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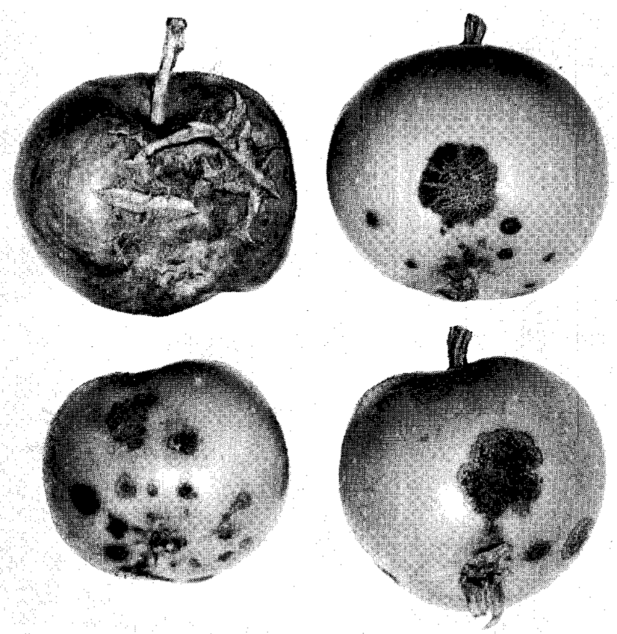
Canadian Plant Disease Survey



Compiled and Edited by D. W. Creelman

PLANT RESEARCH INSTITUTE
RESEARCH BRANCH
Canada Department of Agriculture

CANADIAN PLANT DISEASE SURVEY

Volume 44 December, 1964 Number 4

CONTENTS

SOME RECORDS OF KNOWN AND SUSPECTED PLANT-PARASITIC NEMATODES ENCOUNTERED IN CANADA IN 1964

M. O. Tyler[1]

Root-knot Nematodes

Two possible cases of the peanut root-knot nematode, *Meloidogyne arenaria* (Neal, 1889) Chitwood, 1949 and the northern root-knot nematode, *Meloidogyne hapla* Chitwood, 1949, were intercepted on hydrangea roots from Alabama, *Weigela* sp. roots from Michigan, U.S.A., and rose roots from Holland.

The northern root-knot nematode, *Meloidogyne hapla* Chitwood, 1949 was intercepted on several occasions on rose roots from Texas, Ohio, Pennsylvania, U.S.A., from Holland and Belgium, and also from *Rosa multiflora* roots from Pennsylvania, U.S.A. It was intercepted on *Forsythia* sp. roots from New York, Michigan, and Alabama, *Weigela* sp. roots from New York, and *Artemisia dracunculus* roots from Vermont, U.S.A. It was recorded from *Viburnum* sp. roots from St. Hilaire, Quebec, and peony roots from the Toronto, Ontario, area. Two probable cases of this nematode were intercepted on *Weigela* sp. roots from Alabama, and *Paeonia* sp. roots from Iowa, U.S.A.

The southern root-knot nematode, *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949 was intercepted on *Fraxinus* sp. and *Syringa* sp. roots from Alabama, and tomato roots from Georgia, U.S.A. Also two possible cases were intercepted on rose roots from Texas, and tomato roots from Georgia, U.S.A. *Meloidogyne* sp., possibly *M. incognita*, mixed with some *M. hapla*, was found on *Weigela* sp. roots from Alabama, U.S.A.

Seven interceptions of the Javanese nematode, *Meloidogyne javanica* (Treub, 1885) Chitwood, 1949, were made on tomato roots from Georgia, U.S.A. It was found on tomato roots from the Windsor, Ontario area. Two possible cases of this nematode mixed with some *M. incognita* were also found on tomato roots from Georgia.

Meloidogyne spp. were recorded on tomato roots from Windsor, Ontario, and intercepted on *Rosa* sp. roots from Arizona, *Forsythia* sp. roots from New York, and tomato roots from Mississippi and Georgia, U.S.A.

Cyst-forming Nematodes

The oat cyst nematode, *Heterodera avenae* Wollenweber, 1924, was intercepted from Holland in soil associated with rhododendron, hydrangea, rose, *Taxus hilli*, *Taxus* sp., *Picea* sp., *Thuja* sp., conifers, and imported balled stock; from Italy in *Laurus* sp. and carnation soil; from Germany in *Acer* sp. and *Tilia* sp. soil; and in soil from an improperly washed car from England. It was identified from a soil survey of the Toronto, Ontario, area and also there were a few probable cases of this nematode in the same area. Several possible cases were intercepted in soil about the roots of azalea, *Juniperus* sp., *Malus* sp., *Euonymus* sp., *Taxus* sp., spirea, *Metasequoia* sp., *Thuja* sp., and conifers from Holland.

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[1]Nematology Section, Entomology Research Institute, Research Branch, Canada Department of Agriculture, Ottawa.

The cactus cyst nematode, *Heterodera cacti* Filipjev & Schuurmans-Stekhoven, 1941, was intercepted in soil from cactus from Austria and also tentatively identified from the same host plant and same area. It was found in a soil survey in the Windsor, Ontario, area and tentatively identified as *H. cacti*.

Two tentative identifications of the cabbage cyst nematode, *Heterodera cruciferae* Franklin, 1945, were made from soil about the roots of *Ribes* sp. from Holland and an improperly washed tractor from Scotland. The fig cyst nematode, *Heterodera fici* Kirjanova, 1954, was both definitely and tentatively identified from fig tree soil samples from Italy.

The hop cyst nematode, *Heterodera humuli* Filipjev, 1934, was intercepted from Holland in soil about the roots of rhododendron, hydrangea, *Taxus* sp., conifers, *Cornus* sp., *Thuja* sp., and various house plants; from Italy, associated with aspidistra, grape vine and fig tree, and soil from Germany, Romania and Yugoslavia. It was also found in a soil survey of nurseries in the Niagara Falls, Ontario, area in which the plants originally came from Holland. In addition it was tentatively identified from Holland on azalea, *Berberis* sp., *Betula* sp., *Cotoneaster* sp., *Picea pungens*, *Lonicera* sp., *Cornus* sp., *Thuja* sp., *Juniperus* sp., conifers and imported balled stock; from Italy, associated with *Pelargonium* sp., fern and carnation. It was also found in soil from the U.S.S.R., and in a soil survey in Newfoundland.

The grass cyst nematode, *Heterodera punctata* Thorne, 1928, was intercepted from Holland in the soil about the roots of rhododendron, hydrangea, *Betula alba*, quince, *Sorbus* sp., *Berberis* sp., *Juniperus* sp., *Ilex* sp., *Malus* sp., *Picea* sp., *Thuja* sp., azalea, *Acer* sp., spirea, conifers, and imported balled stock. It was found associated with ornamental plants from Belgium; aster and heather from England; carnation from Italy; *Tilia* sp. and herbaceous plants from Germany; improperly washed vehicles from Scotland, Germany and the United Kingdom. It was also found in a soil survey of Newfoundland. Two possible cases of this nematode were recorded on hydrangea and *Taxus* sp. from Holland.

The golden nematode, *Heterodera rostochiensis* Wollenweber, 1923, was found in a soil survey from Newfoundland and tentative identifications were made from various plants and soil from the United Kingdom, Germany and Newfoundland.

The sugar-beet nematode, *Heterodera schachtii* Schmidt, 1871, was found on the roots of red beet at Woodbridge, Ontario; in the soil about the roots of *Lonicera* sp. from Holland. In addition, it was tentatively identified from the soil of *Pelargonium* sp., carnation and cactus soil from Portugal.

The clover cyst nematode, *Heterodera trifolii* Goffart, 1932, was intercepted from the soil of polyantha rose, hydrangea, *Quercus* sp., *Taxus* sp., *Metasequoia* sp., *Thuja* sp., and *Juniperus* sp. from Holland; hydrangea from New York, U.S.A.; *Pelargonium* sp., aspidistra and *Saintpaulia* sp. from Italy; aster and heather from England; soil from Romania; herbaceous plants and an improperly washed car from Germany. It was also found in a soil survey of Newfoundland, Prince Edward Island, Quebec, Ontario, and British Columbia. Several possible cases of this nematode were found associated with rhododendron, clematis, *Pinus strobus*, azalea, conifer, and nursery stock from Holland; improperly washed tractors from New York, U.S.A.; and a soil survey of Newfoundland, Prince Edward Island, Quebec, Ontario, and British Columbia.

Cysts identified only as Heterodera sp. were found in the soil from hydrangea, Sorbus sp., azalea, Taxus sp., Thuja sp., Pinus sp., Malus sp., Azalea mollis, Juniperus sp., rhododendron, Acer sp., rose, spirea, Metasequoia sp., and conifer from Holland; ornamentals, ivy, cactus, laurel, and Pelargonium sp. from Italy; Tilia sp. from Germany; soil from England; soil from an improperly washed tractor and car from Czechoslovakia and the United Kingdom. Soil from Newfoundland, Prince Edward Island, Quebec, and British Columbia also contained this nematode.

Root-lesion Nematodes

Pratylenchus crenatus Loof, 1960 was found in soil around the roots of white birch from Oregon, U.S.A.; Sorbus sp. and quince from Holland; Betula sp. and Sorbus sp. from Holland (possibly from Belgium); Malus sp. from Holland, and strawberry from Yarmouth County, Nova Scotia.

Pratylenchus neglectus (Rensch, 1924) Filipjev and Schuurmans-Stekhoven, 1941 was found in the soil associated with gladiolus from Germany, and Acer rubrum from Galt, Ontario.

Pratylenchus penetrans (Cobb, 1919) Filipjev & Schuurmans-Stekhoven, 1941 was found in the soil around the roots of aster, phlox, Heuchera sp., and Thymus sp. from England; Paeonia sp. from Iowa, white birch from Oregon, phlox from Michigan, and Rubus spp. from New York, U.S.A.; Sorbus sp., quince, Picea pungens glauca from Holland; Betula sp. and Sorbus sp. from Holland (possibly from Belgium); a vegetable root and soil, possibly taro from the Azores; strawberry from Yarmouth County, Nova Scotia, and soil from Ontario and Nova Scotia. This species was tentatively identified in aster and in Heuchera sp. soil from England. Pratylenchus pratensis (de Man, 1880) Filipjev, 1936 was found in soil from Holland.

Pratylenchus vulnus Allen & Jensen, 1951 was found on two occasions in the soil about the roots of rose imported from Oregon, U.S.A. In addition, two possible cases of this nematode were found associated with the roots of Rosa sp. from California, U.S.A., and Cotoneaster acutifolia from Holland.

Pratylenchus spp. were found in the soil from rhododendron and Thuja occidentalis from Holland; Heuchera sp. from England; rose and white birch from Oregon, and Dahlia sp. from Michigan, U.S.A.

Stunt Nematodes

Tylenchorhynchus acutus Allen, 1955 was found in Rosa sp. soil from Texas, U.S.A. Tylenchorhynchus brevidens Allen, 1955 was found associated with aster, phlox, and Heuchera sp. soil from England and Tylenchorhynchus bursifer Loof, 1959 was found in soil from Holland.

Tylenchorhynchus clarus Allen, 1955 was tentatively identified from soil around the roots of rose from California; possibly T. ewingi or T. clarus was also found in rose soil from Arizona, U.S.A. Tylenchorhynchus claytoni Steiner, 1937 was found in soil and rhododendron soil from Holland and in Sorbus aucuparia soil from Holland (possibly from Belgium).

Tylenchorhynchus dubius (Bütschli, 1873) Filipjev, 1936 was found in the soil about Heuchera sp. from England; Malus sp. from Holland; gladiolus from Germany, and succulents from West Germany. This species was tentatively identified from aster and Heuchera sp. soil from England. Tylenchorhynchus maximum Allen, 1955 was found in cedar soil from Burritt's Rapids, Ontario and Tylenchorhynchus nothus Allen, 1955 was found in soil from succulents from West Germany.

Tylenchorhynchus spp. were found in the soil about the roots of Rosa sp. from Arizona, and Texas; Paeonia sp. from Iowa, U.S.A.; gladiolus bulb soil from Germany and soil from Alabama, U.S.A. and in Pinus sylvatica fastigiata from Holland.

Spiral Nematodes

Helicotylenchus spp. were found in association with soil about the roots of Korean boxwood from Port Burwell, Ontario; Calamagrostis canadensis from Rupert, Quebec, and gladiolus from Germany.

Rotylenchus goodeyi Loof & Oostenbrink, 1958 was found in aster, phlox and Heuchera sp. soil from England. Rotylenchus uniformis (Thorne, 1949) Loof & Oostenbrink, 1958 was found in the soil about the roots of Pinus sylvatica fastigiata and rhododendron from Holland.

Ring Nematodes

Criconemoides curvatum Raski, 1952 was found in Thymus sp. soil from England and Criconemoides spp. were found in Korean boxwood soil from Port Burwell, Ontario.

Pin Nematodes

Paratylenchus nanus Cobb, 1923 was found in association with gladiolus soil from Germany and Acer rubrum soil from Galt, Ontario. Paratylenchus spp. were found in the soil about the roots of aster and Heuchera sp. from England; rose from Oregon, U.S.A., and rhododendron from Holland.

Other Tylenchids

Aglenchus sp. was found in the soil of Korean boxwood from Port Burwell, Ontario. Boleodorus sp. was found in the soil from succulents from West Germany. Ditylenchus dipsaci (Kühn, 1857) Filipjev, 1936 was found in iris bulbs from Washington, U.S.A. and Ditylenchus sp. was found in the soil of Pinus sylvatica fastigiata from Holland and from soil from Ontario.

