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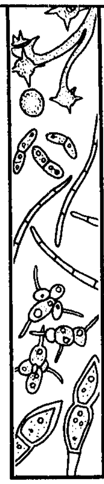
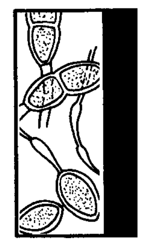


CANADIAN PLANT DISEASE SURVEY



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RESEARCH BRANCH CANADA DEPARTMENT OF AGRICULTURE

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CANADIAN PLANT DISEASE SURVEY

RESEARCH BRANCH CANADA DEPARTMENT OF AGRICULTURE

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. It will not accept results of original research suitable for publication in more formal scientific journals".

THE OCCURRENCE OF YELLOW-NET VEIN VIRUS IN GERANIUMS IN ONTARIO[1]

W. G. Kemp [2]

Introduction

A geranium disease similar to yellow-net vein, described in the U.S.A. for the first time in 1961 (2), has been noticed in a number of scattered greenhouses in Ontario. In March, 1963, two potted plants of the cultivar 'Red Irene' with pronounced yellow veins were found among thousands of stock plants of many cultivars in the greenhouse of a specialized geranium propagator in the Niagara Peninsula, Ontario. Late in December of the same year, a plant of the cultivar 'Princess Irene' with the same type of symptom was received from a grower in Essex County. Since that time this disease has been observed in the cultivars 'Dark Red Irene' and 'Salmon Irene'.

Symptoms

Affected plants show striking yellow vein patterns (Fig. 1b). No puckering or other distortion of the foliage occurs and the flower petals have no color breaks or other abnormalities. The stems are not pitted or marked in any way. Yellowing of the primary and secondary veins is the most conspicuous symptom but often the tertiary veinlets form a yellow network.

Expression of symptoms in the greenhouse

Grower inquiries about this disease are seasonal, suggesting that some environmental factor controls symptom development. Four naturally-infected plants were closely observed during 1964 and 1965 in an attempt to correlate the occurrence of symptoms with specific environmental conditions prevailing in the laboratory greenhouse. In December, January and February of each year these plants showed marked vein yellowing. Later in the spring and summer the symptoms became much less severe but did not completely disappear. Occasionally, some of the plants showed a series of yellow-veined leaves alternating with a series of symptomless leaves. This again suggests controlling environmental factors that fluctuate periodically, such as temperature or light intensity and winter greenhouse temperature but these factors are not necessarily the only determining factors in the expression of symptoms.

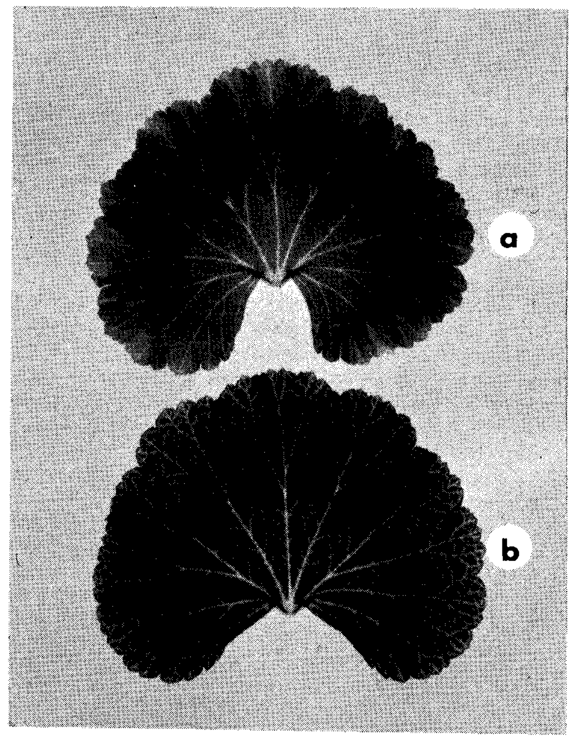

Fig. 1. (a) Normal leaf of *Pelargonium hortorum* 'Princess Irene'. (b) Symptoms of yellow net vein virus in the same cultivar.

Plants grown from cuttings taken from affected stock continued to exhibit the characteristic symptoms in the winter. By contrast, plants propagated from cuttings of the same cultivars taken from symptomless stock showed no symptoms under the same environmental conditions.

Transmission

These symptoms are different from those reported for other diseases of geraniums in Canada. They are suggestive of a virus disorder, possibly yellow-net vein. Since this virus was unreported in Canada, confirmation of its presence was sought.

In January, 1964, two scions from healthy seedlings of Pelargonium zonale Ait. were top grafted to affected 'Princess Irene'. Again in November of the same year, three scions were grafted to an unknown cultivar with pronounced symptoms. Within 4 weeks

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[1] Publication No. 121, Research Station, Research Branch, Canada Department of Agriculture, Vineland Station, Ontario.

[2] Plant Pathologist.

one of the two scions grafted to 'Princess Irene' showed pronounced yellow veins in the newest leaves. Older leaves were not seriously affected. During the seventh week, the second graft exhibited faint yellow veins on only the newest leaves. Initially, only some to the veins on a leaf were affected but later the entire vein network showed the symptoms. In the November series of grafts, only one of the scions showed symptoms and then only mild ones even though the stock plant was markedly affected at the time.

Mechanical inoculation with diseased leaf tissue ground in 0.2M phosphate buffer at pH 8.0 failed to infect beans, cowpeas, squash, snapdragons, Gomphrena globosa L., tobacco, cucumber, Chenopodium amaranticolor Coste and Reyn. and seedlings of Pelargonium zonale Ait. No fungi nor bacteria were isolated from the stems of plants showing symptoms of yellow-net vein.

Discussion and conclusions

The positive graft transmissions, although few in number, strongly suggest that the yellow-net vein symptom on 'Princess Irene' and the unknown cultivar was of virus origin. It seems reasonable to conclude from the similarity in symptoms that the other cultivars observed, but not tested, were infected with the same virus and that it is probably the same as yellow-net vein virus reported in the U.S.A.

In 1961, the author (1) described a disease of geranium whose symptoms include pronounced vein yellowing followed by severe leaf curl. This disease, demonstrated to be of virus origin, was named curly-top. The possibility that curly-top was a composite disease caused by multiple virus infection was not excluded at that time. It is now considered possible that curly-top was, in fact, caused by more than a single virus, one of which was yellow-net vein.

Yellow-net vein virus does not appear to be prevalent in geraniums in Ontario. It has been found mostly in 'Irene' cultivars. However, this fact and the wide differences in symptom response to this virus among seedlings of P. zonale grafted to the same infected source suggests that it might be present but not apparent in other cultivars. Since a satisfactory test plant for this virus is lacking at present, the extent of its occurrence in a masked condition would be difficult to determine.

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INTERNAL BREAKDOWN OF RED CLOVER IN PRINCE EDWARD ISLAND[1]

C. B. Willis [2]

Abstract

An internal breakdown (IB) of the crown tissues of red clover was found in all fields observed in Prince Edward Island. With increasing chronological age of the plants, the incidence of IB increased. Plants 4, 16 and 28 months old had 1, 20 and 68 percent IB, respectively. Regardless of age, from any given site, plants with IB had a larger mean root diameter. Considering plants of the same root diameter, the incidence of IB was higher among older plants. Fusarium spp. were the organisms most frequently isolated from IB tissues.

