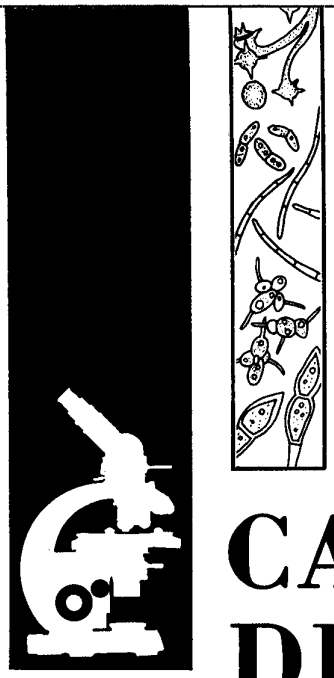
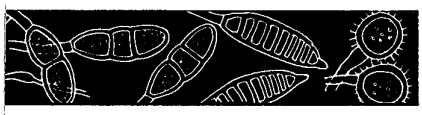
VOL. 48, No. 4, DECEMBER, 1968



CANADIAN PLANT DISEASE SURVEY



EDITOR W.L. SEAMAN

RESEARCH BRANCH CANADA DEPARTMENT OF AGRICULTURE

VOL. 48, No. 4, DECEMBER, 1968

CANADIAN PLANT DISEASE SURVEY

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CONTENTS

"The Canadian Plant Disease Survey is a periodical of information and record on the occurrence and severity of plant diseases in Canada. It will also accept other original information such as the development of methods of investigation and control, including the evaluation of new materials. Review papers and compilations of practical value to phytopathologists will be included from time to time."

A STEM EYESPOT OF RED FESCUE IN NORTHERN ALBERTA[1]

J. Drew Smith[2], C.R. Elliott[3], and R.A. Shoemaker[4]

Abstract

A stem eyespot of creeping red fescue, Festuca rubra L. subsp. rubra was found affecting all crops of this grass surveyed in the Beaverlodge area of northern Alberta in July 1968. The fungus Phleospora idahoensis Sprague was consistently isolated from lesioned plant material and shown to be pathogenic. It sporulated sparingly in culture. The fungus was isolated from inflorescences, and spores were recovered from seed washings, indicating that the disease may be seed-borne. The disease was more severe in parkland locations than in the open prairie.

In July 1967, a stem eyespot was noted in two seed crops of creeping red fescue, Festuca rubra L. subsp., rubra in the Beaverlodge area in northern Alberta. Both growers reported poor seed yields in the 1966 seed crop. About 11.3 million lb of creeping red fescue seed were produced in Canada in 1967, mostly in the Peace River Region of Alberta and British Columbia. In the 1967/68 crop year[5] 10.8 million lb were exported. The subspecies is used extensively in pastures, for the reclamation of cleared and burned-over bushland in the Black, Transition, and Gray Wooded Soil Zones in some parts of the western provinces of Canada, and for amenity turf (5).

Disease incidence

In mid-July 1968, 20 seed crops of creeping red fescue (comprising about 1000 acres) were examined in the Beaverlodge area and estimates were made of the percentage of infected culms in each (Table 1). Six crops in the open prairie to the south and east of Beaverlodge had less than 5% infection. The remainder, in rolling parkland and cleared bush to the north and east of the center, were more heavily infected.

Table 1. Incidence of infected culms in crops of creeping red fescue, 1968

Infection (%)	Number of crops
0	0
1-5	6
6-10	2
11-25	2
26-50	3
51-90	6
91-100	1

On flowering culms, symptoms varied from vague brown or brown-purple spots, linear in outline, through sharp brown linear streaks to clear eyespots with dark brown or purple-brown margins and white or gray-white centers. Lesions usually did not exceed 1 cm in length but were occasionally confluent (Fig. 1). On the exterior of leaf sheaths the outline of a spot was less definite than on the culms (Fig. 2); inside the leaf sheath brown streaking was apparent. On culms which had ceased to elongate, spots on the outside of the sheath corresponded with lesions on the stem inside. On culms which were still elongating, lesions on the exserted stems could be related to those on the leaf sheath through which the stem had grown. Spots occurred on the rachis, rachillae, and glumes of plants in heavily infected crops. Leaf blade lesions were infrequent.

Pathogen

A fungus was found associated with stem, sheath, and inflorescence lesions. No spores or

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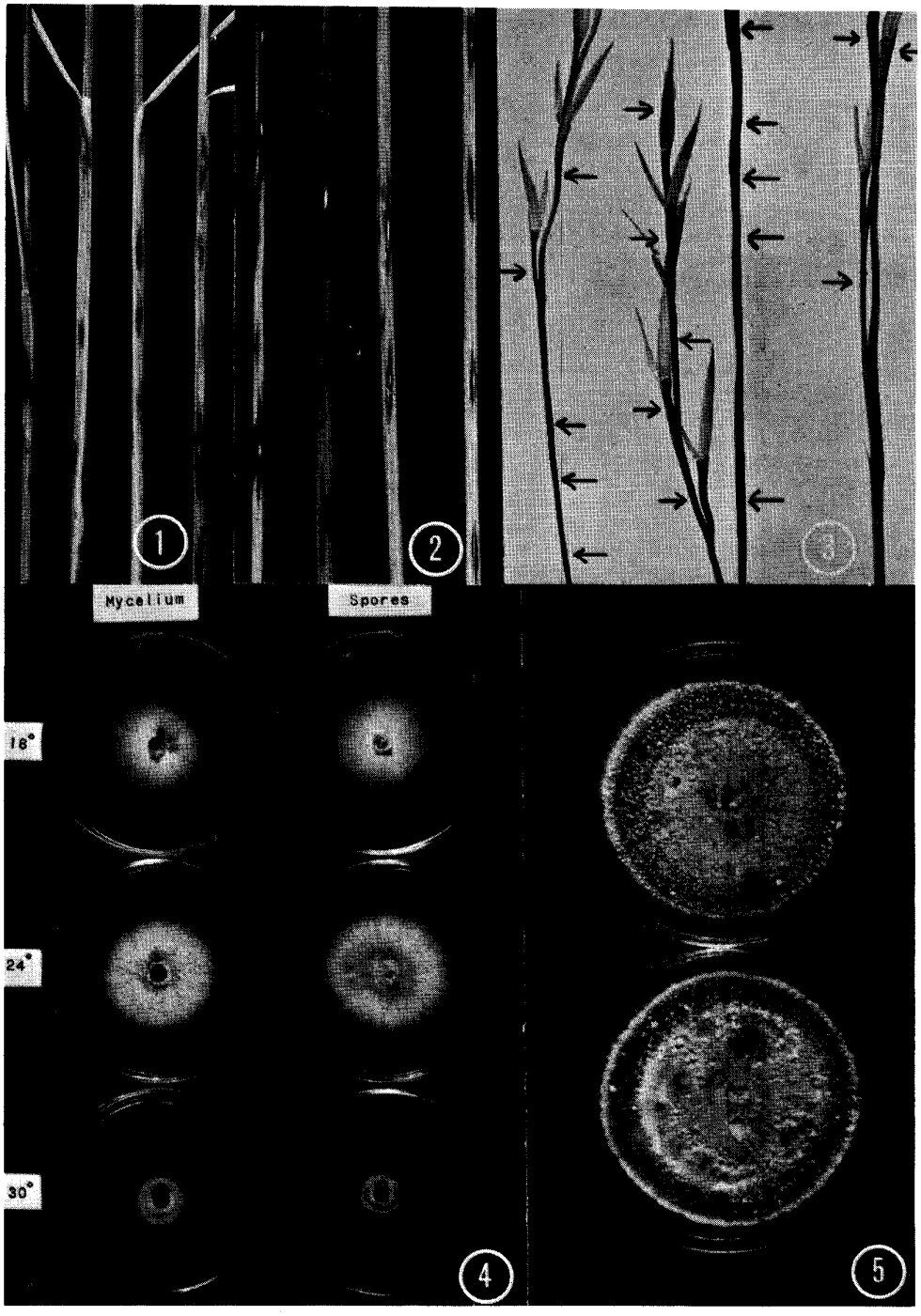
[5] Crop years ending 30 June. Data from Plant Products Division, Production and Marketing Branch, Canada Department of Agriculture, Ottawa.



Figures 1–3. Lesions on 1) leaf sheaths, 2) culms, and 3) inflorescences of *Festuca rubra*. Figure 4. Growth of mycelial and spore isolates of *Phleospora idahoensis* on PDA at three temperatures. Figure 5. Spore isolate (upper) and mycelial isolate (lower) on PDA, showing stromatic cushions. (Figures 1–5. Francis Dolezsar)

sporophores were seen on field material in 1967. In 1968, a few pink spore masses were found on a lesioned culm and an inflorescence in fresh samples from two of the 20 crops. Pycnidia were found, eventually, by sectioning through the dried spore mass on a stem lesion. Spores were found in washings of seeds from heavily infected culms. Occasional spores were found in five of 40 commercial seed samples from the Beaverlodge area in 1968.

After incubation of diseased stems in a moist chamber, the superficial mycelium could be picked from "clean" eyespot lesions with a sterile needle. The fungus was readily isolated by plating fragments, from sheath and inflorescence lesions after surface sterilization with 70% alchol, on potato dextrose agar (PDA) containing 50 µg/ml streptomycin and vancomycin. The fungus made satisfactory vegetative growth on a wide range of natural, semi-defined, and defined media. Growth was not enhanced in six isolates by riboflavin, nictoinic acid, pyridoxine, thiamine, biotin, folic acid, pantothenic acid, p-amino-benzoic acid and yeast nucleic acid when these were incorporated in minimal medium (10). The optimum temperature for growth in six isolates was about 24C; some growth occurred at 3C and 30C on minimal medium and PDA (Fig. 4).

Colonies on PDA in petri dishes were at first white, later gray-white with occasional faint green, yellow or brown tints in the aerial mycelium. Small white stromatic cushions of mycelium developed behind the advancing margin as the colonies aged (Fig. 5). The surfaces of older colonies in tubes became crenellated, and, as they aged, the bases darkened through light brown to creosote brown. A brown pigment diffused into the medium of older cultures when the fungus was grown at 18C and above. Dark chestnut-brown sectors commonly occurred and brown drops of exudate appeared on them. The fungus did not penetrate deeply into agar media and it grew superficially on sterile straws. Racquet-cells developed in culture. In water agar, seeded with inoculated straw, mycelial loops developed; these were precursors of stromatic cushions. Single-spore isolates produced colonies indistinguishable morphologically from those of mycelial origin (Figs. 4, 5), even to the extent of producing chestnut-brown sectors. Cultures made from approximately 150 isolates in 1967 and 1968 had a similar morphology. Pycnidia and spores developed sparingly in culture.*

Mycelium on the lesions was mostly superficial, hyaline, septate, without clamps, much branched, thin-walled, sharply curved towards the tips, and 1.0-1.5 µ in diameter.

Pycnidia were inconspicuous, immersed, intraepidermal, globose, 100-150 µ diam., with a small circular opening (Fig. 6). The pycnidium wall consisted of two layers of thin-walled, yellow rectangular cells 6-8 x 3-5 µ. Conidiophores were hyaline, slightly curved, thin-walled, mostly aseptate, rarely 1- or 3-septate, 30-62 x (3) 5-6 µ, pointed at the apex, truncate at the base with an inconspicuous scar, with finely granular cytoplasm when observed in water, and with guttules when mounted in lactic acid (Fig. 7). Conidia accumulated in a slimy white to pink mass outside the pycnidium and provided the best indication of the location of the easily overlooked pycnidia. Conidia germinated from either or both ends within 12 hours on PDA at room temperature.

The fungus matched well the original description and illustration given by Sprague (12) but was not compared with the type. It was distinct from two other Phleospora species: P. graminearum Sprague & Hardison on Agropyron repens (L.) Beauv. and Elymus canadensis L., and P. muhlenbergiae Sprague & Solheim in Solheim on Muhlenbergia arizonica Scribn., particularly in spore color, size, and septation (13).

Pycnidia were not obvious or abundant on heavily infected flowering stems of F. rubra subsp. rubra collected in mid-July at Beaverlodge. These structures may have just commenced development then. However, they have not yet been found on overwintered potted material with abundant stem spots.

Pathogenicity tests

Lesions similar to those occurring on plants in the field developed on flowering culms of F. rubra and F. ovina following inoculation. Fragments of mycelium from cultures of several isolates were placed on moist cotton gauze. The gauze was applied to the culm and fastened with masking tape. Lesions developed after incubation for 7 days in an illuminated moist chamber in the greenhouse. Check culms showed no lesions. The fungus was reisolated from the infected tissues.

Discussion

The disease was probably responsible for considerable reductions in seed yield of some creeping red fescue crops. Three experienced growers in the Beaverlodge area in whose crops the disease was found, reported that potential seed yields of about 600 lb/ac were reduced to less than 300 lb in 1968. More extensive, detailed surveys in the seed growing areas in western Canada are indicated, since the

* A few pycnidia and spores developed in about 5% of the isolates from refrigerated culm material in February 1969. Isolation was effected on PDA containing vancomycin and streptomycin; and spores developed in the first subculture on slopes of lima bean agar after 14 days' growth at 18C in 12 hr fluorescent light. Spore morphology in culture was similar to that reported from plant material (JDS).