Psilenchus hilarulus de Man, 1921 was found in association with Rosa sp. soil from Arizona, U.S.A. and Psilenchus sp. was found in soil from Alabama, and Paeonia sp. soil from Iowa, U.S.A. A possible identification of Rotylenchulus sp. was made from a few specimens found in the soil about gladiolus bulbs from Germany.

Tylenchus (Cephalenchus) spp. were found associated with azalea soil; from Picea pungens glauca soil from Holland; Betula sp. and Sorbus aucuparia soil from Holland (possibly from Belgium). Tylenchus spp. were found in association with aster, phlox, and Heuchera sp. from England; soil from Alabama, and phlox from Michigan, U.S.A.; rhododendron from Holland; and soil from Ontario.

Aphelenchids

Aphelenchoides parietinus (Bastian, 1865) Steiner, 1932 was tentatively identified from soil from Rubus spp. from New York, U.S.A.; gladiolus from Germany, and soil from Nova Scotia and Ontario. Aphelenchoides bicaudatus (Imamura, 1931) Filipjev & Schuurmans-Stekhoven, 1941 was tentatively identified from Lilium candidum soil from France.

Aphelenchoides ritzemabosi (Schwartz, 1911) Steiner & Buhrer, 1932 was found in the soil about the roots of aster, phlox, and Heuchera sp. from England. A tentative identification was also made of this species in astilbe soil from Holland (possibly from Belgium).

Aphelenchoides spp. were found in association with Euphorbia splendens, Citrus aurantifolia, Senecio mikanioides, Pilea sp. from Michigan, U.S.A.; Sorbus sp. and quince from Holland; rose from Belgium; and succulents from West Germany. Aphelenchoides subtenuis was tentatively identified in rose soil from New Jersey, U.S.A.

Aphelenchus avenae Bastian, 1865 was found in soil from aster, phlox, and Heuchera sp. from England; rose from New Jersey, and sunburst locust from Iowa, U.S.A.; Juniperus sp. from Holland; strawberry from Yarmouth County, Nova Scotia; Korean boxwood from Port Burwell, Ontario; soil from Alabama, U.S.A., and Ontario; alfalfa from British Columbia, and succulents from West Germany. In addition, tentative identifications were made from rose soil and soil from California, U.S.A., and from Ontario.

Aphelenchus spp. were found in rose soil from New Jersey and Arizona, and phlox soil from Michigan, U.S.A.; soil from the London, Ontario, area, and Lilium candidum soil from France.

Seinura spp. were found in the soil associated with Euphorbia splendens, Citrus aurantifolia, Senecio mikanioides, and Pilea sp. from Michigan, U.S.A.; a vegetable root, possibly taro, from the Azores, and Acer rubrum from Galt, Ontario.

Dorylaimids

Trichodorus pachydermus Seinhorst, 1954 was found in soil from Holland. Trichodorus spp. were found in rose and Picea pungens glauca soil from Oregon, U.S.A., and Holland, respectively.

Xiphinema americanum Cobb, 1913 was found in soil from Alabama, and white birch soil from Oregon, U.S.A. Xiphinema sp. was found in cedar soil from Burritt's Rapids, Ontario.

ENTOMOLOGY RESEARCH INSTITUTE,
RESEARCH BRANCH, CANADA AGRICULTURE,
OTTAWA, ONTARIO.

BARLEY YELLOW DWARF VIRUS IN MANITOBA IN 1964

C.C. Gill[1]

Barley yellow dwarf virus (BYDV) was found to be widespread throughout cultivated areas of the province. During the survey reported here, attention was directed mainly to oats as this crop is considered the best indicator crop among local field-grown cereals.

Positive transmission tests to confirm the presence of BYDV in cereals were obtained from selected fields near Melita, Holland, Rathwell, Carmen, Portage La Prairie, Winnipeg, Dauphin, Swan River and The Pas. About 80% of the positive tests were from oats and the remainder was evenly divided between wheat and barley. BYDV was also recovered from samples of Bromus inermis from Bowsman and Winnipeg and from Panicum capillare from Winnipeg.

Visual rating of the disease in 27 oat fields showed 10% with no red leaf symptoms. Infection was a trace in 41%, slight in 19%, moderate in 26% and severe in 4%. One late-sown field of mixed wheat, oats and barley near Swan River had 70% of the plants infected. This seems to confirm that early sowing is one means of reducing damage by this virus.

Groups of 4 aphids of each of 5 species collected from cereals in 4 fields near Winnipeg on August 13 were all viruliferous. However, 34 similar sized groups of aphids collected from other areas over a period of 6 weeks before this date showed only 17% of the total samples to be viruliferous. No virus was found in large samples of the greenbug taken from a heavily infested oat field near Elm Creek during July.

Six species of aphids were shown to be carrying BYDV in the field, namely, English grain aphid (Macrosiphum avenae), cornleaf aphid (Rhopalosiphum maidis), bird-cherry oat aphid (Rhopalosiphum padi), the greenbug (Schizaphis graminum), rose grass aphid (Metopolophium dirhodum) and quackgrass aphid (Sipha agropyrella). The first 4 mentioned were the most commonly encountered species on cereal crops. These species have previously been reported as vectors for BYDV in other parts of North America.

At least 3 different clones of each of the first 5 above-mentioned aphid species have been cultured in the greenhouse. The relative transmission efficiency of these aphids for many of the virus isolates collected in the field is now being examined.

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[1]Plant Pathologist, Canada Agriculture Research Station, P.O. Box 6200, Winnipeg, Manitoba.

ASTER YELLOWS IN PRINCE EDWARD ISLAND IN 1964

L.S. Thompson[1]

Aster yellows in head lettuce was not as severe in Prince Edward Island in 1964 as in the previous year, whereas losses in carrots in some districts were slightly greater. Losses in untreated head lettuce ranged from 40-60 per cent and in carrots from 20-46 per cent.

Populations of the aster yellows vector, Macrosteles fascifrons (Stål), the six-spotted leafhopper, were not as high as in 1963, but tests showed the proportion of viruliferous leafhoppers in field populations to be as high as 11 per cent in late July. If conditions during July and August had been more favourable for vector multiplication, losses in lettuce and carrots could have been much greater. A sudden increase in the adult population observed during the first week of July indicated the possibility of a migration of adults into the province. Weather conditions were favourable for such a movement just prior to and during this period.

In 1964, a field plot experiment was conducted near Charlottetown to determine the efficacy of 5 different insecticides for the control of the six-spotted leafhopper and the prevention of aster yellows in head lettuce. The results of these tests along with other pertinent data are shown in Table 1. The insecticides tested were malathion, phorate, carbaryl, Di-Syston® (O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate, and Bayer 25141 (O,O-diethyl O-p-(methylsulfinyl)phenyl phosphorothioate.

Time-mortality studies were also conducted in 1964 using the six-spotted leafhopper and lettuce plants from the field plots. These studies were made to determine approximately how long the systemic insecticides, phorate, Di-Syston and Bayer 25141 in the lettuce plants remained effective in controlling the vector, and to compare further the effectiveness of the various treatments under more closely controlled conditions. The results are presented in Table 2.

[1]Entomologist, Experimental Farm, Research Branch, Canada Agriculture, Charlottetown, P.E.I.

Table 1 - Performance of insecticides and methods of application for lettuce yellows prevention through control of the six-spotted leafhopper - 1964.

Insecticide	Method of Application	Toxicant Per Acre (lbs.)	Mean[4] Percentage Yellows
Check	-	-	40.5 a
Di-Syston	Granules	1.5	29.8 ab
Di-Syston + Carbaryl[1]	Granules	1.5	26.0 bc
Malathion	Spray	1.5	21.2 bcd
Bayer 25141	Granules	1.0	20.5 bcd
Bayer 25141 + Carbaryl[1]	Granules	1.0	19.3 bcd
Phorate	Granules	1.5	15.9 cd
Phorate + Carbaryl[1]	Granules	1.5	15.8 cd
Malathion[3]	Spray	1.5	15.7 cd
Carbaryl[2]	Spray	1.5	10.6 d
Carbaryl[3]	Spray	1.5	10.5 d

[1]Weekly carbaryl spray beginning August 10, 1964.
[2]Approximately once weekly; [3]approximately twice weekly.
[4]Means followed by the same letter are not significantly different at the 5% level.

Table 2. Effect of insecticides as determined by mortality of leafhoppers 72 hours after they were caged on plants brought in from field plots approximately 5, 6 and 8 weeks following treatment with granular systemic insecticides. 1964.

Insecticide	Mean per cent mortality		
	5 weeks	6 weeks	8 weeks
Check	3.75	0.00	7.50
Phorate	97.50	100.00	100.00
Bayer 25141	100.00	98.75	88.75
Di-Syston	100.00	88.75	98.75
Phorate + Carbaryl[1]	100.00	88.75	100.00
Bayer 25141 + Carbaryl[1]	100.00	80.00	81.25
Di-Syston + Carbaryl[1]	100.00	90.00	92.50
Malathion	43.75[2]	100.00[3]	20.00[4]
Malathion	100.00[3]	98.75[3]	91.25[5]
Carbaryl	100.00[2]	100.00[3]	98.75[4]
Carbaryl	100.00[3]	100.00[3]	98.75[5]

[1]Carbaryl sprays not applied till 8 weeks following planting.
[2]Insects placed on plants 5 days following a spray application; [3]/1-day; [4]/6-days; [5]/2 days.

Where control of aster yellows in head lettuce was significant it was assumed that leafhopper control was adequate. Granular phorate and Bayer 25141 applications at planting time were as effective as malathion and carbaryl spray treatments. Late sprayings of the granular systemic-treated plots proved of no value. It is doubtful if spraying these plots before August 10 would have been practical as time-mortality studies showed the 3 systemics to be effective against the vector up to this date. Twice-weekly sprays with carbaryl were no more effective than weekly sprays. The difference in per cent yellows resulting from twice-weekly and weekly sprays with malathion was not significant at the 5% level; however, time-mortality studies indicated that malathion gave little control of the vector 3-4 days after application. Malathion applications should, therefore, be made twice a week, or at least every 5 days for the most effective control of the vector.

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DISEASES OF SUNFLOWERS IN WESTERN CANADA IN 1964

J.A. Hoes and E.D. Putt[1]

The sunflower acreage in western Canada in 1964 was about 80,000 acres of which 48,000 were planted in Manitoba, and the balance in Saskatchewan and Alberta. Nearly 70% of the total acreage in Manitoba was planted to Peredovik, a variety excelling in yield and oil content compared with the older variety Mennonite and the hybrids Admiral and Advent. Almost the entire acreage in the other provinces was planted to Peredovik.

Disease surveys in Manitoba on September 3 and 10 were made in 21,12 and 7 fields of Peredovik, Mennonite and hybrid varieties, respectively. The spring and summer in Manitoba were cool and precipitation was above normal in June. The average yield per acre in Manitoba is estimated to be less than 600 lbs. A much higher average yield of 900 - 1000 lbs was estimated in early September but two days with below-freezing temperatures in mid-September caused severe reductions in yield as well as in oil content.

Rust (*Puccinia helianthi* Schw.) was not found in fields of hybrid varieties and occurred in all fields of the other two varieties. Of the latter, 23 fields showed only traces of rust and in the other 10 fields 50-100 per cent of the plants were only lightly infected. Damage due to rust was negligible.

Leaf mottle (*Verticillium albo-atrum* Reinke & Berth.) caused less damage this year than in the previous three seasons. Symptom expression was mild in general. Differences in susceptibility between Peredovik on the one hand, and Mennonite and hybrid varieties on the other hand were suggested by the proportions of fields with different disease incidences (Table 1).

Table 1. Incidence of leaf mottle in fields of different varieties

Diseases plants in field	Peredovik	Mennonite	Hybrid
0%	8/21*	1/12	1/7
less than 1%	5/21	2/12	3/7
5-20%	8/21	4/12	2/7
50-100%	0/21	5/12	1/7

* Proportion of fields

[1]Plant Pathologist and Plant Breeder, respectively, Research Branch, Canada Agriculture, Experimental Farm, Morden, Manitoba.

The proportion of fields where leaf mottle was absent was greatest and the proportion of fields with severe infection was smallest for Peredovik. The difference between Peredovik and Mennonite was especially striking in one field of 40 acres which had one-half planted with Peredovik and one-half with Mennonite. On September 3, the percentage of plants with leaf mottle were 15 and 80, respectively. The entire field had grown sunflowers in 1958 and oats and flax alternately between 1959 and 1963.

Sclerotinia wilt (Sclerotinia sclerotiorum (Lib.) DeBy) caused little damage. It was absent in 23 fields and affected a few to 2% of the plants in 17 other fields. Septoria leaf spot (Septoria helianthi Ell. & Kell.) was absent in 11 fields and affected 50-70% of the plants in 22 fields; infection was moderate to severe on 100% of the plants in seven fields, and yield here was likely affected. Downy mildew (Plasmopora halstedii (Farl.) Berl. & de T.) was absent in 22 fields, affected a few to 2% of the plants in 14 fields, and 10-15% of the plants in four fields.

Between August 25 and 28, 33 sunflower fields in Saskatchewan were examined. Disease was negligible. One field had 2-3% head rot believed due to Rhizopus sp. Leaf mottle and downy mildew were not found. Rust, sufficient for specimens only, occurred in a few fields. Traces of sclerotinia wilt appeared in 50% of the fields. All fields showed traces of injury suggestive of drift of 2,4-D or a similar herbicide. On the whole, fields in Saskatchewan were late; many had not finished blooming when they were examined and some were barely in full bloom. S.H. Pawlowski, J.S. Horricks and P.W. Bergen participated in the surveys.

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MORDEN, MANITOBA.