Introduction

The lack of persistence of red clover stands has been attributed to various disorders. A crown and root-rot complex is one of the factors responsible for this lack of persistence (4). Graham et al (3) reported that an internal breakdown (IB) of crown tissues, a physiogenic, disease has also been observed in Washington (1). The longevity of red clover is affected by IB which is often considered as part of the crown and root-rot complex.

In recent studies concerning factors affecting the development of root rots in red clover, a breakdown of the crown tissues was observed in all lots of roots examined. A summation of those observations is reported herein.

Materials and methods

The red clover plants studied were obtained from fields throughout Prince Edward Island and ranged in age from 4 to 28 months. Each lot consisted of a minimum of 100 plants collected at random. More than 4,700 plants were lifted, washed, the tap root split, and examined for discoloration and breakdown in the crown tissues. Root diameters were measured at the crown. Isolations were made from internal crown tissues surface-disinfected with 70% alcohol and 5% sodium hypochlorite and transferred to plates of potato dextrose agar containing 100 ppm streptomycin sulphate.

Results and discussion

No characteristic external symptoms of internal breakdown of the crown tissues were visible. Breakdown areas varied from small, watery, necrotic areas to dry corky areas and eventually to hollow crown piths. In advanced stages, IB often extended to external necrotic areas. The numbers of crowns affected increased with the age of the plants (Table 1). Considering any one lot of roots, those of that lot having IB invariably had larger mean root diameter regardless of age.

When all the roots of a particular age were grouped according to root diameter, the incidence of IB increased with increasing root diameter (Table 2). Considering roots of the same diameter, the older roots had a higher incidence of IB. The data indicate that IB is correlated with chronological age and with root diameter.

No one organism was consistently recovered from the internal necrotic and adjacent tissues. Of more than 400 isolates recovered, Fusarium spp. accounted for 27%, Chaetomium spp. 25%, Phoma spp. 19% and Gliocladium, Penicillium and Rhizoc-

Table 1. Internal breakdown of red clover in Prince Edward Island.

Root lot number	Age of roots (months from seeding)	Size of sample	Roots with IB (%)	Mean diam. tap roots (mm): With IB	Mean diam. tap roots (mm): Without IB
A	4	519	1	4.8	3.1
B	16	417	15	6.5	5.8
C	16	603	35	11.2	9.5
D	16	921	11	9.8	7.4
E	16	1618	20	10.8	8.7
F	16	100	33	10.4	9.7
G	28	125	78	12.1	9.8
H	28	265	60	8.7	7.5
I	28	100	72	10.2	9.1
J	28	100	77	14.0	10.7

[1] Contribution No. 151, Experimental Farm, Canada Department of Agriculture, Charlottetown, P. E. I.

[2] Plant Pathologist.

Table 2. Relationship of internal breakdown of red clover to tap root diameter and chronological age of the root.

Tap root diam. (mm)	Roots 16 months old: With IB (%)	Roots 16 months old: Total no.	Roots 28 months old: With IB (%)	Roots 28 months old: Total no.
5	6	345	41	34
6	7	438	49	43
7	8	437	47	51
8	13	477	59	64
9	20	489	66	71
10	28	499	72	79
11	37	330	75	67
12	46	189	81	43
13	44	144	78	32
14	43	65	84	25
15	48	48	90	21

tonia spp. another 18%. The fungi isolated, and in the proportions indicated, did not differ appreciably from those obtained from other necrotic areas associated with the same roots.

Cressman (1) reported that the incidence of IB was similar in clovers of all flowering types but that it developed more rapidly in plants which flowered more intensively. Histological and histochemical studies, in general, have been negative or inconclusive. Selection within red clover varieties for resistance to IB is possible and some progress has been made (2). The selection of IB-resistant varieties would contribute to the persistence of red clover and would also aid in the elucidation of the crown and root rot complex.

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CONTROL OF ROOT DISEASE IN PEAS ON IRRIGATED LAND BY SEED TREATMENT

F. R. Harper [1]

Abstract

The effect of seed treatment with seven fungicides on emergence, yield, and root rot of peas (Pisum sativum L.) was determined on irrigated land. Emergence and yield were significantly greater from treated than from untreated seed. Results were generally better for peas treated with captan, Hercules 3944X, Bayer 47531, and HRS 1591B than for those treated with thiram, dichlone, and Chemagro 4497. Severity of root rot was essentially unaffected by seed treatment.

Introduction

Seedling and root diseases cause severe damage to peas (1, 4, 5). In southern Alberta Pythium is the important pathogen of pea seedlings, whereas Fusarium, Pythium, and Rhizoctonia are the important root pathogens of older plants (4). In 1964 and 1965 several registered and experimental fungicides were evaluated as seed treatments for their effect on peas on irrigated land in this area. The results are given here.

Materials and methods

The fungicides tested were 65% captan, 75% thiram, 50% dichlone, Bayer 47531 (70% N'-(dichlorofluoromethylthio)-N, N-dimethyl-N'-phenylsulphamide)[2], Chemagro 4497 (50% of a halogenated sulfur-containing aliphatic product of undisclosed formula)[2], HRS 1591B (ethylenebis(tetrahydrothiophenonium)-dibisulfate)[3], and Hercules 3944X (30% 5-chloro-4-phenyl-1, 2-dithiol-3-one + 40% captan + 20% hexachlorobenzene)[4]. Pea seeds were treated in bulk and subdivided for sowing. The fungicides were applied as slurries at the lowest and highest rates recommended by the manufacturer.

Experiments were conducted each year at Taber, Alberta, on land abandoned for commercial production of peas because of severe root rot, and at the Canada Department of Agriculture Research Station, Lethbridge, Alberta, on land cropped with peas each year since 1960. 'Early Sweet 11' peas were sown at 160 seeds/row in randomized blocks with 6 replicates. Plots were single 20-foot rows, 1 foot apart. Each replicate contained two untreated plots and one plot of each treatment.

Emergence counts were taken 3 weeks after sowing. Yield was expressed as fresh weight of plants per row at processing maturity (about 60 days after sowing). Root rot was estimated at the same time on a 0 to 5 scale using 50 plants per treated row in each of 6 replicates in 1964 and 2 replicates in 1965. In this rating 0 denoted no root rot and 5 a dead plant.

Differences among treatments were evaluated by Duncan's multiple range test (2).

Results

Emergence counts of 'Early Sweet 11' peas were greater ($P<0.01$) from seed treated with fungicides than from untreated seed (Table 1). In all three tests where there were statistically significant differences in emergence among the treated plots, captan at 3 and 6 ounces and Hercules 3944X at 2 and 4 ounces were the most effective fungicides. In the 1964 test where there were statistically significant differences in emergence among treated plots, Bayer 47531 at 6 ounces and thiram at 4 ounces were among the most effective fungicides. In the 1965 experiments HRS 1591B at 2 and 5 ounces was among the most effective fungicides in both tests. Dichlone at 4 ounces and Chemagro 4497 at 2 ounces were among the most effective fungicides only in one of the two tests in 1965.

Yield of peas from treated seed was higher ($P<0.05$) than from untreated seed (Table 2). Generally the treatments with the highest emergence counts also had the highest yields. The treatments with the lowest emergence in each experiment had the lowest yield.

Emergence and yield in 1964 for peas treated with Bayer 47531 and thiram generally confirm those for 1963 reported previously (4).

Severity of root rot in untreated peas from the 4 experiments was as follows:-

Location	1964	1965
Taber	4.11	3.76
Lethbridge	3.64	3.60

There was no appreciable differences in severity of root rot between treated and untreated peas except at Lethbridge in 1964 when there was less ($P<0.01$) root rot in peas treated with captan and Bayer 47531 at 6 ounces than in the untreated peas.

