PREVALENCE AND SEVERITY OF DISEASES OF PROCESSING PEAS IN CANADA, 1970-71[1]

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Abstract

The prevalence and severity of diseases of commercially grown processing peas were assessed in a cooperative survey in seven provinces in 1970 and 1971. Uniform methods of sampling and assessing disease severity were used to survey approximately 10% of the acreage of green peas, Pisum sativum, grown for canning and freezing in British Columbia, Alberta, Ontario, Quebec, New Brunswick, Nova Scotia, and Prince Edward Island each year. In most provinces fusarium root rot was the predominant disease in green peas, affecting, overall, 83% and 86% of the fields examined in the two years. Ascochyta diseases (blight, foot rot, and leaf spot), gray mold, rust, and downy mildew followed in decreasing order of prevalence, Powdery mildew, fusarium wilt, septoria blight, anthracnose, cladosnorium snot, rhizoctonia stem rot, bacterial bliqht, virus diseases, nutritional disorders and insect damage were found infrequently. Diseases of field peas, P. sativum var. arvense, were assessed in 1971 in Manitoba, where bacterial bliqht and mycosphaerella bliqht were the most important diseases.

Introduction

Green peas, Pisum sativum L., grown for cannina and freezing are an important cash crop in many areas of Canada. In 1970 and 1971 green peas were grown on approximately 50 thousand acres and had an annual farm value of more than $6 million (Table 1). In the same years field peas, P. sativum var. arvense (L.) Poir., were grown on approximately 86.0 and 75.5 thousand acres, respectively. About two thirds of the Canadian production of fields peas are qrown in Manitoba (G.O. Code, Statistics Canada, personal communication).

A number of pea diseases have been reported from time to time in various reqions of Canada (3, 7, 9, 11, 17), but their importance in limiting production is largely unknown. To assess the need for studies on yield–loss relationships and on control a coordinated program was undertaken to determine initially the prevalence and severity of various diseases in the chief pea-growing areas of Canada. This paper reports the results of a cooperative 2-year survey of green peas in seven provinces and a 1-year survey of field peas in Manitoba.

Materials and methods

Uniform methods of sampling, identifying, and rating the severity of diseases were used, and in each province the survey was carried out on consecutive days during the main harvest period.

The number of fields examined was determined from the total acreage contracted by each pea processor. Because of limitations of time and personnel, fields were chosen on the basis of two fields for every 500 acres, with a minimum of two fields per processor. Using a table of random numbers (12), two groups of equal numbers of fields per processor were selected independently from among those to be harvested durinq the week of the survey. One of the two groups of fields was designated as replication 1 and the other as replication 2.

In each field, 10 sampling sites were chosen alonq the arms of a W pattern, covering the whole field except for a 15- to 20-ft-wide margin. The location of the first sampling site was determined by walking a number of paces from one corner of the field

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Table 1. Acreage, production, and farm value of green peas grown for processing in Canada, 1970 and 1971*

Province or region	Acres planted under contract		Acres harvested		Tons processed		Total amount paid to producers		Avg yield	
	1970	1971	1970	1971	1970	1971	1970	1971	1970	1971
	('000 acres)		('000 acres)		('000 tons)		($ million)		(tons/acre)	
Maritimes	9.6	6.1	8.6	5.7	10.9	8.0	0.89	0.69	1.3	1.4
Quebec	15.6	17.0	15.1	16.8	13.5	16.4	1.23	1.32	0.9	1.0
Ontario	18.6	19.0	18.0	18.3	28.6	25.1	3.08	2.71	1.6	1.4
Prairies	3.5	3.0	3.2	2.8	4.7	4.7	0.36	0.37	1.5	1.7
British Columbia	4.6	5.2	4.6	4.8	8.7	9.8	1.01	1.08	1.9	2.0
Canada	51.9	50.2	49.5	48.4	66.4	64.1	6.58	6.17	1.3	1.3

* Data compiled by Statistics Canada (4,13).