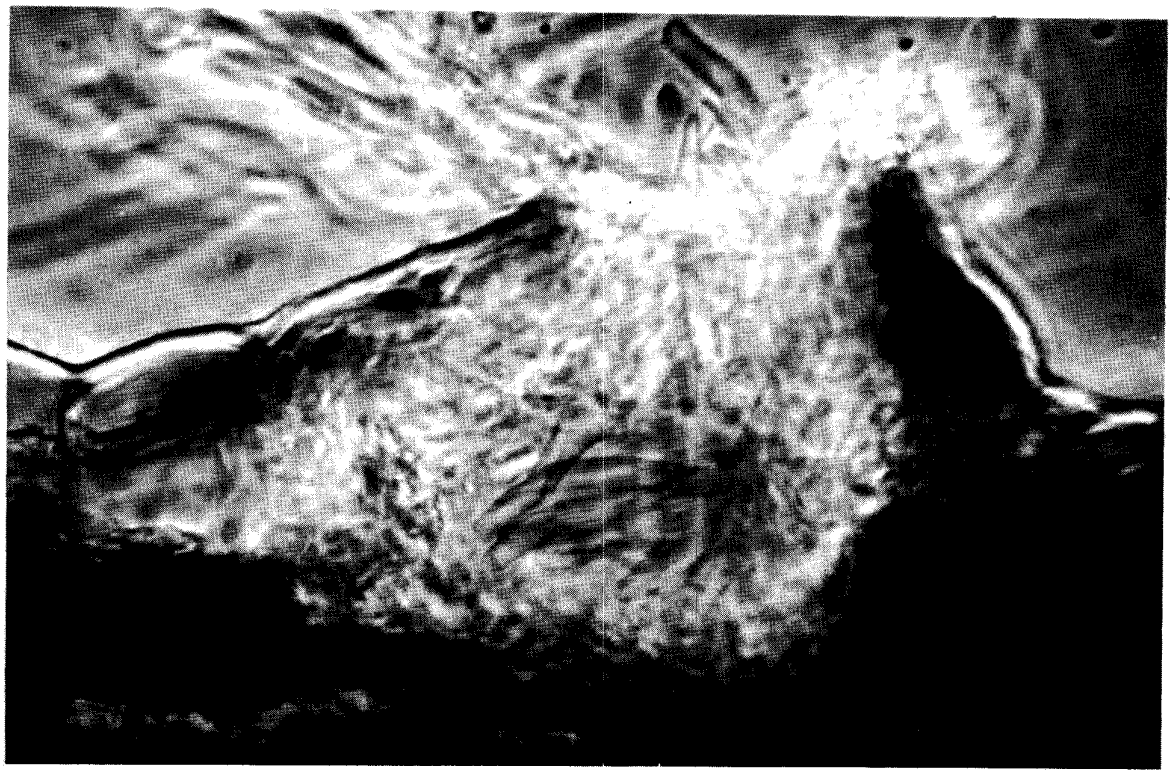


Figure 6. Intraepidermal pycnidium and spores (x1000).

disease may be of considerable economic importance.

Spores of the fungus were found in seed washings, indicating that the disease is potentially seedborne. However, the paucity of spores of P. idahoensis in concentrated washings compared with the abundance of spores of such pathogens as Selenophoma spp. and Colletotrichum graminicola (Ces.) Wils. suggests a low risk of seed transmission of the disease.

The severity of the disease on crops of creeping red fescue appeared to be related to microclimate. Crops in the more sheltered rolling parkland and cleared bush, where the evaporation rate is usually lower, were more severely affected than those in the open prairie.

P. idahoensis was first described on F. idahoensis Elmer (8) from Idaho in 1948 (12). The next record was on F. elatior and F. rubra from Alaska in 1955 (14). It was not recorded in Canada (3).

The sudden appearance of this severe disease is of considerable epidemiological interest. The

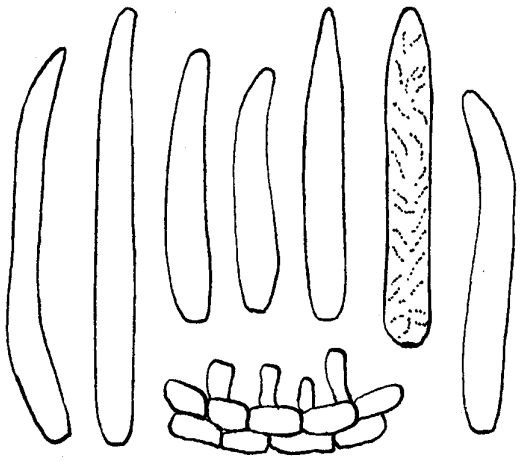


Figure 7. Pycnidium wall cells, conidiophores, and conidia (x1000). Figures 6 and 7 from DAOM 126188.

possibility that the pathogen is endemic on the native F. idahoensis and F. scabrella in the western prairies (2, 4, 7) should be examined. Since F. rubra subsp. rubra is an introduction (5), the native fescues may be the original source of inoculum. Infected F. idahoensis, the dominant species in the Palouse prairie of western Idaho and Eastern Washington (2), was reported to be localized in this zone in the area west of Yellowstone National Park (12). However, the distribution of the pathogen, as Sprague (loc cit) comments, "remains somewhat of a mystery." There is a floristic continuity from the Palouse prairie through the valleys of British Columbia and mountain passes into Montana and southern Alberta (7, 11). It has been suggested that many of our Canadian species have moved in through this route (7). Their pathogens may have moved in with them. F. scabrella is the dominant species in the native grasslands of central and southwestern Alberta, taking the place of the F. idahoensis of the Palouse prairie in the south (7). The F. scabrella association extends into the mixed prairie of the parkland belt of Alberta and Saskatchewan, but the Peace River grasslands lack F. scabrella (6). Both F. scabrella and F. idahoensis are found together in the Cypress Hills of southeastern Alberta and southwestern Saskatchewan (1). It may be rewarding from an ecological and epidemiological standpoint to determine the distribution of P. idahoensis on the native fescues in Saskatchewan, Alberta, and British Columbia.

Studies have commenced on the control of the pathogen by crop sanitation and the development of resistant varieties.

Acknowledgments

We are indebted to Dr. J.R. Hardison, Oregon State College, Corvallis, and Emeritus Professor T. C. Vanterpool, University of Saskatchewan, Saskatoon, for opinions on the possible identity of the pathogen.

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A COMPARISON OF TWO SYSTEMIC FUNGICIDES WITH NON-SYSTEMICS FOR CONTROL OF FRUIT ROT AND POWDERY MILDEW IN STRAWBERRIES

Jack A. Freeman[1] *and H.S. Pepin*[2]

Abstract

Fungicide 1991 (Du Pont), a systemic fungicide, proved as effective as the nonsystemics captan, dichlofluanid and DAC 2787 for preharvest control of gray mold and powdery mildew fruit rot in 'Northwest' strawberries. Another systemic, Bay 33172, and Du-Ter, a nonsystemic, gave poor control. The addition of dimethyl sulfoxide to captan did not affect the efficacy of the fungicide. Both systemic fungicides proved less effective than the nonsystemics for the control of postharvest rot. Bay 33172 was the least effective of the fungicides. Fungicide 1991 proved more effective than sulfur for the control of powdery mildew on strawberry foliage and provided effective control of postharvest mildew up to 8 weeks beyond the last spray. The same result was obtained whether 5 or 7 sprays were applied. Bay 33172 proved ineffective for powdery mildew control.

Introduction

In a previous study, Fungicide 1991 (1-butylcarbamoyl)-2-benzimidazole carbamic acid, methyl ester), a systemic fungicide, showed considerable promise for the control of gray mold caused by Botrytis cinerea Pers. ex Fr., and powdery mildew caused by Sphaerotheca macularis (Wallr. ex Fr.) Magn. in strawberries and raspberries (2).

Experiments were conducted in 1968 with strawberries to gain additional information on the efficacy of Fungicide 1991; to evaluate the systemic fungicide Bay 33172 [2(2-furyl)-benzimidazole] and the nonsystemic Du-Ter (triphenyltinhydroxide) for the control of fruit rot and powdery mildew in comparison with the nonsystemics captan, dichlofluanid, DAC 2787 (tetrachlorisophthalonitrile) and sulfur; and to determine whether the addition of dimethyl sulfoxide to captan would increase the efficacy of this fungicide.

Methods

Preharvest and postharvest fruit rot

Abbotsford trial - Fungicide 1991[3] and Bay 33172 were compared with captan, DAC 2787, and dichlofluanid for control of fruit rot at the Small Fruits Substation, Abbotsford. A 2-year-old planting of 'Northwest' strawberries was used in this trial. Dimethyl sulfoxide (DMSO) was also used with captan to determine its effect on the efficacy of the fungicide. DMSO is a good solvent for many chemicals, and it apparently aids in their absorption and translocation in plants (4). The treatment rates and times of application are listed in Table 1. The experiment was laid out in a randomized block design with six replicates. Each plot consisted of a single 30-foot row. The plots were grown by the matted row system.

The crop was picked four times between June 26 and July 9. Control of preharvest infection was determined by weighing infected, marketable, and cull fruit from each plot. The size index of sound fruit from each plot was determined at each picking. The effect of treatment on postharvest fruit rot was determined from a random sample of at least 4 lb of sound berries picked on June 27, July 2, and July 9 from each plot in each replicate. The berry samples were placed in common storage at Agassiz and the percentage of sound berries was recorded 24 and 48 hr after harvest.

Vancouver trial - A trial was conducted at the Vancouver Research Station to compare Fungicide 1991 and Bay 33172 with captan and Du-Ter for the control of preharvest fruit rot. The experiment was laid out in a completely randomized design with four replicates. A plot consisted of a single 10-ft row with plants grown by the matted row system. Fungicide 1991 at 0.25 lb active ingredient/acre, Bay 33172 at 0.5 lb active ingredient/acre, captan at

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[3] Fungicide 1991 was supplied by Dupont of Canada Ltd.; Bay 33172, by Chemagro Ltd., Toronto; Du-Ter, by Green Cross Products, Montreal; and DAC 2787, by Diamond Alkali Canada Ltd., Toronto. Fungicide 1991 is now known by the trade name Benlate and the active ingredient by the common name benomyl.

Table 1. Influence of systemic and nonsystemic fungicides on preharvest and postharvest fruit rot of 'Northwest' strawberries

Fungicide	Rate (lb active ingredient/ acre)	Number of sprays*	Rotted fruit (lb/plot)	Sound fruit (lb/plot)	Increase over unsprayed (%)	Sound fruit (%)*** after picking: 24 hr	48 hr
Unsprayed		0	6.3 a**	26.7 e	0	90.5	49.4
Fungicide 1991	0.25	5	3.1 bc	35.4 ab	33	93.8	64.7
Fungicide 1991	0.25	7	3.8 b	35.9 ab	35	94.0	65.4
Bay 33172	0.5	5	5.7 a	32.6 bcd	22	92.4	57.5
Bay 33172	0.5	7	3.6 b	29.8 cde	12	92.1	58.4
Dichlofluanid	1.0	5	2.3 c	35.8 ab	34	97.2	74.2
Dichlofluanid	1.0	7	2.2 c	38.3 a	44	96.4	79.8
DAC 2787	1.5	5	2.3 c	33.7 abc	26	97.2	70.7
DAC 2787	1.5	7	2.5 bc	34.2 abc	28	97.4	78.3
Captan	1.5	5	2.8 bc	37.4 ab	40	95.8	74.6
Captan	1.5	7	3.4 bc	37.2 ab	39	96.3	81.0
Captan + 4% DMSO	1.5	5	3.5 bc	34.2 abc	28	94.5	67.6
Captan + 4% DMSO	1.5	7	2.8 bc	35.3 ab	33	97.0	84.6
Mean			3.4	34.4		95.0	69.7
S. E. Mean			0.42	1.45			

* Fungicide sprays were applied on May 8 (first bloom), May 17 (about full bloom), May 27, June 6 and June 17 (last spray before harvest). Plants receiving seven applications were also sprayed on June 27 and July 5.

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

*** Mean of three harvests.

1.5 lb active ingredient/acre, and Du-Ter at 0.75 lb active ingredient/acre were applied May 21 and 31, June 10 and 21, and July 1. The crop was picked seven times between June 13 and July 5. The number and weight of sound fruit was recorded at each picking. In addition, the amount of berry infection was determined by counting the number of berries affected by botrytis rot and powdery mildew. These figures were converted to a percentage of the total number of berries. Percentages were transformed for statistical analysis. The size index was determined on the entire harvest.

Postharvest powdery mildew

Fungicide 1991 and Bay 33172 were compared with sulfur (Magnetic 6) for the control of postharvest powdery mildew in a field test at the Small Fruits Substation, Abbotsford. A 2-year-old planting of 'Northwest' strawberries was used in this trial. The experiment was laid out in a randomized block design with three replicates. Each plot consisted of a single 30-foot row.

Preharvest treatments were applied five or seven times for mildew and gray mold control, followed by either four postharvest treatments for mildew control or no treatment. Preharvest applications were made on May 8, 17, and 27, June 6 and 17 (five sprays), and on June 27 and July 5 (seven sprays). Postharvest treatments were applied August 8 and 22, and September 5 and 19. Fungicide 1991 was applied at a rate of 0.25 lb active ingredient/acre and Bay 33172 at 0.5 lb active ingredient/acre and sulfur at 3.6 lb active ingredient/acre.

A random sample of 20 leaves was collected from each plot in each replicate on August 14 and 28 and September 11 and 27 to determine the percentage of mildew infection. The total area of mildew infection on each leaf was determined as a percentage, which was averaged for each replicate. Percentages were transformed for statistical analysis.

Table 2. Influence of Fungicide 1991, Bay 33172, captan, and Du-Ter on preharvest fruit rot of 'Northwest' strawberries

Fungicide	Rate (lb active ingredient/ acre*)	Rotted fruit rating**	Sound fruit (lb/plot)	Increase over unsprayed (%)
Unsprayed		26.0 a***	6.98 b	0
Fungicide 1991	0.25	9.9 b	10.87 a	56
Bay 33172	0.50	27.3 a	8.60 ab	23
Captan	1.5	12.2 b	10.74 a	54
Du-Ter	0.75	26.1 a	8.64 ab	24
Mean		20.3	9.16	
S.E. Mean		1.60	0.93	

* Sprays were applied on May 21 and 31, June 10 and 21, and July 1.

** Arcsine transformations of mean percentages.

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

Results and discussion

From the results of both the Abbotsford and Vancouver trials, Fungicide 1991 proved as effective as captan, dichlofluanid, and DAC 2787 for preharvest control of fruit rot (Tables 1 and 2). Similar results were obtained in 1967 at Abbotsford with raspberries (2). Bay 33172 and Du-Ter both gave a low level of control. The addition of DMSO to captan did not affect the efficacy of the fungicide. Helton and Kochan (3), working with cytospora canker disease of prune trees, found that the effects of DMSO vary widely, sometimes enhancing the therapeutic effect of accompanying fungicides and sometimes aggravating the disease. Fruit size was not affected significantly by treatment, although there was a slight trend for fruit from plots sprayed with dichlofluanid and Bay 33172 to be smaller than fruit from other plots. In previous tests, dichlofluanid has caused a significant reduction in fruit size of both strawberries and raspberries (1, 2).

Five sprays appeared as effective as seven sprays for preharvest fruit rot control. Seven sprays, especially of the nonsystemics, gave added protection against postharvest rot.

Within 48 hours after picking approximately half of the unsprayed berries had rotted (Table 1). Both of the systemic fungicides proved less effective than the nonsystemics for the control of postharvest rot. Bay 33172 was the least effective. In 1967, Fungicide 1991 tended to be more effective for postharvest fruit rot control in raspberries than either captan, dichlofluanid or DAC 2787 (2). Perhaps Fungicide 1991 is absorbed and translocated more efficiently in the raspberry plant because of relatively large cane area.