Phytotoxicity to peas was not encountered with any of the seven fungicides in these experiments.

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1 Plant Pathologist, Canada Agriculture Research Station, Lethbridge, Alberta.

2 Chemagro Corp., Kansas City, Mo.

3 Hooker Chemical Corp., Niagara Falls, N. Y.

4 Hercules Powder Co., Wilmington, Del.

Table 1. Emergence of 'Early Sweet 11' peas following seed treatment.

Seed treatment	Rate oz/cwt	Emergence, %[1]			
		Taber		Lethbridge	
		1964	1965	1964	1965
Captan, 65%	3.0	85.5a[2]	94.2a	87.7ab	92.1abc
	6.0	88.9a	94.0a	93.8a	93.8ab
Bayer 47531	1.0	79.4a		84.5bc	
	6.0	90.3a		93.3a	
Hercules 3944X	2.0	87.7a	91.5ab	88.8ab	91.7abc
	4.0	88.2a	94.1a	91.8a	95.1a
Thiram, 75%	2.0	76.8a		78.2c	
	4.0	83.2a		90.1ab	
HRS 1591B	2.0		89.5ab		94.9a
	5.0		94.3a		94.7a
Dichlone, 50%	2.0		84.8b		86.6cd
	4.0		89.1ab		88.5bc
Chemagro 4497	0.5		64.7c		79.8d
	2.0		85.3b		91.9abc
Untreated	-	37.8b	14.3d	21.7d	49.0e
	-	29.0b	14.9d	19.4d	52.9e

[1] Mean of 6 replicates.

[2] Means in each column followed by the same letter do not differ from each other at P = 0.01.

Discussion

Seed treatment protected germinating peas from seed rot and seedling blight but was not effective in controlling root rot of older plants. Yields were related to emergence but not to root rot. McCallan (6) and Cruikshank (1) also reported no reduction in root rot of peas by seed treatment. At present there appears to be no practical chemical control of pea root rot although Lockwood (5) and Haglund (3) have reported a reduction of root-rot severity by soil application of fungicides in the greenhouse.

Table 2. Fresh weight of plants at harvest of 'Early Sweet 11' peas following seed treatment.

Seed treatment	Rate oz/cwt	Yield/row, g[1] Taber 1964	Taber 1965	Lethbridge 1964	Lethbridge 1965
Captan, 65%	3.0	1102ab[2]	2152ab	1591ab	1214ab
	6.0	1138ab	2321a	1641ab	1157ab
Bayer 47531	1.0	999ab		1616ab	
	6.0	1256a		1772a	
Hercules 3944X	2.0	1265a	1867ab	1546ab	1086ab
	4.0	1124ab	1913ab	1501b	1130ab
Thiram, 75%	2.0	940b		1483b	
	4.0	1214ab		1591ab	
HRS 1591B	2.0		2053ab		1198ab
	5.0		1966ab		1253a
Dichlone, 50%	2.0		1947ab		1108ab
	4.0		2078ab		1196ab
Chemagro 4497	0.5		1717b		1034b
	2.0		2112ab		1142ab
Untreated	-	426c	358c	405c	552c
	-	298c	342c	352c	620c

1 Mean of 6 replicates.

2 Means in each column followed by the same letter do not differ from each other at P = 0.05.

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COLD STORAGE MOLD LOSSES AND LOSSES IN STRAWBERRY FIELDS IN NOVA SCOTIA — 1965

C. L. Lockhart and A.A. MacNab[1]

Introduction

Commercial cold storage of strawberry plants for nursery stock is relatively new in Nova Scotia. The plants are dug in the fall, most of the leaves are removed, and the plants are tied in bundles of 25. From 20-40 bundles are stored in a polyethylene-lined crate with the liner folded over the plants to prevent desiccation. Ambient storage temperatures are maintained at or near 28° F which results in a plant temperature of about 30° F. Mold often develops on plants when storage temperatures rise above 30° F.

Growers have reported losses in new plantings which they attributed to poor plants from cold storage. In 1965 surveys were carried out in strawberry plant cold storages to follow ambient and plant temperatures and mold development. A field survey was also done to determine the causes of mortality in new plantings.

Losses in cold storage

In the four storages (A, B, C and D) surveyed, traces of mold were first observed on February 17, three months after the plants were in storage, on roots which had cortical root rot lesions. Where mold occurred plant temperatures were 30.5° F or higher. No mold was found on plants maintained at 30° F. Little change in mold development was observed until May when plants were being removed from storage. The highest losses were in storage C (Table 1) where a plant temperature of 33° F and an ambient temperature of 32° F were recorded on May 20. It is not known how long the plants were at these temperatures. On April 5 normal temperatures were recorded.

The average loss in Table 1 is similar to that reported in 1964 (1). Apart from the high losses in storage C, the losses would not be considered excessive. In storages A, B and D ambient temperatures were maintained at or near 28° F throughout the storage season.

The organisms usually associated with moldy plants and cortical root rots were Cylindrocarpon sp. Fusarium spp., Rhizoctonia sp. and bacteria.

Causes and extent of mortality in new strawberry plantings in 1965

The field survey was made of 51 new plantings of fall or spring dug cold-stored plants as well as of plantings where plants were not from cold storage. The survey encompassed 72 acres or 358,000 plants. The results of this survey are shown in Table 2.

Table 1. Percent loss of cold-stored strawberry plants due to mold during 1964-65 storage season.

Storage	No. of plants	Varieties affected	% loss in storage
A	700,000	Redcoat, Cavalier Sparkle, Catskill	0.6
B	85,000	Redcoat and Sparkle	0.1
C*	43,000	Sparkle and Surecrop	25.0
D	12,000	Several varieties	2.8
Total	840,000		1.8

* Wide temperature fluctuations were recorded in this storage.

The average loss in new plantings was 9.9% and 6.0% of this was attributed to poor planting practices such as planting too deep or too shallow or roots not spread out, misuse of herbicides, stem borer damage, high soluble salt content of the soil, and planting winter-killed plants. Poor planting was the most important factor in the survival of new strawberry plantings in Nova Scotia.

Losses sustained by growers receiving moldy storage plants were 9.4%. Of 51 growers surveyed only five were found to have received moldy plants which did not survive following planting. Green petal accounted for 0.6% loss but some of the dead or poor plants removed by growers prior to the survey may have been infected with green petal.

The mortality of some plants could not be explained. Such plants usually produced only a few leaves, eventually lost vigor, and died. These above-ground symptoms were associated with poor root development. This occurred on plants that were cold stored and on those that were freshly dug prior to planting. This is one of the more serious problems in new strawberry plantings and no explanation can be offered for its occurrence.

Literature cited

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[1] Plant Pathologists, Canada Agriculture Research Station and Nova Scotia Department of Agriculture and Marketing, Kentville, N. S.

Table 2. Percent losses in new strawberry plantings in 1965.

