succulent part of a shoot or plant.

Dark lesions with watersoaked margins were produced around the point of inoculation on pear fruit inoculated with the white forms of E. amylovora. Pear shoots did not become infected when inoculated with the bacterial isolates probably because succulent wood was past its prime for the season. Infections occurred on bean plants where yellow isolates from cankers collected from two different pear orchards and one from a canker on apple wood were used as inoculum. This indicated the bacterium was probably Ps. syringae.

The white form of E. amylovora was isolated from cankers formed on pear wood at 6 locations in 1966 and from 2 locations where cankers had been formed prior to this date. It was also isolated from wood cankers on apple at locations 2 and 17 and on hawthorn at location 14 in 1966. The bacteria isolated from fire blight cankers may be either a white virulent form or a yellow avirulent form of E. amylovora or a mixture of both forms (2, 4). The yellow form may predominate in host tissue as a result of conditions unfavorable for the white virulent type (2, 4).

Table 1. Extent of fire blight cankers in 17 pear orchards in the Annapolis Valley.

Orchard	Acreage	Canker rating 1966	Canker rating Previous years
1	3	+a*	+
2	1	-	++a
3	11	+a	+
4	13	-	+
5	10	-	+
6	3	+	-
7	2	-	+
8	0.5	+++a	+++
9	2	++a	+++
10	1	-	+
11	1	-	+a
12	2	+a	+
13	6	-	+
14	8	++a	+++
15	3	+	+
16	15	-	+
17	1	-	+

*Cankers were rated as + few, ++ moderate in number, +++ many.

[a]E. amylovora isolated (white virulent form).

Discussion and conclusions

Fire blight occurs throughout the North American continent wherever apples and pears are grown, with the exception of a few favored localities which until recently included the Annapolis Valley (1). Agriculturists in Nova Scotia believed that their climatic conditions were not conducive to the development of fire blight on its hosts. It is not understood why fire blight should only now become a problem of economic importance in Nova Scotia because the disease is considered indigenous to North America and has been present since before 1900 (1).

Most of the approximately 1000 pear trees brought into the Province annually come from areas that have a history of fire blight and it appears unlikely that their stock has been entirely free of the disease until recent years. Several 2 to 3-year-old pear trees which were cankered by fire blight for a distance of 12 to 14 inches from the tip were found at location 12 (Fig. 1). These cankers were referred to as "die back" by the grower who thought they were the result of an infection following winter injury. Bacterial cankers may have occurred on pear wood in the past and may have been pruned out before they could be recognized as fire blight infections.

During April and May in Nova Scotia temperatures are generally cool and not conducive to the growth of the bacterium or the copious oozing of it

Figures 2 to 6. Fire blight infections on pear and hawthorn hosts. Figure 2–Severe 1966 infection on pear; Figure3–Twig blight of pear with canker formed in 1966; Figure4–Seasonal extension of cankers formed on pear wood prior to 1966; Figure 5–Typical shepherds crook effect of pear root sprouts infected in 1966; Figure 6–An old fire blight canker on hawthorn.

from hold-over cankers. Temperatures within the range of 65° F to 85° F are most favorable for the growth of bacteria in hold-over cankers (1). The number of days of consecutive high temperatures exceeding 65° and 75° F during the pear bloom period, May 23 to 31, for the last 5 years in Nova Scotia was as follows:

Year	Consecutive days exceeding 65° F	Consecutive days exceeding 75° F
1966	8	6
1965	3	0
1964	4	2
1963	5	2
1962	4	3

The number of days of consecutive temperatures exceeding the minimum required for activating hold over cankers was about doubled in 1966 over the 4 preceeding years. The increase in the amount of fire blight in Nova Scotia in 1966 may be a direct result of the effect of temperature which may have increased the amount of the inoculum produced from hold over cankers. Heavy rains which occurred on May 21, 28 and June 1 and 8 provided ideal conditions for the spread of the bacteria and infection of blossoms, young fruits and new growth in 1966.