Fungicide 1991 proved more effective than sulfur for the control of powdery mildew on strawberry foliage (Table 3). In previously unsprayed plots two sprays of Fungicide 1991 applied August 8 and 22 significantly reduced the mildew. To obtain comparable control with sulfur, a third spray was necessary on September 5. Similarly, in 1967 sulfur

Table 3. Influence of Fungicide 1991, Bay 33172, and sulfur on control of powdery mildew on 'Northwest' strawberries

Fungicide	Rate (lb active ingredient/ acre)	Number of sprays* FR	PM	Powdery mildew rating** on: Aug 14	Aug 28	Sept 11	Sept 27
Unsprayed		0	0	44.9 ab***	54.5 ab	52.1 abc	47.9 ab
Fungicide 1991	0.25	5	4	22.2 e	18.1 e	16.4 f	17.8 d
Fungicide 1991	0.25	5	0	27.9 cde	40.5 bcd	42.8 bcde	48.0 ab
Fungicide 1991	0.25	7	4	25.1 cde	21.7 e	19.4 f	12.6 d
Fungicide 1991	0.25	7	0	24.5 de	38.3 cd	39.3 cde	47.2 ab
Fungicide 1991	0.25	0	4	37.5 abcd	29.7 de	19.4 f	15.1 d
Bay 33172	0.5	5	4	35.0 bcde	57.3 a	36.5 de	36.9 bc
Bay 33172	0.5	5	0	48.6 ab	57.6 a	57.6 a	54.6 a
Bay 33172	0.5	7	4	37.8 abcd	46.7 abc	40.7 cde	42.5 ab
Bay 33172	0.5	7	0	49.3 ab	51.3 abc	56.3 ab	49.0 ab
Bay 33172	0.5	0	4	50.6 a	53.5 abc	43.7 abcd	37.4 bc
Sulfur	3.6	0	4	39.5 abc	42.8 abcd	28.4 ef	26.2 cd
Mean				36.9	42.7	37.7	36.3
S.E. Mean				4.51	4.68	4.43	4.40

* FR = fruit rot sprays; PM = powdery mildew sprays

FR sprays were applied on May 8 (first bloom), May 17 (about full bloom), May 27, June 6, June 17 (last spray before harvest), June 27 and July 5. PM sprays were applied on August 8 and 22, and September 5 and 19.

** Arcsine transformations of mean percentages of leaf surface affected.

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

was found to be less effective than Fungicide 1991 for mildew control in strawberries (2). In 1968, applications of Fungicide 1991 for fruit rot control also provided effective control of postharvest mildew infection up to 8 weeks after spraying had ceased. This was equally true whether 5 or 7 sprays had been applied. Bay 33172 proved ineffective for powdery mildew control.

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CLIMATE AND DISEASE DEVELOPMENT ON MUCK-GROWN VEGETABLES SOUTH OF MONTREAL, QUEBEC, IN 1968[1]

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

Abstract

In 1968, carrot and onion foliar diseases were observed early in July, and potato late blight developed severely in early plantings. A similar situation was observed in 1967. The prevalence of foliage diseases is attributed to the fact that in both years the amount of rainfall in June was close to the 31-year average for the district. These results corroborate our 1962 hypothesis on the relationship of rainfall to the development of foliage diseases of vegetables.

Résumé

En 1968, les maladies foliaires de la carotte et de l'oignon sont apparues tôt en juillet et le mildiou de la pomme de terre s'est développé à l'état grave dans les plantations précoces de cette culture. Une situation semblable a été observée en 1967. Cela est attribué au fait que la précipitation du mois de juin de ces deux années était sensiblement le même que la moyenne de 31 ans pour la région. Ces résultats confirment notre hypothèse en ce sens émise en 1962.

Introduction

The aim of this annual survey, initiated in 1959, is to record the annual occurrence and severity of diseases of the main vegetable crops in the muck soil district south of Montréal and to note their relationship with annual climatic conditions, especially with the amount of rainfall in June (1, 2, 3, 4). Early in the course of this work, the accumulated annual observations were also found very useful for the orientation of our research work and the improvement of our advice to growers regarding the timing of fungicide applications (8).

Methods

In 1968, most fields were examined in the middle of August, but as usual, some individual observations and visits were made at other times during the growing season. The disease ratings were based on the percentage of plants affected by viruses or soil-borne diseases and on the percentage of leaf area affected by leaf blights; the ratings were expressed as follows: trace (1-10%), slight (11-30%), moderate (31-60%), severe (61-100%).

The pertinent meteorological data recorded at Ste. Clotilde (Table 1) were obtained from Mr. C. Peron, Research Station, St. Jean, Qué.

Results

The most striking observations (Table 2) included the general occurrence and relatively high intensity of carrot blights caused by Alternaria dauci (Kühn) Groves & Skolko and Cercospora carotae (Pass.) Solh. in all of the 20 fields visited in August; the occurrence of onion leaf specks (Botrytis spp.) in all of the 18 fields surveyed and Alternaria porri (Ell.) Cif. in 11 of the fields; and the high intensity of late blight of potato caused by Phytophthora infestans (Mont.) de Bary in the 7 fields of the early crops surveyed in early August and its occurrence at a low level in the 7 fields of the fall crop visited later in August. It should also be noted that low temperatures and slow emergence favored the development of Rhizoctonia solani Kühn on potato, and the generally cool summer promoted the occurrence of white rot caused by Sclerotium cepivorum Berk. in a few onion fields. Onion mildew caused by Peronospora destructor (Berk.) Casp. develops only sporadically in this district and was observed in a few fields. The root knot nematode Meloidogyne hapla Chitwood caused severe damage in one carrot field at the Ste. Clotilde station, but only a trace infection was detected in one of the commercial carrot fields surveyed.

Discussion

The amount of rainfall in June of both 1967 and 1968 was close to the 31-year average (Table 1), a

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Table 1. Total rainfall and mean temperatures for June, July, and August at Ste. Clotilde, Chateauguay Co., Québec

Year	June		July		August	
	Rainfall (inches)	Temp. (F)	Rainfall (inches)	Temp. (F)	Rainfall (inches)	Temp. (F)
1967	3.64	66.7	3.37	68.9	2.02	66.1
1968	3.30	61.4	5.14	68.3	2.38	63.2
31-year average	3.40	63.8	3.56	67.8	3.40	65.6

Table 2. Diseases in the muck soil area south of Montreal in 1968

Crop	No. fields examined	Disease	No. of fields and disease rating*
CARROT	20	Leaf blights (Alternaria dauci and/or Cercospora carotae)	5 tr, 8 sl, 5 mod, 2 sev
		Root knot (Meloidogyne hapla)	1 tr, 1 sev
CELERY	8	Blotch and crater rot (Erwina carotovora)	1 tr
		Pink rot (Sclerotinia sclerotiorum)	1 tr, 1 sl
		Aster yellows (Callistephus virus 1)	2 tr
		Black heart (Improper water relations)	2 tr, 1 sl
		Manganese deficiency	3 tr
LETTUCE	4	Downy mildew (Bremia lactucae)	2 tr, 1 sl
		Basal rot (Rhizoctonia solani)	1 tr
		Drop (Sclerotinia sclerotiorum)	3 tr
		Aster yellows (Callistephus virus 1)	4 tr
		Mosaic	1 tr

Table 2. (continued)

Crop	No. fields estimated	Disease	No. of fields and disease rating*
ONION	18	Mildew (Peronospora destructor)	5 tr
		Purple blotch (Alternaria porri)	8 tr, 1 sl, 2 mod,
		Leaf flecks (Botrytis cinerea and/or B. squamosa)	14 tr, 3 sl, 1 mod
		Smut (Urocystis magica)	1 sl
		White rot (Sclerotium cepivorum)	2 tr, 1 mod
		Calcium deficiency	2 tr, 2 sl
POTATO	14	Black leg (Erwinia atroseptica)	2 tr
		Late blight (Phytophthora infestans)	
		Early crops (7 fields)	7 sev
		Late crops (7 fields)	7 tr
		Rhizoctonia (Thanatephorus cucumeris)	2 tr

* Disease ratings indicate the percentage of plants affected by viruses or soil-borne diseases or the percentage of leaf area affected by foliage blights; tr = 10%, sl = 11-30%, mod - 31-60%, sev = 61-100%.

condition that we have repeatedly found to favor the early establishment and epidemic development of foliar diseases (4, 7, 8, 9, 10, 11). In both 1967 and 1968, leaf blights of carrots and onions were noticed in early July, and growers were accordingly advised to start their spray applications earlier than usual. During July 1968, the higher than normal amount of rainfall favored the rapid spread of carrot blights. We noticed that, under these conditions, the control of carrot blights could be improved by measures to be further investigated.

As noticed in 1961, 1967, and again this year (5, 6, 11), a high amount of rainfall in June seems to favor the establishment and severe development of late blight in the early crops of potato grown in a few sections of the muck soil district. This greatly increases the inoculum and is a threat to the fall crops. The reason that the late blight fungus spreads rapidly in early plantings following favorable weather in June but appears only later on in fields of late varieties seems to be related to the stage of development of the potato plants and remains to be more fully investigated.

A last comment deals with onion leaf blight, caused by Botrytis squamosa Walker, a disease characterized first by the appearance of numerous flecks followed by a die-back or blight of the leaf. Similar leaf flecks without a blight phase are incited by Botrytis cinerea Pers. In both 1967 and 1968, numerous flecks appeared early in July and developed extensively. However, the blight phase developed extensively only in 1967. This suggests that B. squamosa prevailed in 1967 and B. cinerea in 1968, a year also characterized by an extensive development of gray mold in various crops. The alleged prevalence of B. squamosa in 1967 may be due to the fact that the higher than normal mean temperature in June 1967 was in accordance with the temperature requirements of the fungus. On the other hand, the mean temperature in June 1968 was lower than the 31-year average and presumably less favorable to B. squamosa.

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EFFECT OF PLANT TEMPERATURES ON DEVELOPMENT OF MOLD ON COLD-STORED STRAWBERRY PLANTS[1]

C.L. Lockhart[2]

Abstract

Strawberry plant temperatures and occurrence of mold were observed in strawberry storages over a 5-year period. Losses due to mold were mainly caused by a Typhula sp., with occasional outbreaks of Cylindrocarpon radicicola, Fusarium sp. and Sporotrichum sp. Less mold developed on fall-dug strawberry plants when they were cooled to -1.1C within 15 days of digging and maintained at this temperature for the entire storage period. Adequate air movement around storage crates was essential for rapid cooling.

Introduction

Losses of cold-stored strawberry plants due to mold have been reported in Nova Scotia (1), and it has subsequently been shown that a psychrophilic Typhula sp. was the pathogen most frequently involved (2).

This paper reports on observations in commercial storages over a 5-year period of strawberry plant temperatures and losses due to mold.

Materials and methods

From 1963 to 1968, strawberry plant temperatures in four commercial storages in Nova Scotia were recorded at intervals of 1 to 4 weeks during each yearly storage period from November to May. Plants were normally tied in bundles of 25, with 500-750 plants in each polyethylene-lined crate (4). Temperatures were determined with a Tele-thermometer (Model 42 SC, Yellow-Spring Instrument Co. Inc., Yellow Springs, Ohio) by inserting the temperature probe into the center of a crate of strawberry plants. Temperatures in 4 to 6 crates selected at random in each storage were recorded on each sampling date. Dates of digging and placing in storage were also recorded. Observations were made on the occurrence of mold at each sampling date, and estimates of losses during storage were obtained from the growers.

Results and discussion

Losses due to mold were mainly caused by a Typhula sp., with occasional outbreaks of Cylindrocarpon radicicola Wollenweber, Fusarium sp., and Sporotrichum sp. C. radicola and Fusarium sp. appeared responsible for the high losses in storage "J" in 1964-65, when 119 days were required to reduce plant temperatures to -1.1C (Table 1).

Sporotrichum sp. developed on plants in storage "W" in 1965-66. Here some freshly dug plants were stored temporarily in polythylene-lined crates with the liner left open to speed cooling, and the plant temperatures were reduced to -1.1C in 4 days. However, the plants in the top layer of the polyethylene-lined crates became desiccated and overgrown with Sporotrichum. This organism has frequently been found on plants which had been exposed to freezing temperatures.

A serious outbreak of Typhula in the 1966-67 storage season appeared to be associated with the rapid filling of storages and the stacking of crates too close to one another, thus prolonging the time required for the plants to reach the optimum storage temperature of -1.1C (4). The largest losses occurred in storages "A" and "C", which were filled with plants faster than in previous years and in which adequate spacing for air movement around each crate was not provided. All losses in storage "W" occurred on plants stored in solid-side crates that were stacked directly on top of one another; under these conditions, cooling for 75 days was required for all plants to reach -1.1C. In contrast, the bulk of the plants in storage "W" were stored in partly filled, slatted crates that permitted adequate air movement; in these crates mold did not develop during the 16 days required to lower the temperature to -1.1C.

In 1967-68 losses were lowest when the average plant temperature for the entire storage season was less than -1.0C and when all plants were cooled to -1.1C in 15 days or less (Table 1). Cooling was most rapid in all storages when stacks were spaced 2 to 4 inches apart and air spaces of 1 inch or more were left between crates in each stack.

Development of mold on plants was usually associated with conditions that extended the cooling-down period over 15-20 days, although, in some instances, little or no mold developed on plants that required 69 days to cool to -1.1C. Mold development was not associated with date of digging. Plants dug in mid-November, when plants are normally hardened off, stored as well as those dug in early

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Table 1. Losses of strawberry plants from mold during various cooling periods and 6 months' cold storage

Year*	Storage	Average plant temperatures (C)	Days required to reduce plant temperature to -1.1C		Number of plants stored	Losses due to mold (%)
			First plants	All plants		
1963-64	C	-0.71	22	47	97,000	<0.1
	W	-1.04	25	53	692,000	1.5
	J	-0.99	22	88	43,000	5.0
1964-65	C	-0.88	23	60	85,000	0.1
	W	-1.09	10	37	700,000	0.6
	J	-0.75	53	119	43,000	25.0
1965-66	C	-1.00	51	69	200,000	0.1
	W	-1.10	4*	45	1,000,000	3.3
1966-67	C	-0.90	16	53	269,000	26.4
	W	-1.02	16	75	850,000	5.8
	A	-0.90	16	75	155,000	11.0
1967-68	C	-1.03	15	15	60,000	0.1
	W	-1.08	11	14	100,000	1.1
	A	-1.06	14	14	22,000	0.0

* November to May

* Plants were stored loosely in polyethylene-lined crates and removed from storage, cleaned, and restored at a later date.