Variety	No. of plants	Acres	Percent loss	Percent of losses caused by: Green petal	Storage mold	Stem borer	Poor planting	Herbicides	Winter killing[1]	High salts	Others[2]
Redcoat	99,475	22.0	3.7	0.6	0.07	0.5	1.1	0.0	0.0	0.8	0.6
Sparkle	81,800	18.2	11.3	0.9	0.4	0.5	3.0	1.2	0.0	2.8	2.5
Cavalier	81,000	18.0	14.3	0.01	0.5	1.8	5.8	0.0	1.2	0.2	4.8
Surecrop	40,575	9.0	12.8	0.6	0.4	0.7	4.5	0.0	0.0	0.0	6.6
Catskill	27,800	6.2	7.5	1.3	1.0	0.1	0.0	5.0	0.0	0.0	0.1
Guardsman	10,150	2.2	23.1	0.0	1.4	0.5	0.0	21.2	0.0	0.0	0.0
Acadia	8,950	2.0	13.8	0.0	0.4	0.0	5.0	8.4	0.0	0.0	0.0
Grenadier	7,300	1.6	2.2	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Midway	1,000	0.25	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	358,050	72.0	9.9	0.6	0.5	0.8	2.9	1.5	0.3	0.5	2.9

[1] Refers to injury confined to two fields.

[2] Includes plants in which losses could not be accounted for.

FUNGICIDES AS SAFENERS FOR LEAD ARSENATE ON APPLE FOLIAGE[1]

R. G. Ross and K. H. Sanford [2]

Abstract

Fungicidal cover spray mixtures of captan or zineb and lead arsenate were relatively non-phytotoxic to 'Cortland' apple foliage. Ferbam did not consistently safen a mixture of glyodin and lead arsenate but, at a rate of 1 lb. per 100 gal., it reduced arsenical injury resulting from sprays of a dodine and lead arsenate mixture. Captan was more effective in safening the dodine-lead arsenate mixture in the first year of the test than in the second.

Introduction

Lead arsenate is widely used in Nova Scotia apple orchards for the control of the apple maggot and several lepidopterous pests. When used alone or in mixtures with certain fungicides it sometimes causes injury to apple foliage. This injury consists of necrotic areas of irregular shape varying in size from pinpoint to over 1 inch in diameter and is often accompanied by marginal necrosis. Apple varieties differ in their susceptibility to arsenical injury, 'Cortland' and 'Delicious' being very susceptible. Trees growing on light sandy soils also seem to be more susceptible than trees on heavier soils.

Some fungicides safen lead arsenate while others aggravate the injury or do not have any safening effect. In Nova Scotia spray mixtures containing glyodin and lead arsenate are very phytotoxic and mixtures of lead arsenate and dodine often cause foliage injury particularly if used in repeated applications. Palmiter (2) found that ferbam was a good safener for the glyodin-lead arsenate mixture and it has been generally recommended to apple growers for use as a safener for this mixture. In Nova Scotia severe foliage injury has often occurred with the glyodin-lead arsenate mixture even when ferbam was added as a safener. Since there has been no experimental work done in Nova Scotia on organic fungicides as correctives for arsenical injury a test was carried out in 1964 and 1965 on the use of fungicides as safeners for lead arsenate. The results are given in this paper.

Materials and methods

The mature apple trees used were the variety 'Cortland' located on light sandy soil. The trees were divided into 3 blocks each containing 8 plots. Each plot consisted of 4 trees. On the plots containing treatments 1, 6, 9 and 10 (Table 1) the 2 west trees were sprayed with the appropriate fungicide alone while the 2 east trees received the fungicides and lead arsenate. Treatments 4 and 5 were on the 2 west trees of the plots containing treatments 2 and 3, respectively. Treatments 7 and 8 were applied to all the trees in their respective plots. Except for treatments 4 and 5, the treatments were randomized within each block.

The sprays were applied dilute with a hand gun and the trees were sprayed to run-off. In both years, 1964 and 1965, the trees were sprayed 8 times with the fungicide and lead arsenate at 3 lb. per 100 gal. and the ferbam or captan safeners were added in the last 3 applications. These were applied at about 10-day intervals beginning near July 1. Prior to the lead arsenate treatments the plots containing treatments 1 to 5 and 6 to 8 were sprayed with dodine and glyodin, respectively, and those containing treatments 9 and 10 with captan.

The materials used were:

Dodine (Cyprex Dodine 65 - W), n dodecylguanidine acetate 65% (Cyanamid of Canada, Ltd., Rexdale, Ont.)

Glyodin (Crag Glyodin Solution Protective Fungicide), 2-heptadecyl-2-imidazoline acetate, 34% (Union Carbide Canada, Toronto, Ont.)

Captan (Captan 50 - W), N(trichloromethylthio) - 4 - cyclohexene - 1, 2 - dicarboximide, 50% (Stauffer Chemical Co., New York, N.Y.)

Zineb (Parzate C), zinc ethylene bisdithiocarbamate, 75% (DuPont Co. of Canada, Ltd., Montreal, P.Q.)

Ferbam (Fermate) ferric dimethyldithiocarbamate, 76% (DuPont Co. of Canada Ltd., Montreal, P.Q.)

Lead arsenate (Niagara Brand Chemicals, Burlington, Ont.)

In September the foliage of the trees in each plot was rated for arsenic injury on a scale of 0-5, 0 being the foliage of trees with no arsenic injury and 5 being the most severely injured. At a rating of 5 about 50% of the leaves on the trees would have necrotic areas or marginal necrosis. With a rating of 1, there would only be a trace of injury and with a rating of 2, the injury would be light and not considered serious.

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[2] Plant Pathologist and Entomologist, respectively.

Table 1. Arsenical injury on 'Cortland' apple foliage

Treatment and rate per 100 gal.	Arsenical injury rating* 1964	1965	Average
Lead arsenate, 3 lb. +			
1. dodine, ½ lb.	4.3	3.2	3.8
2. dodine, ½ lb. + ferbam, ½ lb.	1.7	3.2	2.4
3. dodine, ½ lb. + ferbam, 1 lb.	1.3	1.7	1.5
4. dodine, ½ lb. + captan, ¾ lb.	1.0	3.0	2.0
5. dodine, ½ lb. + captan, 1 lb.	1.5	2.0	1.8
6. glyodin, 1 qt.	4.7	3.5	4.1
7. glyodin, 1 qt. + ferbam, ½ lb.	4.2	2.7	3.4
8. glyodin, 1 qt. + ferbam, 1 lb.	3.5	1.5	2.5
9. captan, 1½ lb.	1.5	1.0	1.2
10. zineb, 2 lb.	1.0	1.5	1.2

* 0, no injury; 5, most severe.

Results and discussion

The results given in Table 1 are the average of the 3 replicates for each treatment. They show that there was considerable variation between years particularly with captan as a safener for the dodine-lead arsenate mixture. According to Hilborn et al. (1) lead arsenate is more injurious in hot dry summers. In this test the summer of 1965 was much drier than 1964. This climatic difference may account for the seasonal variation in results. There was little arsenical injury where captan and zineb were used alone with lead arsenate. Zineb is recommended in Nova Scotia as a final cover spray on apples for controlling late or pin-point scab. In recent tests in New York captan reduced the amount of blossom-end injury caused by lead arsenate (3, 4). There were no necrotic areas or marginal necroses where the fungicides were used without lead arsenate.

Ferbam was not generally effective as a safener for the glyodin-lead arsenate mixture, although at the 1 lb. rate in 1965 it did reduce the injury. Ferbam at the 1 lb. rate was fairly effective with the dodine-lead arsenate spray in both years. The lower rate of ½ lb. was effective for glyodin in New York (2) but apparently did not safen the mixture under the conditions of this test. Hilborn et al. (1) suggested that the safening effect of ferbam might be due to the absorption of iron by the leaf followed by an increase in the iron-manganese ratio. The variation between orchards in the susceptibility of apple trees to arsenical injury and the differences between here and elsewhere in the effect of ferbam as a safener may be due to differences in the iron-manganese ratio or other nutritional conditions.

