DISEASES OF BRASSICA SPECIES IN SASKATCHEWAN, 1970-72
III. STEM AND ROOT ROTS[1]

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Abstract

Yield losses caused by stem rot fungi collectively were of little significance in a vast majority of the fields of Brassica campestris and B. napus sampled during the 3-year survey period. Nevertheless, the prevalence and incidence of footrot substantially increased. In approximately one-third of the fields of B. napus examined in 1972, over 50% of the plants had small basal lesions. Fusarium roseum 'Acuminatum' and Rhizoctonia solani were the principal pathogens isolated from footrot lesions. Sclerotinia stem rot decreased in importance, occurrring in 40% of the 1970 fields and 18% of the 1972 fields.

Introduction

The diseases to be considered are footrot, which has been attributed to Fusarium spp. and Rhizoctonia solani Kühn, and sclerotinia stem rot caused by Sclerotinia sclerotiorum (Lib.) de Bary. Leptosphaeria maculans (Desm.) Ces. & de Not., the fungus responsible for blackleg, will be considered part of the footrot complex in this report. Most of the survey data for blackleg have already been published (3).

Duczek and Morrall have published the results of an extensive survey of sclerotinia stem rot conducted in Saskatchewan in 1970 (1).

Methods

Techniques employed in field sampling and calculation of the disease severity index (DSI) have already been presented in detail (4). Disease severity classes for footrot and sclerotinia stem rot are defined in Table 1. Isolations were made routinely from field collections as described in an earlier paper (3). Methods used for seedling pathogenicity tests were also much the same as those previously described at length (2).

Results and discussion

The data for sclerotinia stem rot are in Tables 2 and 3. Those for footrot appear in Tables 2, 4, and 5. The geographical distribution of fields having the two diseases may be found by consulting Figure 1 in addition to the tables.

Table 1. Disease severity classes used for footrot and sclerotinia stem rot

Severity class	Description of symptoms: Footrot	Description of symptoms: Stem rot
0	No disease	
TR*	Discrete lesion near ground level 1 cm diam	
1	Lesion up to a few cm long but stem not girdled	Up to ¼ of stem rotted
2	Lesion up to several cm long girdling stem	From ¼ to ½ of stem rotted, plant ripening prematurely
3	Stem girdled, plant stunted, ripened prematurely, seed set reduced substantially	Over ½ of stem rotted, pronounced premature ripening, seed set substantially reduced

* Plants in this class were considered healthy when the disease severity index was calculated.

Sclerotinia stem rot decreased in prevalence from 1970 to 1972, most notably in Brassica campestris L. fields. In both this species and B. napus L. lesions were usually relatively small, occurring high up on the stems and probably resulting from ascospore infections. The average loss in yield was clearly much less than 1% in each of the 3 years.

The prevalence and incidence of footrot increased during this period, particularly in fields of B. napus (Table 2). In 5 of a total of 19 inspected in 1972, over 50% of the plants were infected. All five occurred

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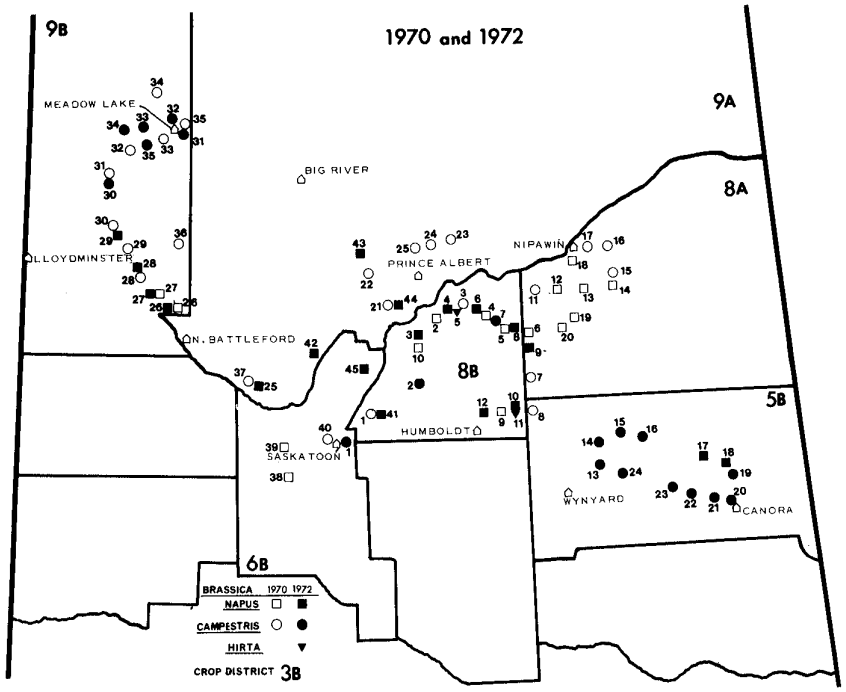

Figure 1. Commercial fields of *Brassica napus*, *B. campestris*, and *B. hirta* sampled during disease surveys conducted in Saskatchewan in 1970 and 1972.