Now that pear trees in a number of orchards in the Annapolis Valley are severely cankered, the danger of fire blight infection for the next growing season will be greatly increased because more cankers containing living bacteria will be present in the spring of 1967 than in former years. The fact that a number of apple orchards had symptoms of fire blight infection, especially those near infected pear orchards, adds to the potential hazard. From 2 to 10 per cent of the fire blight cankers formed in a season have been reported to contain living bacteria the following spring (1). However, few fire blight infections may occur in Nova Scotia in future years if climatic conditions parallel those recorded for the 4 years preceeding 1966.

This is the first authentic report of fire blight on apple, pear and hawthorn in Nova Scotia. The disease is not expected to be a major problem in Nova Scotia orchards. Growers can prevent a build up of fire blight by pruning out scattered infections which may occur in the orchard. It may be the only control measure necessary to keep fire blight at a minimum during years with normal climatic conditions and may prevent outbreaks from occurring during years when climatic conditions are ideal for infection and spread of the disease. The destruction of native hosts of E. amylovora in the vicinity of orchards will greatly assist in the control of the disease.

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BRIEF ARTICLES

Disease survey of registered field beans in Ontario - 1966

M. D. Sutton and V. R. Wallen[1]

Nine hundred and sixty-five acres of registered field beans, representing 27 seed stocks, were inspected for disease this past summer. The survey was made primarily to ascertain the incidence of bacterial blight in accordance with the plan to produce disease-free beans in southwestern Ontario. Most of the acreage was represented by the varieties Sanilac and Seaway with smaller acreages of Seaway '65 and Michelite. The fields were inspected during the first week of August and some of the fields were reinspected during the second week of September. Isolations and identifications of the pathogens were made from all diseased material suspected to be bacterial blight.

The survey was made for two purposes: to determine the incidence of blight in registered seed stocks in relation to the origin of the breeder seed, either Ridgetown, Ontario or Idaho, U. S. A.; to determine the incidence of blight in relation to the number of generations of its production in Canada. The information regarding the origin of the seed and the number of generations of its production in Canada were provided by the Canadian Seed Growers' Association. Five of the 27 seed stocks originated from 1962 Ridgetown foundation seed and 22 seed stocks came from Michigan breeder seed imported into Canada in 1963, 1964, and 1965.

All foundation plots produced from Michigan breeder Sanilac and Seaway seed were free of bacterial blight. Two of 15 registered seed stocks, representing their second increase in Canada, showed trace infections of blight. Three of 12 certified seed lots, representing their third increase in Canada, also showed a trace of blight. Although there was little difference in the overall rate of infection among the various seed lots, either registered or certified, more fields of certified seed representing individual seed stocks were infected. In all cases the causal organism was identified in the laboratory as Xanthomonas phaseoli var. fuscans, cause of fuscous blight. Each isolate was further characterized as a phage type indigenous to the bean growing area of southwestern Ontario.

The results of this survey indicate that regardless of the origin of the seed, or the variety, if healthy seed is sown the ensuing crop is free of bacterial blight. In most cases, the crop remains free of blight for at least two years. By the third year infection becomes apparent and increases in subsequent years through a build up of seed-borne infection.

A trace of root rot, probably due to a Fusarium species was noted in four of 42 fields inspected. The disease was not severe. Although sclerotinia wilt (Sclerotinia sclerotiorum) was not observed during the first survey, traces of it were found later in several fields during the second week of September.

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Rust on maize in Quebec

R. I. Brown[1]

A moderate amount of rust, likely Puccini sorghi Schw., was observed on maize plantings at Macdonald College on the Island of Montreal and at Deschambault, 40 miles west of Quebec City on the north shore of the St. Lawrence River in Portneuf County, in September 1966.

Rust has become a recurring problem at Macdonald College where much maize of diverse genotype is grown annually. Commercial hybrids rarely show more than a few scattered pustules, but some lines in the breeding nursery are nearly killed by rust each year. Again in 1966 Hooker's Cuzco gene (Rp^d), when present, conferred resistance to all races of rust present in the natural inoculum at Macdonald College.