FIELD CORN DISEASES IN SOUTHWESTERN ONTARIO IN 1964

R. E. Wall[1]

The corn disease situation in Essex and Kent Counties was aggravated by cool spring weather with delayed seedling emergence, severe wind damage to seedlings, and a midsummer drought. Leaf diseases were present but were not severe enough to cause yield reductions. Most losses could be attributed to drought. Sunscald was widespread in July, appearing on flag leaves shortly before tassel break. Seed-rots and damping-off, although largely controlled by seed treatment, were found in few instances. In the Harrow selection 632-335, which was extremely susceptible to seed rot, kernels were found to be heavily infested with *Fusarium graminearum* Schwabe (*F. roseum* Lk. f. *cerealis* (Cke.) Snyd. & Hans.).

Northern corn leaf blight (*Bipolaris turcica* (Pass.) Shoem.) which reached epidemic proportions in 1961 and 1962, has been virtually absent in 1963 and 1964. Two factors responsible for the decline of this disease may have been the absence of prolonged wet periods in August during the past two years, and the increased sales of blight-resistant hybrids to growers.

A new leaf spot characterized by circular or oblong spots with brown margins and gray, almost transparent centres was observed in a few fields during the latter part of the growing season. It occurred mainly on lower leaves. Its cause is not yet known.

Corn smut (*Ustilago maydis* (DC.) Cda.) was found in most fields visited. Significant levels of infection were observed in only one field, near Tilbury, where about 50% of the plants had smut galls on the lower stalks. Rust (*Puccinia sorghi* Schw.) was rarely found and was not severe in any field where it was observed.

Considerable barreness, with accompanying ear proliferation, was observed during the autumn. In one field at Ridgetown, approximately 70% of the plants were barren. Affected plants were usually damaged by the corn leaf aphid (*Rhopalosiphum maidis*). The midsummer drought probably contributed to this situation.

Also prevalent in 1964 but not seen in previous years was a longitudinal red striping of kernels. Kernels near the tip of the ear were most intensely colored. The condition varied from plant to plant but it was found in all fields visited. The cause is under investigation.

Ear and kernel rots were more prevalent than in other years. Much of the kernel rot (*Fusarium moniliforme* Sheldon) was associated with bird damage. Considerable superficial growth of *Fusarium moniliforme* was also seen on cobs of late maturing hybrids. This presents a threat to safe storage of grain, especially where the corn has been harvested too early.

Stalk rot was serious in fields where susceptible hybrids were planted, approaching 100% by harvest time in some fields. In 60-90 per cent of the affected plants stalk-rot could be traced to previously rotted roots. The remainder of the infections were associated with above-ground nodes (5-20%) and corn borer tunnels (2-10%). *Fusarium graminearum* was again associated with stalk-rot, as in 1963. Stalk breakage was further augmented by heavy frosts during the first week of October.

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

DISEASE SURVEY OF REGISTERED FIELD BEANS IN ONTARIO - 1964

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

A disease survey was conducted in the main bean-growing areas of southwestern Ontario in the latter part of August. The survey was divided into three areas: in the north, the Kippen, Hensall and Zurich area; in the central part, Strathroy and adjacent areas, and in the south, the Blenheim and Chatham area. Particular attention was paid to the incidence of "fuscous" blight (Xanthomonas phaseoli (E.F. Sm.) Dows. var. fuscans (Burkh.) Starr & Burkh.).

In 1964 more of the acreage was sown to "disease-free" seed produced in Michigan under the supervision and inspection of plant pathologists. Formerly, breeder seed was produced in the Ridgetown area of Ontario where environmental factors were conducive to fuscous blight. Recently, however, the Canadian Seed Growers' Association has entered into an agreement with the producers of Michigan foundation seed to provide Ontario growers with a certain amount of Michigan foundation bean seed in 1965. This influenced many growers to use Michigan seed in 1964.

A steady increase in the incidence of fuscous blight in the bean crop has been observed since 1957, and in 1961 and 1962 it reached epidemic proportions. The prime purpose of this survey, in addition to determining the incidence of fuscous blight and common blight by field inspection, was to compare the incidence of bacterial blights in Ontario-grown and Michigan-grown seed.

Twenty-seven fields, approximately 385 acres, representing four bean varieties were examined. The number of fields and the acreage of each variety examined were as follows: Sanilac, 10 fields, 181 acres; Seaway, 12 fields, 170 acres; Saginaw, 3 fields, 32 acres and Michelite, 2 fields, 1 acre. Of the total acreage examined 44.4% was sown with breeder and foundation seed from Michigan and 37.1% with similar seed from Ontario. The balance of the acreage, 18.5%, was produced from Ontario-registered first generation seed.

Bacterial blight was found in trace amounts in only 3 of the 27 fields examined. Specimens of infected plant material were taken and the pathogens isolated and identified by laboratory methods. One field grown from Michigan breeder seed was infected with the fuscous blight pathogen, X. phaseoli var. fuscans. The other two fields, which were sown with Ontario-grown foundation seed, one of Saginaw and one of Sanilac, were infected with the common blight pathogen, X. phaseoli. Discrete loci of infection apparent in all three of the above-mentioned fields indicated that the infections were of seed-borne origin. It was not possible to make a comparison of the health status of Michigan and Ontario seed with regard to bacterial blight as a result of the small amount of infection observed in the 1964 bean crop.

Sunscald and moderate to severe damage to the foliage by the green clover worm, Plathypena scabra Fabr. were general throughout the area examined. The development of both sunscald and the heavy infestation of the green clover worm were favoured by the climatic conditions in the area. One of the fields of Saginaw infected with bacterial blight was also infected with sclerotinia wilt.

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[1]Plant Pathologists, Plant Research Institute, Research Branch, Canada Agriculture, Ottawa, Ontario.

SURVEY OF WHITE BEAN FIELDS IN 1964

R. N. Wensley[1]

Four surveys were made of white bean fields in southwestern Ontario in July and August of 1964 in response to numerous reports of leaf disorders and defoliation. As of July 22, however, the condition of beans was generally excellent with luxuriant growth and freedom from disease. At this date reports of retarded growth and foliage breakdown emanated only from drought areas and here, the problems were quickly corrected by subsequent rainfall. Spraying for manganese deficiency on several farms was clearly ineffective.

Drought during June was a major factor in most of the early problems found in some areas. The date of planting relative to this period and to a subsequent period of continuous wet and cool weather during July and August and into September appreciably influenced the condition of white beans. In late of August and September foliage deterioration and defoliation became prevalent. Neither pod production nor ripening occurred normally in affected areas.

Affected areas, however, were confined mainly to depressions and low-lying fields in which drainage was inadequate. This association of conditions was clearly observed on August 12 when margins of surface water from overnight rain were found to coincide with outlines of areas showing foliage deterioration and defoliation. The sensitivity of white beans to excess soil moisture was shown by relatively normal development of plants above and at either side of tile drains as compared to near complete defoliation of plants between drains in one low-lying field. In other fields the influence of natural drainage was readily recognized.

In affected areas excess water undoubtedly profoundly disturbed soil processes and the absorption of nutrients by plants. Interference with the process of nitrification and assimilation of nitrogen and other nutrients was indicated by yellowing, tissue breakdown and browning of leaves and ultimately defoliation. These disorders predominated among others attributed mainly to bacterial blights.

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

1964 PEA DISEASE SURVEY IN THE OTTAWA AREA

V. R. Wallen[1]

Powdery mildew was the most important disease on field peas on the Central Experimental Farm and adjacent areas this past summer. This disease, caused by Erysiphe polygoni DC., increased considerably near maturity of the pea crop. All fields examined were slight to moderately infected. The variety Arthur appeared to be more susceptible than Century or Chancellor as all plants in a one-acre plot were moderately infected. As the disease incidence was low during most of the growing season only a slight drop in yield could be expected. The disease intensity in Century and Chancellor was much lower than in Arthur with about 1/10 of the plants affected to a slight degree.

Ascochyta blight (Mycosphaerella pinodes (Berk. & Blox.) Vest.) was present only on the variety Century. Although this disease infected only a few plants to a moderate degree, the susceptibility of this variety to blight is causing considerable concern to growers of field peas, particularly in Manitoba. Seed produced in that area is heavily infected with M. pinodes. Century first became popular because of its high yielding capacity and its resistance to leaf and pod spot (Ascochyta pisi Lib.). Ascochyta pisi was found infecting a few plants of Arthur, Chancellor and Century but the disease severity was low.

Pea rust (Uromyces fabae (Lib.) De Bary) caused a slight infection on the variety Arthur. Only a few plants were infected in localized areas in the field.

Although certain virus diseases were present on the three varieties Arthur, Century and Chancellor none caused any appreciable damage. Enation pea mosaic was present on a few plants of the varieties Chancellor and Century. Considerable pod damage resulted on affected plants. Pea streak was present on a few plants in a field of Arthur peas and pods had failed to fill out. Common pea mosaic infected two plants in a small plot of Arthur pea.

[1]Plant Research Institute, Research Branch, Canada Agriculture, Ottawa, Ontario.

NOTEWORTHY AND NEW RECORDS OF GRASS VIRUSES IN CANADA IN 1964

J. T. Slykhuis[1]

Re-isolation of wheat spot mosaic from wheat in Alberta

Wheat spot mosaic was first recognized in southern Alberta in 1952 when it was found to be caused by a virus transmitted by the mite *Aceria tulipae* (K.), the vector of wheat streak mosaic virus (WSMV) (3). In the field, plants infected with wheat spot mosaic virus (WSPMV) sometimes had a chlorotic speckling, and were usually more chlorotic than plants infected with WSMV alone. However, it was difficult to recognize its presence because the symptoms were often confused by various combinations of wheat streak mosaic, barley yellow dwarf, mildew, rust and other diseases. Since WSPMV has not been transmitted manually, transmission tests with individual mites were necessary to determine its presence and separate it from WSMV. However, it appeared to be frequently associated with WSMV and was isolated repeatedly with mites from diseased wheat between 1952 and 1955. Highly pathogenic isolates were difficult to maintain in culture and when experiments were temporarily discontinued in 1956-57, all cultures of WSPMV were lost. New isolates were readily obtained from field plants in 1958. These were cultured on wheat at Ottawa until 1960, but again the virus isolates were lost.

Although no virus similar to WSPMV has been reported by investigators in Kansas or any other areas in the U.S.A. where WSMV commonly occurs, we assumed that we could re-isolate it any time we wished from mosaic-diseased wheat in Alberta. To our dismay, we failed in our attempts to isolate it from plants collected in Alberta in 1962. More deliberate efforts were made to isolate it from plants collected in June, and from extensive collections in October 1963, but these also failed. Then, quite unexpectedly, we isolated it from mosaic-diseased wheat collected at Lethbridge by Dr. T.G. Atkinson in May, 1964. As though to taunt us, it eluded us in another attempt to isolate it from plants collected in July.

The isolates we now have from the May, 1964 collection, cause severe symptoms and require careful attention to maintain in culture on wheat. Less seriously affected hosts will be sought, and studies made on the characteristics of this elusive but destructive virus.

A. tulipae from wheat in Ontario were found to carry a factor similar to WSPMV causing a mild chlorotic mottle (5). This condition was found at Ottawa again in 1964.

High incidence of Agropyron Mosaic and low incidence of Soil-Borne Wheat Mosaic in Ontario.

In May, 1964, very few plants with symptoms of soil-borne wheat mosaic were identified in winter wheat in the counties of York, Simcoe, Huron, Middlesex or Perth where this disease has been common in other years. Conversely, Agropyron mosaic was found at the edges of most fields examined in the same areas. In some fields, 75% to 100% of wheat plants near diseased *Agropyron repens* (L.) Beauv. at the borders were affected.

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

The temperature during the early stages of growth in the fall can strongly influence the incidence of these diseases in winter wheat. Infection by the soil-borne wheat mosaic virus is favored by cool soil temperatures (near 10°C) for long periods when the plants are young. Conversely, Agropyron mosaic virus (AMV) spreads most readily in summer and may continue to spread in the autumn if temperatures are very warm (6). The mean temperature in southern Ontario for October, 1963, was 6°F above normal (1). These high October temperatures apparently had a major influence on the low incidence of soil-borne wheat mosaic and the high incidence of Agropyron mosaic observed in the wheat crops in 1964.

Wheat Streak Mosaic on Winter Wheat in Ontario

Winter wheat plants with mosaic symptoms were collected in southwestern Ontario in May, and manual transmission tests were done to verify the presence of viruses. The symptoms on test plants inoculated with juice from several diseased wheat plants found in a field near Clandeboye in Middlesex County differed from the symptoms on plants inoculated from other collections infected with Agropyron mosaic virus (AMV). Like known isolates of wheat streak mosaic virus (WSMV), the causal virus infected oats but not A. repens, and was transmitted by A. tulipae.

More diseased plants were collected from the field and again a virus similar to common isolates of WSMV was isolated. Cross protection tests with known isolates of AMV and WSMV and serological tests with antisera specific for each of these viruses have verified that the virus is identical with WSMV.

This is the first known observations of WSMV in Ontario. The question is, how did it get there? Was it carried in during the summer or fall of 1963 by wind-borne mites from winter wheat areas 900 to 1000 miles west, or is it established on perennial hosts in the area? To test the latter possibility, it is planned to seed plots of winter wheat in the area next spring to determine if the virus spreads during the summer.

Ryegrass Mosaic in British Columbia

Mosaic symptoms were found on ryegrass growing on roadsides near Ladner, B.C., in August. Transmission tests at Ottawa showed that a virus from the diseased ryegrass infected Lolium multiflorum L., L. perenne L. and oats, but not wheat, barley or rye. The disease appears to be similar to ryegrass mosaic found in Washington, U.S.A. (2) and England (5).

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PLANT RESEARCH INSTITUTE
CANADA DEPARTMENT OF AGRICULTURE
OTTAWA, ONTARIO.