December. Typhula and Sporotrichum sometimes occurred on plants at -1.1C. C. radicicola and Fusarium sp. were usually found on plants with storage temperatures 0.5 to 1C above the recommended plant temperature of -1.1C.

Traces of Typhula sp. were first observed on root rot lesions 3 months after plants were placed in storage. Evidence of Typhula growing all over the surface of the plants appeared in 4 to 5 months, and the greatest mold growth occurred after 5 months. Sclerotia were often found on Typhula-infected plants after 6 months in storage. Since Typhula sometimes occurred on plants at -1.1C and appeared on bundles in various positions within the crate, all plants had probably not been infected or in contact with Typhula inoculum. Infection time is not known. However, Remsburg (3) reported that Typhula sporulated in the fall and winter months during rain and snow flurries with temperatures near 0C. Similar weather conditions suitable for sporulation of Typhula often occur in Nova Scotia during November, when plants are being dug for winter storage. In commercial fields, basidiospores have not been found, although Typhula mycelium has been found in April in scattered patches on strawberry plants under mulch. However in field plots containing Typhula-inoculated plants, basidiospores have been found on mycelial mats on the soil in mid-November (unpublished results).

To avoid excessive development of mold in storage, the temperature of fall dug strawberry plants must be reduced to -1.1C within 15 days after digging and plant temperature maintained at this temperature for the entire storage period. Crates should be stacked to allow adequate air movement.

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PINK SNOW MOLD IN SOUTHERN ALBERTA

J.B. Lebeau[1]

Abstract

Pink snow mold caused by Fusarium nivale (Fr.) Ces. was found in southern Alberta in the spring of 1967 and 1968 on winter cereals and turfgrass. The damage was extensive in the spring of 1967 following severe storms of wet snow. The pathogen was isolated from winter wheat (Triticum aestivum L.), Kentucky bluegrass (Poa pratensis L. 'Merion'), and creeping bentgrass (Agrostis palustris Huds. 'Penncross'). Pink snow mold had previously been described as occurring sporadically in Western Canada and was considered of minor importance. It now appears that F. nivale is widespread in southern Alberta and probably causes damage every year.

Occurrence of low-temperature pathogens

The distribution of psychrophilic pathogens tends to follow a geographic pattern. Within the temperate zone Sclerotinia borealis Bub. & Vleug. is found in the northern regions and Fusarium nivale (Fr.) Ces. occurs farther south. Typhula spp. and the unidentified basidiomycete (3) are usually isolated from intermediate zones (4, 6, 7). The geographic separation of these pyschrophils, however, is not always so distinct. Lebeau and Logsdon (9) isolated S. borealis and the low-temperature basidiomycete in Alaska and Typhula idahoensis Remsb. in the Yukon. Bruehl (2) reported that Typhula spp. and F. nivale often occur together in the Pacific Northwest and form a disease complex.

Pink snow mold

The disease on winter cereals and grasses caused by F. nivale is commonly called pink snow mold although the pigment produced by the fungus is a complex of yellow, red, carmine, and very intense orange (1). The formation of orange or red-orange pigment is often used for a rapid diagnosis of this disease. The disease caused by Typhula spp. is called gray snow mold because of the appearance of the fungus on affected plants. Winter damage caused by the low-temperature basidiomycete could logically be named white snow mold because of the fluffy white appearance of the pathogen.

Pink snow mold has been reported from most of the agricultural regions in the temperate zones. Until recently, however, F. nivale has been found only sporadically on the Canadian prairies and was considered of minor importance (7). In 1963, by limiting the minimum soil temperature to 6C or 3C with buried heating cables, Lebeau (8) produced an epiphytotic of pink snow mold on field plots of turfgrass. This demonstrated that the causal organism was present in southern Alberta and required only the right environmental conditions to incite the disease. The fungus isolated from these plots was identified in 1962 by the late Dr. W. L. Gordon, who stated that it was the first authentic culture of F. nivale of Canadian origin that he had received. In the spring of 1967, following severe storms of wet snow, pink snow mold was found on winter cereals and turfgrass throughout southern Alberta. The damage was extensive and the disease was apparent even to the most casual observer (Fig. 1). The pathogen, F. nivale, was isolated from winter wheat (Triticum aestivum L.), Kentucky bluegrass (Poa pratensis L. 'Merion'), and creeping bentgrass (Agrostis palustris Huds. 'Penncross'). Small pieces of tissue from the bases of the culms were plated on potato dextrose agar (PDA) and incubated at 6C. The growth on PDA showed the characteristic red-orange pigment. The conidia were 0-1 septate and measured 10-18 $\mu \times$ 2.3-5 μ (Fig. 1B); this size range is in agreement with the description of the 0- to 1-septate conidia of F. nivale, given by Gordon (5). No conidia with 2 or more septa were observed.

Pink snow mold was observed in southern Alberta again in the early spring of 1968, and the pathogen was isolated from winter wheat and turfgrass. Damage to these crops then was much less than in 1967, presumably because of a lighter snow cover in the spring of 1968 than in 1967.

Conclusions

Lebeau (7) reported that the unidentified low-temperature basidiomycete was the principal snow mold pathogen in Western Canada and that F. nivale occurred sporadically but was of minor importance. It now appears that in southern Alberta F. nivale is widespread and probably causes damage every year. Evidently F. nivale occasionally can incite an epiphytotic on winter cereals and turfgrasses in this region when heavy wet snow produces moist conditions in the spring. It is also quite likely that snow mold in southern Alberta is caused by a disease complex whose principal components are F. nivale and the psychrophilic basidiomycete.

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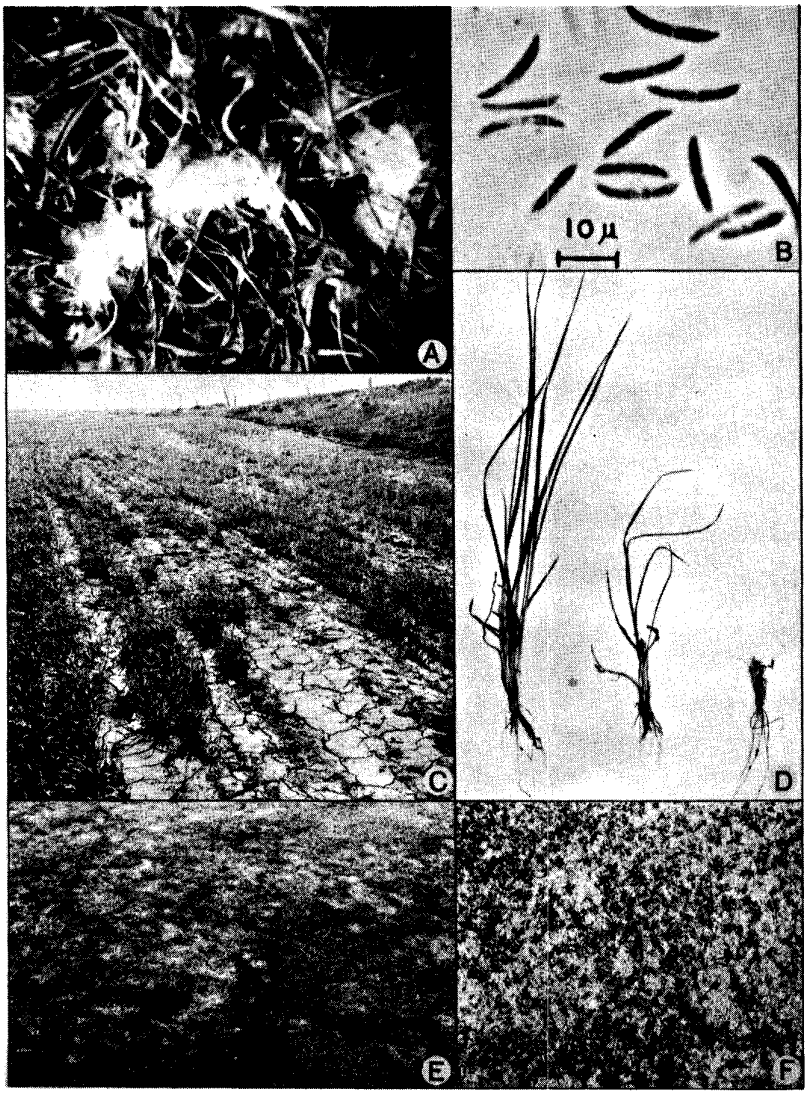

Figure 1. Pink snow mold on winter wheat and turfgrass in southern Alberta. A) Mycelial mats of pink snow mold on creeping bentgrass plots at the Canada Department of Agriculture Research Station, Lethbridge. B) Typical conidia of *Fusarium nivale* isolated from winter wheat in southern Alberta in 1967. C) Damage caused by pink snow mold to winter wheat in a field near Raymond, Alberta. D) Damage to winter wheat plants by *F. nivale*: healthy (left), intermediate (center), and severe (right). E) Pink snow mold on creeping bentgrass on a green at the Henderson Lake Golf Club, Lethbridge. F) Severe damage from pink snow mold on a lawn of 'Merion' bluegrass at Lethbridge.

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CONTROL OF MUMMY BERRY OF HIGHBUSH BLUEBERRY[1]

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Abstract

Ferbam remains the most effective fungicide for control of Monilinia vaccinii - corymbosi on highbush blueberry. Fungicide 1991 (benomyl) and dodine gave good control, as measured in terms of yield increase, even though the systemic Fungicide 1991 was used at a low rate of application. Zineb and captan did not significantly increase yield, although zineb was most effective in reducing leaf shoot and flower cluster infections. Berry size was not affected by any of the fungicides.

Introduction

Mummy berry of highbush blueberry has risen to epiphytotic proportions in the lower Fraser Valley of British Columbia during the past few years. In March, apothecia of Monilinia vaccinii - corymbosi (Reade) Honey produce ascopores that infect opening leaf and flower cluster buds to initiate the blight phase of this disease. Conidia produced on the buds then infect the ovary of the opening flowers from mid-April to mid-May to initiate the mummy berry phase.

Control of the blight phase depends on either the destruction of the apothecia on the ground before ascospore liberation or the application of a fungicidal dust or spray to the aerial portions of the bush to protect the opening buds.

A number of workers have studied the effects of various fungicides on control of this disease. Gilgut (2) obtained partial control with ferbam. Ferbam or zineb was recommended by Lockhart (3) for control of the blight phase in lowbush blueberry. Fulton (1) found zineb to be more effective than captan. None of these gives more than partial control under Fraser Valley conditions. Recently systemic fungicides have been developed for the control of plant diseases. The effectiveness of one of these, Fungicide 1991[4] (1-(butylcarbamoyl)-2-benzimidazole carbamic acid, methyl ester) (Dupont, Wilmington, Delaware), was compared with other fungicides for control of the blight phase of mummy berry in this experiment.

Methods

A field of mature highbush blueberry 'Rancocas',[5] heavily carpeted with developing mummy berry apothecia, was used. Twenty-four bushes in a block, six bushes by 4 bushes, were sprayed on March 18, March 28, April 8, April 20, and May 1 with ferbam, 3 lb/acre; captan, 2 lb/acre; zineb, 3 lb/acre; Fungicide 1991 50% WP, 0.125 lb active ingredient plus 2 oz Surfactant F/acre; dodine, 1.5 lb/acre; and no treatment. Each treatment was replicated four times in randomized blocks with one bush per replicate. Bushes were ranked in order of size from 1 to 24.

Bushes were examined on May 14. Leaf shoot and flower cluster infections were counted and recorded for each bush. Mummy berries in each replicate were recorded on July 17. Fruit was picked four times: July 19, July 29, August 5, and August 26. Weights and cup size (number of berries in a half-pint [US]) were recorded for each replicate. Analysis of covariance was calculated for each set of data to eliminate any effects of bush size.

Results and discussion

The fungicides used in this trail were compared under conditions of heavy mummy berry infection. The corrected data are recorded in Table 1. Cup size and weight of berries was not affected by any of the fungicides. All fungicides tested reduced the number of mummy berries by approximately one half over the control but were not significantly different from one another.

Zineb, dodine, ferbam, and Fungicide 1991 all significantly reduced infections of leaf shoots and flower clusters. Ferbam, Fungicide 1991, and dodine increased yield, but zineb, which decreased infections the most, failed to show any significant increase in yield. No treatments showed any evidence of phytoxicity.

Although Fungicide 1991 was not very effective in controlling leaf shoot and flower cluster infection,

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[4] Fungicide 1991 is now known by the trade name Benlate; the common name of the active ingredient has been designated benomyl.

[5] Derived from (Vaccinium corymbosum L. 'Brooks' × V. lamarckii Camp. 'Russell') × V. australe Small 'Rubel'.

Table 1. Influence of fungicides on mummy berry of highbush blueberry

Treatment	Active ingredient (lb/acre)	Yield* (lb/bush)	Blight infections* (no./bush)	Mummy berries* (no./bush)	Cup size**
Ferbam	3.000	35.3 a***	105.6 b	858.3 a	153 a
1991	0.125	30.6 ab	140.2 c	500.4 a	139 a
Dodine	0.500	28.9 ab	84.8 ab	894.9 a	137 a
Zineb	3.000	26.3 bc	67.6 a	788.6 a	144 a
Captan	2.000	24.1 bc	146.9 cd	636.9 a	147 a
Check	0.000	21.5 c	172.4 d	1349.4 b	139 a

* Data adjusted to bush size by regression analysis.

** Cup size = no. of berries/half-pint (US).

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

it reduced the number of mummy berries more efficiently than any other fungicide. This reduction was not statistically significant, but it may explain the increase in yield, which was second only to ferbam. It would appear that either Fungicide 1991 or dodine could be used in place of ferbam, but a systemic that does not require complete coverage for control would have an advantage. The rate of application of Fungicide 1991 was relatively low. Future trials will test the effectiveness of higher rates.

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OAT YIELD LOSSES DUE TO CROWN RUST

R.V. Clark[1]

Abstract

Four applications of Daconil 2787 at weekly intervals to oat plants naturally infected with crown rust largely controlled the disease. Untreated plants yielded approximately 20% less than treated plants, indicating the magnitude of the losses caused by crown rust. There was no apparent reduction in kernel weight due to crown rust.

Introduction

The control of cereal diseases with foliar applications of chemicals has been investigated for many years (3). The need for frequent chemical applications and the incomplete disease control achieved with chemicals have made their general use impractical. However, they have been used for cereal disease yield loss studies, where they have provided striking evidence of the losses caused by some diseases (1, 2, 4). More effective and more specific chemicals would provide additional information in this regard.

The fungicide Daconil 2787 has been found to have a wide spectrum of activity and has been effective against certain rusts (5). Its usefulness in controlling septoria leaf blotch, rusts, and other diseases of oats was investigated in field trials in 1967.