The presence of a significant amount of rust at Deschambault is rather surprising. The area is clearly outside the area of adaptation of even the earliest commercial field corn hybrids and the few farmers which grow this crop have only a small acreage. Some sweet corn is grown for local consumption. It is unlikely that more than 500 acres of corn is grown in all of Portneuf County, an area of 1,440 square miles. A breeding nursery of the world's earliest accessions of corn was first planted at Deschambault in 1965 and repeated again in 1966. Severe leaf damage due to rust was observed on many lines in this nursery in 1966. Particularly susceptible were 20 accessions of maize from the Northern Great Plains and Canadian Indians for instance, 'P.I. 213800' to '213808' and 'P.I. 213791' to '213799'. Here, too, some 70 different commercial field corn hybrids showed few rust pustules. Hooker's Rp^d gene was not present in this nursery.

Since it is expected that most, if not all, of the maize cultivars grown in this area are commercial hybrids which are relatively resistant to rust, the high incidence of rust on a small isolated planting of exotic material is considered unusual. Species of Oxalis, the alternate hosts for P. sorghi, are common weeds throughout the cultivated areas of Quebec, but they are not known to be rusted here.

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Apple viruses in Ontario in 1966

T. R. Davidson and Wayne R. Allen[1]

During September and early October of 1966 surveys for visible virus symptoms were conducted in 25 apple orchards in the Aylmer, Brighton, Collingwood, Picton, Simcoe, Smithville and St. Catharines districts of Ontario. With two exceptions these were large orchards of 500 trees or more. Each contained a number of varieties. 'McIntosh', 'Red Delicious' and 'Northern Spy' made up the bulk of these plantings but a number of trees of the following varieties were also observed: 'Red Spy', and other 'Spy' sports, 'Snow', 'Dutchess', 'Golden Russet', 'St. Lawrence', 'R. I. Greening', 'Baldwin', 'Bancroft', 'Golden Delicious', 'Wealthy', 'Tolman's Sweet', 'Red Astrachan', 'Melba', 'Cortland', and lesser numbers of a few others.

Two or three observers, searching somewhat at random, examined a large number of trees in each orchard. Fruit deformities and blemishes, as well as leaf and stem symptoms of possible virus origin were the chief concern. The growers were asked if they had noticed any unusual conditions and Extension Specialists in each area also were queried.

In an orchard near Smithville, two apple trees of unknown variety were observed with pronounced apple mosaic symptoms. Fruits were normal on these trees.

In an orchard at Aylmer, two 'Northern Spy' trees had an unexplainable fruit-color break. Green stripes of varying width extended from the calyx towards the stem, and persisted in ripening fruits. This condition was not uniform throughout the tree as some branches bore normal fruits. Some leaves on new growth developed irregular chlorotic sectors.

In the Picton and Brighton areas severe leaf puckering due to early season frost was observed on a number of varieties. Misshapen fruits (elongate, flattened and egg-shaped) were common in McIntosh. This condition has been observed in many apple growing areas of Canada in the past two years. Early frost injury has been suggested as a possible

At Collingwood a fruit deformity of a somewhat different nature was seen in 1965 (Canadian Plant Dis. Survey 46: 7: 1966) and again this year. As before the condition affected a number of varieties on a number of root-stocks. A satisfactory explanation has not been found but this is probably not a virus problem.

These surveys were concerned with diseases of possible virus nature that resulted in unsalable fruits, extreme reduction yield, or tree injury obvious by reduced vigor or altered habit. On these bases no important virus diseases were encountered.

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Plant - parasitic nematode genera associated with crops in Ontario

J. L. Townshend[1], *Th. H. A. Olthof*[1] *and J. E. Staples*[2]

One hundred and eighty soil samples were examined by the Ontario Nematode Diagnostic and Advisory Service between Jan. 1 and Oct. 1, 1966. These samples originated from cereal, fruit, ornamental and vegetable crops. The majority of the samples came from tobacco. Data on the plant-parasitic nematode genera detected are compiled in Table 1.

The oat cyst nematode Heterodera avenae caused severe damage in some oat fields. In one field the crop was a total loss. Unfortunately, the root lesion nematode Pratylenchus sp. appears to be compounding the problem.