SCREENING OF POTATO FUNGICIDES IN 1964[1]

L. C. Callbeck[2]

In 1964, the fungicides listed below were compared for efficiency in the control of potato late blight, *Phytophthora infestans* (Mont.) de Bary, in the Screening Test at Charlottetown, P.E.I.

1. Bordeaux mixture -- 8-4-80 formula, included annually as a standard treatment.

2. Calumet 20-E -- a liquid copper derived from nabam. 1.5 qt./ 80 gal. Calumet and Hecla Inc., Calumet, Michigan, U.S.A.

3. Copper 20-M -- a liquid copper derived from sodium dimethyl-dithiocarbamate. 1.5 qt./80 gal. Calumet and Hecla Inc., Calumet, Michigan, U.S.A.

4. Difolatan 80W -- N-(1,1,2,2,-tetrachloroethylsulfenyl)-cis-Δ-cyclohexene-1, 2-dicarboximide. 1.0 lb./80 gal. California Chemical (Canada) Limited, Oakville, Ontario.

5. Dithane M-45 -- zinc co-ordinated manganese ethylene-bisdithiocarbamate. Mn, 16%; Zn, 2%. 1.0 lb./80 gal. Rohm and Haas Company of Canada Limited, West Hill, Ontario.

6. Dodine -- n-dodecylguanidine acetate. 68 gm. + 1364 cc of a special oil/80 gal. Imperial Oil Enterprises Ltd., Sarnia, Ontario.

7. DuTer -- triphenyl tin hydroxide (20%). 0.75 lb./80 gal. Philips-Duphar, Amsterdam, Holland.

8. F-300 -- confidential product. 1.0 lb./80 gal. Green Cross Products, Montreal.

9. Hortocritt -- ethylene thiuram monosulfide. 2.5 lb./80 gal. S.I.A.P.A., Rome, Italy.

10. Manzate Aqueous -- a slurry of manganese ethylene bis-dithiocarbamate. 1.0 U.S.A. qt./80 gal. DuPont of Canada Limited, Montreal.

11. Manzate D -- maneb powder containing zine sulphate in physical mix. 1.0 lb./80 gal. DuPont of Canada Limited, Montreal.

12. Miller 658 -- copper-zinc-chromate. 3.0 lb./80 gal. Miller Chemical and Fertilizer Corporation, Baltimore, U.S.A.

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[1]Contribution No. 140, Experimental Farm, Research Branch, Canada Department of Agriculture, Charlottetown, Prince Edward Island.

[2]Plant Pathologist.

13. NIA 11130 -- a confidential product. 1.0 lb./80 gal. Niagara Brand Chemicals, Burlington, Ontario.

14. Organil 66 -- a confidential product. 1.0 lb./80 gal. Procida, Neuilly sur Seine, France.

15. Polyram 80W -- zinc activated polyethylene thiuram disulfide. 1.0 lb./80 gal. Niagara Brand Chemicals, Burlington, Ontario.

The plots were planted on June 1, exactly 50 seed pieces of the Green Mountain variety being dropped in each 50-foot row. Each plot was 50 feet long x 4 rows wide and 16 plots, being one for each fungicide and an unsprayed control, were set out in each of 5 ranges. Single rows of potatoes were planted as borders and buffers. These rows were not sprayed, their function being to equalize the epidemic over the area.

Seven applications of the fungicides were made between July 15 and September 10, the mean interval being 9.5 days. They were applied with a tractor-sprayer unit which delivered approximately 120 gallons per acre at a pressure of 375 pounds per square inch. The boom was fitted with 4 nozzles per potato row, 2 being above the plants and 2 spraying from drop pipes. Insects were controlled by spraying all rows with Thiodan, three applications being made in the season.

The season of 1964 produced very high yields of potatoes on Prince Edward Island and, in the twenty-two years that this investigator has been conducting the experiments on late blight disease, the highest plot yields were recorded. On the other hand, it was not a favourable season for working with the blight fungus, the cool weather and the few periods of high relative humidity that characterized the season retarding its development and spread.

Because of the scarcity of natural infection, it was necessary to resort to the application of water suspensions of spores to the plants. A light sprinkling of spores was made over the buffer rows on July 22 but no lesions developed. The procedure was repeated on August 6 but only three lesions were found on the 12th. Similar attempts were made, some being in the evenings, on August 15, 18, 23, 25, 26, September 2, 6.

Even with the persistent inoculations, the disease built up very slowly, the five unsprayed check plots showing only a 20 per cent defoliation at the end of the first week of September, at which time the Dodine and Copper 20-M plots had defoliation means of 9 and 10 per cent respectively and other plots showed mere traces of disease. By September 14 only 40 per cent of the foliage in the check plots was infected, whereas in 1963 these plants were dead several days earlier.

Under the conditions of the test, all but four of the fungicides gave satisfactory control of disease on the foliage. Two fungicides performed rather badly, Dodine, in particular, having almost no merit. Of the two liquid coppers, it is interesting to note the disparity that occurred, the plots sprayed with Calumet 20-E having a mean disease reading of 16

Table 1. Percentage Defoliation (Means of Five Plots).

Treatment	Sept. 14	Sept. 21	Sept. 25
Hortocritt	T	1	3
Organil 66	T	1	4
Manzate D	T	1	5
Manzate (Aqueous)	T	1	6
Polyram	T	2	6
DuTer	T	3	6
Dithane M45	1	2	7
Difolatan	1	4	7
NIA 11130	T	2	8
F-300	T	3	8
Bordeaux	1	4	8
Miller 658	3	6	13
Calumet 20-E	2	5	16
Copper 20-M	15	30	55
Dodine	18	38	75
Check	40	82	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
Difolatan	641.4	21.1	3.1	616.9	0.5
Manzate (Aqueous)	651.2	31.7	9.2	610.3	1.4
Polyram	644.2	24.6	10.6	609.0	1.6
Organil 66	655.2	26.0	25.1	604.1	3.8
DuTer	632.3	27.7	7.5	597.1	1.2
F-300	644.6	29.0	19.4	596.2	3.0
Manzate D	640.2	28.6	22.4	589.2	3.5
Miller 658	631.8	29.0	15.4	587.4	2.4
Bordeaux	623.0	30.3	7.5	585.2	1.2
Dithane M-45	638.9	27.7	26.0	585.2	4.1
NIA 11130	627.9	34.3	10.6	583.0	1.7
Hortocritt	627.9	29.0	18.5	580.4	2.9
Calumet 20-E	620.8	29.0	19.4	572.4	3.0
Copper 20-M	587.4	31.2	52.4	503.8	8.9
Dodine	559.2	38.7	37.8	482.7	6.8
Check	538.5	34.3	43.1	461.1	8.0
S.D. 5%	33.1			35.3	2.5
S.D. 1%	44.0			47.0	3.3

*Arranged in descending order of No. 1 tuber yields.

per cent on the end date while those sprayed with Copper 20-M had a mean of 55 per cent. These copper products were prepared respectively from disodium ethylene bisdithiocarbamate and sodium dimethyldithiocarbamate. Earlier studies have shown that ethylene salts are superior to dimethyl salts in this region. This recognized difference may account for one reason (there could be others) for the differences in foliage blight control between 20-E and 20-M in the 1964 test.

The test was terminated by the application of a sodium arsenite top killer on September 25, 116 days after planting. The tubers were dug, graded, examined for disease, and weighed on October 13, 14.

EXPERIMENTAL FARM,
RESEARCH BRANCH, CANADA AGRICULTURE,
CHARLOTTETOWN, P.E.I.

CO-OPERATIVE SEED TREATMENT TRIALS - 1964[1]

J.E. Machacek and H.A.H. Wallace[2]

Twenty-six seed treatment materials were tested in 1964 against common bunt of wheat (Mixed *Tilletia foetida* (Wallr.) Liro and *T. caries* (DC.) Tul.), oat smut (mixed *Ustilago avenae* (Pers.) Rostr. and *U. kolleri* Wille), covered smut of barley (*U. hordei* (Pers.) Lagerh.), and against seed rot of flax caused by a complex of soil-borne and seed-borne micro-organisms.

Materials and Methods

Kinds of seed used in trials

Wheat bunt trials - Variety Red Bobs. Seed artificially contaminated (1:200, by weight) with mixed spores of *T. foetida* and *T. caries*.

Oat smut trials - Variety Vanguard. Seed naturally contaminated by loose and covered smut.

Barley smut trials - Variety Plush. Seed naturally contaminated by covered smut.

Flax seed-rot trials - Variety Marine. About 50.0% of seeds cracked during threshing.

Fungicides

The 26 seed treatment materials received for testing and brief statements concerning their nature and source are listed below.

1/ Contribution No. 173 from the Canada Department of Agriculture Research Station, Winnipeg, Manitoba.

2/ Plant Pathologists.

Treatment No.	P.C.P. No.	Description of Products
1		Check — Seed not treated.
2	2521	A powder containing 3.2% mercury as ethylmercuric p-toluene sulfonanilide. E.I. du Pont de Nemours, Wilmington, Delaware.
3		A powder containing hexachlorobenzene and captan. Green Cross Products, Montreal, Quebec.
4		A powder containing 50.0% tetrachloronitroanisole obtained from Pittsburgh Plate Glass Company. Mooretown, New Jersey.
5		A powder containing 20.0% captan and 20% hexachlorobenzene. Ortho Agricultural Chemical (Canada) Limited, New Westminster, B.C.
6		A powder containing 35.0% p-dimethylaminobenzenediazo sodium sulfonate and 35.0% trichlorodinitrobenzene. Chemagro Corporation, Kansas City, Missouri.
7		A powder containing 70.0% trichlorodinitrobenzene. Chemagro Corporation, Kansas City, Missouri.
8, 9	6767	A powder containing 75.0% captan. Ortho Agricultural Chemical (Canada) Limited, New Westminster, B.C.
10	4677	A liquid containing 3.7 oz./Imp. gal. methylmercuric dicyandiamide (2.5 oz. mercury equivalent). Morton Chemical Company, Woodstock, Illinois.
11, 12	8566	A liquid containing 2.25% mercury as mixed methylmercuric - 2, 3, - dihydroxypropyl mercaptide and methylmercuric acetate. E.I. du Pont de Nemours, Wilmington, Delaware.
13, 14	5725	A liquid containing 2.30% mercury as ethylmercuric-2, 3 - dihydroxypropyl mercaptide and ethylmercuric acetate. E.I. du Pont de Nemours, Wilmington, Delaware.

Treatment No.	P.C.P. No.	Description of Products
15, 16	8782	A liquid containing 1.53% mercury as methylmercuric-2, 3 - dihydroxypropyl mercaptide and methylmercuric acetate. Green Cross Products (Sherwin-Williams), Montreal, Quebec.
17		A liquid containing 2.36 oz./Imp. gal. mercury as methylmercuric dicyandiamide. Chipman Chemicals Ltd., Winnipeg, Manitoba.
18	6750	A liquid containing 2.36 oz./Imp. gal. mercury as methylmercuric dicyandiamide. Chipman Chemicals Ltd., Winnipeg, Manitoba.
19	7284	A liquid combination fungicide-insecticide containing 0.89 oz./Imp. gal. mercury as methylmercuric dicyandiamide and 2.5 lbs./Imp. gal. heptachlor. Chipman Chemicals Ltd., Winnipeg, Manitoba.
20	8239	A liquid containing 4.2% mercury as methylmercuric-oxime. Seventy Seven Oil Co. Ltd., Lethbridge, Alberta.
21	8542	A liquid containing 7.8 oz./gal. of mercury as methylmercuric dicyandiamide. Seventy Seven Oil Company, Ltd., Lethbridge, Alberta.
22	8246	A liquid containing methylmercuric benzoate 4.2 oz./Imp. gal. (Mercury equivalent 2.5 oz. /Imp. gal.). Morton Chemical Company, Woodstock, Illinois.
23	8428	Liquid combination fungicide-insecticide containing methylmercuric dicyandiamide 0.77% (Mercury equivalent 0.5%), and 2 1/3 lbs. Aldrin per Imp. gal. Morton Chemical Company, Woodstock, Illinois.
24	8708	A liquid containing mercury of undisclosed composition. Morton Chemical Company, Woodstock, Illinois.
25		A liquid containing methylmercuric p-toluene sulfonate 2.89% (1.5% mercury). Morton Chemical Company, Woodstock, Illinois.

Table 1. Co-operative Seed Treatment Trials - 1964 (Summary of Data from 4 Stations for Wheat, 7 Stations for Oats, 9 Stations for Barley, 9 Stations for Flax).