Methods

One-acre blocks of the oat varieties 'Stormont', 'Rodney', and 'Garry' were planted with a 7-inch drill for seed increase. A 3-m square plot within each of these blocks was treated with Daconil 2787 (75% tetrachloroisophthalonitrile) at the rate of 2 lb wettable powder per 100 gal water. It was applied four times at weekly intervals, and the first spray was applied on July 20, when the oat plants were heading. Disease initiation was dependent on natural inoculum in all cases. Oats were harvested on August 24 from four 3 m-long rows picked at random in each of the treated plots and from a similar number of adjacent untreated rows. Yield and 1000 kernel weight data were obtained for each of the treated and untreated samples.

Results and discussion

The septoria disease caused by Leptosphaeria avenaria Weber f. sp. avenaria was of minor importance on these plants in 1967. Because of the light infection, little difference in the prevalence of septoria was evident between the treated and untreated oats, and an accurate assessment of the effect of Daconil 2787 on this disease was not possible.

Crown rust caused by Puccinia coronata Cda. f. sp. avenae Eriks. & E. Henn was prevalent on oats in the Ottawa Area in 1967. A trace to light infection of crown rust was present on 10% of the oat plants at the time of the first application of the fungicide. By maturity the rust had developed on the untreated oats to a severe infection on 100% of the plants and many of the red pustules had changed to the black telial stage. Only a very light infection was present on about 25% of the treated plants at maturity, pustules were small and few telia had formed. At the time the oats ripened, the appearance of the treated plants was markedly better than that of the untreated ones because of freedom from rust. Treated plants, however, required a longer period to complete the ripening process. There was little evidence of difference in rust development on the varieties as all three were quite susceptible. The treated oat plants of the three varieties yielded considerably more than the untreated ones (Table 1) but their 1000 kernel weights were almost the same.

Daconil 2787 effectively controlled crown rust under the present conditions. Further tests are required to determine the most efficient rates and the number of applications needed to control the various

Table 1. Yields and 1000 kernel weights of seed from untreated crown-rust infected oat plants and from plants sprayed with Daconil 2787

Variety	Treatment*	Yield (g)	1000 kernel weight (g)
Stormont	untreated	123.6	30.0
	treated	149.8	29.6
Rodney	untreated	144.5	25.8
	treated	171.5	25.8
Garry	untreated	187.8	24.7
	treated	218.5	25.1

* Four sprays at weekly intervals of Daconil 2787 at 2 lb 75% W.P./100 gal water.

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levels of rust development encountered. The heavy natural infection of crown rust reduced yields by approximately 20%. This reduction compares favorably with results reported previously (4). Since there was practically no other disease present on oats in 1967, the results emphasize the importance of crown rust in oat production. The indication that crown rust does not affect kernel weight is not in agreement with previous findings (4, 6). The small differences in kernel weight between the treated and untreated samples may have resulted because of the loss of light seed during machine threshing.

Acknowledgments

The experimental sample of Daconil 2787 was supplied by the Diamond Alkali Company, Cleveland, Ohio. The technical assistance of J. H. Clark is appreciated.

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NEMATODES ASSOCIATED WITH LONG-ESTABLISHED TREE SPECIES AND FRUIT CROPS IN ESSEX COUNTY, ONTARIO

G.W. Bird[1] and L.W.D. Boekhoven[2]

There are four general types of published Canadian survey records of soil-inhabiting nematodes. These are the annual records of nematodes encountered by the nematologists of the Entomology Research Institute, Canada Department of Agriculture; the annual reports of the Ontario Nematode Diagnostic and Advisory Service; surveys of specific agricultural crops; and surveys of specific nematodes. There are few general geographical surveys of soil-inhabiting nematodes.

In 1968, 100 soil samples were collected from about the roots of long-established non-cultivated fruit crops in Essex County, Ontario. Five specimens of Acer saccharum March, (maple), Betula alba L. (birch), Juniperus virginiana L. (cedar), Populus tremuloides Michx. (poplar), Prunus armeniaca L. (apricot), Prunus persica (L.) Batsch. (peach), Pyrus communis L. (pear), Malus pumila Mill. (apple), Quercus alba L. (oak), and Vitis labrusca L. (grape) were selected at various locations in Essex County, and two soil samples were taken

Table 1. Occurrence of thirteen nematode genera in soil associated with ten plant species

Plant species	Criconemoides	Diptherophera	Helicotylenchus	Hemicycliophora	Hoplolaimus	Longidorus	Meloidogyne	Paratylenchus	Pratylenchus	Rotylenchus	Trichodorus	Tylenchorhynchus	Xiphinema
Acer saccharum Marsh.	40*	0	10	40	0	0	0	60	20	0	0	20	80
Betula alba L.	30	20	10	20	0	0	0	0	40	0	10	30	60
Juniperus virginiana L.	60	0	20	0	0	10	10	20	30	0	20	20	20
Populus tremuloides Michx.	80	50	30	50	0	0	0	0	10	0	10	0	20
Prunus armeniaca L.	20	0	0	0	0	0	0	0	80	0	0	10	20
Prunus persica L.	10	10	0	0	0	0	0	30	80	0	20	20	40
Pyrus communis L.	30	0	40	20	0	0	0	30	40	0	0	20	60
Malus pumila Mill.	10	0	30	0	0	0	0	60	40	10	0	10	80
Quercus alba L.	80	0	20	0	0	0	0	50	20	0	0	20	20
Vitis labrusca L.	60	0	10	0	20	0	0	40	50	0	10	40	30
Total	43	8	17	13	2	1	1	29	41	1	7	19	43

* Percentage of samples containing the genus.

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from the root zone of each plant. One sample was taken at a soil depth of 0-6 inches and the other at a 6 to 12-inch depth. Each sample consisted of approximately 500 g of soil, collected with a one-inch diameter soil tube. Nematodes were extracted from 100 g of each sample by a centrifugal-flotation technique (2), identified to genus, and counted.

Frequency of occurrence

Eighteen stylet-bearing nematode genera were identified during the survey. Aphelenchoides Fisher, 1894; Aphelenchus Bastian, 1865; Psilenchus de Man, 1921; Neotylenchus Steiner, 1931; and Tylenchus Bastian, 1865 were found in many of the samples. However, population density and frequency of occurrence data were not recorded for these genera. Xiphinema Cobb, 1913, and Criconemoides Taylor, 1936 were the most frequently occurring genera, being isolated from 43% of the samples (Table 1). Pratylenchus Filipjev, 1936 was found in 41% of the samples. Four genera, Hoplolaimus Daday, 1905; Longidorus (Micoletzky, 1922) Thorne and Swager, 1936; Meloidogyne Goeldi, 1887; and Rotylenchus Filipjev, 1936 occurred in less than 5% of the samples.

Criconemoides; Diptherophora de Man, 1880; and Hemicycliophora de Man, 1921 were isolated more frequently from long-established tree species than from fruit crops (Table 2). Pratylenchus was found in twice as many fruit crop samples, as from long-established tree species samples. Helicotylenchus Steiner, 1945 was found more often at soil depths of 0-6 inches than 6-12 inches, while Hemicycliophora and Trichodorus Cobb, 1913 occurred more frequently at the greater soil depth (Table 2).

Xiphinema americanum Cobb, 1913 and Hemicycliophora similis Thorne, 1955 were the only species of these two genera collected. The three species, Criconemoides annulatum Cobb in Taylor, 1936, C. xenoplax Raski, 1952, and C. lobatum Raski, 1952 were identified, and two undescribed speceis of the genus were collected; one closely resembled C. tribulis Raski and Golden, 1965 and

Table 2. Frequency of occurrence of thirteen nematode genera in 50 soil samples from long-established non-cultivated tree species, fruit crops, and two soil depths

Genus	Long established tree species	Cultivated fruit crops	0-6 inch soil depth	6-12 inch soil depth
Criconemoides	60*	26	42	44
Diptherophora	14	2	8	8
Helicotylenchus	18	16	22	12
Hemicycliophora	22	4	8	18
Hoplolaimus	0	4	2	2
Longidorus	2	0	2	0
Meloidogyne	2	0	0	2
Paratylenchus	28	30	28	30
Pratylenchus	24	58	40	42
Rotylenchus	0	2	2	0
Trichodorus	8	6	4	10
Tylenchorhynchus	18	20	20	18
Xiphinema	52	46	50	48

* Percentage of samples containing the genus.

C. petasus Wu, 1965. Several samples from Pelee National Park contained more than one species of Criconemoides, while samples from fruit crops often contained more than one species of Paratylenchus.

All specimens of Trichodorus were similar, and closely resembled Trichodorus teres Hooper, 1962, T. allius Jensen, 1963, and T. rhodesiensis Siddiqi and Brown, 1965. Positive identification was not possible, since no males were found. Females of Trichodorus were cylindrical, tapering to the lip region, and had rounded tails. Body length ranged from 620 to 790 μ. The excretory pore was located midway between the base of the stylet and the base of the esophagus, while the esophagus had a pronounced ventral overlap of the intestine. The reproductive system consisted of a median vulva (V = 52-55%) with a transvere slit and paired opposite ovaries. No lateral pores were observed; the anus was subterminal, and a single pair of terminal caudal pores were present.

Population density

With the exception of the single population of Hoplolaimus, the greatest mean population density was 34 Pratylenchus/100 g soil (Table 3). There were 31, 20, and 18 Paratylenchus, Criconemoides, and Helicotylenchus, respectively/100 g soil. The largest single population, 472 Paratylenchus/100 g soil was recovered from about the roots of A. saccharum.

Population densities of Helicotylenchus and Paratylenchus were greater in samples from long-established tree species than in samples from fruit crops, while population densities of Pratylenchus,

Table 3. Population density of thirteen nematode genera in soil associated with ten plant species

Plant species	Criconemoides	Diptherophera	Helicotylenchus	Hemicycliophora	Hoplolaimus	Longidorus	Meloidogyne	Paratylenchus	Pratylenchus	Rotylenchus	Trichodorus	Tylenchorhynchus	Xiphinema
Acer saccharum Marsh.	30*	0	2	3	0	0	0	111	3	0	0	2	4
Betula alba L.	21	2	1	2	0	0	0	0	3	0	2	5	5
Juniperus virginiana L.	5	0	59	0	0	4	1	4	7	0	8	7	9
Populus tremuloides Michx.	27	5	5	1	0	0	0	0	4	0	3	0	5
Prunus armeniaca L.	23	0	0	0	0	0	0	0	56	0	0	5	10
Prunus persica L.	1	1	0	0	0	0	0	1	72	0	7	11	5
Pyrus communis L.	2	0	5	12	0	0	0	8	6	0	0	18	25
Malus pumila Mill.	3	0	9	0	0	0	0	14	57	2	0	5	16
Quercurs alba L.	23	0	61	0	0	0	0	15	20	0	0	6	6
Vitis labrusca L.	29	0	7	0	80	0	0	9	12	0	2	6	12
Total	20	4	18	3	80	4	1	31	34	2	5	7	10

* Mean number of nematodes/100 g of soil recovered from samples containing the genus.

Hemicycliophora, Tylenchorhynchus, and Xiphinema were greater in samples from cultivated fruit crops. Mean population densities of Criconemoides and Paratylenchus were greater at 0-6 inch than at a 6-12 inch soil depths.

There are several differences between the frequency of occurrence of nematode genera and population densities reported in the present investigation and those of some previous surveys. For example, Criconemoides and Xiphinema were recovered from 43% of the present samples, while Criconemoides was present in 20% and Xiphinema in 11% of the samples processed in 1967 by the Ontario Nematode Diagnostic and Advisory Service (4). On the other hand, Pratylenchus occurred in 93% of the Advisory Service samples and in only 41% of those in the present survey. These variations occurred because different extraction techniques were used and different hosts were surveyed. Paratylenchus, which occurred in a similar number of samples from long-established tree species and fruit crops (Table 2), had a similar frequency of occurrence in the present survey and in the Advisory Service Report.

In some cases, the depth at which a sample is taken can influence frequency of occurrence and population density (Tables 2 and 4). It is generally believed that phytopathogenic nematodes are most abundant in the upper portion of a rhizosphere (3). However, populations have been reported at substantially greater depths (1, 5).

The frequency of occurrence and population densities of ectoparasitic nematodes in Essex County, indicate that there is a definite need for research on the host-parasite relationships of ectoparasitic nematode species, and on the possibility of their joint action in certain disease complexes.

Table 4. Population density of thirteen nematode genera in 50 samples of soil from long-established non-cultivated tree species, fruit crops, and two soil depths

Genus	Long-established tree species	Cultivated fruit crops	0-6 inch soil depth	6-12 inch soil depth
Criconemoides	20*	18	29	12
Diptherophora	4	1	3	2
Helicotylenchus	28	7	15	21
Hemicycliophora	2	12	5	3
Hoplolaimus	0	80	83	76
Longidorus	4	0	4	0
Meloidogyne	1	0	0	1
Paratylenchus	57	10	24	11
Pratylenchus	7	46	19	27
Rotylenchus	0	2	2	0
Trichodorus	5	5	3	5
Tylenchorhynchus	5	9	4	6
Xiphinema	6	15	12	8

* Mean number of nematodes/100 g of soil recovered from samples containing the genus.

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EVALUATION OF SEED TREATMENT CHEMICALS FOR THE CONTROL OF SEEDLING BLIGHT OF BARLEY[1]

H.A.H. Wallace and J.T. Mills[2]

Abstract

Eighty-six seed treatment chemicals were tested for their efficacy in controlling seedling blight of barley caused by Cochliobolus sativus, using 100%-infested seed. Based on emergence and disease ratings 4-6 weeks from sowing, mercury compounds generally gave the best results. Among the mercurials, Hoechst 2874 and Pennsalt TD 8538 were of merit, while Morton EP 433 and Busan 72 were phytotoxic at the dosages used.

Introduction

In 1942 Greaney & Wallace (2) tested available fungicidal seed treatment compounds for control of seedling blight of barley caused by Cochliobolus sativus (Ito and Kurib. ex Kurib.) Drechs. ex Dastur. No further work was done at Winnipeg until 1968, when a severe infestation of barley in eastern Canada in 1967 gave an opportunity to evaluate with diseased seed the performance of current registered and experimental fungicides and fungicide-insecticide combinations. The effectiveness of available chemicals for control of seedling blight and their potential for control of common root rot caused by soil-borne C. sativus and other fungi was determined.

Barley (Hordeum vulgare L. 'Herta') seed obtained from Charlottetown, Prince Edward Island, was used throughout the experiments. One hundred percent of the seeds were infected with C. sativus; the seed also carried spores of Alternaria, Cephalosporium, Cladosporium, Streptomyces and other fungi.