Table 2. Number of fields and acreage of green peas surveyed in seven provinces of Canada, 1970 and 1971

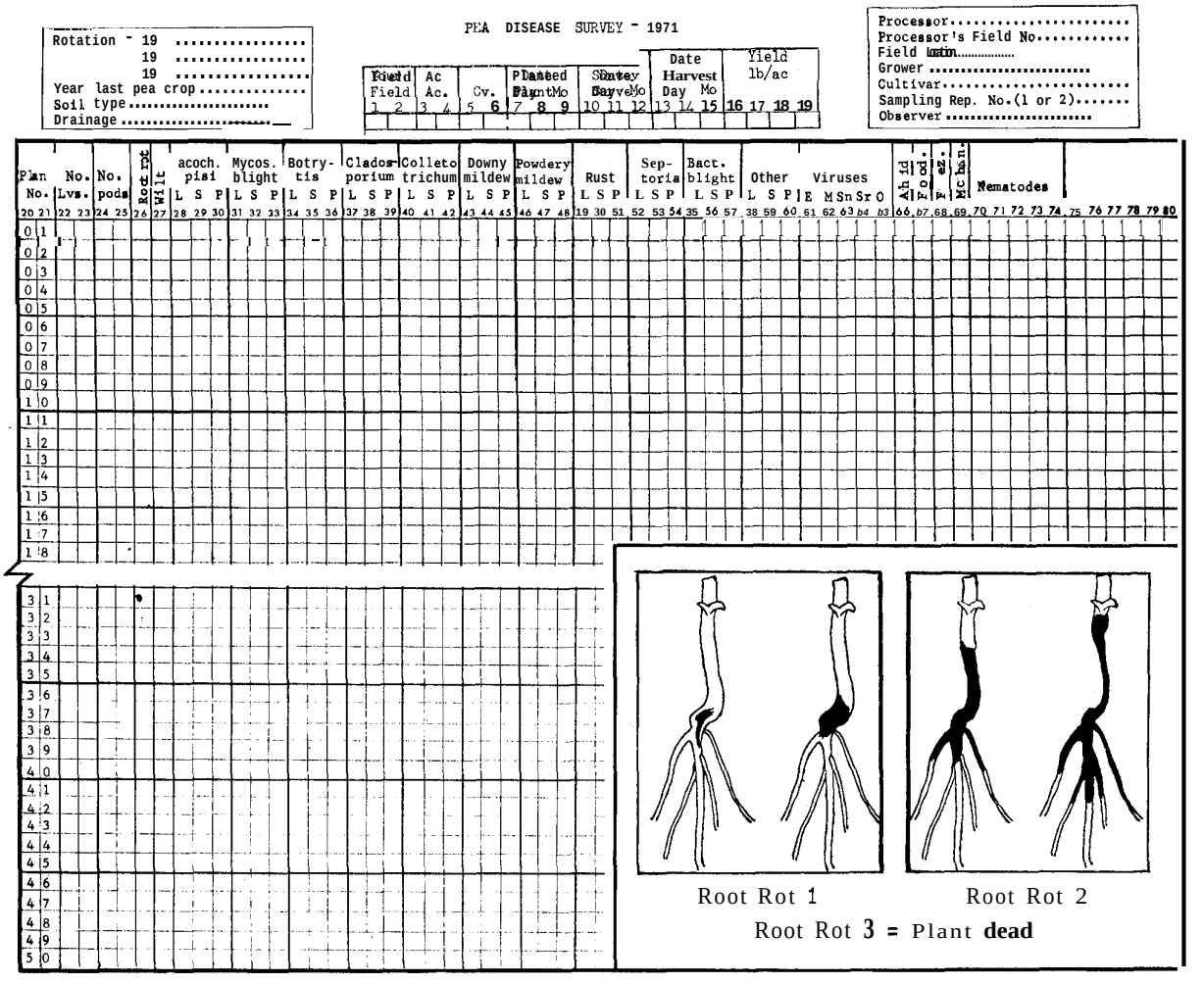
Province	1970		1971	
	No. fields	Acreage	No. fields	Acreage
Prince Edward Island	20	760	14	475
Nova Scotia	6	107	6	131
New Brunswick	31	511	12	350
Quebec	42	1,346	43	1,398
Ontario	70	1,400	74	1,771
Alberta	10	234	8	241
British Columbia	44	984	19	414
Total	223	5,342*	176	4,780**

* Represents 10.3% of the total acreage planted in 1970.

** Represents 9.5% of the total acreage planted in 1971.

as dictated by a random number drawn from 5 to 30. The remaining nine sites were spaced approximately equally along the sampling path. At each site, five consecutive plants in a row were removed carefully from the soil and examined for symptoms of disease.