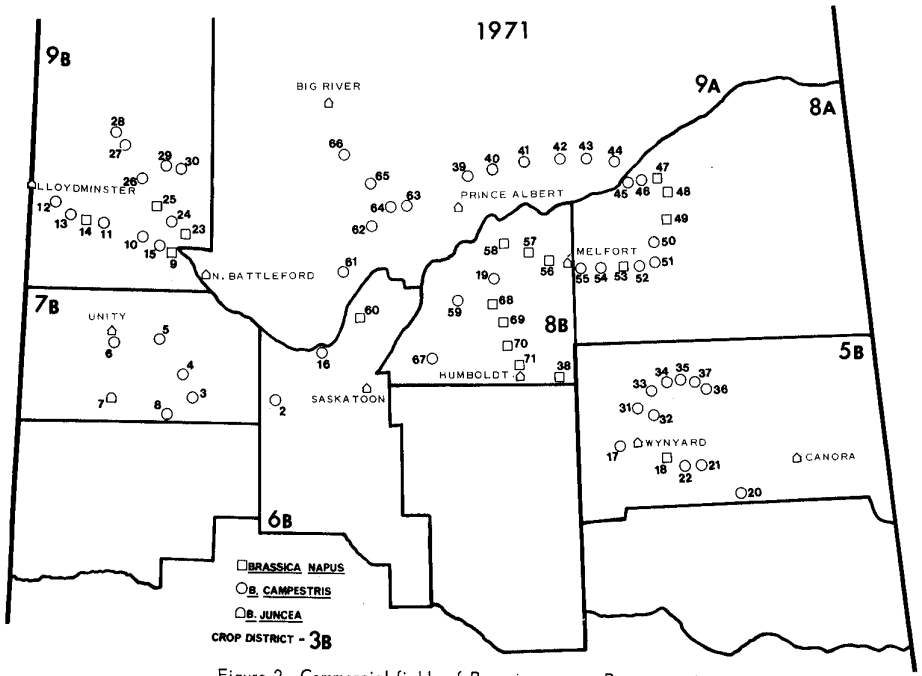

Figure 2. Commercial fields of *Brassica napus*, *B. campestris*, and *B. juncea* sampled in Saskatchewan during the 1971 disease survey.

Table 2. Prevalence, incidence, and severity of footrot and sclerotinia stem rot in Saskatchewan, 1970-1972

		Brassica napus			*Brassica campestris*			All fields*		
	Disease	1970	1971	1972	1970	1971	1972	1970	1971	1972
No. of fields		16	18	19	24	51	19	40	70	40
% of fields having the disease	footrot	88	83	100	58	82	94	70	83	97
	stem rot	50	39	32	33	12	6	40	19	18
% of plants per field diseased (avg)	footrot	6	21	25	1	7	4	3	11	14
	stem rot	4	1	<1	<1	<1	<1	2	1	<1
Avg DSI (%)	footrot	1	3	7	<1	1	1	<1	2	4
	stem rot	2	1	<1	<1	<1	<1	<1	<1	<1

* Including *Brassica hirta* and *Brassica juncea* fields (Figs. 1 and 2).

Table 3. Incidence and relative severity of sclerotinia stem rot in Saskatchewan from 1970 to 1972. Infection levels in individual fields*

Brassica napus						*Brassica campestris*					
Field no.	Crop District	% of plants infected	% of sites with plants infected	Highest % infection at any site	DSI	Field no.	Crop District	% of plants infected	% of sites with plants infected	Highest % infection at any site	DSI
					1970						
4	8B	1	17	8	1	3	8B	2	20	8	1
5	8B	17	100	32	8	11	8A	1	20	4	<1
12	8A	7	40	23	4	21	9A	2	17	12	2
13	8A	4	60	12	2	23	9A	1	20	4	<1
18	8A	3	40	8	2	24	9A	1	17	4	1
19	8A	2	40	4	1	30	9B	1	20	3	1
26	9B	2	40	4	1	33	9B	1	20	4	<1
27	9B	21	100	52	11	40	6B	1	20	3	<1
					1971						
14	9B	2	10	20	1	16	6B	1	10	10	1
25	9B	1	11	10	<1	24	9B	8	60	20	3
56	8B	5	50	10	2	42	9A	1	10	10	<1
57	8B	10	60	30	5	55	8A	1	10	10	<1
58	8B	4	30	20	3	61	9A	1	13	10	<1
60	6B	1	10	10	1	66	9A	1	13	10	<1
68	8B	1	10	10	1						
					*1972***						
3	8B	<1				34	9B	3	10	30	<1
8	8B	2	10	20	<1						
9	8A	<1									
10	8B	<1	10	10	<1						
12	8B	2	10	20	<1						
45	6B	<1									

* Fields having no infection are not listed.