Treat-ment No.	Treatment	Dose (oz./bu.)				Smut (%)			Germ-ination %
		Wheat	Oats	Barley	Flax	Wheat	Oats	Barley	Flax
1	Check (dry, untreated seed)	0.00	0.00	0.00	0.00	5.69	9.69	14.13	66.3
2	Ceresan M	0.50	0.50	0.50	1.50	0.00	0.00	0.13	64.1
3	Green Cross 3944 X	1.00	1.00	1.00	2.00	0.00	0.30	0.10	60.0
4	TCNA (50%)	0.50	0.50	0.50	1.50	0.03	7.63	14.04	53.0
5	Orthocide 20-20	2.00	2.00	2.00	4.00	0.00	3.32	1.85	66.6
6	Dexon-Chemagro	1.00	1.00	1.00	2.00	0.00	0.02	2.54	60.8
7	Chemagro 2635	0.50	0.50	0.50	1.50	1.31	0.68	2.75	50.2
8	Orthocide 75	0.50	0.50	0.50	1.50	0.38	4.87	1.96	67.1
9	Orthocide 75	1.00	1.00	1.00	2.00	0.94	2.61	0.83	69.5
10	Panogen 15	0.75	0.75	0.75	1.50	0.00	0.00	0.28	71.2
11	Ceresan L	0.50	.50	0.50	1.00	0.03	0.00	0.31	72.8
12	Ceresan L	0.75	0.75	0.75	1.50	0.00	0.04	0.14	69.0
13	Ceresan 100	0.50	0.50	0.50	1.00	0.00	0.02	0.49	67.9
14	Ceresan 100	0.75	0.75	0.75	1.50	0.00	0.00	0.39	63.5
15	Liquisan 10 L	0.50	0.50	0.50	1.00	0.13	0.09	0.71	68.2
16	Liquisan 10 L	0.75	0.75	0.75	1.50	0.00	0.11	0.29	68.9
17	Agrosol	0.75	0.75	0.75	1.50	0.00	0.00	0.28	69.4
18	Agrosol (standard)	0.75	0.75	0.75	1.50	0.00	0.00	0.31	68.8
19	Mergamma Liquid	2.00	2.00	2.00	4.00	0.00	0.00	0.29	64.6
20	Seventy-seven* P.C.P. 8239	0.75	0.75	0.75	1.50	0.03	0.16	0.21	66.5
21	Seventy-seven* P.C.P. 8542	0.75	0.75	0.75	1.50	0.00	0.00	0.25	70.0
22	E.P. 209	0.75	0.75	0.75	1.50	0.28	0.00	0.11	70.6
23	E.P. 219	2.12	2.12	2.12	4.00	0.00	0.02	0.17	64.4
24	E.P. 228	0.75	0.75	0.75	1.50	0.13	0.00	0.13	68.7
25	E.P. 254	0.75	0.75	0.75	1.50	0.06	0.04	0.08	70.2
26	Drinox H34	2.00	2.00	2.00	4.00	11.53	11.71	12.86	54.2
27	Drinox H34B	2.00	2.00	2.00	4.00	15.94	10.21	12.59	58.7
28 a	Pentadrin	2.00	--	--	--	0.03	--	--	--
28 b	Green Cross 3958	--	2.00	2.00	4.00	--	9.41	8.71	59.8
29	Pandrinox	2.00	2.00	2.00	4.00	0.25	0.04	0.13	67.2
30	Panogen CS*	0.75	0.75	.75	1.50	0.03	0.04	0.11	66.3
Least Sign. Difference						4.26	2.90	3.58	4.0

* Dilute with water (one part concentrate with 2 parts water).

Treatment No.	P.C.P. No.	Description of Products
26	8130	A liquid insecticide containing heptachlor 2.5 lb./Imp. gal. Morton Chemical Company, Woodstock, Illinois.
27	6521	A liquid insecticide containing heptachlor 2.5 lb./Imp. gal. Morton Chemical Company, Woodstock, Illinois.
28 (a)	8034	A liquid fungicide-insecticide containing 1.6 lb./Imp. gal. pentachloronitrobenzene and 2.6 lb./Imp. gal. heptachlor. Morton Chemical Company, Woodstock, Illinois.
28 (b)		A powder containing 15% RD 8684 (a non-mercurial fungicide). Green Cross Products (Sherwin-Williams), Montreal, Quebec.
29	7208	A liquid fungicide-insecticide containing methylmercuric dicyandiamide 1.33 oz./Imp. gal. (0.89 oz./gal. mercury equivalent), and 2.63 lb./ Imp. gal. heptachlor. Morton Chemical Company, Woodstock, Illinois.
30	4790	A liquid containing methylmercuric dicyandiamide 11.7 oz/Imp. gal. (7.8 oz./ Imp. gal. mercury equivalent). Morton Chemical Company, Woodstock, Illinois.

Experimental Results

The field data collected in 1964 are summarized in Table 1. The insecticides Drinox #34 and Drinox #34B significantly increased bunt of wheat, had no effect on barley and oat smuts, and significantly decreased germination of wheat and flax. Chemagro 2635 and Orthocide 75 gave moderate control of all smuts. Chemagro 2635 decreased germination of wheat and flax, but Orthocide 75 tended to increase germination. TCNA (50%) and Green Cross 3958 were unsatisfactory for oat and barley smut and were injurious to seed germination of wheat and flax. Green Cross 3944X gave excellent control of all smuts, and Orthocide 20 - 20 was very effective against bunt of wheat, and gave excellent germination of wheat and flax. These two non-mercurials indicate that the present use of hazardous mercurials could be replaced by safer to handle fungicides.

Acknowledgements

The writers wish to thank the following for conducting tests and recording field results during 1964: Dr. D.C. Arny, University of Wisconsin, Madison, Wis.; Mr. H.R. Ballantyne, C.D.A. Experimental Farm, Melfort, Sask.; Mr. J.E. Campbell, C.D.A. Experimental Farm, Charlottetown, P.E.I.; Dr. W. Crosier, Agr. Exp. Station, Geneva, N.Y.; Dr. S.G. Fushtey, Ontario Agr.

College, Guelph, Ont.; Mr. D.G. Faris, C.D.A. Experimental Farm, Beaverlodge, Alta.; Dr. T.G. Atkinson, C.D.A. Research Station, Lethbridge, Alta.; Dr. M.L. Kaufmann, C.D.A. Experimental Farm, Lacombe, Alta.; Dr. R.O. Lachance, Faculty of Agriculture, Laval University, Quebec City, Quebec, Mr. K.B. Last, Genetics and Plant Breeding Research Institute, Ottawa, Mr. D.S. McBean, C.D.A. Experimental Farm, Swift Current, Sask.; Dr. M.B. Moore, Institute of Agriculture, University of Minnesota, St. Paul, Minn.; Dr. L.H. Purdy, Regional Smut Research Lab., State College, Pullman, Wash.

CANADA AGRICULTURE, RESEARCH STATION,
WINNIPEG, MANITOBA.

SEED POTATO CERTIFICATION IN CANADA IN 1964

D. S. MacLachlan[1]

Introduction

The total acreage of seed potatoes passed in 1964 was approximately 53,000 which represents a reduction of nearly 3,000 acres from the previous year. In spite of this reduction in acreage, production increased to 9.5 million cwt., which represents an increase of approximately one quarter million hundredweight over 1963. Weather conditions at planting time were not ideal in various locations, particularly in Prince Edward Island. The late spring was followed by cool dry weather and if it had not been for two months of good growing weather in July and August, there would have been a considerable reduction in yield. Harvesting conditions in the Maritime provinces were generally good, but in Ontario and the western provinces rainy weather and heavy frost caused considerable damage. Tables 1 and 2 present data relevant to production and the principal diseases encountered.

Table 1. Summary of acres passed by variety and province

Variety	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Totals
Sebago	16,294	12	654	46	311	5			17	17,339
Kennebec	4,191	92	8,577	762	399	644		9	123	14,797
Netted Gem	58	25	3,041		25	923	75	1,064	877	6,088
Katahdin	251	4	4,703	173	68				1	5,200
Red Pontiac	19	22	2,043		27	121		20		2,252
Irish Cobbler	1,611	16	116	38	52	160		11		2,004
Green Mountain	714	7	63	1,099	4				15	1,902
Norland			14		37	811	104	62	51	1,079
Keswick	87	12	276	98	56					529
Hunter	135	13	338				1			487
Cherokee	213	20	70	15	43			3		364
Warba	33	5	2		3	49	11	92	55	250
Avon	72	8	43	4	3					130
Fundy	30	23	36		11		1		2	103
Chippewa	1		9		70					80
Pungo	44		15	10						69
Waseca						38	5		3	46
White Rose									31	31
Early Epicure									29	29
Pontiac							3		21	24
Columbia Russett						1	17		5	23
Others	19	7	2	10	2	14	22	10	19	105
1964 Totals	23,772	266	20,002	2,255	1,111	2,766	239	1,271	1,249	52,931
1963 "	27,303	271	20,131	1,979	653	1,967	318	1,475	1,510	55,607
1962 "	23,318	362	16,504	2,030	769	2,576	329	1,444	1,507	48,840
1961 "	27,944	462	14,194	2,666	952	1,723	333	1,440	2,099	43,133

[1]Chief, Seed Potato Section, Plant Protection Division, Production and Marketing Branch, Canada Agriculture, Ottawa, Ontario.

Table 2. Fields rejected on field inspection, 1964.

Province	Leaf Roll	Mosaics	Bacterial Ring Rot	Black Leg	Fungus Wilts	Spindle Tuber	Adjac. to Diseased Fields	Misc.
P. E. I.	11	87	7	271	15	26	13	92
N. S.	2	0	0	1	0	0	0	0
N. B.	2	20	75	7	6	21	5	23
Que.	0	93	101	78	0	1	18	7
Ont.	13	4	3	17	14	0	4	9
Man.	1	0	7	2	4	0	1	0
Sask.	3	1	0	3	0	0	0	3
Alta.	1	0	2	0	0	0	0	8
B.C.	3	2	0	1	1	0	0	24
Totals	36	207	195	380	40	48	41	166

Principal Disease Problems

Black leg (*Erwinia atroseptica*) was the principal cause of rejection of fields in 1964. Infection with black leg was undoubtedly increased because of the cool, damp spring. Germination in many areas was poor and in some cases was below 50 per cent. The incidence of bacterial ring rot (*Corynebacterium sepedonicum*) decreased in 1964 although it remained the principal cause of rejection of fields in Quebec and New Brunswick. The decreased incidence was particularly evident in Prince Edward Island where there were only seven positive cases diagnosed as compared with twenty-two the previous year. Bacterial ring rot was not found in Nova Scotia, Saskatchewan and British Columbia.

Mosaics were the principal cause of rejections among the virus diseases. In general, the incidence of mosaics was quite low, and in most fields rejected the mottle was not pronounced. Undoubtedly most of the mosaic was due to infection with strains of Virus X. There was a general reduction in the amount of leaf roll found in seed potato fields in 1964. This disease continues to cause problems in seed potato production in British Columbia, but a testing program, and the supplying of leaf-roll-free seed to better growers has resulted in a marked reduction in the incidence of leaf roll in the potato growing areas of that province. Early top killing is also being practised by many of the better growers in British Columbia and this again has served to reduce the incidence of leaf roll. Spindle tuber caused the rejection of a number of fields in Prince Edward Island and New Brunswick, but apparently it is either masked or does not occur to any great extent in Ontario, Quebec or the western provinces.

Verticillium wilt (*Verticillium albo-atrum*) was again of particular significance in Ontario. Most of the infections recorded are in the variety Kennebec which is now being grown extensively for the production of crops for processing. It is not possible yet to determine to what extent the verticillium infections result from the planting of infected seed. There is evidence that at least a few fields have become infected through infected seed, but in general it appears that infection occurs through contaminated soil. This contamination of the soil has resulted primarily from a failure on the part of some of the growers to use proper rotation.

It was feared that late blight (Phytophthora infestans) infection might be general through the potato growing area in 1964. However, generally cool temperatures apparently prevented sporulation in the field, and as a result most outbreaks of the disease were controlled and there is little evidence of tuber infection. There were isolated areas in Quebec and Nova Scotia where late blight did cause a considerable amount of damage.

PLANT PROTECTION DIVISION,
PRODUCTION AND MARKETING BRANCH,
CANADA AGRICULTURE,
OTTAWA, ONTARIO.

A FURTHER REPORT ON VARIATIONS IN VARIETAL SUSCEPTIBILITY TO RED STELE IN STRAWBERRY FIELDS OF OF COASTAL BRITISH COLUMBIA

Hugh A. Daubeny[1] and H. S. Pepin[2]

In 1962, Daubeny and Pepin (1) reported that the incidence of red stele, caused by Phytophthora fragariae Hickman, in strawberry fields of coastal British Columbia was widespread. Since that time, additional outbreaks of the disease have been noted. Particular attention has been paid to incidences of the disease in test plantings of three new varieties, Columbia, Cascade and Molalla, at various locations throughout the area. Two of these varieties, Columbia and Molalla, had been released as showing some resistance to red stele (2). It had been thought that either or both varieties might show greater resistance to red stele than Siletz, which has been the standard for resistance in the Pacific Northwest (1).

In 1962, the three new varieties were planted in various fields throughout the southwest coastal area of British Columbia. Examinations for red stele were made in 1963 and again in 1964. The reaction of Columbia, Cascade, or Molalla to the disease was compared to the reaction of Siletz, Northwest, British Sovereign, or Puget Beauty in the various fields (Table 1).

Table 1. Variations in varietal susceptibility to red stele in different strawberry fields of coastal British Columbia

Variety	Field[1]					
	A	B	C	D	E	F
Columbia	R	S	R	S	S	Sl
Cascade	-	S	S	-	S	S
Molalla	R	-	R	-	S	R
Siletz	R	S	R	R	S	R
Northwest	S	S	S	-	S	S
British Sovereign	-	S	S	S	S	S
Puget Beauty	R	S	R	-	S	R

R = Resistant S = Susceptible Sl = Slightly susceptible

[1]Location of fields: A - Bradner; B - Bradner; C - Yarrow; D - Lulu Island; E - Lulu Island; F - Saanichton Experimental Farm.

[1]Research Branch, Canada Department of Agriculture, Experimental Farm, Agassiz, B.C.

[2]Research Branch, Canada Department of Agriculture, Research Station, Vancouver, B.C.

Siletz and Molalla showed identical reactions to red stele in the fields where both varieties were grown (Table 1). Columbia was susceptible and slightly susceptible, respectively, in two fields in which Siletz and Molalla were each classed as resistant. Except for field F, Columbia showed a reaction similar to Puget Beauty in each field where the two varieties were tested. Like Northwest and British Sovereign, Cascade was susceptible to red stele in each of the fields in which it was tested.