Illustrated descriptions of most known pea diseases (2, 5, 8, 14, 15, 16, 19) were provided for field diagnosis. These included fusarium root rot [Fusarium solani (Mart.) Sacc. f. sp. pisi (F.R. Jones) Snyd. & Hans.], fusarium wilt [Fusarium oxysporum Schl. f. sp. pisi (van Hall) Snyd & Hans.], aphanomyces root rot [Aphanomyces euteiches Drechsl.], rhizoctonia stem rot [Rhizoctonia solani (Kühn)], ascochyta leaf spot [Ascochyta pisi Lib.], mycosphaerella or ascochyta blight [Mycosphaerella pinodes (Berk. & Blox.) Vestergr., syn. Didymella pinodes (Berk. & Blox.) Petr., stat imperf. Ascochyta pinodes (Berk. & Blox.) L.K. Jones], ascochyta foot rot [Phoma medicaginis var. pinodella (L.K. Jones) Boerema, syn. Ascochyta pinodella L. K. Jones.], gray mold [Botrytis cinerea Pers.], cladosporium spot [Cladosporium cladosporioides (Fres.) De Vries f. sp. pisicola (Snyd.) De Vries], mildew [Peronospora viciae (Berk.) Casp.], downy mildew [Erysiphe polygoni DC.], powdery mildew [Uromyces viciae-fabae (Pers.) Schroet.],



DISEASE RATINGS

Root rot: see diagram

Wilt:
1 - 1 or 2 lvs. wilted
2 - 3 to 5
3 - 6 or more
note color vasc. in stem

DISEASE ABSENT: LEAVE SPACE BLANK

Foliage Diseases (except viruses)

L = leaves	S = stems	P = pods
1 - 1 or 2 affected	1 - 1 or 2 nodes/internodes	1 - 1 to 4 affected
2 - 3 to 5	2 - 3 to 5	2 - 5 to 10
3 - 6 or more	3 - 6 or more	3 - 11 or more

Virus Diseases
insert 1 if present
E = enation Sn = stunt O = other
M = mosaic Sr = streak

Cols. 66-69: insert 1 if damage present
Nematodes: insert 1 if present (identify in space at right)

REMARKS:

Figure 1. Data sheet used to record disease ratings in each field; insert: diagramatic key for rating root rot.

septoria blight [*Septoria pisi* West.], bacterial blight [*Pseudomonas pisi* Sackett], and the virus diseases mosaic, streak, stunt, and enation. Except for suspected virus diseases, the identification of most diseases was confirmed by isolating the casual organism.

Symptoms on roots, stems, leaves, and pods of individual plants were rated separately using a numerical scale to express severity. For root rot, plants with a trace to 2 cm brown-to-black discoloration of the tap root and below-ground portion of the stem were rated 1, those with more than 2 *cm* discoloration were rated 2, and dead plants were rated 3 (Fig. 1). For foliage and wilt diseases, ratings of 1, 2, and 3 were given when the symptoms appeared on 1–2, 3–5, and more than 5 leaves, respectively. Stem infections were rated similarly on the basis of number of internodes (1–2, 3–5, or more than 5) affected. For pods, the ratings 1, 2, and 3 represented symptoms on 1–4, 5–10, and more than 10 pods. Virus diseases, insect damage, and other injuries were noted without reference to severity.

Disease severity in a field or province was expressed as the average of the numerical ratings of the infected plants. The severity values for roots, stems, leaves, and pods were averaged separately because they were not considered additive. The percentage of plants showing symptoms on each of these organs was also calculated, based on the total number of infected plants.

For each field the percentage of plants diseased was estimated on the basis of 50 plants from the 10 sites. For each province a weighted mean % was then calculated for the fields in each of the two groups (replications), as follows:

$$\text{Mean} = \frac{\Sigma(\%\text{ diseased plants per field } x \text{ field acreage})}{\text{Total acreage of fields}}$$

From these data, the combined mean [(mean rep. 1 + mean rep, 21/21 and its variance, s^2 = 1/4 (mean rep. 1 - mean rep. 2)^2, were estimated. By extracting the square root of the variance (s^2) an estimate of standard deviation of the combined mean (standard error) was obtained, As a relative measure of variability, the standard error was expressed as a percentage of the mean.

A data sheet (Fig. 1) for recording disease incidence, severity, and other relevant information was prepared for each field.

Results and discussion

Fourteen pea diseases and disorders reported previously in Canada (3) were detected during the 1970 and 1971 surveys (Table 4). Since the fields examined (Table 2) were selected at random and sampling sites were predetermined, no apparent bias existed with respect to any of the diseases or to the 63 cultivars and lines of green pea that were encountered.

Disease prevalence

The percentage of affected fields and plants in seven provinces (Table 3) clearly shows the dominance in green peas of fusarium root rot, followed by ascochyta diseases, gray mold, rust, and downy mildew. The high error values (>10%) associated with the means indicated considerable variation, and consequently a lack of uniformity, in the distribution of the diseases. From the provincial data (Table 3), it appears that only the most prevalent diseases can be expected to be more or less uniformly distributed; for example, the occurrence of fusarium root rot in Quebec, Ontario, Alberta, and British Columbia. While the fixed sample of 50 plants per field was not proportional to field size, which varied from 8 to 96 acres, the problem of estimating accurately % diseased plants in an area having fields of different sizes was partially resolved by the weighting method described.