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SCALE ROT TEST FOR HYBRID LILIES[1]

J. Drew Smith[2] and Edward A. Maginnes[3]

Abstract

Isolates of Cylindrocarpon radicicola Wr., Colletotrichum dematium (Pers. ex Fr.) Duke and Rhizoctonia solani Kühn from bulb scales of hardy lilies caused scale rot and lowered bulblet production in a pot test. R. solani had less effect than the other fungi. Cultivar differences in susceptibility to scale rot, apparent in the field, were noted in the pot test. None of the 6 lily cultivars tested were resistant to rot. Wounding of scales did not markedly increase rot.

Introduction

A collection of 50 named, hardy, hybrid lily cultivars and many unnamed seedlings are maintained by the Department of Horticulture, University of Saskatchewan at Saskatoon. Twenty of the named cultivars and all of the seedlings originate from a program of the late Dr. C. F. Patterson of the University. When samples were lifted in early October of 1965 for multiplication by scaling, cultivars were noted to differ in the amount of root, bulb and scale rot. 'Enchantment', 'Dunkirk' and 'Apricot Glow' appeared particularly susceptible to root, bulb and scale rot (Figs. 1 and 2). In some cultivars, e.g. 'Apricot Glow' and 'Enchantment', disease was so severe that few healthy scales were available for bulblet production. In other cases although bulbs were apparently healthy when dug they showed marked deterioration after storage.

Bulbs were examined for fungal pathogens and Rhizoctonia solani Kühn, several species of Fusarium, and Cylindrocarpon radicicola Wr. were common on diseased roots. On bulb bases and scales these pathogens and Colletotrichum dematium (Pers. ex Fr.) Duke (1) predominated. C. dematium was associated with a "pit" lesion and a general scale base and scale tip rot similar to that described by McWhorter (2), and Moore (3). Although mycelial strands of R. solani were common on the upper parts of the scales, that organism appeared to be causing little damage. Botrytis blight (Botrytis elliptica (Berk.) Cke.) was not found on lily foliage. After the bulbs had dried, Penicillium spp. developed on most of the cultivars examined. Mites, symphilids, staphylid beetles, fungus gnats and lesser bulb fly larvae were found on rotted bulbs.

Several years are required to appraise lily hybrids for disease reaction since they must be propagated as clones from scales. The cultivar differences in the amount of scale rot seen in the field suggested that lily scales might be used to screen cultivars for resistance to particular rot pathogens before field testing.

Laboratory moist-chamber tests for resistance to rotting proved unsatisfactory so a pot technique was developed. This paper outlines the method and the results obtained.

Materials and methods

Bulbs of six cultivars of lily were dug in the fall of 1965 and stored for 6 weeks at 4°C. From apparently healthy bulbs, samples were drawn and washed free of soil. The outer scales of these bulbs were discarded and the remaining scales carefully removed. The small inner scales were not used in tests. The scales were then rewashed, drained and placed in 10% Javex (active ingredient, 5% chlorine) for five minutes and washed again in running water for 2 hours. After draining, the scales were held at 20°C for 48 hours to suberize.

Isolates of R. solani, C. radicicola and C. dematium from lily scales were grown on autoclaved, moistened wheat bran in 500 ml Erlenmyer flasks for 21 days at 22°C. The cultures were air dried for 3 days and crumbled fine, sieved, and mixed by repeated sieving with autoclaved potting soil in the proportion of 1 to 200 by weight. An equivalent weight of autoclaved check soil was prepared from the same batch.

Six-inch clay pots were filled with potting soil to 2 inches from the top and autoclaved for 1 hour. After cooling, 4 lots of 24 pots were topped off with soil inoculated with the appropriate pathogen or with the check soil and firmed.

Half of the scales of each cultivar, at random, were wounded once on the inner face, approximately one-third of the distance from the base, by pressing gently with a 4 mm glass rod with a 2 mm pip at the end. All scales were planted immediately after the wounding. In each pot, 6 scales of a cultivar were planted base down, inner surface to the centre of the pot, so that between half and two-thirds of the scale was buried. The pots were watered by sub-irrigating and placed on a bench in a greenhouse maintained at 18 ± 3°C. The pots were top watered three times per week for the 11-week test period.

Three weeks after first leaf production, all scales were carefully lifted and scored for severity of rot on a scale 0 to 4, where 0 represented no visible rot and 4, complete rot. Bulblet production was also recorded on a 0 to 4 scale. The criteria used for rating rot and bulblet production are illustrated in Figs. 3 and 4. The individual scale ratings were converted to a pot index figure.

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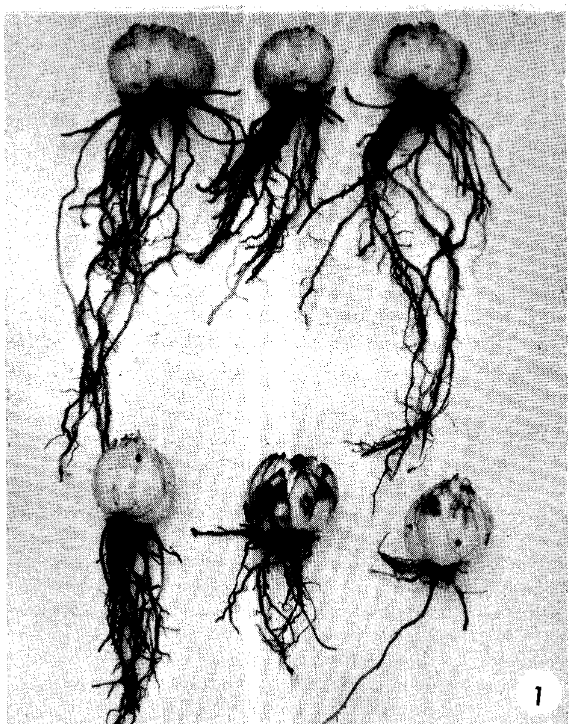