The source, formulation, and composition of the 86 seed treatment chemicals used are given in Table 1. Each chemical was applied to 200 g of seed at the indicated dosage (Tables 2-5) and shaken well in a 1-quart glass jar. The jars were kept sealed for 2 days to allow the vapor, if any, to act and then lots of 200 seeds were packaged in envelopes. Envelopes that contained seed from the same treatment were then placed in polyethylene bags and stored at 15C until seeding 28 to 48 days later. One of the compounds, SWF 2000, was used as a slurry prepared by adding 4.2 ml of water to each gram of wettable powder. Because of the large number of treatments the trial was split for convenience into four tests described in Tables 2 to 5.

Test 1 was sown at Brandon and Morden, and tests 2 to 4, at Brandon, Morden, and Winnipeg, Manitoba. The one-row plots were 12 feet long, 9 inches apart, and replicated four times at each location. Two hundred seeds were sown in each row; the plants were pulled 4-6 weeks after seeding and the percentage emergence was recorded. One hundred of the emerged plants from each row were rated for seedling root rot using a 0-5 scale (1). The disease rating percentage for each treatment was determined by the following formula:

$$\text{Disease rating percentage} = \frac{\text{average of numerical ratings of individual plants} \times 100}{5}$$

Results and discussion

Emergence ranged from 32.6% to 84.5% depending on the treatment. Emergence in the untreated checks was relatively constant, about 60% for all tests (Tables 2-5); therefore any large increases or decreases in emergence were probably caused by the treatment. Twelve chemicals at one or more dosages gave significantly lower emergence than the untreated checks. Phytotoxicity was apparent with Busan 72 (treatment nos. 133, 147, 149) and EP 433 (nos. 56 and 57), where emergence decreased as dosage was increased. The reasons for the low emergence associated with the other chemicals could not be established.

Twenty-eight chemicals gave significantly greater emergence than the checks. Panogen 15B (nos. 32, 58, 90) gave the best emergence with 79.2%, 80.1%, and 84.5% compared to 61.5%, 59.0%, and 60.5%, respectively, in the checks. Some non-mercurials, notably Vitavax (no. 2) with 78.0%, SWF 910 (no. 93) with 78.2%, and Hoechst 2874 (no. 60) with 76.0%, also increased emergence appreciably compared to 58.8%, 60.5%, and 59.0% in the respective checks.

The disease rating percentage of the emerged plants in the untreated checks ranged from 20.0 to 43.6; with two exceptions they were in the range

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Table 1. Source, product name, and composition of seed treatment materials used in the four tests

Treatment no.	Source*	Product name	Chemical name
1	Du Pont	Ceresan M	ethyl mercury-p-toluene sulfonanilide
2	Uniroyal	Vitavax (D735)	5, 6-dihydro-2-methyl-1, 4-oxathiin-3-carboxanilide
3	Niagara	Puraseed	phenylmercury formamide (5.5%) + phenylaminocadmium dilactate (2.5%)
4	Morton	Panogen PX	methylmercury dicyandiamide
5	Rohm & Haas	Dithane M45	zinc co-ordinated manganese ethylenebis (dithiocarbamate)
6	Green Cross	3922	RD8684 (15%) + hexachlorobenzene (5%)
7	Chipman	53-64	maneb (50.0%)
8	Green Cross	RD8684 + maneb	RD8684 + maneb
9	Chemagro	4497 (50%)	bis (1, 2, 2-trichloroethyl) sulfoxide
10	Green Cross	SWF 790	identity not available
11	Niagara	Polyram (80%)	zinc activated polyethylene thiuram disulphide
12	Morton	EP 277	identity not available
13	Green Cross	RD8684	identity not available
14	Uniroyal	G696	2, 4-dimethyl-5-carboxanilido thiazole
15	Chipman	TF56-67	maneb (18.25%) + zineb (18.25%)
16	Olin	Terracoat	quintozene (2%) + 5-ethoxy-3-trichloromethyl-1, 2, 4-thiadiazole (1.0%)
17	Green Cross	SWF 810	identity not available
18	Green Cross	SWF 1040	identity not available
19	Chemagro	Dexon (70%)	p-dimethylaminobenzenediazo sodium sulfonate
20	Green Cross	Res-Q	hexachlorobenzene (20%) + captan (20%) + maneb (15%)
21	Co-op	Hexa	hexachlorobenzene
22	Green Cross	SWF 800	identity not available
24	Uniroyal	F427	2, 3-dihydro-5-ortho-phenyl-carboxanilido-6-methyl-1, 4-oxathiin
25	Uniroyal	Plantvax (F461)	2, 3-dihydro-5-carboxanilido-6-methyl-1, 4-oxathiin-4, 4-dioxide
27	Green Cross	SWF 850	identity not available
28	Niagara	Polyram (53.5%)	zinc activated polyethylene thiuram disulphide
29	Green Cross	SWF 840	identity not available
30	Uniroyal	G696	2, 4-dimethyl-5-carboxanilido thiazole
31	Green Cross	SWF 860	identity not available
32	Morton	Panogen 15B	methylmercury dicyandiamide
33	Morton	Panogen PX	methylmercury dicyandiamide
34	Morton	EP 279B (?3.0%)	identity not available
36	Morton	EP 431 (25.0%)	identity not available
37	Morton	EP 411A (27.5%)	identity not available
38	Morton	EP 405A (25.0%)	identity not available
39	Morton	EP 411 (62.5%)	identity not available
40	Morton	EP 347 (54.7%)	identity not available
41	Morton	EP 431 (25.0%)	identity not available
42	Morton	EP 407A (25.0%)	identity not available
43	Morton	EP 339A (25.0%)	identity not available
44	Morton	EP 432 (25.0%)	identity not available
46	Morton	EP 342A (25.0%)	identity not available
47	Morton	EP 339A (25.0%)	identity not available
48	Morton	EP 430 (25.0%)	identity not available
49	Morton	EP 405A (25.0%)	identity not available
50	Morton	EP 342A (25.0%)	identity not available
51	Morton	EP 432 (25.0%)	identity not available
52	Morton	EP 406A (25.0%)	identity not available
53	Morton	EP 407A (25.0%)	identity not available
54	Morton	EP 406A (25.0%)	identity not available
55	Morton	EP 430 (25.0%)	identity not available
56	Morton	EP 433 (25.0%)	identity not available

Table 1 (continued)

Treatment no.	Source*	Product name	Chemical name
57	Morton	EP 433 (25.0%)	identity not available
58	Morton	Panogen 15B	methylmercury dicyandiamide
59	Morton	Pandrinox A	methylmercury dicyandiamide (0.72) + aldrin (2.5 lb/gal.)
60	Hoechst	2874	identity not available
61	Hoechst	2874	identity not available
62	Hoechst	2874	identity not available
63	Chipman	26-68	identity not available
64	Chipman	23-68	identity not available
65	Chipman	28-68	identity not available
66	Chipman	19-68	identity not available
67	Chipman	33-68	identity not available
68	Chipman	22-68	identity not available
69	Chipman	30-68	identity not available
70	Chipman	34-68	identity not available
71	Chipman	24-68	identity not available
72	Chipman	27-68	identity not available
73	Morton	EP 371A (37.5%)	identity not available
74	Morton	EP 279C (12.5%)	identity not available
75	Chipman	32-68	identity not available
76	Morton	EP 279B (23.0%)	identity not available
77	Morton	S 91 (53.5%)	identity not available
78	Morton	EP 279C (12.5%)	identity not available
80	Morton	EP 411A (27.5%)	identity not available
81	Morton	EP 411 (62.5%)	identity not available
82	Morton	EP 371D (31.25%)	identity not available
83	Morton	S 91 (53.5%)	identity not available
84	Morton	EP 347 (54.7%)	identity not available
85	Morton	EP 402 (43.2%)	identity not available
86	Morton	EP 408 (38.0%)	identity not available
87	Morton	EP 408 (38.0%)	identity not available
88	Morton	EP 409 (25.0%)	identity not available
89	Morton	EP 410 (75.0%)	identity not available
90	Morton	Panogen 15B	methylmercury dicyandiamide
91	Green Cross	Tillex DB	ethoxy ethyl mercury hydroxide
92	Green Cross	Tillex DB + lindane	ethoxy ethyl mercury hydroxide + lindane
93	Green Cross	SWF 910	identity not available
94	Pennsalt	TD 8538	identity not available
95	Niagara	BEI-07	identity not available
96	Green Cross	SWF 910	identity not available
97	Green Cross	SWF 580	identity not available
98	Co-op	BL	identity not available
99	Rohm & Haas	RH 575	identity not available
100	Co-op	BL	identity not available
101	Green Cross	SWF 1040	identity not available
102	Green Cross	SWF 2000	identity not available
103	Niagara	BEI-07	identity not available
104	Niagara	Polyram + Furadan	zinc activated polyethylene thiuram disulfide (26.7%) + 2, 3-dihydro-2, 2-dimethyl-7-benzofuranyl N-methylcarbamate (25.0%)
105	Green Cross	SWF 1080	identity not available
106	Co-op	BL	identity not available
107	Green Cross	RD 19693	identity not available
108	Chemagro	Bay 33172 (50%)	identity not available
109	Green Cross	SWF 1090	identity not available
110	Niagara	BEI-06	identity not available
112	Rohm & Haas	RH 575	identity not available

Table 1 (continued)

Treatment no.	Source*	Product name	Chemical name
113	Green Cross	SWF 910	identity not available
114	Niagara	Polyram + Furadan	zinc activated polyethylene thiuram disulfide (26.7%) + 2, 3-dihydro-2, 2-dimethyl-7-benzofuranyl N-methylcarbamate (25.0%)
115	Rohm & Haas	RH 058	identity not available
116	Niagara	Polyram + aldrin	zinc activated polyethylene thiuram disulfide (26.7%) + aldrin ST (25.0%)
117	Niagara	Polyram	zinc activated polyethylene thiuram disulfide (53.5%)
118	Green Cross	SWF 990	identity not available
119	Niagara	BEI-07	identity not available
120	Green Cross	SWF 2000	identity not available
121	Rohm & Haas	RH 893	identity not available
122	Green Cross	SWF 1040	identity not available
123	Niagara	Polyram + Furadan	zinc activated polyethylene thiuram disulfide (26.7%) + 2, 3-dihydro-2, 2-dimethyl-7-benzofuranyl N-methylcarbamate (25.0%)
124	Green Cross	SWF 910	identity not available
125	Rohm & Haas	RH 575	identity not available
126	Niagara	Polyram + lindane	zinc activated polyethylene thiuram disulfide (26.7%) + lindane ST (25.0%)
127	Rohm & Haas	RH 058	identity not available
128	Niagara	Polyram ST	zinc activated polyethylene thiuram disulfide (53.5%)
129	Rohm & Haas	RH 058	identity not available
130	Buckman	Busan 70	identity not available
131	Buckman	Busan 70	identity not available
132	Green Cross	SWF 990	identity not available
133	Buckman	Busan 72	identity not available
134	Green Cross	SWF 1040	identity not available
135	Green Cross	SWF 1040	identity not available
136	Rohm & Haas	RH 893	identity not available
137	Green Cross	SWF 990	identity not available
138	Rohm & Haas	RH 893	identity not available
139	Green Cross	SWF 850	identity not available
140	Co-op	BD	identity not available
141	Green Cross	SWF 990	identity not available
142	Buckman	Busan 70	identity not available
143	Co-op	BD	identity not available
144	Co-op	BD	identity not available
145	Green Cross	SWF 850	identity not available
146	Green Cross	SWF 850	identity not available
147	Buckman	Busan 72	identity not available
148	Green Cross	SWF 850	identity not available
149	Buckman	Busan 72	identity not available

* E. I. Dupont de Nemours & Co., Inc., Wilmington, Delaware; United States Rubber Co., Naugatuk, Connecticut; Niagara Brand Chemicals, Burlington, Ontario; Morton Chemical Co., Woodstock, Illinois; Rohm & Haas Co. of Canada Ltd., West Hill, Ontario; Green Cross Products, Montreal Québec; Chipman Chemical Ltd., Hamilton, Ontario; Olin-Mathieson Chemical Corp., Little Rock, Arkansas; Chemagro Corporation, Kansas City, Missouri; Interprovincial Cooperatives Ltd., Winnipeg, Manitoba; American Hoechst Corp., North Hollywood, California; Pennsalt Chemicals of Canada Ltd., Vancouver, British Columbia; Buckman Laboratories Inc., Memphis, Tennessee.

20.0 to 26.2. The disease rating percentage for treated seed ranged from 7.6 to 45.6, demonstrating that no treatment gave complete control of C. sativus. Although EP 433 (nos. 56 and 57) gave the lowest ratings, this chemical treatment was phytotoxic, as noted previously. Low disease rating percentages were also found with the mercurials Panogen 15B (nos. 32, 58, 90), Panogen PX (no. 33), Tillex DB (no. 91), Pandrinox A (no. 59), Tillex DB + lindane (no. 92), and the non-mercurial Pennsalt TD 8538 (no. 94).

Generally compounds containing mercury gave the best overall results with high emergence and low disease ratings. Two non-mercurial compounds, however, were of merit: Hoechst 2874 (nos. 60, 61, 62) gave high emergence but tended to have higher disease ratings than the mercurials, and Pennsalt TD8538 (no. 94) gave lower emergence but about the same disease rating as the mercurials.

As shown by emergence data (Table 3), the performance of fungicides that contain mercury and

Table 2. Test 1 - Results of field trials at two locations for control of seedling blight of barley

Treatment no.	Product name and formulation†		Dosage (oz/bu)	Emergence†† (%)	Disease rating†† (%)
1	Ceresan M	WP	0.75	78.2*	40.5
2	Vitavax (D735)	WP	1.00	78.0*	45.0
3	Puraseed	L	0.75	77.2*	41.9
4	Panogen PX	D	2.00	76.3*	41.6
5	Dithane M45	WP	2.00	70.6*	40.6
6	3922	D	2.00	69.3*	41.3
7	53-64	D	2.00	69.0*	39.1
8	RD8684 + maneb	D	2.00	68.3*	43.5
9	4497 (50%)	WP	1.00	67.5*	40.9
10	SWF 790	WP	2.00	65.6*	41.0
11	Polyram (80%)	WP	2.00	65.2*	39.3
12	EP 277	Sn	2.00	64.1	41.2
13	RD8684	D	2.00	63.8	45.4
14	G696	WP	2.00	63.6	42.6
15	TF 56-67	D	2.00	62.8	38.0
16	Terracoat	L	6.00	61.4	41.3
17	SWF 810	WP	2.00	60.6	42.7
18	SWF 1040	WP	2.00	60.2	44.7
19	Dexon (70%)	WP	1.00	59.6	42.6
20	Res-Q	WP	2.00	59.3	40.9
21	Hexa	D	0.50	59.3	44.7
22	SWF 800	WP	2.00	58.8	41.0
23	Untreated check			58.8	42.1
24	F427	WP	1.00	58.6	42.3
25	Plantvax (F461)	WP	1.00	58.1	44.4
26	Untreated check			57.8	43.6
27	SWF 850	WP	2.00	56.9	43.8
28	Polyram (53.5%)	WP	2.00	56.4	41.6
29	SWF 840	WP	2.00	55.2	44.0
30	G696	WP	1.00	54.7	44.3
31	SWF 860	WP	2.00	52.6	45.6
	Least Significant Difference			6.1	NS

† Formulation code: D = dust, WP = wettable powder, Sn = solution, L = liquid.