Disease scverity on affected plant parts

The percentage of plants showing symptoms on root, stem, leaf, and pod (Table 3) indicated that the ascochyta diseases, gray mold, and bacterial blight caused more pod infection than the other diseases. Except for fusarium root rot and rhizoctonia stem rot, most diseases affected the foliage. The results suggest that, with the exception of ascochyta diseases, most foliage diseases could be assessed on the basis of leaf symptoms alone, Fusarium root rot was rated on root symptoms, although in severe cases wilting of leaves occurred. The mean severity ratings on root, stem, leaf, and pod (Table 3) for most of the diseases rarely exceeded 2 on a 1–3 scale, indicating moderate infection. In certain fields, however, damage from fusarium and ascochyta diseases was severe. It. should be pointed out that an overall severity value for a disease could be given only when the severity on stem, leaf, and pod ware of the same value (e.g. ascochyta blight in Quebec, 1970) or when a disease was mainly observed on one part of a plant (e.g. fusarium rot on roots, downy mildew on leaves).

Fusarium solani (1, 7, 15) and F. oxysporum (9) have been isolated consistently from plants showing root rot symptoms; occasionally Rhizoctonia solani (3) and Ascochyta pinodella have been isolated from such plants. The symptoms of ascochyta foot rot [A. pinodella] and ascochyta blight [A. pinodes] are similar (11) and no attempt was made to distinguish them by field diagnosis; this complex is referred to here as ascochyta blight.

Regional observations

Prince Edward Island - The two most important diseases observed in P.E.I. fields were ascochyta blight (11) and fusarium root rot (9). Both diseases are endemic in fields that have been cropped repeatedly to peas and each may cause severe losses, depending upon weather conditions and rotation. The incidence of ascochyta bliqht was very high both years (Table 3,A), while the incidence of fields affected by fusarium root rot varied from zero in 1970 to 50% in 1971. The absence of fusarium root rot in the samples in 1970 followed a severe outbreak in one area of the province the previous year (9) and was attributable in large part to efforts by processors in avoiding fields used in 1969. The return of peas to some of these fields in 1971 is reflected in the higher incidence of fusarium root that year (Table 3,A). In two pea fields affected by root rot in 1969 and planted to potatoes in 1970, root rot was so severe in 1971 that the pea crops were plowed under before harvest; neither field was included in the sample reported in Table 3.

Marginal necrosis of the leaves symptomatic of boron toxicity was noted in peas in 1970. Each affected field had been

planted the previous year to a cole crop, and each had received an application of fertilizer containinq boron in the spring of 1969. In two fields in 1970, a few plants of Perfection-type peas showed severe rosettinq, prolonged veqetative growth, and poor seed set similar to symptoms of infection by the seed-borne pea fizzletop virus *(6)*.

In both years a chlorotic condition, occurring typically in parallel strips one to several rows wide, was noted in a number of fields. Plants in the affected areas were a lighter green color than those in "normal" areas. This chlorotic condition was most evident when fields were viewed from a distance but its cause was not identified: in each case the previous crop in the affected fields was potatoes. Similar symptoms have been noted in New Brunswick (q.v.).

Although not indicated in the survey (Table 3), gray mold caused serious losses in several fields following a week of rainy weather just before harvest in 1970. Yield reductions estimated at up to 50% were experienced in fields that showed less than 4% of the plants affected when surveyed a week earlier: the losses were caused by rotting of pods and seeds and by plugging of the combines with partially rotted vines. (W.L.S.)

Nova Scotia - In Nova Scotia pea fields the diseases most commonly associated with a poor plant stand were fusarium root rot and fusarium wilt (Table 3,B). The frequency of F. solani and F. oxysporum recorded when isolations were made from over 100 plants from two fields with poor stands was 14% and 48%, respectively. A 10-acre field cropped successively to peas was completely destroyed in the fifth year by the fusarium wilt and root rot fungi. These fields were not part of the sample reported in Table 3.

During the survey, ascochyta blight was most prevalent in fields successively cropped to peas, and generally this disease was most severe in fields that also had a high incidence of fusarium wilt and root rot, Botrytis gray mold was most prevalent in seasons of heavy rainfall, and it occurred most frequently on the foliage.