The presence of different races of P. fragariae is indicated by variations in varietal reaction. It is obvious that fields A and E contain one or more races different from the races in fields B, C, D, or F. It is quite possible that further variations in varietal susceptibility would be indicated by testing additional varieties or by increased sampling. Work is now underway to determine the actual race or races of P. fragariae present in each of the fields by isolating the organism and subsequently testing its reaction against a standard set of indicator varieties as described by Pepin and Daubeny (2).

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EXPERIMENTAL FARM,
RESEARCH BRANCH, CANADA AGRICULTURE,
AGASSIZ, BRITISH COLUMBIA.

and

CANADA AGRICULTURE RESEARCH STATION,
6660 N. W. MARINE DR.,
VANCOUVER, BRITISH COLUMBIA.

DEVELOPMENT OF WHEAT STREAK MOSAIC IN SOUTHERN ALBERTA DURING 1964

T. G. Atkinson and M. N. Grant[1]

Abstract

Wheat streak mosaic was general on winter wheat in the eastern half of the winter wheat growing area of southern Alberta and many severely diseased fields were cultivated out. However, cool temperatures and ample moisture favoured the vigorous growth and development of winter wheat and prevented maximum disease expression. As a consequence, satisfactory yields were obtained from many fields that would have been seriously damaged under less favourable growing conditions. The failure of populations of the vector to build up also minimized losses by reducing secondary spread. Observations indicated that fall rye may serve as a reservoir of the virus.

Introduction

During the fall of 1963 a severe outbreak of wheat streak mosaic developed in the eastern half of southern Alberta's winter wheat growing area. A previous report (1) presented the results of fall surveys and described the unique sequence of weather events that contributed to the occurrence and determined the localization of this unusual epiphytotic.

The effect of weather on the development of the disease during the spring and summer of 1964 is given in this follow-up report.

Development of the disease in 1964

Winter survival

Although many fields of early-seeded winter wheat were severely damaged by the disease prior to freeze-up in 1963, very few were cultivated out before spring because of the danger of soil drifting. The mean temperature at Lethbridge from November 1963 to March 1964 inclusive, was 26.0°F or 2.6° higher than the 62-year average. Because of the relatively mild weather, winter survival of these severely affected crops was higher than would normally have been expected.

Spring surveys

The widespread and unusually pronounced streak mosaic symptoms that developed during the fall of 1963 forewarned farmers and agricultural extension workers of the problems to be faced the following spring. From mid-April through mid-May, 1964, district agriculturists in the affected area inspected hundreds of fields at the request of growers. Reports giving the location and disease severity of the crops inspected were supplied to us by the six district agriculturists located in and adjacent to the major winter wheat growing area.

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[1]Plant Pathologist and Cerealist, respectively, Canada Agriculture Research Station, Lethbridge, Alberta.

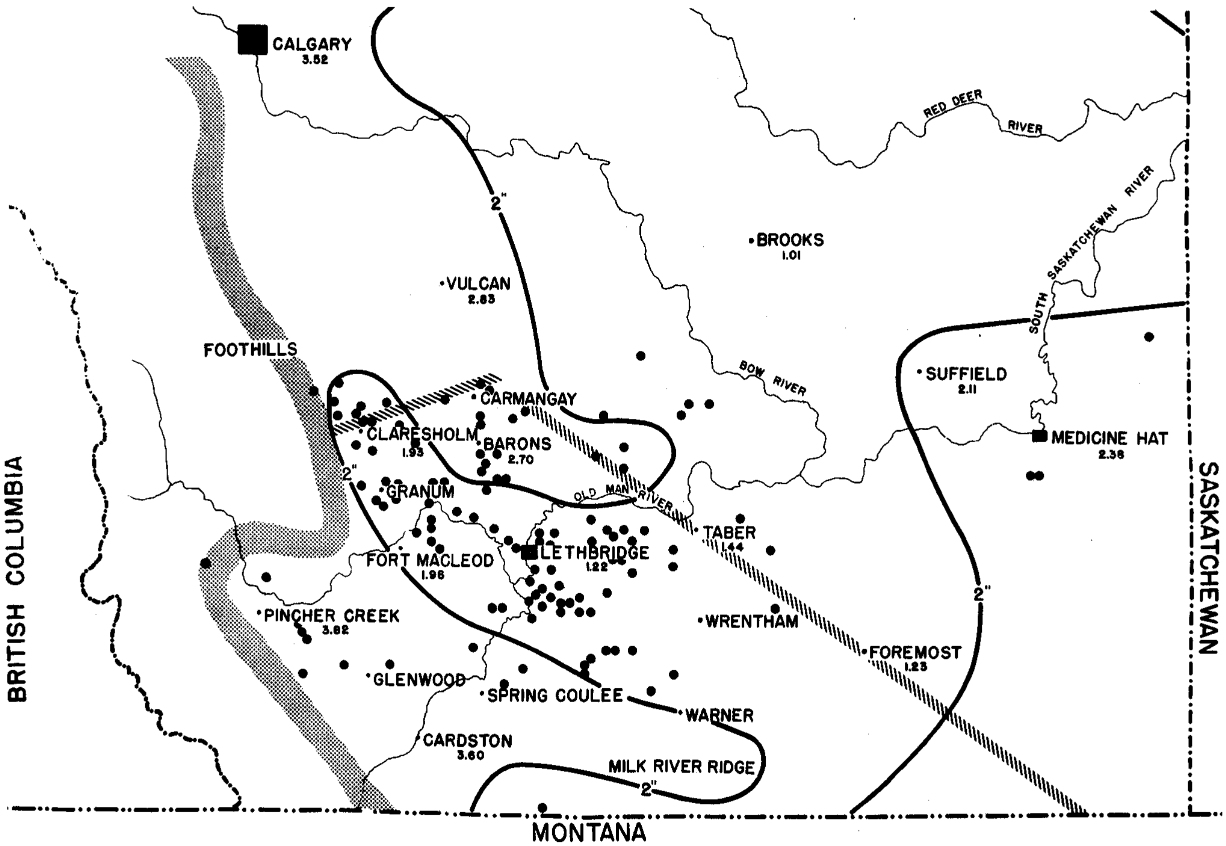

Fig. 1 Distribution of winter wheat fields that showed severe or moderate streak mosaic symptoms in April and May 1964. Winter wheat production is general below the cross-hatched line but diseased crops were most prevalent east of the ischyet, where rainfall from April 1 to June 17 in 1963, totalled less than two inches.

Fig. 2 Winter wheat sown on August 24, 1963, showing severe streak mosaic symptoms on May 28, 1964.

Fig. 3. Mature crop of winter wheat sown on September 3, 1963, showing sparse and stunted growth resulting from severe streak mosaic infection.

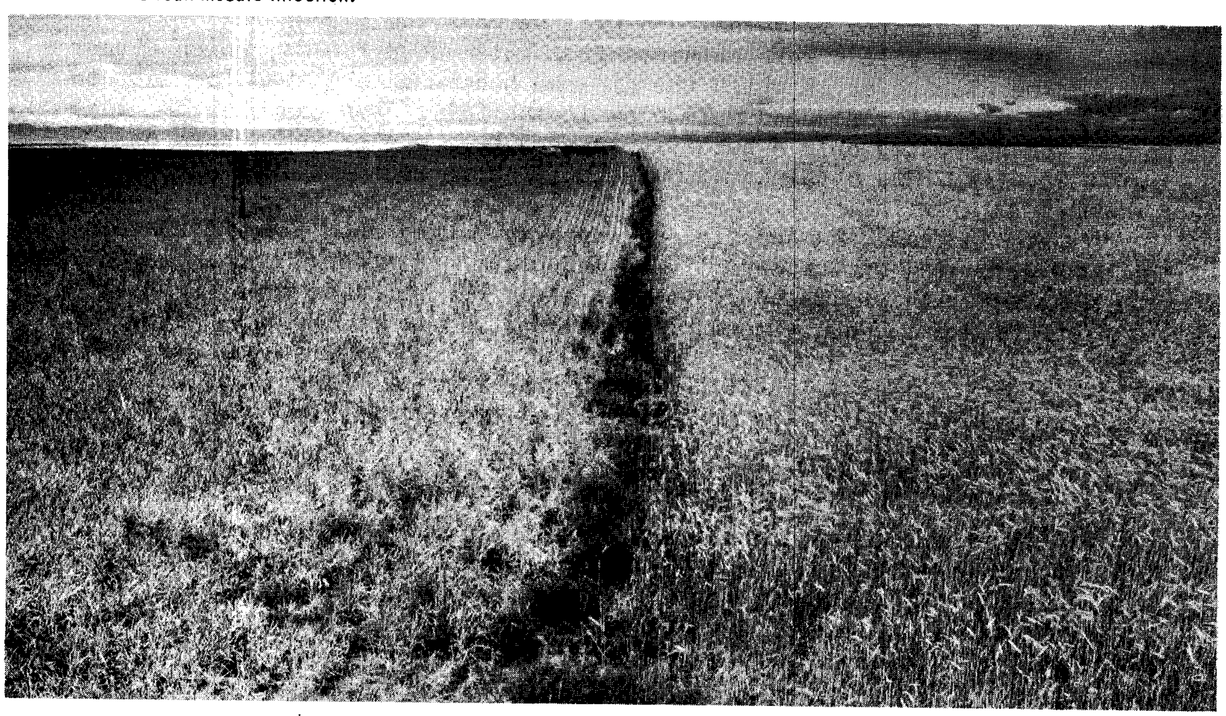

Fig. 4 Streak mosaic symptoms developing on spring wheat (left), adjacent to fall rye, July 15, 1964.

The locations of winter wheat fields visited by the district agriculturists and classified either as 'severe' or 'moderate' are shown on the accompanying map (Fig. 1). These data confirm our earlier report (1) and re-emphasize the major role that the 1963 weather played in determining the localization of the outbreak. The larger number of diseased fields shown in the eastern than in the western half of the winter wheat growing area accurately represents the relative incidence of streak mosaic and is not due to a heavier concentration of winter wheat in the eastern zone.

Effect of the disease on yield

The degree to which streak mosaic reduced winter wheat yields in 1964 depended primarily on the extent to which the disease had progressed within individual fields the previous fall. This, in turn, was largely determined by date of seeding.

By early May many fields of winter wheat that had been sown in August or early September had taken on the uniformly yellowed appearance that most had displayed the previous fall. Most of these crops were cultivated out and the fields resown to flax, oats, barley or, in some cases, to spring wheat. The few fields of severely diseased wheat that were left growing illustrated the destructiveness of the disease.

The field of severely diseased winter wheat shown in Fig. 2 was sown on August 24, 1963. This 100-acre field yielded 5 bushels per acre. Another field sown on September 3 averaged 7 bushels per acre (Fig. 3). Several other fields that obviously were going to yield little grain were cut for green feed.

Many fields of winter wheat, however, yielded unexpectedly well considering the numbers of diseased plants they contained. For example, a field of registered winter wheat sown on September 6 yielded 26 bushels per acre of cleaned seed. When this field was sampled on May 26, 1964, 19% of the plants were yellow and very stunted, 36% had less severe but distinct wheat streak mosaic symptoms, while only 45% appeared free of the disease. The effect of wheat streak mosaic on the yield of winter wheat in this field was investigated in detail and will be reported elsewhere.

The best yields were obtained from later-sown fields, which either escaped the disease or in which the disease became established too late to cause general and pronounced yellowing in the fall. For example, the same farmer who harvested only 5 bushels per acre from winter wheat sown on August 24, (Fig. 2), obtained 35 bushels per acre from a nearby crop sown on September 12.

Yields from diseased fields generally ranged from 5 to 25 bushels per acre depending on the severity of infection and general growing conditions. This compares with yields of 30 to 40 bushels per acre for crops free of wheat streak mosaic, and exceptional yields of 55 to 60 bushels per acre. These yields, far above the 10-year average of 22.34 bushels per acre on fallow at Lethbridge (U. J. Pittman, personal communication), reflect the excellent growing conditions that prevailed for winter wheat during 1963-64.

Factors affecting development of the disease in 1964

The wheat streak mosaic epiphytotic, which began in the fall of 1963, did not reach its full potential because of two subsequent developments. These were the cool, moist spring of 1964 and the conspicuous absence of large populations of the mite vector, *Aceria tulipae* Keifer, throughout both spring and summer.

The mean temperatures recorded at the Lethbridge Research Station for April, May, and June, 1964, of 40.7°, 50.5°, and 59.0° F were close to the 62-year average. Precipitation distributed throughout this same period totalled 9.17 inches, 44% higher than the long-term average. This combination of cool temperatures and ample rainfall favored the vigorous growth and development of winter wheat but did not allow maximum disease expression.

The 1953-54 winter wheat crop in Kansas was exposed to a similar sequence of events (3). A cool, moist spring was credited with minimizing wheat streak mosaic losses. Controlled temperature studies have also shown that the leaf symptoms and stunting effect of streak mosaic are poorly expressed at air temperatures of 60° F or lower (2).

We do not know why significant populations of the mite vector failed to build up during the spring and summer. Perhaps winter survival of the mite population was low and the cool, moist spring did not favor their rapid multiplication. Whatever the reason, the failure of the mites to multiply minimized disease losses by greatly reducing the spread of the virus both within and between fields.

Fall rye as a reservoir of streak mosaic

During the summer of 1964 conspicuous streak mosaic symptoms created yellow borders on several fields of spring wheat growing between alternate strips of fall rye in the Barons district (Fig. 4). To our knowledge, fall rye has not previously been considered important in carrying the virus and mites over winter. However, careful checking by both ourselves and Dr. J.T. Slykhuis failed to reveal any other likely source of the disease. Studies of the role that rye varieties may play in the epidemiology of streak mosaic in southern Alberta are in progress and will be reported later.