** In fields 3, 9, and 45, no infected plants occurred in the samples pulled but one or two were observed elsewhere in each field.

in crop district 8B (Table 4 and Fig. 1). Nevertheless, overall yield losses were not substantial, as infection usually consisted of a small lesion from 0.5 to 1.5 cm long and less than 1 cm wide near soil level.

Observations made in experimental plots and survey results would appear to indicate differences in susceptibility of Brassica species to foot rot. In the only field of B. juncea (L.) Coss (field 7, 1971), over 55% of the plants had footrot symptoms. The average severity index was 16. These figures are considerably higher than those for B. campestris fields in the same area. In 1970 the percentage of footrot-infected plants in plots of B. juncea at Saskatoon was noticeably greater and the symptoms more fully expressed than in adjacent plantings of other Brassica spp. One might conclude from the survey results that varieties of B. napus are more susceptible than those of B. campestris to both foot rot and sclerotinia stem rot. Greenhouse inoculation experiments have shown differences in the rates at which different Brassica species succumb to stem rots (unpublished data). However, the results to date do not support the conclusion that B. napus is more susceptible than B. campestris. Footrot generally appears to develop rather late in the season. For this reason the earlier-maturing B. campestris may

Table 4. Prevalence and relative severity of footrot in Saskatchewan in 1970 and 1972. Infection levels in individual fields*

Brassica napus						*Brassica campestris*					
Field no.	Crop District	% of plants infected	% of sites with plants infected	Highest % infection at any site	DSI	Field no.	Crop District	% of plants infected	% of sites with plants infected	Highest % infection at any site	DSI
				1970							
2	8B	23	100	44	5	3	8B	1	20	4	<1
4	8B	11	83	16	3	11	8A	4	40	14	<1
5	8B	5	67	12	1	15	8A	1	20	4	<1
6	8A	19	100	26	1	17	8A	2	40	4	<1
9	8B	3	40	7	1	22	9A	7	67	23	4
10	8B	3	40	10	1	24	9A	1	17	8	<1
12	8A	19	100	35	1	29	9B	1	20	4	1
13	8A	6	60	15	<1	30	9B	2	40	7	1
14	8A	1	20	4	<1	31	9B	1	20	7	<1
18	8A	3	40	12	<1	32	9B	1	20	4	<1
19	8A	1	20	4	1	33	9B	1	20	4	<1
20	8A	1	20	4	<1	34	9B	7	80	11	1
26	9B	2	20	8	1	37	9A	1	40	3	<1
38	6B	<1				40	6B	4	60	10	<1
				1972							
3	8B	29	90	60	10	2	8B	7	60	20	2
4	8B	52	100	100	13	7	8B	7	50	20	2
6	8B	74	100	100	27	13	5B	1	10	10	1
8	8B	52	100	80	17	14	5B	2	30	8	1
9	8A	29	90	54	4	15	5B	8	60	33	3
10	8B	69	100	100	20	16	5B	4	50	11	2
12	8B	57	100	82	18	19	5B	2	20	14	1
17	5B	4	40	10	1	20	5B	4	50	8	1
18	5B	1	10	10	<1	21	5B	4	40	23	1
25	9B	6	30	33	2	22	5B	10	60	31	4
26	9B	1	10	9	<1	23	5B	1	10	11	<1
27	9B	3	20	17	<1	24	5B	6	50	18	2
28	9B	2	20	8	<1	31	9B	1	10	9	<1
29	9B	4	40	10	1	32	9B	5	40	20	2
42	9A	1	8	10	<1	33	9B	2	30	8	1
43	9A	10	70	27	2	34	9B	2	20	8	1
44	9A	17	88	30	4	35	9B	2	30	8	1
45	6B	<1			<1						

* Fields having no infection are not listed.