Ascochyta leaf spot, downy mildew, and rust were often observed but the overall severity of these diseases was light. Numerous small lesions ("pepper spot") on the upper surface of the leaves were often present late in the season. A. pisi was the predominant organism isolated from these small lesions, Powdery mildew was not recorded on peas in this survey. (C.O.G.)

New Brunswick - The ascochyta blight complex and fusarium root rot were the most important diseases in New Rrunswick, followed by ascochyta leaf spot, ascochyta blight, and gray mold (Table 3,C). The latter was more of a problem on the lower leaves in' fields where plant growth was excessive.

Losses due to nutritional disorders were also a problem in some fields. Most of the pea crops examined were grown on potato land where the pH of the soil ranqed from 4.8 to 5.4. At seeding time lime was applied in the drill at the rate of 400-700 lb per acre. This amount had little or no effect on soil pH but did have a pronounced effect on the health and viqor of the pea plants. Where lime was missed due to pluqginq or mechanical failure of the machinery, plants became chlorotic and nodulation was absent or sparse. Yields from these areas were poor and often the peas had hardened-off before the remainder of the crop was ready for harvesting. (C.H.L.)

Quebec - Fusarium root rot was the disease observed most frequently in Quebec (Table 3,D). When weather conditions are favorable for its development, this disease causes severe losses in affected fields. Ascochyta leaf spot and ascochyta blight occurred in more than 50% of the fields in 1970 but the severity of these diseases was only slight. Rust was also noticed in many fields but it caused very little damage. In general disease occurrence was greater in 1970 than in 1971. The low yields in Quebec (Table 1) are considered to be due chiefly to the lack of proper management. Poor drainage and lack of rotation, particularly, seem to favor the development of root rot diseases even though no correlation was found between the incidence of fusarium root rot and yield (Table 5). (R.C.)

Ontario - The general distribution of pea diseases (Table 3,E) in three reqions of Ontario was as follows:

In eastern Ontario, fusarium root rot, ascochyta leaf spot, downy mildew, and rust were found consistently but the overall severity of these diseases was slight to moderate, Powdery mildew occurred only late in the season.

In central Ontario, fusarium root rot and fusarium wilt were found in most fields surveyed. However, these two diseases were difficult to distinquish under field conditions. Ascochyta blight and virus diseases were occasionally observed.

In southern Ontario, fusarium root rot predominated. Gray mold and bacterial blight were found only in this region of Ontario. Ascochyta leaf spot, ascochyta blight, and septoria hliqht were rarely encountered. (P.K.B., J.H.H.)

Alberta - Fusarium root rot continued to be the most important disease of green peas in Alberta (Table 3,F) (7). Some farm land is lost for pea production almost every year because of severe yield losses from root rot.

Table 3. Prevalence and severity of pea diseases in seven provinces of Canada, 1970 and 19'71