Streak mosaic outlook for 1965

There was no wheat streak mosaic outbreak in southern Alberta during the fall of 1964. In contrast to the situation a year earlier, few fields of winter wheat emerged before spring crops had ripened and volunteer wheat was not general. Drought from the last week of June to the end of August brought most crops to maturity during August. Most winter wheat, on the other hand, was sown during the latter half of September not only because rainfall during the first part of the month kept farmers off the land but also because most growers, aware of the streak mosaic danger, deliberately avoided early seeding. Although both mites and disease symptoms were found on volunteer wheat during the fall, serious streak mosaic damage is unlikely in 1965.

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CANADA AGRICULTURE RESEARCH STATION,
LETHBRIDGE, ALBERTA.

A PHYSIOLOGICAL BREAKDOWN IN BRUSSELS SPROUTS

A. R. Maurer[1]

Abstract

An internal breakdown of tissues caused serious losses in 1964 in commercial plantings of Brussels sprouts in the Fraser Valley of British Columbia. Wide and rapid fluctuations in day/night temperatures, as well as the chilling effect of low temperatures on certain nights, are considered to be most likely responsible for initiating the breakdown.

Symptoms

The breakdown occurred at the growing tip of the individual sprout or in the tightly-packed leaves immediately above the growing tip. The affected tissues were not exposed in any way to infection from outside. The sprouts in which breakdown had occurred were normal in appearance and damage could not be detected without dissection. The majority of the affected sprouts were physiologically mature and were located on the lower portion of the plant stem although occasional sprouts on the upper portion of the stem were affected.

The breakdown was similar in appearance to internal "tip burn" of cabbage for which no control measures are known (2). The symptoms were not those of boron deficiency as the tissues in the stems of plants were normal in appearance and did not show the typical cracking and browing associated with boron deficiency.

Etiology

Growers attributed the breakdown to an imbalance in plant nutrients but no evidence could be obtained to support this view. Samples examined for the presence of nematodes showed negative results and an examination by Dr. H. S. Pepin of the Vancouver Research Station revealed that no pathogenic organisms were present.

An examination of meteorological data obtained from the Canada Department of Transport at the Abbotsford Airport gave strong support to the thesis that the physiological breakdown was caused by environmental factors. A period of cool, rainy weather in September was followed by a period of warm, sunny weather in October. Temperatures of 71, 72, 75 and 78° were recorded between the 4th and 7th of October. These were followed by two days of 70°F on the 11th and 12th of October. During this period the differences between day and night temperatures were as much as 38°F. Injury was most likely due to a combination of large diurnal temperature differences and a chilling effect caused by strong outgoing radiation on clear nights. The recorded temperatures were taken in a Stevenson screen but it is a known fact that the temperature of surfaces near the ground may be 8 to 15 degrees colder than that registered in a screen. The breakdown may be due

[1] Experimental Farm, Research Branch, Canada Agriculture, Agassiz, British Columbia.

Table 1. Maximum and minimum temperatures in degrees Farenheit and differences between maximum and minimum at Abbotsford Airport, B. C.* from mid-September to early November, 1964.

Date	Max.	Min.	Diff.	Date	Max.	Min.	Diff.	Date	Max.	Min.	Diff.
Sep 15	59	55	4	Oct 1	58	43	15	Oct 17	54	37	17
16	63	55	8	2	60	43	17	18	61	40	21
17	60	50	10	3	64	35	29	19	68	38	30
18	65	46	19	4	71	40	31	20	67	37	30
19	59	51	8	5	72	44	28	21	66	35	31
20	61	47	14	6	75	42	33	22	67	35	32
21	54	46	8	7	78	40	38	23	62	33	29
22	63	52	11	8	62	53	9	24	52	45	7
23	70	48	22	9	64	53	11	25	53	35	18
24	68	48	20	10	63	51	12	26	52	32	20
25	66	50	16	11	70	44	26	27	54	32	22
26	69	43	26	12	70	41	29	28	51	41	10
27	65	38	27	13	62	47	15	29	53	42	11
28	60	41	19	14	58	47	11	30	56	45	11
29	56	50	6	15	53	38	15	31	65	47	18
30	60	48	12	16	52	41	11	Nov 1	58	43	15
								2	54	40	14

*Meteorological data supplied through the courtesy of the Meteorological Branch, Canada Department of Transport.

to the freezing and rapid thawing effect which would be experienced under the climatic pattern which occurred. On the other hand, it is well known that Brussels sprouts are capable of withstanding mild frost and in mild climates it is common practice to leave the plants in the field or garden throughout the winter (1). The possibility that damage was caused by the higher temperatures experienced can not be ruled out.

Table 1 presents some of the pertinent meteorological data recorded at Abbotsford during the period when injury occurred. The first reports of breakdown came after the warmer weather. The breakdown did not spread markedly to unaffected sprouts, but affected sprouts showed larger areas of injured tissues in early November than was evident in mid-October.

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EXPERIMENTAL FARM,
RESEARCH BRANCH, CANADA AGRICULTURE,
AGASSIZ, B.C.

SURVEY FOR VERTICILLIUM WILT IN ONTARIO

A. T. Bolton[1]

In August 1964, a survey was made of tomato, pepper, and strawberry fields in Ontario. Of 39 strawberry plantations examined, Verticillium wilt was found in 24. Twenty-one out of 29 tomato fields and five out of nine pepper plantations contained at least a few plants infected with Verticillium wilt. Soil samples were taken from fields and plants exhibiting wilt symptoms were collected and these were examined for presence of the fungus. Out of 105 isolations, 101 were identified as *Verticillium dahliae* and 4 as *V. albo-atrum*. The results of this survey are given in Table 1.

Table 1. - Verticillium wilt incidence in strawberry, tomato and pepper plantations in Ontario.

County	Crop	No. of fields infected	No. of samples taken	No. of samples positive	Estimated % infection
Carleton	Strawberry	3	12	11	7
	Tomato	3	9	9	22
	Pepper	1	2	2	4
Northumberland	Strawberry	2	4	2	8
	Tomato	2	6	6	13
Wellington	Strawberry	5	10	6	5
	Tomato	2	6	6	10
Peel	Tomato	2	8	6	16
	Pepper	2	5	5	6
Halton	Tomato	3	6	5	12
Lincoln	Strawberry	5	10	6	8
	Tomato	2	6	6	15
Norfolk	Strawberry	6	12	10	3
	Tomato	2	6	6	8
	Pepper	1	3	3	3
Elgin	Strawberry	3	6	5	2
	Tomato	2	4	4	8
Essex	Tomato	3	6	6	5
	Pepper	1	3	3	3

It was quite apparent from this survey that the visual signs of Verticillium wilt have increased greatly over the last few years. Although the percentage of diseased plants, especially in strawberry and pepper, was not high, the presence of the fungus in the soil provides a potential for much greater losses in future years. For the most part, a higher percentage of tomato plants were infected by the disease, but the damage to the individual plants was less.

[1]Plant Pathologist, Canada Agriculture Research Station, Central Experimental Farm, Ottawa, Ontario.

SUPPLEMENTARY SEED TREATMENT TRIALS - 1964[1]

H.A.H. Wallace[2]

Introduction

Forty-four seed treatment products were tested in 1964 against common bunt of wheat (mixed Tilletia foetida (Wallr.) Liro and T. caries (DC.) Tul.), oat smut (mixed Ustilago avenae (Pers.) Rostr. and U. kolleri Wille), covered smut of barley (U. hordei (Pers.) Lagerh.); against seed rot of rye, durum wheat and flax; and against a complex of soil-borne organisms causing root rot of durum wheat. These tests were sown at Winnipeg, Morden, and Brandon, Manitoba. Samples of all treated seed were placed in bottles and stored in the laboratory at room temperature. This seed was used for greenhouse emergence tests shortly after the treatments were made and again 3 - 4 months later. This seed was also used for a moist filter paper test to determine what fungi grew on the treated seed. The primary objective of these tests was to supplement the Co-operative Seed Treatment Trials (2) and gain a wider knowledge of the behaviour of seed treatments, especially non-mercurial treatments.

Materials and Methods

Kinds of seed used in the trials

Wheat bunt - Variety Red Bobs. Seed artificially contaminated (1:200 by weight) with mixed spores of T. foetida and T. caries.

Oat smut - Variety Vanguard. Seed naturally contaminated by loose and covered smut.

Barley smut - Variety Plush. Seed naturally contaminated by covered smut.

Flax seed-rot - Variety Marine. Seed of this sample was expected to respond well to seed treatment, but this did not occur.

The rye and durum seed treatment trials were added at the last moment. Difficulty was encountered in obtaining untreated seed stocks. The rye was a winter variety, made up of several lots of seed. The durum wheat was an old stock of surplus hybrid seed which germinated poorly, between 30 and 40 per cent.

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[1]Contribution No. 177 from Canada Department of Agriculture Research Station, Winnipeg, Manitoba.

[2]Plant Pathologist

Pesticides

Forty-four seed treatment materials were tested and brief statements on their nature and source are listed below with designating numbers 2 to 49 inclusive. Nos. 2 - 29 are fungicides; of these, 2 - 11 are mercurials, and 12-29 are non-mercurials. Nos. 30 - 34 are insecticides. Numbers 35 - 47 are dual purpose pesticides, among which nos. 35 - 38 contain mercurial fungicides, and 39 - 47 non-mercurial fungicides. The dosages given are for wheat. For flax these dosages were usually doubled.

Treatment No.	P.C.P. No.	Description of Products
1		Check - Seed not treated
2	4677	A liquid containing 3.7 oz./Imp. gal. methylmercuric dicyandiamide (2.5 oz. mercury equivalent). Morton Chemical Company, Woodstock, Illinois.
3	2521	A powder containing 3.2% mercury as methylmercuric p-toluene sulfonanilide. E. I. du Pont de Nemours, Wilmington, Delaware.
4		A liquid containing 2.0% mercury as phenylmercuric acetate. Niagara Brand Chemicals, Burlington, Ont.
5		A liquid containing 2% methylmercuric iodide and 1% ethylmercuric phosphate. Niagara Brand Chemicals, Burlington, Ont.
6		A liquid containing 66.7% phenylmercuric acetate. Niagara Brand Chemicals, Burlington, Ont.
7		A liquid containing 5.5% mercury and 2.5% cadmium. Niagara Brand Chemicals, Burlington, Ont.
8	8780	A liquid containing methylmercuric -2, 3-dihydroxypropyl mercaptide (2.89%) and methylmercuric acetate (10.62%). Green Cross Products, Montreal, Que.
9		A liquid mercury of undisclosed composition. (JF 1553). Chipman Chemicals Ltd., Hamilton, Ont.
10		A liquid containing 1.5% mercury as methylmercuric dicyandiamide. Chipman Chemicals Ltd., Hamilton, Ont.

Treatment No.	P.C.P. No.	Description of Products
11		A liquid containing 1.5% mercury as methylmercuric dicyandiamide. Chipman Chemicals Ltd., Hamilton, Ont.
12	34	A liquid containing 37% formaldehyde. Standard Chemicals Ltd., Montreal, Que.
13	5841	A dust containing 75% thiram. E. I. du Pont de Nemours, Wilmington, Delaware.
14		A dust containing 75% captan. Ortho Agricultural Chemicals, Oakville, Ont.
15		A dust containing 20% hexachlorobenzene and 20% captan. Ortho Agricultural Chemicals, Oakville, Ont.
16	4050	A dust containing 60% pentachloronitrobenzene. Canadian Hoechst Ltd., Montreal, Que.
17	7398	A dust containing 70% p-dimethylaminobenzenediazo sodium sulfonate. Chemagro Corporation, Kansas City, Mo.
18		A dust containing 70% trichlorodinitrobenzene. Chemagro Corporation, Kansas City, Mo.
19		A dust containing 35% p-dimethylaminobenzenediazo sodium sulfonate and 35% trichlorodinitrobenzene. Chemagro Corporation, Kansas City, Mo.
20		A dust containing 15% RD 8684 and 5% hexachlorobenzene. Green Cross Products, Montreal, Que.
21		A dust containing 15% RD 8684. Green Cross Products, Montreal, Que.
22	4695	A dust containing 40% hexachlorobenzene. Interprovincial Co-operative Ltd., Winnipeg, Man.
23		A dust containing 2% Blasticidin S. Niagara Brand Chemicals, Burlington, Ont.
24		A dust containing 2.2% barium pentachlorophenate. Niagara Brand Chemicals, Burlington, Ont.

Treatment No.	P.C.P. No.	Description of Products
25		A dust containing 30% N,N-dimethyl-carbamyl-N,N-dimethylthiocarbamyl disulfide. Niagara Brand Chemicals, Burlington, Ont.
26	2827	A dust containing 95% tetra chloro-p-benzoquinone. Naugatuck Chemicals, Elmira, Ont.
27		A dust containing 75% tetrachloro-nitroanisole. Smith Kline and French Laboratories, Philadelphia, Pa.
28		A non-mercurial dust containing Hercules 3944, hexachlorobenzene and captan. Green Cross Chemicals, Montreal, Que.
29		A suspension of 4 lbs. captan/U.S. gal. Chipman Chemicals, Ltd., Hamilton, Ont.
30, 31		A liquid insecticide containing 2.5 lb./Imp. gal. heptachlor. Leytosan (Canada) Ltd., Winnipeg, Man.
32	4761	A dust containing 75% gamma BHC (from lindane). Ortho Agricultural Chemicals, Oakville, Ont.
33	5065	A dust containing 50% gamma BHC (from lindane). Chipman Chemicals Ltd., Hamilton, Ont.
34	5278	A dust containing 50% aldrin. Chipman Chemicals Ltd., Hamilton, Ont.
35		A liquid containing 2.40% phenyl-mercuric acetate and 30.86% aldrin. Niagara Brand Chemicals, Burlington, Ont.
36		A liquid containing 2.40% phenyl-mercuric acetate and 30.86% aldrin. Niagara Brand Chemicals, Burlington, Ont.
37, 38		A liquid containing 1.38 oz. methyl-mercuric-8-hydroxyquinolinate and 2.5 lb./Imp. gal. heptachlor. Metalsalts Corporation, Hawthorne, N.J.