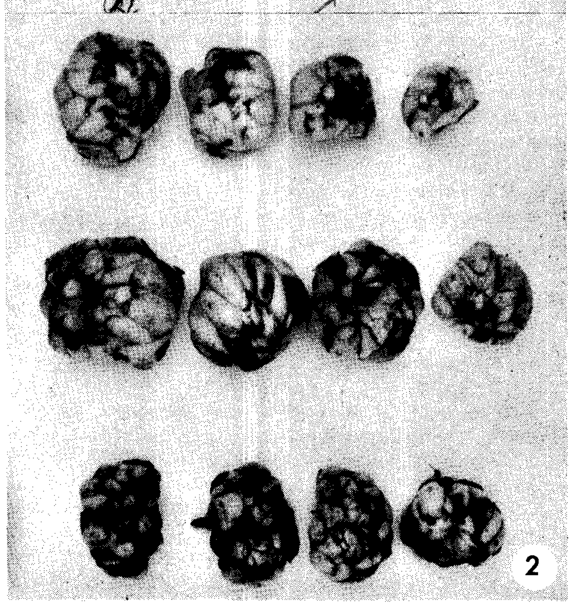

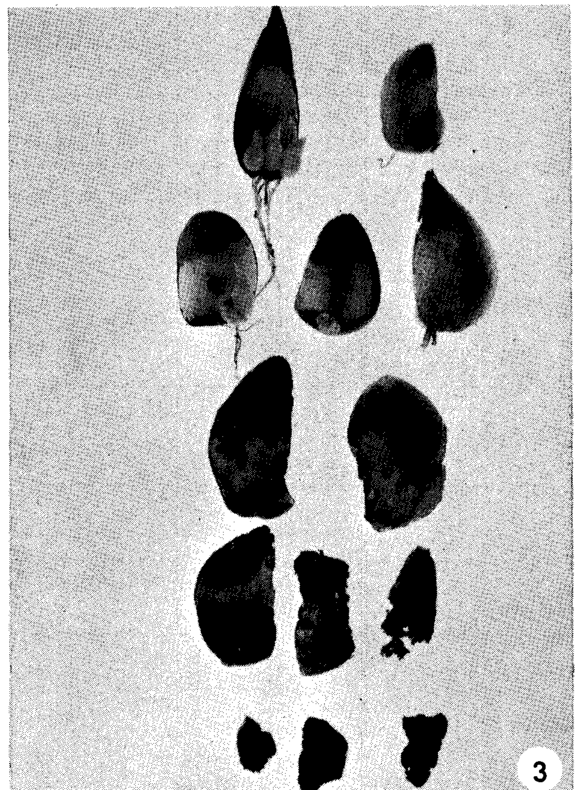

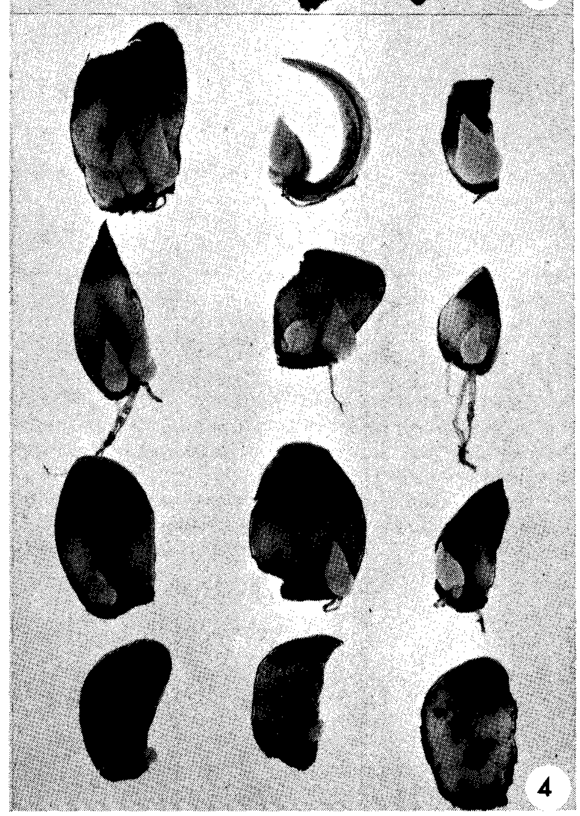

Fig. 1. Root, bulb and scale rot symptoms on 2 lily varieties. Top to bottom row – Dunkirk, Apricot Glow.

Fig. 2. Bulb and scale rot symptoms on 3 lily varieties. Top to bottom row – Dunkirk, Apricot Glow, Enchantment.

Fig. 3. Scale rot ratings. Examples of rating O (upper row) to 4 (lower row).

Fig. 4. Bulblet production ratings. Examples of rating 1 (lower row) to 4 (upper row). Zero rating not shown.

Table 1. The effect of inoculum (a) and cultivar (b) on rot and bulblet production.

Inoculum	Rot Mean	Bulblet Mean
Check	1.30	1.56
R. solani	1.67	1.18
C. radicicola	2.62	0.33
C. dematium	2.56	0.35
LSD 0.05	0.25	0.18
0.01	0.32	0.24

Cultivar	Rot Mean	Bulblet Mean
'Dunkirk'	2.63	0.34
'Jasper'	2.35	0.16
'Lilian Cummings'	2.06	0.55
'Crimson Queen'	1.81	0.31
'Apricot Glow'	1.73	0.72
'Burnished Rose'	1.65	0.55
LSD 0.05	0.30	0.22
0.01	0.39	0.29

Results

Most scales showed fungal rot and superficial blemishes occurred on unrotted scales. A few scales were damaged by insect larvae; these were recorded as rotted.

Differences in the severity of rotting due to the three pathogens were highly significant over the check (Table 1a). However, R. solani caused much less rotting than C. radicicola or C. dematium which produced similar amounts of damage. Bulblet production was inversely proportional to rot severity (Table 1a) and differences between the inoculated pots and the check in bulblet production were highly significant. R. solani had much less effect on bulblet production than the two other pathogens.

Although none of the cultivars was very resistant to rot, differences between the least susceptible, 'Apricot Glow' and 'Burnished Rose', and the most susceptible, 'Dunkirk' and 'Jasper' were highly significant (Table 1b). There was no clear cut correlation between rot and bulblet production among cultivars. The effect of wounding on rot was not highly significant.

Discussion

Although all three fungi increased rotting in the test the isolate of R. solani was of low pathogenicity and this fungus might be omitted from further studies. On the other hand, further tests should include Fusarium spp. since several species were isolated from lily bulbs and some are known causes of bulb rot (2, 3, 4). 'Apricot Glow', which was one of the two cultivars less severely affected in the pot test but most severely damaged in the field, may be very susceptible to fusarium rot. Wounding introduced complications, perhaps reducing precision of the test in respect to cultivars and inocula.

Scale and bulb rots appear to be a limiting factor in the successful cultivation of hardy lilies. Thus, a scale test such as that outlined here would be useful in screening new hybrids before field testing and commercial introduction.

We are indebted to Dr. B. C. Sutton for advice on the nomenclature of Colletotrichum dematium and for confirmation of the identity of Cylindrocarpon radicicola.

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EAR ROTS OF CORN IN SOUTHWESTERN ONTARIO

R. E. Wall [1]

In 1964 and 1965, ear rots were a source of concern in the corn-growing areas of Ontario. In each year the situation was different in that the fungi involved and the problems to which they gave rise differed.

In 1964, the main fungi associated with ear rots were Fusarium moniliforme (Sheld.) Snyder and Hansen and Hormodendrum cladosporioides (Fres.) Sacc. The former appeared in late September and October as a light surface growth but was not associated with extensive decay. Hormodendrum appeared shortly before harvest and spread rapidly in corn cribs where wet ears were present. On many farms, actual heating occurred in the cribs, preventing storage of the crop for the winter months.

In 1965, pink ear rot was found in high proportions on several farms near Harrow. Since this presented certain dangers in the use of the grain as feed, a survey was conducted of corn cribs throughout southwestern Ontario. Where corn was noticeably moldy, samples were collected for isolation and identification of the fungi present.

Most of the farms with a severe ear rot problem were found in the Lake Erie region where the fungus associated with decay was Fusarium graminearum Schwabe. Further north, in Middlesex, Huron and Bruce Counties, severe infections of Fusarium tricinctum (Cda.) Snyder and Hansen were found (Figure 1). Most of the corn examined throughout southwestern Ontario also had the condition known as red-striped pericarp and a light surface growth of Hormodendrum cladosporioides. However, in contrast to 1964, there was no evidence of further decay in storage in the cribs examined.