†† Means of tests at Morden and Brandon.

* Significant at the 5% level.

Table 3. Test 2 - Results of field trials at three locations for control of seedling blight of barley

Treatment no.	Product name and formulation†		Dosage (oz/bu)	Emergence†† (%)	Disease rating†† (%)
32	Panogen 15B	Sn	0.75	79.2*	11.2*
33	Panogen PX	D	2.00	75.7*	12.3*
34	EP 279B (23.0%)	Sn	0.50	63.9	25.5
35	Untreated check			61.5	23.1
36	EP 431 (25.0%)	WP	12.00	61.2	20.0
37	EP 411A (27.5%)	Sn	1.00	59.8	24.8
38	EP 405A (25.0%)	WP	4.00	59.6	24.6
39	EP 411 (62.5%)	WP	0.50	59.5	22.9
40	EP 347 (54.7%)	WP	0.75	59.3	26.2
41	EP 431 (25.0%)	WP	6.00	59.2	25.6
42	EP 407A (25.0%)	WP	4.00	58.5	22.9
43	EP 339A (25.0%)	WP	0.75	58.2	24.6
44	EP 432 (25.0%)	WP	4.00	58.1	25.2
45	Untreated check			58.1	24.1
46	EP 342A (25.0%)	WP	8.00	57.8	23.5
47	EP 339A (25.0%)	WP	1.50	57.3	27.2
48	EP 430 (25.0%)	WP	6.00	56.7	25.3
49	EP 405A (25.0%)	WP	8.00	56.3	25.8
50	EP 342A (25.0%)	WP	4.00	56.2	22.0
51	EP 432 (25.0%)	WP	2.00	56.1	22.1
52	EP 406A (25.0%)	WP	6.00	55.2	26.0
53	EP 407A (25.0%)	WP	2.00	55.0	23.0
54	EP 406A (25.0%)	WP	12.00	52.8	25.3
55	EP 430 (25.0%)	WP	12.00	52.1	21.5
56	EP 433 (25.0%)	WP	6.00	45.2	7.6*
57	EP 433 (25.0%)	WP	12.00	32.6	10.3*
	Least Significant Difference			4.7	3.9

† Formulation code: D = dust, WP = wettable powder, Sn = solution

†† Means of tests at Winnipeg, Morden, and Brandon

* Significant at the 5% level.

Table 4. Test 3 - Results of field trials at three locations for control of seedling blight of barley

Treatment no.	Product name and formulation†		Dosage (oz/bu)	Emergence†† (%)	Disease rating†† (%)
58	Panogen 15B	Sn	0.75	80.1*	10.2*
59	Pandrinox A	Sn	2.00	78.5*	12.3*
60	2874	WP	2.00	76.0*	18.7
61	2874	WP	1.50	75.8*	23.0
62	2874	WP	2.50	75.5*	17.3
63	26-68	D	2.00	71.8*	16.2
64	23-68	D	2.00	70.2*	14.4*
65	28-68	D	2.00	69.0*	15.1
66	19-68	D	2.00	66.4*	15.7
67	33-68	D	2.00	66.2*	18.5
68	22-68	D	2.00	65.6*	14.7*
69	30-68	D	2.00	65.3*	21.0
70	34-68	D	2.00	65.0*	20.7
71	24-68	D	2.00	64.8*	20.0
72	27-68	D	2.00	63.9	18.8
73	EP 371A (37.5%)	P	2.00	62.9	24.0
74	EP 279C (12.5%)	P	2.00	62.7	23.0
75	32-68	D	2.00	62.5	18.4
76	EP 279B (23.0%)	Sn	1.00	61.4	23.2
77	S 91 (53.5%)	P	3.00	60.5	16.6
78	EP 279C (12.5%)	P	1.00	60.5	21.0
79	Untreated check			59.0	20.0
80	EP 411A (27.5%)	Sn	2.00	58.5	21.2
81	EP 411 (62.5%)	WP	1.00	57.5	20.5
82	EP 371D (31.25%)	P	2.00	56.7	20.2
83	S 91 (53.5%)	P	1.00	56.1	19.9
84	EP 347 (54.7%)	WP	1.50	55.9	22.4
85	EP 402 (43.2%)	Sn	2.00	55.7	22.9
86	EP 408 (38.0%)	Sn	1.00	54.8	21.0
87	EP 408 (38.0%)	Sn	2.00	54.3	19.1
88	EP 409 (25.0%)	P	2.00	53.8	20.0
89	EP 410 (75.0%)	P	2.00	53.0	22.0
	Least Significant Difference			5.0	5.1

† Formulation code: D = dust, P = powder, WP = wettable powder, Sn = solution.

†† Means of tests at Winnipeg, Mordon, and Brandon.

* Significant at the 5% level.

Table 5. Test 4 - Results of field trials at three locations for control of seedling blight of barley

Treatment no.	Product name and formulation†		Dosage (oz/bu)	Emergence†† (%)	Disease rating†† (%)
90	Panogen 15B	Sn	0.75	84.5*	10.5*
91	Tillex DB	WP	1.00	81.4*	12.6*
92	Tillex DB + lindane	WP	2.00	79.6*	15.0*
93	SWF 910	WP	2.00	78.2*	17.7*
94	TD 8538	WP	2.00	71.8*	9.4*
95	BEI-07	WP	3.00	68.0*	20.2*
96	SWF 910	WP	1.50	67.6*	21.6
97	SWF 580	D	2.00	65.1	22.6
98	BL	L	4.00	65.0	21.5
99	RH 575	WP	1.92	64.8	24.5
100	BL	L	2.00	64.2	25.8
101	SWF 1040	WP	1.50	62.2	21.5
102	SWF 2000	D	2.00	61.6	21.1*
103	BEI-07	WP	2.00	61.6	19.7*
104	Polyram + Furadan	WP	4.00	61.5	24.7
105	SWF 1080	D	2.00	61.3	22.8
106	BL	L	6.00	61.0	20.5*
107	RD 19693	D	2.00	60.7	25.0
108	Bay 33172 (50%)	WP	2.00	60.6	26.8
109	SWF 1090	D	2.00	60.5	21.7
110	BEI-06	WP	2.00	60.5	18.5*
111	Untreated check			60.5	26.2
112	RH 575	WP	0.96	60.3	24.5
113	SWF 910	WP	1.00	60.0	22.9
114	Polyram + Furadan	WP	3.00	60.0	24.2
115	RH 058	L	1.32	59.7	21.3*
116	Polyram + aldrin	WP	2.00	59.5	26.8
117	Polyram	WP	2.00	59.5	23.1
118	SWF 990	WP	1.50	59.0	28.8
119	BEI-07	WP	1.00	59.0	22.9
120	SWF 2000	SL	2.00	58.8	19.4*
121	RH 893	L	1.32	58.7	21.3*
122	SWF 1040	WP	2.00	58.7	22.8
123	Polyram + Furadan	WP	2.00	58.6	22.8
124	SWF 910	WP	0.50	58.1	23.6
125	RH 575	WP	0.48	57.8	25.3
126	Polyram + lindane	WP	2.00	57.6	22.3
127	RH 058	L	0.66	57.5	24.6
128	Polyram ST	WP	1.00	56.9	22.2
129	RH 058	L	0.33	56.2	25.3
130	Busan 70	L	1.20	55.9	23.9
131	Busan 70	L	0.45	55.6	23.4
132	SWF 990	WP	1.00	55.5	30.9

† Formulation code: D = dust, WP - wettable powder, SL = slurry, Sn = solution, L = liquid.

†† Means of tests at Winnipeg, Morden and Brandon.

* Significant at the 5% level.

Table 5. (Cont'd.)

Treatment no.	Product name and formulation[†]		Dosage (oz/bu)	Emergence[††] (%)	Disease rating[††] (%)
133	Busan 72	L	0.30	54.7	25.6
134	SWF 1040	WP	0.50	54.3	26.1
135	SWF 1040	WP	1.00	54.3	24.1
136	RH 893	L	0.33	54.1	22.4
137	SWF 990	WP	0.50	53.6	28.0
138	RH 893	L	0.66	53.4	22.8
139	SWF 850	WP	2.00	53.0	28.2
140	BD	D	2.00	53.0	23.3
141	SWF 990	WP	2.00	52.6	26.4
142	Busan 70	L	0.75	52.6	22.9
143	BD	D	6.00	52.1	24.2
144	BD	D	4.00	51.7	22.3
145	SWF 850	WP	1.50	50.9	26.9
146	SWF 850	WP	1.00	49.6	25.5
147	Busan 72	L	0.45	49.4	24.4
148	SWF 850	WP	0.50	49.4	27.9
149	Busan 72	L	0.90	48.7	24.7
	Least Significant Difference			5.4	4.8

maneb approximates that obtained in laboratory tests (3, 4) with the same seed treated for control of C. sativus. The discrepancy in disease ratings between test 1 and the others is thought to be because the former were made by one person and the latter by another.

Acknowledgments

The writers wish to thank the staff of the Brandon and Morden Research Stations for making land available for these trials.

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BRIEF ARTICLES

AN EARLY WILT AND RUSTY ROOT PROBLEM IN CARROTS AT THE BRADFORD MARSH

S.G. Fushtey[1] *and C.C. Filman*[2]

The Bradford Marsh is an area of approximately 8,000 acres of muck soil located about 50 miles north of Toronto. This area represents an important sector of the vegetable producing industry in Ontario. About 2,000 acres of this land is used for carrots and any threat to this crop is of considerable importance to the growers.

Historically, this probelm was first brought to the attention of government and university personnel in 1962 when it occurred on two separate farms and was serious enough to cause some concern. Several persons were consulted but no one could identify the condition. The problem recurred in 1965, this time on several farms and with more extensive damage. Again, no one was able to identify the condition or suggest measures for control. Another outbreak occurred in 1968 causing extensive damage on a number of farms. During the years between these outbreaks the disease was comparatively mild and attracted little attention. The 1968 outbreak was undoubtedly serious enough to warrant an organized programme of study directed towards providing some of the answers.

Briefly, the problem can be described as follows: The first symptoms are noticed when the carrots are about 4 to 6 inches tall. The tops wilt during the day and recover at night. After several days of this intermittent wilting the older leaves begin to show signs of necrosis at the margins and the affected areas in the field become quite conspicuous because of leaf discoloration and reduced growth. Examination of the roots reveals various degrees of decay on the tap root, especially at the point of origin of branch roots, and also on the branch roots themselves. Affected roots tend to become distinctively rusty-red in color in the vicinity of the nectrotic areas which appear flaky in texture. As the disease progresses and the amount of decay increases, plants begin to die, resulting in a reduced stand. However, if conditions for growth are good, the plants recover from these early symptoms and continue to grow and develop into a reasonably healthy-looking stand above ground. Below ground the situation is somewhat different. The carrots formed are short and stubby, the lower portion of the root having failed to expand. Other carrots are forked and knobby. Many of these misshapen carrots produce excessive fibrous branch roots which hold the soil during harvesting operations. The "rusty root" symptom is evident on these fibrous roots throughout the growing season. In 1968 this condition was so bad that several acreages were disced-under at harvest time because the carrots were considered non-marketable.

In a few instances, growers had reseeded the carrots where the initial stand was badly affected. These reseeded areas resulted in stands that were sufficiently disease-free to be economically harvested. This suggests the possibility that temperature and moisture may be involved in the problem. There is also some indication of difference in varietal susceptibility but the evidence is insufficient for a recommendation at the present time.

Although several persons have attempted to diagnose the problem, its cause has not yet been established. A reliable diagnosis with appropriate recommendations for control will undoubtedly require a substantial programme of careful research. An effort is being made to establish such a programme.

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EFFECTIVE RANGE OF BASIDIOSPORES OF GYMNOSPORANGIUM[1]

J.A. Parmelee[2]

References to effective basidiospore dissemination of Gymnosporangium are often understandably vague (Palmiter 1953, Bernaux 1956), but MacLachlan (1935) has made a definite estimate of a range as great as 7 or 8 miles. Recent field evidence has led to the conclusion that basidiospores may be effectively disseminated for even greater distances.

In the fall of 1968, roestelia of Gymnosporangium globosum Farl. were very abundant on leaves of Crateagus crus-galli L. and C. ?submollis Sarg. along edges of pasture and mixed wood near Maberly, Lanark Co., Ontario. The rust was first observed at this site on September 9, when aecia were slightly past maturity, many of them having lost half their spore mass. The infection was so heavy that the alternate host was assumed to be

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nearby even though the area is at the northern limit of Juniperus virginiana L. [red cedar] (Fox and Soper 1953). However the J. virginiana was not close by and was not found even within a mile of the site. Further search revealed rare and widely scattered Juniperus 5 miles southwest that were healthy or exhibited very rare rust galls, and, many acres of red cedar trees some 15 miles south at Westport, Leeds Co., Ont. Galls were abundant in the latter area and telia have been collected from them in previous years; it seemed probable that these stands were the source of the inoculum for the rust outbreak at Maberly.

In eastern Ontario telia become evident in the first half of May and have gelatinized by the end of May or the first week of June. If climatological data should indicate a northerly spore dispersal pattern at this period, there would be strong evidence in favor of Westport as the site of origin for the basidiospore inoculum on the Crataegus near Maberly.

Weather data for May and June were obtained from the Canada Department of Transport for the Kingston-Trenton area, and the following summary has been extracted:

WINDS: In May, winds prevailed form the southwest at 10 mph and continued through June. This wind direction was almost continuous from May 7 to 19. For the remainder of the month, the southwest winds were interrupted every other day by northerly and easterly wind flows. During June 1 to 8, winds were continuously from the southwest and south-southwest at 7 to 15 mph.