Treatment No.	P.C.P. No.	Description of Products
39		A dust containing 12.5% diazinon and 37.5% captan. Chipman Chemicals Ltd., Hamilton, Ont.
40	6920	A dust containing 60% captan and 15% dieldrin Stauffer Chemical Co., North Portland, Oregon.
41	5030	A dust containing 17% gamma isomer BHC (from lindane) and 50% captan. Ortho Agricultural Chemicals, Oakville, Ont.
42		A dust containing 56.2% thiram and 18.7% aldrin. Morton Chemicals of Canada Ltd., Winnipeg, Man.
43	5071	A dust containing 14% heptachlor and 47% thiram. Green Cross Products, Montreal, Que.
44		A dust containing 40% aldrin and 8% hexachlorobenzene. Shell Oil Co. of Canada Ltd., Toronto, Ont.
45	7711	A dust containing heptachlor 2.5 lb./Imp. gal. and 1.5 lb./Imp. gal. pentachloronitrobenzene. Green Cross Products, Montreal, Que.
46	6337	A liquid containing 40% aldrin and 16% hexachlorobenzene. Green Cross Products, Montreal, Que.
47		A dust containing captan and lindane.

Experimental Results (Tables 1 and 2)

Bunt Untreated seed yielded 15.25 and 6.75% bunt at Brandon and Morden, respectively. All treatments, insecticides included, significantly reduced bunt infection. However, all insecticides, and the fungicides NIA9210 and NIA11100 permitted too much bunt infection to be considered as suitable fungicides. All mercurials and 7 non-mercurial fungicides gave complete protection against bunt. Many other non-mercurials gave good protection, since only trace amounts of bunt occurred following their application.

Table 1. Supplementary Seed Treatment Trials - 1964 - Fungicides

Treat-ment No.		Dosage (wheat)	Smutty heads (%)			Emergence (%)			Root rot rating (%)
			Wheat	Oats	Barley	Flax	Rye	Durum	
	No. of Stations		2	3	3	3	1	3	3
1	Check untreated	-	11.00	19.75	15.30	72.8	42.0	29.3	6.5
	Mercurials								
2	Panogen 15	0.75	0.00	0.71	0.17	81.2	61.3	33.3	12.3
3	Ceresan M	0.50	0.00	0.00	0.04	72.6	57.0	35.4	11.5
4	NIA 102	2.00	0.00	0.67	0.13	76.3	60.3	33.8	10.3
5	Soilcin EC	2.00	0.00	1.58	0.13	59.3	27.5	25.8	10.4
6	MED 169	2.00	0.00	2.63	0.79	75.7	58.0	33.5	9.6
7	MRC 1186	0.50	0.00	5.21	1.50	75.8	60.8	33.9	9.4
8	Liquisan Conc.	0.75	0.00	.46	0.67	78.2	55.3	35.2	9.0
9	JF 1553	0.75	0.00	.42	0.17	75.0	56.5	35.6	10.1
10	JF 1571	0.75	0.00	0.00	0.08	79.1	56.8	36.2	11.7
11	JF 1727	0.75	0.00	0.04	0.00	75.7	61.5	38.4	10.1
	Non-mercurials								
12	Formalin	1/320	0.00	0.13	0.75	-	26.8	21.4	10.0
13	Arasan	1.00	0.13	3.23	1.93	66.8	60.8	31.4	9.7
14	Orthocide 75	1.00	0.07	5.42	1.00	69.0	56.0	32.3	9.1
15	Orthocide 20-20	2.00	0.00	6.04	1.15	69.4	55.0	30.3	9.0
16	Tritisan	.50	0.37	15.42	15.17	67.7	50.3	27.1	9.2
17	Dexon	1.00	0.00	3.42	14.46	70.1	49.5	29.4	7.9
18	Chemagro 2635	1.00	0.19	.17	0.50	61.8	40.5	27.9	9.9
19	Dexon Chemagro	1.00	0.00	.08	1.96	65.7	47.0	31.8	7.8
20	Green Cross 3822	2.00	0.00	12.13	10.50	68.2	40.8	32.1	8.0
21	Green Cross 3958	2.00	0.25	13.06	10.60	70.5	45.3	28.0	7.9
22	Coop Hexa	.50	0.13	18.92	17.15	64.7	44.3	25.7	8.8
23	NIA 9210	2.00	1.94	16.01	17.25	58.2	40.3	27.8	8.3
24	NIA 11100	2.00	1.82	15.04	14.67	62.0	40.8	28.4	8.4
25	MED 171	6.00	0.13	.68	0.63	58.2	49.0	36.3	7.2
26	Spergon	2.00	0.00	9.96	2.83	71.6	57.5	33.7	9.4
27	TCNA 75	.50	0.25	9.35	10.65	63.8	41.0	35.3	7.2
28	Green Cross 3944X	1.00	0.00	1.58	.04	74.4	50.5	31.7	8.4
29	Flowable Captan	2.00	0.44	8.25	2.01	73.1	57.3	31.7	8.8
	Least Sign.Diff.		1.02	3.55	2.55	4.4	8.5	4.9	2.7

Table 2. Supplementary Seed Treatment Trials - 1964 - Insecticides and Dual Purpose Fungicide-Insecticides

Treat-ment No.		Dosage (wheat)	Smutty heads (%) Wheat	Oats	Barley	Emergence (%) Flax	Rye	Durum	Root rot rating (%)
1	No. of Stations	-	2	3	3	3	1	3	3
1	Check untreated	-	11.00	19.75	15.30	72.8	42.0	29.3	6.5
	Insecticides								
30	Aaheptan	2.00	5.07	15.40	14.27	66.2	50.3	25.0	8.0
31	Aaheptan	3.00	5.07	26.61	14.92	64.2	45.3	23.3	8.5
32	Isotox	1.00	2.63	18.04	18.45	62.1	48.3	26.8	6.8
33	Abol	1.60	3.07	18.00	17.92	63.7	51.8	27.5	6.6
34	Aldrin	1.60	3.94	19.53	16.87	63.9	50.0	26.8	6.5
	Dual purpose								
	(a) with mercurial								
35	MEC 791	2.00	0.00	1.98	0.42	73.0	61.3	33.5	10.9
36	B 169	2.00	0.19	2.46	0.58	69.5	60.8	39.5	9.1
37	Metasol MMH	.75	0.44	0.71	3.09	72.4	61.3	34.5	9.2
38	Metasol MMH	2.00	0.07	0.00	0.13	69.7	57.8	43.5	10.9
	(b) non-mercurial								
39	Captan-diazinon	2.40	0.13	8.98	1.00	74.2	51.3	33.9	8.5
40	Captan-dieldrin	1.00	0.26	6.29	0.88	72.5	55.5	34.9	8.4
41	Ortho-Seed Guard	1.50	0.34	8.20	1.76	75.0	62.0	31.8	9.0
42	Panoram D31	1.50	0.00	4.41	2.38	71.9	60.8	29.5	8.1
43	Heptachlor-thiram	1.50	0.07	4.83	1.60	70.2	58.5	30.5	10.3
44	Shell-Aldrin HCB	2.50	0.00	19.13	19.04	61.2	45.0	25.2	7.5
45	Dual Purpose Bunt No More	1.25	0.13	19.13	16.79	62.2	46.3	24.7	7.4
46	Liquid " " "	2.00	0.00	9.29	11.40	65.5	40.8	25.8	7.3
47	Lindane-Captan	3.00	0.07	9.75	3.88	71.1	50.5	31.5	6.4
	Least Sign. Diff.		1.02	3.55	2.55	4.4	8.5	4.9	2.7

Oat Smut Untreated oat seed yielded 22.5, 20.8 and 16.0 per cent smut at Brandon, Morden and Winnipeg, respectively. Oat smut was very difficult to control. Ceresan M, JF1571, Metasol MMH (2 oz.) completely controlled oat smut. Formalin, Chemagro 2635, Dexon-Chemagro 2635, and MED171 were very good. Green Cross 3944X is probably in this class as most of the smut that developed following its use occurred in only one plot at one station, indicating a possible error. Dual-purpose non-mercurials were not satisfactory and insecticides probably had no effect.

Barley Smut Untreated barley seed yielded 18.0 per cent smut at Winnipeg and Morden, and 9.9 per cent at Brandon. Barley smut was easier to control than oat smut. One product JF1727 gave complete control. Generally, mercurials gave satisfactory control. Formalin, Chemagro 2635, MED171 and Green Cross 3944X were also effective. Products containing captan were also fairly effective. Insecticides had no effect on barley smut.

Flax Although this test failed to show the expected benefits due to seed treatment the results indicate that mercurials tend to increase germination and insecticides to depress it.

Rye Due to wet weather and the profuse stooling of the rye seedlings, emergence counts were only made at Winnipeg. Germination was significantly increased by all products containing mercury, captan, thiram and Spergon. Formalin and Soilcin EC reduced germination.

Durum Wheat Generally, seed treatments has no effect on germination.

Root Rot Durum wheat plants were pulled when they were near the "shot" blade stage and rated for root rot. Each 12-foot plot produced 60 - 70 plants; each living plant was given a root-rot rating of 0 - 5. These ratings were later converted to percentages. The ratings were taken when the disease was fairly light, and when the plots were on summerfallow. Average root-rot ratings were 6.8, 7.4 and 12.3 per cent for Brandon, Morden, and Winnipeg, respectively. Statistically, root-rot ratings for treatments are significant, as seed treatments were not expected to increase root rot. When the treatments are grouped into classes the root rot on plants grown from mercury-tested seed is nearly double that of the check. (Table 3).

Table 3. Root rot ratings of treated durum wheat, when the treatments are grouped into types of treatment.

No. of Treatments	Pesticide Group	Mean Root Rot Rating	Range
1	Untreated	6.53	—
10	Mercurials	10.43	9.03 - 12.28
4	Dual Purpose - Mercurials	10.01	9.09 - 10.93
1	Formalin 1/320	10.00	—
17	Non-mercurials	8.53	7.20 - 9.68
9	Dual Purpose - Non-mercurials	8.10	6.43 - 10.31
5	Insecticides	7.28	6.54 - 7.98

Table 4 Fungi on treated durum seeds after incubation for 1 week on moist filter paper

No. of Treatments	Treat. Class	Alternaria		No Spores (Alternaria?)		Penicillium		Trichothecium		Streptomyces	
		Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
1	Check	26.0	-	2.0	-	48.0	-	58.0	-	34.0	-
10	Mercurials	0.2	0 - 2	35.2	4-46	9.2	0-44	2.0	0-12	1.4	0-8
1	Formalin	14.0	-	20.0	-	10.0	-	12.0	-	68.0	-
17	Non-mercurials	6.8	0 -26	26.8	0-62	40.2	0-96	31.5	2-64	15.3	0-64
5	Insecticides	36.4	22-46	4.0	0-6	75.6	66-88	62.6	38-60	37.6	10-58
4	Dual Purpose-Mercury	5.5	0-16	38.5	18-54	19.5	4-50	13.5	0-42	11.0	0-42
9	Dual Purpose-No Mercury	10.2	0-28	24.4	6-62	40.7	4-80	40.2	10-88	7.8	0-20

Greenhouse Tests

Formalin reduced seed germination, especially in Red Bobs wheat and rye. There was a tendency to produce weak plants due to a light infection by damping-off fungi. This was especially true of Red Bobs where seed treated with insecticides, hexachlorobenzene, formalin, Chemagro 2635, NIA 9210, MED 11100, and TCNA were fairly susceptible; indicating a lack of control of soil-borne organisms. Soilcin EC at 2 oz. appears to have been used at too high a dosage as the number of poisoned seeds was high.

Moist Filter Paper Tests

Twenty-five seeds from each treatment and stock were placed in each of two Petri dishes, incubated at room temperature, and later examined for seed borne fungi. The species of fungi were identified and their frequency of appearance recorded. They appeared most commonly on durum wheat. The predominant genera were Alternaria, a non-sporulating fungus which appears to be Alternaria, Penicillium, Trichothecium, and Streptomyces. Other organisms occasionally found were Bipolaris sorokiniana, Aspergillus versicolor, A. niger, Fusarium and Chaetomium spp. (Table 4).

Summary

Fungicides containing mercury are widely recommended as seed treatments for the control of cereal smuts and seed borne pathogens. Although they are highly effective for this purpose their toxicity represents a hazard to operators and to consumers of contaminated grain. Several non-mercurial fungicides, some available now and others to be registered soon, proved as effective as mercurials in this and other tests (2). Some chemicals such as hexachlorobenzene and captan enhance the effectiveness of other non-mercurial fungicides indicating further possible improvement still to come in formulation in this group.

The fact that all treatments tended to increase root rot requires further research. This does not always occur. There appears to be an interaction of climate, seed, and soil which sometimes gives an adverse effect following seed treatment.

The occurrence of fungi on treated seeds placed on moist filter paper is a good bioassay test, especially if the seed lot contains mechanically injured seeds. Such seed, for example, becomes infected with Penicillium and this lowers the germination of seeds sown in soils of subgermination moisture content (3). The Penicillium counts for mercurials were usually low, but had a wide range among non-mercurials. Among the latter Orthocide 75, Orthocide 20-20, Chemagro 2635, MED 171, Spergon and 3944 all had low Penicillium counts, as did also those dual-purpose products containing captan.

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CANADA AGRICULTURE RESEARCH STATION,
WINNIPEG, MANITOBA.

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