Province and disease	% fields and plants affected				% diseases plants showing symptoms on root, stem, leaf, and pod, and meanseverity (sev.)*													
	1970		1971		1970								1971					
					Root		Stem		Leaf		Pod		Root		Stem		Leaf		Pod	
	Fields	Plants** (mean)	Fields	Plants,, (mean)	%	Sev.	%	Sev	%	Sev.	%	sev.	%	Sev.	%	Sev.	%	Sev.	%	Sev.
A. Prince Edward Island																				
Fusarium root rot	0.0		50.0	12.2(23.1)									100.0	1.2						
Ascochyta leaf spot	10.0	0.3(100.0)	7.1	0.4 (100.0)					100.0	1.0							100.0	1.0		
Ascochyta blight	80.0	44.4(11.1)	78.6	18.1(9.4)			73.0	1.3	35.0	1.3	0.2	1.0	16.2	1.1	61.5	1.0				
Gray mold	15.0	1.9(28.3)	57.1	11.9(15.8)					100.0	1.1	3.3	1.0			2.2	1.4	99.1	1.2	2.6	1.0
Rust	65.0	17.9(1.6)	64.3	7.8(36.5)			4.6	1.0	98.5	1.0							100.0	1.0		
Wwny mildew	20.0	1.2(5.4)	92.9	26.4(4.9)					100.0	1.0							100.0	1.0		
Powdery mildew	0.0		7.1	0.2(100.0)													100.0	1.0		
Virus diseases	5.0	0.3(100.0)	0.0																	
Boron toxicity	10.0	2.8(42.0)	0.0																	
B. Nova Scotia																				
Fusarium root rot	16.6	2.9(100.0)	100.0	10.6(38.5)	100.0	1.0							100.0	1.4						
Ascochyta leaf spot	100.0	53.7(34.6)	83.3	46.8(6.9)			56.3	1.0	64.7	1.0	11.0	1.0			30.3	1.1	87.6	1.0		
Ascochyta blight			66.6	36.4(45.6)											39.7	1.0	65.7	1.0		
Gray mold	100.0	75.5(29.9)	100.0	88.8(11.3)			24.5	1.4	100.0	2.0	4.7	1.0			20.8	1.3	93.7	1.6	1.0	1.0
Rust	66.6	36.4(97.4)	66.6	23.5(65.9)			1.0	1.0	98.9	1.1							100.0	1.0		
Downy mildew	83.3	28.0(20.5)	50.0	1.3(6.1)					100.0	1.0							100.0	1.0		
Fusarium wilt	50.0	18.7(86.3)	50.0	6.1(100.0)					100.0	1.4							100.0	1.4		
Bacterial blight	83.3	14.4(73.7)	0.0						100.0	1.0										
Virus Diseases	16.6	0.3(100.0)	16.6	0.8(100.0)																
C. New Brunswick																				
Fusarium root rot	83.9	48.7(44.6)	91.7	34.8(9.8)	100.0	1.2							100.0	1.2						
Ascochyta leaf spot	51.6	22.6(56.9)	100.0	84.5(2.0)			20.0	1.0	86.1	1.0	18.6	1.0			98.5	1.6	68.9	1.7	57.7	1.2
Rscochyta blight	90.3	69.3(16.9)	33.3	0.6(2.7)			71.5	1.4	81.9	1.6	36.1	1.0			25.0	1.0	78.0	1.0		
Gray mold	58.1	23.6(34.8)	66.6	24.7(22.6)			9.2	1.3	100.0	1.5	1.5	1.0					100.0	1.1		
Rust	19.4	15.2(0.9)	0.0				6.8	1.0	100.0	1.2										
Downy mildew	16.1	5.0(54.1)	0.0						100.0	1.1										
Fusarium wilt	16.1	3.5(84.8)	0.0						100.0	1.8										
Bacterial blight	12.9	2.6(84.6)	0.0						100.0	1.0										
Virus diseases	0.0		16.6	1.0(36.4)																
D. Quebec																				
Fusarium root rot	97.6	54.3(9.8)	95.3	25.8(9.3)	100.0	1.3							100.0	1.3						
Ascochyta leaf spot	69.0	13.4(19.8)	39.5	4.6(14.7)			33.4	1.0	64.3	1.1	23.0	1.0			2.0	1.0	91.5	1.0	4.0	1.0
Ascochyta blight	50.0	4.2(27.4)	27.9	2.1(63.5)			2.9	1.0	97.0	1.0	3.1	1.0			3.3	1.0	96.6	1.0		
Gray mold	9.5	0.3(25.9)	7.0	5.1(51.1)					100.0	1.0	12.5	1.0					100.0	1.0		
Rust	88.1	10.3(9.5)	53.5	19.5(4.9)			0.6	1.1	100.0	1.0							100.0	1.0		
Powdery mildew	21.4	7.0(22.7)	4.7	3.7(83.3)					100.0	1.1							100.0	1.0		
Fusarium wilt	9.5	0.3(7.1)	4.7	0.1(100.0)					100.0	2.3							100.0	1.5		
Septoria blight	31.0	3.4(10.8)	9.3	1.0(25.8)			8.3	1.0	92.3	1.0							100.0	1.0		
Anthracnose	31.0	5.0(33.2)	0.0				83.3	1.0	34.4	1.0										
Cladosporium spot	2.3	0.2(100.0)	0.0						100.0	1.0										
Bacterial blight	2.3	<0.1(100.0)	0.0				100.0	3.0	100.0	2.0	100.0	1.0								
Virus diseases	59.5	21.2(5.1)	48.8	6.6(9.5)																
E. Ontario																				
Fusarium root rot	90.0	55.1(8.8)	79.7	71.6(1.7)	100.0	1.4							100.0	1.3						
Ascochyta leaf spot	12.9	1.8(19.4)	13.5	0.9(9.3)			48.7	1.0	75.6	1.0					76.8	1.0	26.4	1.0	1.6	1.0
Ascochyta blight	7.1	1.0(50.0)	5.4	0.4(45.4)			30.4	1.0	81.3	1.7	0.9	1.0			8.3	1.0	91.5	1.0		
Gray mold	30.0	5.3(29.3)	16.2	1.8(11.4)			71.4	1.0	100.0	1.1					19.6	1.2	83.2	1.0	9.0	1.0
Rust	4.8	0.3(100.0)	0.0						100.0	1.0										
Downy mildew	18.6	2.3(17.6)	20.3	6.8(25.8)					100.0	1.0							100.0	1.0		
Powdery mildew	5.7	3.6(75.6)	0.0				50.0	2.2	100.0	1.6	50.0	1.8								
Fusarium wilt	28.7	5.3(32.5)	36.5	9.9(15.1)					100.0	1.0							100.0	1.0		
Septoria blight	0.0		2.7	0.1(42.9)													100.0	1.0		
Bacterial blight	10.0	3.8(21.1)					71.4	1.0	100.0	1.1										
Virus diseases	0.0		2.7	0.1(60.0)																
F. Alberta																				
Fusarium root rot	100.0	70.7(18.3)	100.0	59.6(38.6)	100.0	1.4							100.0	1.2						
Ascochyta leaf spot	50.0	3.6(37.3)	87.5	17.6(61.9)			20.0	1.0	80.0	1.0					74.0	1.0	30.3	1.0		
Ascochyta blight	60.0	24.7(66.9)	87.5	40.5(23.7)			82.1	1.1	90.5	1.3	13.1	1.0			87.1	1.0	4.4	1.2		
Gray mold	50.0	8.4(18.9)	100.0	7.9(24.4)					100.0	1.0	1.3	1.0								