TEMPERATURE: Mean temperature for May was 52.8°F (11.5°C) with a mean maximum and mean minimum of 62.0°F (16.7°C) and 43.6°F (6.5°C). The days are described as partly cloudy to cloudy and overcast with only 10 clear days during the month. June 1 to 4, the mean maximum and mean minimum were 65.4°F (18.5°C) and 52.8°F (11.5°C), with mostly cloudy and overcast skies.

PRECIPITATION: Total rainfall in May was 5.03 inches (12.78 cm) recorded over 20 days. Slight rain was recorded for May 2-6, and southwesterly winds began on May 7 and continued through May 19. During this period, May 9, 11, 12, and 16-22 were rainy, as were May 28-31 and June 1-3.

Natural basidiospore dissemination takes place during and immediately following periods of precipitation (MacLachlan 1935). According to data summarized above, spore discharge would have occurred mainly between May 5 and May 23 and between May 29 and June 5. Basidiospores would have been directed towards Maberly during May 7-19 by southwesterly winds that continued at least every other day until June 8. Roestelia of G. globosum require 80-90 days to mature from time of inoculation (Parmelee 1965), hence the estimated dates for maturity at Maberly would be chiefly between August 7 and 23, and as late as September 3. The aecia that were collected on Crataegus on September 9 were estimated to be a week to 10 days past prime condition which is taken as fully elongated and just prior to rupturing. They had probably reached full maturity by the end of August, a date which fits adequately within the predicted periods.

The cool moist conditions in May and early June favored abundant basidiospore discharge, and the accompanying southwesterly winds secured northward spore dispersal toward Maberly. The time required for aecial development, added to the estimated period of spore dispersal, agrees with the date of aecial maturity at Maberly. Thus field evidence strongly supported by climatological data is the basis for concluding that Crataegus spp. near Maberly, Ontario, were infected by aerial inoculum originating some 15 miles away. Basidiospores of other species of Gymnosporangium may have a similar range of effective spread.

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BIPOLARIS IRIDIS ON IRIS IN BRITISH COLUMBIA

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In May, 1968, P. Froese and B. Lawson of the Vancouver office of the Plant Protection Division submitted diseased specimens of the bulbous iris (Iris xiphium L.) of cultivars 'Wedgewood', 'Imperator' and 'Blue Ribbon' to the Divisional Central Identification Laboratory, Ottawa, for confirmation of the causal organism, which had been identified in the field as Heterosporium iridis (Fautr. & Roum.) Jacques. H. iridis was found on some of the leaves. However, the most frequently observed fungus was Bipolaris iridis (Oudemans) Dickinson, which was reported on bulbous iris in the Netherlands and Ireland (1). This fungus has not been reported previously in North America. Illustrations are provided from specimen DAOM 119240 (Fig. 1).

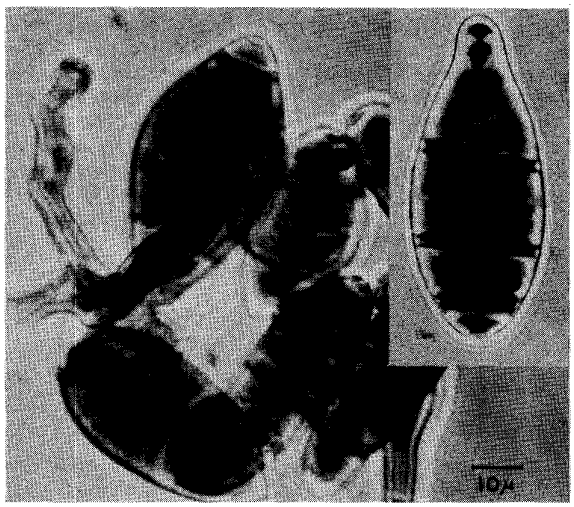

Figure 1. Conidia and conidiophores of *Bipolaris iridis*, DAOM 119240,

Approximately 15% of a one-acre field of iris grown for cut flower production at Richmond, British Columbia, was infected. An examination of numerous diseased plants showed that both fungi were generally present. The disease was first noticed on heavily infected 'Wedgewood' volunteers, and was then observed as a light infection on current crop 'Wedgewood', as well as on 'Imperator' and 'Blue Ribbon' growing near the volunteers. The source of the 1968 infection appears to have been the 'Wedgewood' volunteers, which carried the fungus over from the previous year on the dry outer bulb scales. There were no other iris fields in the vicinity and the grower had maintained the same 'Wedgewood' stock for 15 years. The grower stated that he had observed a similar disease in his iris crop in previous years, but it had never caused as much injury as in 1968.

The disease made its appearance as the plants approached maturity. B. iridis grew most profusely on the older leaves but was also found on the younger leaves, on the flower stalks and occasionally on the flowers. The first symptoms were chlorotic streaks of various lengths that became brown before conidia were produced. Darkening of the chlorotic streaks was not observed on the floral parts. Fusoid, glossy, brown-black conidia were produced in large numbers on the lower leaves but less profusely on the upper parts of the plant and very sparsely on the flowers. At the time of conidium production, the original streak lesions had broadened and coalesced, so that up to 50% of some lower leaves was covered with conidia. The color of these massed conidia is of some assistance as an aid in distinguishing this fungus from H. iridis in the field, since the latter produced masses of conidia that are olive-brown as compared with the brown-black conidia of B. iridis.

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DISEASES OF POTATO IN MANITOBA IN 1968[1]

J.A. Hoes and R.C. Zimmer[2]

Verticillium albo-atrum Reinke & Berth. was the principal pathogen of 'Irish Cobbler' potato in a field near Winkler, Manitoba, in 1968. Approximately 25% of the plants in the 40-acre field showed symptoms of wilt. Potatoes had been grown in this field in 1964 and 1966, and the inoculum level apparently increased rapidly as a result of the short crop rotation. In 1966 the senior author isolated V. albo-atrum from 'Kennebec' potatoes in another 10-acre field near Winkler that showed 8% wilt. The fungus from the latter field produced typical resting mycelium and conidiophores with pigmented bases.

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In greenhouse experiments it was pathogenic to potato and tomato but not to sunflower (J.A.H., unpublished data). There are few reports of Verticillium on potato in Manitoba. Bisby et al. (1) reported V. albo-atrum McA. on rotting potato tubers and commented "It has not been found to cause potato wilt in Manitoba." The relationship of V. albo-atrum McA. to V. albo-atrum Reinke & Berth. is not known to the authors. Verticillium wilt was reported to have caused severe damage to potatoes in Manitoba in 1934, but the fungus was not identified (4). In 1956 verticillium wilt affected approximately 25% of the plants in a potato field near Altona, Manitoba, and V. albo-atrum was isolated from the stems of affected plants (3).

Cephalosporium spp. and the causal agent of black dot, Colletotrichum coccodes (Wallr.) Hughes, were also isolated in 1968 from plants in the wilt-affected field near Winkler. Either C. coccodes or Cephalosporium spp. or both were also obtained from diseased potato plants in three other fields in the Winkler area that showed a trace to 1% wilted plants. All isolates of C. coccodes were initially sterile, producing only sclerotia and setae, but on subculturing one isolate produced typical conidia and setae in sporodochium-like bodies on potato dextrose agar. Symptoms of black dot disease in potato resemble those of verticillium wilt, and the pathogen may be systemic (2). A species of Cephalosporium isolated from wilted sunflower caused light symptoms of wilt in potato in greenhouse experiments (J. A. Hoes, unpublished data). Perhaps Cephalosporium spp. were involved in potato wilt occurring in the field in 1968. Other fungi isolated were species of Cylindrocarpon and Volutella, along with an undescribed species of Verticillium. Colletotrichum coccodes (= C. atramentarium (Berk. & Br.) Taub.) was previously recorded on potato by Bisby et al. (1). New host records for Manitoba are Cephalosporium spp., Cylindrocarpon sp., and Volutella sp.

Eight potato fields were surveyed in the Carberry area. Blackleg caused by Erwinia atroseptica (van Hall) Jennison occurred in four fields showing a trace to 2% diseased plants. Rhizoctonia solani Kühn occurred on stolons in all fields examined. In five fields the degree of infection was light, while in the other three fields 50-100% of the plants were infected. Freezing temperatures in mid-August prematurely killed all plants in one field and reduced yield; in three other fields the damage was slight.

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DISORDERS OF FLAX IN MANITOBA IN 1968

J.A. Hoes and E.O. Kenaschuk [1]

Frost damage, aster yellows, and rust were the most conspicuous disorders of flax (Linum usitatissimum L.) in Manitoba in 1968. Our survey covered the entire southern part of the province and extended as far north as Dauphin. Fifty-six fields were checked for disease.

Frost damage was widespread on flax around Carberry and Dauphin. Symptoms consisted of black, empty, and rotting bolls in earlier planted fields and unopened and sterile flowers in late fields. Reductions in yield were estimated to be 5-10% in several fields. Aster yellows was widespread, occurring in trace amounts in 33 fields, affecting 1-3% of the plants in six fields, and causing appreciable damage in three fields, where 5-10% of the plants were affected.

Rust caused by Melampsora lini (Ehrenb.) Lév. was frequent in southern Manitoba but was not found in the western and northern parts of the province. Race 300 was identified in all cases. The rust situation is a cause for concern. Since the discovery of race 300 in 1962, the Manitoba acreage of susceptible varieties dropped from 61% in 1962 to 11% in 1966, while the frequency of rust dropped at the same time (1). No flax rust was found in surveys in 1967 in Manitoba and Saskatchewan. In 1968 rust was prominent in southern Manitoba, undoubtedly favored by the continued cool and wet weather. Apparently susceptible varieties are still being grown widely in Manitoba, particularly in the Red River Valley. With time a rust race might arise that is able to overcome the resistance of popular varieties as 'Noralta', 'Raja', 'Redwood', and 'Redwood 65'. Such an event would nullify the efforts of many years of flax breeding. Only four or five genes are known that still confer resistance to rust. With continued culture of susceptible varieties, it is only a matter of time until effective resistance genes are unavailable.

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1. Hoes, H.A., and E.O. Kenaschuk. 1966. The 1966 status of varieties and rust of flax in Canada. 36th Annual Flax Inst. U.S. p. 12-13.

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OCCURRENCE OF THE NORTHERN ROOTKNOT NEMATODE MELOIDOGYNE HAPLA ON FIELD-GROWN CUCUMBER IN MANITOBA[1]

R.C. Zimmer and C. Walkof[2]

In June 1968 cucumber plants, Cucumis sativus L. 'SRX-6758', in a field near Winkler, Manitoba, appeared stunted and showed some yellowing of the foliate. Diseased plants occurred throughout the field with occasional patches of more severely affected cucumber plants showed rootknot or gall formation (Fig. 1). Dr. K. C. Sanwal, Entomology Research Institute, CDA, Ottawa, Ontario, identified the organism as Meloidogyne hapla Chitwood, the northern rootknot nematode. Initially the crop appeared to be a complete loss, but the plants recovered with the avent of above-normal rainfall and cooler temperatures.

The soil, a sandy loam, was apparently heavily infested with the pathogen and the high inoculum density may be explained by the fact that alfalfa, which is highly susceptible to the nematode (1), was grown in five of the seven preceding years. From 1961 to 1965 this field was planted with a mixture of alfalfa-brome grass, in 1966 with oats, and in 1967 with flax.

A pathogenicity test was carried out using soil from the diseased field. Typical gall formation occurred on the roots of 100% of the plants of carrot 'Eureka', cucumber 'Morden Early', and tomato 'Meteor', but not on the roots of sweet corn '62C60 B.I.B.', wheat 'Manitou', or rye (mixture). The respective susceptibility and resistance of these crops to this nematode agrees with that mentioned by Chester (1). What is important is that two other susceptible crops, peas and potatoes, are rather widely grown in southern Manitoba. Crop rotations in which the cereals wheat, rye, barley, oats, or corn are included and in which susceptible crops are not planted more often than once every three years should give good control of this pathogen. It should also be pointed out that the effect of control by crop rotation will be reduced if susceptible weeds are not eliminated. Other hosts found to be naturally infected in the cucumber field were wild buckwheat. Polygonum convolvulus L.; wild mustard, Sinapis arvensis L.; and cultivated flax, Linum usitatissimum L. The occurrence of this nematode on the roots of flax constitutes a new host record for Canada.

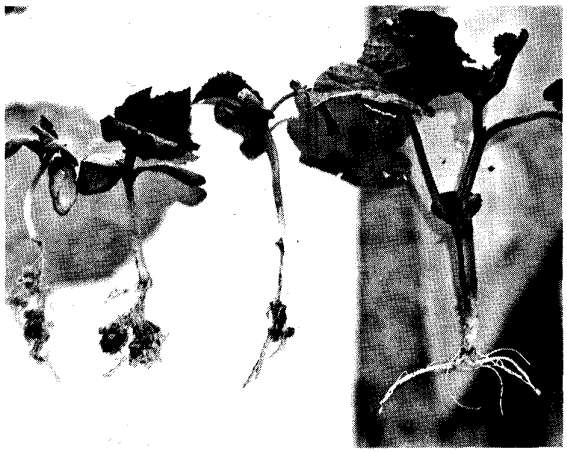

Figure 1. Cucumber plants from a rootknot-infested field near Winkler, Manitoba. The plant on the right is healthy. Rootknot formation caused by *Meloidogyne hapla* Chitwood is severe on the roots of the other plants, which are somewhat stunted.

Also of interest is that M. hapla has not previously been reported in Canada from cucumber seeded directly in the field though it has been reported on greenhouse-grown cucumber in British Columbia and Ontario (2).

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1. Chester, K. Starr. 1947. Nature and prevention of plant diseases. 2nd ed. The Blakiston Company, Philadelphia-Toronto. 525 p.

2. Conners, I. L. 1967. An annotated index of plant diseases in Canada. Can. Dep. Agr. Pub. 1251. 381 p.

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2 Plant Pathologist and Vegetable Breeder, respectively.

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Errata

FUNGAL AND BACTERIAL DISEASES OF CRUCIFERS AND CUCURBITS IN WESTERN ONTARIO IN 1967

A. A. Reyes, G. H. Comly, L.F. Mainprize, D. A. Pallet, C. A. Warner, and W.A. Willows

Volume 48, no. 3, page 95, column 1, line 2: Change "1968" to "1967". On page 96, Literature citation 1: Change K. W. Priest to K. L. Priest.

XANTHOMONAS TRANSLUCENS ON WHEAT IN MANITOBA IN 1968

W. A. F. Hagborg

Volume 48, no. 3, page 112, column 1, paragraph 2: Sentence 1 should read, "A sample of wheat plants affected by bacterial black chaff was collected by Dr. C. C. Gill on July 19 west of St. Joseph, and surveys were made by the author on July 22 and August 1."