Among fruit crops, failure of individual trees in cherry and peach orchards because of P. penetrans continues to bother the growers. Tree site fumigation is recommended in the replacement of trees. Fewer samples from strawberry plantings were processed this year. Nevertheless more fumigation may be done this fall for the control of P. penetrans in prospective plantings than ever before. The root knot nematode Meloidogyne hapla was found only once in peach and strawberry.

In floral crops in greenhouses, the dagger nematode Xiphinema diversicaudatum is the most important and destructive nematode on roses. The root lesion nematode P. penetrans has become a problem on roses as well, particularly in ground beds with sandy soil. The occurrence of the stunt nematode Tylenchorhynchus, perhaps T. claytoni and the stubby root nematode Trichodorus christiei on greenhouse azaleas may become important. Both nematodes arrest growth.

The root lesion, root knot and cyst nematodes were all found on vegetables. The sugar beet cyst nematode Heterodera schachtii was found on table beet and rhubarb in the Woodbridge area above Toronto. The root knot nematode Meloidogyne hapla was found mainly on vegetables grown on muck soils. Pratylenchus penetrans was found in all vegetable soils.

Seventy-three of the 80 tobacco soil samples contained P. penetrans. Root samples were included in 67 of the samples. They were rated for severity (0-5) of black root rot (Thielaviopsis basicola). The results were as follows; no black root rot (0) -16; trace (1) -22; light (2) -16; moderate (3) -10; severe (4) -3; and very severe (5) -0.

In summary, almost every crop was attacked by the root lesion nematode. This indicates its wide distribution in Ontario. Cherry, oats, peach, rose, strawberry and tobacco suffered the most damage. The cyst and root knot nematodes occur more sporadically and they have a more specific distribution.

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Table 1. Plant parasitic nematodes associated with Ontario crops in 1966.

Crop	Pratylenchus	Paratylenchus	Xiphinema	Criconemoides	Rotylenchus	Tylenchorhynchus	Meloidogyne larvae	Heterodera larvae	Trichodorus
Azalea (3)[1]						856[2]/3[3]			440/1
Bean (2)	150/1						11600/1		
Beet (4)	120/1	150/1						4450/1	
Cabbage (2)	3350/2								
Carrot (2)	40/1				40/1				
Celery (1)	200/1								
Cherry (sour) (2)	22720/1		450/1						
Cherry (sweet) (1)	5660/1	1090/1							
Corn (3)	2173/2	300/1						450/2	
Cucumber (1)	400/1							240/1	
Fallow (2)	700/2								
Juniper (12)	320/2		120/2			40/1			
Lettuce (1)							7920/1		
Nursery stock (6)		2150/3			100/3				
Oats (5)	367/3	650/2						556/5	
Onions (8)	538/4								
Peach (7)	1133/6	1558/6		100/1	100/1		800/1		
Potatoes (2)	120/1								
Raspberry (2)	755/2	265/2							
Rhubarb (2)	1575/2							2050/2	
Rose, field (1)		250/1	20/1						
Rose, greenhouse (17)	2649/10	840/5	170/2				80/1		
Rye (1)	100/1						4650/1		
Strawberry (9)	1700/7	300/3					100/1		
Tobacco (80)	1055/73					217/6	900/1		
Tomato (4)	463/4	50/1					2150/2		
Total samples (180)	2104/128	691/25	190/6	100/1	80/4	371/10	3525/9	1549/11	440/1

[1]No. of soil samples processed. [2]Av. no. of nematodes per lb. of soil. [3]No. of samples containing the nematode.

Phytophthora citricola Sawada, in relation to shoot blight of lilacs and crown rot of elders in Alberta

A. W. Henry and D. Stelfox [1]

Phytophthora citricola a fungus described by Sawada in 1927(4) as the cause of a brown rot of oranges in Formosa, is now known to be capable of attacking a number of other plants in various parts of the world. In the United States it was studied by Chester as a pathogen of lilac. He described it in 1932 as a new variety of Phytophthora cactorum and called it P. cactorum var. applanata(3). Later, in 1957, this variety was shown by Waterhouse to be the same as P. citricola, which name, as she points out, has priority(4).