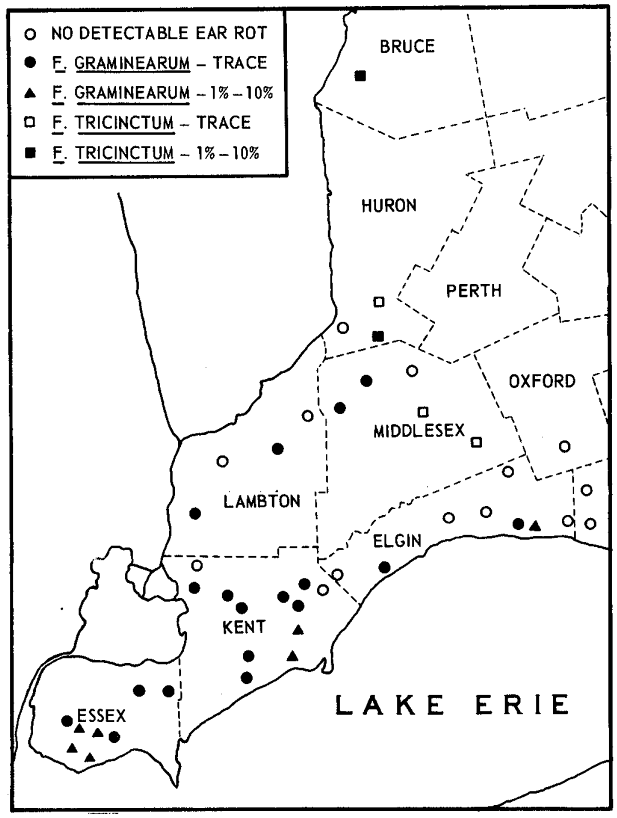

Fig. 1. Outline map of southwestern Ontario showing locations of corn crops inspected for ear rot, December, 1965.

The presence of large amounts of corn infected with F. graminearum was potentially dangerous to the feed industry because of the possible presence of toxic substances in the infected grain (2). Although reports were received of sickness and refusal of feed by farm animals fed corn, no deaths directly attributed to Fusarium-infected grain were documented. This demonstrated a definite need for study of the effects on animals of grain infected by various fungi. For instance, no information could be found on the toxic properties of F. tricinctum, a fungus very similar in appearance to F. graminearum.

In both 1964 and 1965, severe drought and below-normal temperatures during the first half of growing season, and cool or wet weather during the autumn were probably the major factors predisposing the crop to ear rots. At present, there is little evidence of heritable resistance to ear rots (1), and the possibility of direct control measures appears remote. However, certain agronomic practices should be explored in connection with ear rot incidence, and certain features related to ear drying incorporated into commercial hybrids. For instance, much of the ear rot observed in both years was associated with tight husks, a feature which might be reduced by hybrid selection. Furthermore, poor ear declination, resulting in inadequate drainage of the ripening ear, was observed in certain fields with a high incidence of ear rot. This may have been due to several causes such as low ear weight or stiff shanks. Lodging of plants resulted in a large number of ears coming into contact with the soil. Much of this lodging could be prevented by the incorporation of stalk-rot resistance into the hybrids. In addition, many of the hybrids grown were of later maturity than those recommended for the area. These hybrids ripened and dried during the cool, wet part of the autumn when fungus infection would be most likely.

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SCLEROTINIA CROWN ROT OF FORAGE LEGUMES IN PRINCE EDWARD ISLAND[1]

C. B. Willis[2]

Abstract

Significant losses from sclerotinia crown rot caused by Sclerotinia trifoliorum Erikss. have been observed in forage legume stands in Prince Edward Island over the period, 1964 to 1966. Field and greenhouse tests showed that red clover was the most susceptible of the forage legumes studied. In greenhouse tests birdsfoot trefoil was the most resistant. Under conditions of natural infection in the field 'Ladino' white clover was the most resistant in broadcast populations and alfalfa in spaced populations. An isolate of S. sclerotiorum (Lib.) de Bary was less pathogenic than 3 isolates of S. trifoliorum. The role of S. trifoliorum infections in the persistence of forage legumes in Prince Edward Island is discussed.

Introduction

The longevity of perennial legumes used for forage has been of concern for many years. A number of the factors responsible for shortening the life span include 'winter-killing', diseases, improper nutrition, and poor management. 'Winter-killing' is a term used to describe the failure to survive from one growing season to another usually without making any attempt to explain the underlying cause or causes of death. Sclerotinia crown rot caused by Sclerotinia trifoliorum Erikss., is known to be a factor in the overwinter loss of red clover (1). Observations indicate that sclerotinia crown rot is an important factor in the 'winter-killing' of forage legumes in Prince Edward Island (4). This paper presents a further summation of these observations and the results of pathogenicity tests of Sclerotinia isolates on forage legumes.

Materials and methods

The areas examined for 'winter-killing' in the spring of 1964 were located on six distinct soil series (3). All fields had been seeded the previous year to a forage mixture which included red clover, alsike clover and timothy. In each field, 100 random square-foot areas were examined for the presence of red clover plants. The number of plants, both living and dead, was recorded and all dead plants were dissected and carefully examined for the presence of sclerotia. If sclerotia were found attached to, or embedded in, a dead plant it was assumed to have been infected with S. trifoliorum.

Data on 'winter-killing' in 1965 and 1966 were obtained from replicated field plots of 'Lasalle' red clover which had been established the previous year as part of a study of factors affecting root rot development. Data were also obtained from replicated field plots, representing both spaced and broadcast populations, of several forage legume species.

Artificial inoculations were carried out in the greenhouse. A modification of Kreitlow's (2) dried grain method of crown inoculation was used. A number of isolates of S. trifoliorum were used as well as one isolate of S. sclerotiorum which had been obtained from carrot.

Plants for artificial inoculation were grown in five-inch pots, 10 plants per pot, and inoculated at 8 weeks of age. All plants were held in a mist chamber at 60° to 65° F for 7 days following inoculation. The plants were then maintained on a greenhouse bench at the same temperature for a further 14-day incubation period after which individual plants were recorded as being healthy, infected or dead.

Table 1. Relationship between 'winter-killed' red clover plants in mixed stands and dead plants infected with S. trifoliorum, winter of 1963-1964.

Soil Series[1]	Number of plants[2]	Dead plants %	Dead plants infected %
Dunstaffnage	5.0	4	64
Culloden	1.2	26	96
Alberry	3.8	15	46
Charlottetown	9.1	10	70
O'Leary	3.0	34	53
Queens	2.1	29	5

[1] Soil series arranged in order of texture from light (Dunstaffnage) to heavy (Queens).

[2] Number of seedling red clover plants per square foot; 100 random one-foot squares counted.

[1] Contribution No. 155, from the Experimental Farm, Canada Department of Agriculture, Charlottetown, P. E. I.

[2] Plant Pathologist.

Table 2. Relationship between 'winter-killed' plants of forage legume species and dead plants infected with S. trifoliorum, winter of 1965-1966.

Forage Legume and Variety[1]	Spaced populations[2] Dead plants %	Dead plants infected %	Broadcast populations Density[3]	Dead plants %	Dead plants infected %
Red Clover					
'Lasalle'	95.6	100	6.0	42	100
Alsike Clover					
commercial	98.4	95	13.5	22	100
White Clover					
'Ladino'	78.4	98	16.3	12	100
Alfalfa					
'Vernal'	6.3	100	6.5	23	100
Birdsfoot Trefoil					
'Empire'	68.0	69	5.5	27	100
'Viking'	76.7	78			

[1] Seeded in the spring of 1965.

[2] 80 plants per variety 18 inches apart in rows 27 inches apart.

[3] Mean number of plants per square foot.

Table 3. Pathogenicity of Sclerotinia trifoliorum on forage legumes species.