Table 3 (cont'd.)

Province and disease	% Fields and plants affected				% diseases plants showing symptoms on root, stem, leaf, and pod, and meanseverity (sev.)													
	1970		1971		1970								1971					
					Root		Stem		Leaf		Pod		Root		Stem		Leaf		Pod	
	Fields	Plants,, (mean)	Fields	Plants,, (mean)	%	Sev.	%	Sev.	%	Sev.	%	Sev.	%	Sev.	%	sev.	%	Sev.	%	Sev.
F. Alberta (cont'd.)																		
Downy mildew	50.0	5.6(56.4)	62.5	3.3(33.3)					100.0	1.0					97.5	1.0	2.5	1.0		
Powdery mildew	90.0	26.9(68.3)	100.0	59.5(17.2)			13.3	1.4	100.0	1.2					2.5	1.0	99.3	1.1	0.6	1.0
Septoria blight	100.0	24.2(33.1)	100.0	21.5(1.1)					100.0	1.0							100.0	1.0		
Fusarium wilt	0.0		12.5	0.2(100.0)													100.0	1.0		
Rhizoctonia stem rot	0.0		37.5	2.7(36.3)																
Bacterial blight	30.0	13.4(94.0)	0.0				34.6	1.3	72.3	1.1	5.6	1.0								
Virus diseases	0.0		37.5	0.5(60.0)																
G. *British* Columbia																		
Fusarium root rot	100.0	96.1(2.7)	100.0	50.6(19.5)	100.0	1.8							100.0	1.6						
Ascochyta leaf spot	4.5	0.2(62.5)	0.0				75.0	1.5	75.0	1.0	50.0	1.0								
Ascochyta blight	4.5	0.3(75.0)	0.0				75.0	2.0	50.0	2.0	25.0	1.0								
Gray mold	11.4	1.1(50.9)	0.0				38.2	1.0	76.2	1.0	27.0	1.0								
Rust	11.4	1.0(49.4)	0.0						100.0	1.0										
Downy mildew	45.5	12.6(15.9)	0.0				0.5	1.0	100.0	1.1										
Fusarium wilt	4.5	0.5(100.0)	0.0						100.0	1.8										
Virus diseases	9.1	0.9(75.0)	0.0																	

The mean severity rating is based on diseased plants only and is expressed on a 1-3 scale where 3 =maximum severity.

** Mean = combined mean of two weighted means obtained from two independent sets of fields per province; figures in parentheses are standard errors expressed as % of the combined means.

Ascochyta blight and ascochyta leaf spot appear to be increasing in importance in Alberta. This may be due to more frequent periods of high humidity in the plant canopy resulting from increased use of sprinklers to irriqate the pea crop. Powdery mildew was frequently found in pea crops; this disease is rarely important on crops grown for processing but occasional fields of late-maturing cultivars grown for seed are severely affected. (F.R.H.)

British Columbia - Processing peas are grown only in the lower Fraser Valley in the coastal strip of B.C. The most prevalent disease noted in both years was fusarium root rot, which was present in 100% of the fields surveyed (Table 3,G). In spite of this and even when affected fields had supported peas for several recent years, the averaqe yield was higher than that of other areas (Table 1). In 1970 downy mildew occurred in 45% of the fields but no other disease was of any importance. (H.N.W. T.)