A disease of common lilac, Syringa vulgaris, L., in the form of a shoot blight of suckers, was observed in Edmonton in 1965. From aboveground necrotic stem tissues of the diseased shoots we isolated a fungus and sent a culture of it to Dr. D. L. McIntosh of the Canada Department of Agriculture at Summerland, B.C., who identified it as P. citricola(4). This, as far as we are aware, constituted the first finding of this pathogen in Alberta and the first record of its occurrence on lilac in Canada (1).

During the last few years a serious disease of elders (Sambucus sp.) has been observed in the Edmonton district and specimens affected, apparently with the same disease, have been received by the Crop Clinic of the Alberta Department of Agriculture from other sections of Alberta. The disease, which we have called Crown Rot, appears to be widespread in the province, and to have caused the death of numerous individual elder plants. To our knowledge, it has not been reported elsewhere. It is characterized by a brownish necrosis of the basal part of the stem, the crown and attached roots and in time by a wilting of the foliage of part or of the whole plant.

From the symptoms shown by elders affected with Crown Rot we suspected that it was caused by a species of Phytophthora, but until recently were unable to isolate a member of this genus from the necrotic tissues. We did find a Pythium quite commonly associated with diseased tissues(2) of some specimens, but were unable to satisfy ourselves that it was the main pathogen involved. Species of Fusarium were also commonly present, but they too, appeared to be secondary organisms. Recently, we have isolated a species of Phytophthora from necrotic basal stem tissues of diseased red elders from two widely separated points in Alberta, namely, Three Hills and Fairview. Moreover, the two isolates so far obtained from these two points appear to be the same and to resemble closely our lilac isolate of P. citricola. Both proved to be highly pathogenic when stems of red elders were artificially inoculated. Noteworthy, as well is the fact that our known isolate of P. citricola from lilac has produced infection as readily as have the two elder isolates when red elder stems have been inoculated with all three isolates under similar conditions. It would appear, therefore, that P. citricola is an important pathogen of elders as well as of lilacs and that it may be a major cause of Crown Rot of the former.

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Storage rot of carrots incited by a Sclerotinia - Candida complex

D. Stelfox

Most of Alberta's commercial carrot crop must be held in either common or cold storage for extended periods lasting as long as seven or eight months. During this time it is essential that storage temperature be low and humidity very high. Such conditions often favor fungal development.

A disease of stored carrots (Daucus carota L. var. sativa) in the form of a cup rot, as yet undescribed in the literature, was observed in Edmonton in 1963. These carrots had been in cold storage nearly three months, after harvest, in closed heavy-duty polyethylene bags. Early symptoms of cup rot were discoloration and softening of tissue in a section about an inch wide extending approximately halfway around the circumference of the carrot. Later, the centre of the affected area caved inward and the damaged surface tissue took on a glistening, slimy appearance, and was eventually covered by a thick creamy-white ooze. No weft of surface mycelium was evident in either early or late stages of cup rot development.

Preliminary investigations indicated that Sclerotinia sclerotiorum (Lib.) deBary was initially associated with the rot. This association was eventually obscured by a yeast, Candida kruzei (Cast.) Berkh., which frequently overgrew the entire affected area. Cup rot was reproduced in the laboratory, during later investigations, and it was shown that the Sclerotinia-Candida complex was primarily responsible. Also, some of the physiological factors involved were studied to show reasons for the successive appearance of the two fungi.

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Hordeum mosaic virus on perennial grasses in Manitoba

J. T. Slykhuis[1]

A virus isolated in 1957 from diseased barley leaves, that had been collected in southern Alberta in 1952 and stored in a deep freeze, appeared to be related to both wheat streak mosaic virus (WSMV) and agropyron mosaic virus (AMV) (2). Like the latter viruses, it caused mosaic symptoms on wheat and had flexuous rod shaped particles 698 mμ long. Like WSMV it infected oats but not Agropyron repens (L.) Beauv., a host of AMV, but like AMV it was not transmitted by Aceria tulipae (K.), vector of WSMV. In cross inoculation tests on wheat it interfered with infection by AMV but was synergistic with WSMV. Serological tests indicated that it was distantly related to WSMV and AMV, but it was sufficiently different from them to be considered as a distinct virus. It was designated hordeum mosaic virus (HMV).