Species and Variety	Plants killed %	Plants infected but not killed %	Total
Red Clover Trifolium pratense L.			
'Lasalle'	80	20	100
'Kenland'	77	21	98
'Lakeland'	55	45	100
Alfalfa Medicago sativa L.			
'Vernal'	25	65	90
'Rhizoma'	52	37	89
Alsike Clover Trifolium hybridum L.			
commercial	29	54	83
White Clover Trifolium repens L.			
'Old Gold'	47	22	69
'Ladino'	19	66	85
Birdsfoot Trefoil Lotus corniculatus L.			
'Empire'	6	51	57
'Viking'	0	55	55

Table 4. Pathogenicity of Sclerotinia sclerotiorum and S. trifoliorum on forage legume species.

Species and Variety	Sclerotinia sclerotiorum	Sclerotinia trifoliorum 13-64	C-65	U-65
Red Clover Trifolium pratense L.				
'Lasalle'	20[1]	96	96	96
Alsike Clover Trifolium hybridum L.				
commercial	6	30	58	66
White Clover Trifolium repens L.				
'Ladino'	4	30	68	50
Alfalfa Medicago sativa L.				
'Vernal'	24	80	90	86
Birdsfoot Trefoil Lotus corniculatus L.				
'Empire'	4	14	14	20
'Viking'	4	16	8	18

[1] Percentage of plants infected, including those killed.

Results

The percentages of red clover plants which failed to survive the winter of 1963-1964 ranged from 4 to 34 (Table 1). The failure to survive did not appear to be related to the texture of the soil in which the plants had grown. The lowest percentages of dead plants were in the forage stands with the greatest density of red clover plants. The percentage of dead plants which had sclerotia associated with them varied from 5 to 96.

Forty-one percent of the plants in 'Lasalle' red clover plots failed to survive the winter of 1964-1965. All dead plants examined in the spring of 1965 were found to have sclerotia associated with them.

The data in Table 2 compare the failure to survive and Sclerotinia infections in a number of forage legume species both in spaced and broadcast populations except for 'Vernal' alfalfa. Sclerotia were associated with a lower proportion of the dead birds-foot trefoil plants than with the other species. Even though a high proportion of the alfalfa plants survived, many of the survivors showed varying amounts of damage from Sclerotinia infections as evidenced by wilting and often death of part or all of the early growth. Sclerotia were associated with many of these infected plants. The percentages of dead plants among the broadcast populations were lower except for alfalfa. Sclerotia were associated with all dead plants examined.

The data presented in Table 3 show that forage legume species, when inoculated in the greenhouse, display varying degrees of susceptibility to attack by a mixture of isolates of S. trifoliorum. The red clover varieties were the most susceptible and the birdsfoot trefoil varieties the least.

An isolate of S. sclerotiorum was considerably less pathogenic to a number of forage species than S. trifoliorum isolates (Table 4). S. trifoliorum isolate 13-64 appeared to be less pathogenic to alsike and white clovers, otherwise no differences were apparent among the isolates of S. trifoliorum. The birdsfoot trefoil varieties again were less susceptible than the other species.

Discussion

Sclerotinia crown rot caused widespread losses in forage legumes in Prince Edward Island over the period from 1964 to 1966. The 3 winters and springs concerned were similar in aspects which favored the development of S. trifoliorum. Large areas of fields were observed with abundant and almost continuous snow cover which persisted into the spring period. These areas invariably had little or no frost in the ground and, therefore, provided environmental conditions suitable for activity by S. trifoliorum.

Sclerotia were observed associated with many plants which failed to survive the previous winter. Their presence suggests that infection with S. trifoliorum does not necessarily imply that the organism was solely responsible for the death of the plant. Many of the dead plants with which no sclerotia were associated may have been infected with S. trifoliorum, the infection being responsible, in part at least, for the ultimate death of the plants. Plants which apparently survived the winter, but which became infected to varying degrees by S. trifoliorum, would be less productive and have a shorter life expectancy than healthy plants. The surviving plants which are under stress because of infection by S. trifoliorum would be more readily attacked by other root-rotting organisms which in turn shorten life expectancy (5).

Field and greenhouse tests indicate that birdsfoot trefoil is less susceptible to S. trifoliorum than red clover, the most important forage legume grown in Prince Edward Island at the present time.

Sclerotinia crown rot, as a part of the root and crown rot complex of forage legumes, requires further investigation.

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BRIEF ARTICLES

Elephant hide of potato

E. H. Peters[1]

A skin defect of potato, called elephant hide, is reported for the first time in Canada. It was observed by L.M. Casserly of the Ottawa Research Station on one tuber in a hill of potato seedling 'G-581-25' in October 1965 and identified by Dr. D.S. MacLachlan of the Plant Protection Division.

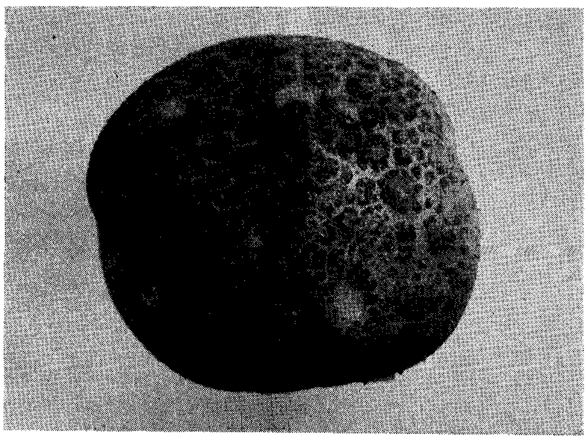

Fig. 1. 'Elephant hide' on potato seedling G. 581-25.

The symptoms (Figure 1) are typical of those described by Blodgett and Rich (1) who state that portions or the entire surface of some tubers show very coarse netting or furrowing of the outer skin. The condition has been reported (1, 2) in the United States wherever the cultivar 'Russet Burbank' is grown.

The cause of the condition is not known but, according to Blodgett and Rich it is probably due to environmental factors such as contact with decaying organic matter or possibly with fertilizer or soil salts. Tests (1) have shown that it is not perpetuated through the stock.

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[1] Plant Protection Division, Production and Marketing Branch, Canada Department of Agriculture, Ottawa, Ontario.

Drechslera phlei as a contaminant of red clover seed

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Drechslera phlei (Graham) Shoem. was found on seed of red clover, Trifolium pratense L. The seed from the 1962 crop was obtained from Dr. W.R. Childers, Ottawa Research Station, C. D. A. and was a blended mixture of 'Dollard' and 'La Salle' varieties. The seed was untreated and for examination was separated according to color into three groups: yellow (Dollard), dark brown (La Salle), and medium brown. Seeds were plated on yeast-extract mannitol medium and examined for percentage germination, and for contamination by fungi and bacteria. The yellow (Dollard) seed had 89% germination and 21% contamination and the dark brown (La Salle) seed had 77% germination and 16% contamination. The medium brown seed had only 16% germination and the contamination was 45%; 24% by bacteria and 21% by fungi. The fungi included species of Alternaria, Penicillium, Aspergillus, Cladosporium, Candida and Fusarium, with Penicillium and Aspergillus being the most common fungi found on the 'Dollard' and 'La Salle' seed and Alternaria the most common fungus in the medium brown group. Drechslera phlei was found in the sample of medium brown seed possessing low germination. This is the first record of the occurrence of Drechslera phlei on red clover seed. The low incidence of the fungus on the seeds suggests that it may only have been present as a contaminant, and was not a cause of the lowered germination.

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