Other diseases and pests

In Ontario and Prince Edward Island, a "pepper spot" symptom on pea leaves was noted in several fields; attempts to isolate a pathogen from affected leaves were unsuccessful, and damage appeared to be minor.

In 1970, soil samples from the fields surveyed in eastern Ontario were examined for the presence of plant-parasitic nematodes, and the results have been reported by Sanwal (10).

Aphids were noted in pea crops in all provinces but, in general, little damage was observed. Pod development was affected in only a few fields where insecticides had not been used or where the control program had not been effective. The range of aphid infestation, expressed as the percentage of plants infested, was as follows: Prince Edward Island 3-7%, Nova Scotia 2-8%, New Brunswick 1%, Quebec 6-21%, Ontario 0.3%-0.5%, Alberta 2-4%, and British Columbia 0-2%.

In Prince Edward Island in 1970 and 1971, injury caused by leaf miners (*Liriomyza* spp.) was found in 5% and 43% of the fields, affecting 4.7% and 1.6% of the plants, respectively; however, on each affected plant only one or two leaves were attacked and damage was regarded as negligible. The two species of *Liriomyza* that were collected in P.E.I. fields and reared at the Charlottetown Research Station apparently have not been reported on peas in Canada. *Liriomyza fricki* Spencer was identified by G.E. Shewell, Entomology Research Institute, Ottawa; this species has been found previously in Canada and the USA on other legumes. An as yet unnamed species of *Liriomyza*, samples of which were examined by K.A. Spencer, is apparently identical to forms found by him in the USA on *Trifolium* sp. and alfalfa (L.S. Thompson, personal communication).

Table 4. Percentage of green pea fields and plants affected by disease in seven provinces of Canada, 1970 and 1971

Disease	1970		1971	
	Fields	Plants	Fields	Plants
Fusarium root rot	83.0	46.8	85.8	37.9
Ascochyta leaf spot	31.0	13.7	29.5	22.1
Ascochyta blight	35.0	20.5	23.9	14.0
Gray mold	27.8	16.6	25.6	20.0
Rust	30.5	11.6	20.5	7.4
Downy mildew	23.3	7.8	20.5	5.4
Powdery mildew	8.0	5.4	6.3	9.1
Fusarium wilt	15.2	4.0	18.8	2.3
Septoria blight	10.3	3.9	7.9	3.2
Anthracnose	5.8	0.7	0.0	0.0
Cladosporium spot	0.4	<0.1	0.0	0.0
Rhizoctonia stem rot	0.0	0.0	1.7	0.4
Bacterial blight	9.0	4.9	0.0	0.0
Virus diseases	3.5	0.3	5.7	0.2

Diseases of field peas in Manitoba, 1971

All nine fields sampled in Manitoba were affected by bacterial blight and ascochyta blight. These diseases affected 89% and 99%, respectively, of the plants examined, and each had a mean severity rating of 2.4. In one of the nine fields downy mildew was found on 12% of the plants, with a mean severity of 1.0. The range of diseases affectinq field peas is similar to that affecting green peas, except that the cultivar Century, which is the predominant field pea grown in Canada, is resistant to Ascochyta pisi (18). In most years blight incited by Mycosphaerella pinodes is the most prevalent and damaginq disease in Manitoba, where peas are frequently planted within range of wind-blown ascospores produced on debris of a previous year's crop; in this area the fungus is known to survive in refuse for at least 3 years. (R.C.Z.)

Pea yield and fusarium root rot

In 1970, an effort was made to correlate the yield of shelled green peas reported by the processors with the incidence of fusarium root rot in 145 fields selected at random in five provinces. The average yield (1.32 tons/acre) reported from these fields agreed with the national average (Tables 1, 5). However, the yield data reported did not reflect the differences in incidence of root rot observed (Table 5). In the fields surveyed, factors other than root rot apparently had a much more profound influence on yield.

Table 5. Yield of shelled green peas from 145 fields* with different percentages of plants affected by fusarium root rot

% affected plants	NO. Of fields	Avg yield (lb/acre)**
0	13	2489
1–10	11	2605
11–20	10	2880
21–30	8	2841
31–40	4	2852
41–50	4	2226
51–60	8	2196
61–70	10	3008
71–80	8	2041
81–90	15	2601
91–100	54	3366

* Fields surveyed in British Columbia, Ontario, Quebec, New Brunswick, and Nova Scotia for which yield data were available in 1970.

** Yield data were supplied by processors; the average yield of all the fields was 2645 lb (1.32 tons) per acre.

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