Table 5. Prevalence and severity of footrot in Saskatchewan in 1971. Infection levels in individual fields*

Field no.	Crop District	% of plants infected	% of sites with plants infected	Highest % infection at any site	DSI	Field no.	Crop District	% of plants infected	% of sites with plants infected	Highest % infection at any site	DSI
					Brassica napus						
9	9B	2	10	20	<1	57	8B	4	40	10	1
14	9B	42	90	70	8	58	8B	52	90	90	11
18	5B	8	30	40	2	60	6B	28	100	60	2
23	9B	5	30	30	<1	68	8B	28	90	70	4
25	9B	3	11	30	<1	69	8B	29	90	50	2
38	8B	36	100	100	5	70	8B	39	90	80	8
49	8A	31	90	90	4	71	8B	46	100	90	7
56	8B	16	80	40	<1						
					Brassica campestris						
3	7B	7	40	30	1	32	5B	20	60	60	5
4	7B	2	20	10	1	33	5B	6	50	20	<1
5	7B	14	70	30	2	34	5B	14	80	50	3
6	7B	10	70	20	1	36	5B	3	10	30	1
8	7B	10	60	30	1	37	5B	1	10	10	<1
10	9B	6	40	20	1	39	9A	3	10	30	1
11	9B	20	80	60	5	43	9A	4	38	10	1
12	9B	8	40	30	2	44	9A	4	25	20	2
13	9B	1	10	10	<1	46	8A	2	20	10	1
15	9B	2	20	10	<1	51	8A	1	10	10	<1
16	6B	4	30	20	3	52	8A	11	80	20	3
19	8B	13	70	60	3	54	8A	5	30	30	1
20	5B	7	50	20	3	55	8A	15	70	40	2
21	5B	6	20	40	2	59	8B	14	70	50	3
24	9B	18	50	70	3	61	9A	9	56	30	<1
26	9B	7	60	20	2	62	9A	6	50	20	1
27	9B	1	10	10	<1	63	9A	11	60	30	2
28	9B	4	30	20	2	64	9A	3	30	10	1
29	9B	7	40	30	<1	65	9A	10	60	20	2
30	9B	14	60	40	1	66	9A	31	88	50	7
31	5B	16	70	40	5	67	8B	12	60	30	1

* Fields having no infection are not listed.

Table 6. Relative proportions of the principal fungi obtained upon plating stem bases with footrot symptoms*

Year	No. sampled		Percentage of total stems yielding						
	Stems	Fields	*Fusarium*	*Fusarium* & *Rhizoctonia*	*Rhizoctonia*	*Fusarium* &/or *Rhizoctonia*	*Leptosphaeria maculans*	*Sclerotinia sclerotiorum*	*Alternaria alternata*
1970	37	12	87	54	57	89	16	3	57
1971	179	27	84	36	40	88	18	1	68
1972	181	27	85	40	48	93	4	1	54
Avg	397	66	85	40	45	90	11	1	60

* The *Fusarium* cultures were almost all *F. roseum* 'Acuminatum'. Those of *Rhizoctonia* were *R. solani*.

Table 7. Results of a representative seedling pathogenicity test in which isolates of *Fusarium roseum* and *Rhizoctonia solani* from footrot-infected plants were compared

Species	No. of isolates	Disease severity index (%)*			
		Brassica napus var. Zephyr		*Brassica campestris* var. Span	
		Avg DSI	Range in DSI's	Avg DSI	Range in DSI's
Fusarium roseum	23	33	3-100	29	3-70
Rhizoctonia solani	17	93	73-100	97	83-100

* Calculated according to the formula used for field survey material (4) with the exception that severity classes 1, 2, and 3 equalled 0-25%, 26-50%, and 50-100% of a seedling destroyed, respectively.

tend to escape the disease. Many Sclerotinia infections seen in late summer also were small and apparently of recent origin.

Basal segments of approximately 400 stems with footrot symptoms from 66 fields were plated. The principal fungi obtained in culture are shown in Table 6. Fusarium occurred in 85% of the stems. All of the considerable number of isolates identified to species belonged to F. roseum Lk. emend. Snyder & Hansen, and all but a very few could be further classified as F. roseum 'Acuminatum'. Rhizoctonia solani was the second most common pathogen but was isolated from only 45% of the lesions. Leptosphaeria maculans was found in 11% of the platings. Sclerotinia was isolated infrequently from stems having typical footrot symptoms (Table 6), showing that the two stem rots can be reliably distinguished by appearance. The rather frequent occurrence of Alternaria alternata (Fries) Keissler suggests, perhaps, a role of some importance as a secondary invader. Nematodes were found in 6% of the isolations in 1971, occurring in significant amounts in material from only two of the 27 fields.

The results of a representative seedling pathogenicity test comparing isolates of Fusarium roseum and Rhizoctonia solani from footrot-infected plants are summarized in Table 7. The Fusarium cultures were generally considerably less virulent than those of Rhizoctonia, with severity ratings exhibiting a great deal more variation.

Acknowledgments

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