HMV has not been isolated from any other collections of mosaic-diseased cereals. However, host tests in the greenhouse showed that it infected the perennial grasses Hordeum jubatum L., Agropyron trachycaulum (Link) and Elymus canadensis L. A decision was therefore made to search for this virus in perennial grasses in or near the area in southern Alberta where the original sample of infected barley was found.

In June 1966, the author assisted by T.G. Atkinson of the Lethbridge Research Station, collected perennial grasses with mild to moderate mosaic symptoms at 4 locations in southern Alberta and brought them to Ottawa. They were transplanted into pots for continued growth and development of inflorescence to enable identification. A virus was transmitted to wheat from grasses identified by W. G. Dore of the Plant Research Institute as A. trachycaulum and H. jubatum collected near Warner and Jefferson, Alberta, and also from × Agrohordeum macounii (Vasey) Lepage, a natural hybrid of A. trachycaulum × H. jubatum (1), collected at the Jefferson location. Because the isolates of virus from these grasses infected oats and H. jubatum but not A. repens, and reacted specifically with HMV antiserum, they were identified as isolates of HMV.

The susceptible perennial grasses appear to provide a stable reservoir of HMV, but there is no data on the frequency with which the virus spreads to cereals or by what means. The eriophyed mites Aceria tulipae, A. hystrix and Aculus mackenziei (K.) occur on H. jubatum in Alberta, but attempts to transmit HMV with these mites have failed.

1 Plant Research Institute, Research Branch, Canada Department of Agriculture, Ottawa, Ontario.

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A mosaic disease of Poa palustris in Alberta

J. T. Slykhuis[1] and T. G. Atkinson[2]

In June 1966, light green to pale yellow mosaic symptoms were observed on Poa palustris L. growing by a roadway near Nobleford, Alberta. Plant samples were taken to Ottawa, transplanted into pots and tested for the presence of virus.

Juice from the diseased P. palustris was used to inoculate 'Kent' wheat seedlings by the leaf-rub method. Five of the 24 seedlings tested showed a chlorotic mottling by the 7th day. Subsequently, they developed a chlorotic striping and necrotic blotching. They died before the 15th day after inoculation. Other wheat plants developed mosaic symptoms more slowly and did not become necrotic but were slightly stunted.

In subsequent tests, plants in 9 of 54 species of Gramineae inoculated with juice from the diseased P. palustris plants developed mosaic symptoms. The numbers of plants that showed symptoms out of the numbers inoculated in the susceptible species were as follows:

Agropyron cristatum (L.) Gaertn.	2/5
Avena sativa L. var. 'Clintland'	16/35
Echinochloa pungens (Poir.) Rydb.	3/3
Lolium multifolium Lam. var 'S22'	4/38
Poa leptocoma Trin.	1/7
P. nemoralis L.	2/8
P. palustris L.	19/24
Secale cereale L. var. 'Dominant'	3/10
S. cereale L. var. 'Tetra Petkus'	15/23
Triticum aestivum L. var. 'Kent'	53/94

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The species with the highest percentages of infected plants were P. palustris, E. pungens, wheat, rye and oats. Necrosis and death of some of the seedlings occurred only in wheat and rye. Among the 45 species in which none of the plants developed symptoms were Agropyron repens L., Bromus inermis Leyss., Dactylis glomerata L., Hordeum jubatum L., H. vulgare L. var. 'Vantage', Lolium perenne L., var. 'Norlea', Poa compressa L., P. pratensis L., and 4 varieties of Zea mays L. However, since only 8 to 25 plants of each species were tested, further tests may show that some of these species can be infected.

Serological tests did not show a reaction between heat-clarified juice from wheat infected with the virus and antisera prepared against wheat streak mosaic, agropyron mosaic, hordeum mosaic or ryegrass mosaic viruses. Electron microscopic examination of grids prepared from diseased wheat by the quick dip method revealed rod-shaped particles about 750 mμ long, similar to particles of ryegrass mosaic virus.

Although the infectivity tests showed that the mosaic symptoms on P. palustris are caused by a virus, the virus does not appear to be identical with any other grass virus known in Canada.

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