Yield losses in Saskatchewan rapeseed/canola crops from basal stem cankers of blackleg (*Leptosphaeria maculans*) in 1982, with notes on other diseases'

G. A. Petrie

The virulent strain of blackleg (***Leptosphaeria maculans***) occurred in 67.9% of 53 fields of ***Brassica napus*** and ***B. campestris*** surveyed in Saskatchewan in July, 1982. An average of 11.0% of the plants per field had leaf or stem infections, whereas only 0.8% had basal stem cankers. Thirteen of the 53 fields plus four others were sampled again in August. In these 17 fields from 0.0 to 78.0% of the plants had severe basal stem cankers, and yield losses from 0.0 to 56.0%. Seven of the fields which were near Humboldt in central Saskatchewan had an average loss of 29.9%. The estimated average yield loss for the whole province was six percent. Footrot (***Rhizoctonia solani*** and ***Fusarium roseum***) occurred in 79.3% of the 53 fields sampled in July, and had a mean incidence of 8.5%. White rust (***Albugo candida***) occurred in 71.4% of seven fields of B. ***campestris*** but its mean incidence, 24.6%. was relatively low. Other diseases were of little consequence in the July survey. Footrot, alternaria black spot (***Alternaria brassicae*** and ***A. raphani***), sclerotinia stem rot (***Sclerotinia sclerotiorum***), and pod drop (cause unknown) were prevelant in the 17 fields sampled in August but caused minor damage. Aster yellows and grey stem (***Pseudocercosporella capsellae***) were observed only rarely.

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Une forme virulente du champignon de la jambe noire (***Leptosphaeria maculans***) btait présente dans 67.9% de 53 champs de ***Brassica napus*** et ***B. campestris*** inventoriés en Saskatchewan au mois de juillet 1982. En moyenne, 11.0% des plants avaient des infections foliaires ou des tiges, tandis qua seulement 0.8% des plants Btaient infectés a la base de la tige. Treize des 53 champs plus quatre autres furent Bchantilonnes de nouveau en août. Dans ces 17 champs, de 0.0 a '78.0% des plants Btaient sérieusement affectbs par la jambe noire avec des pertes de rendement allant de 0.0 a 56.0%. Sept de ces champs situés prbs de Humbolt au centre de la Saskatchewan avaient une perte moyenne de 29.9%. La perte de rendement moyenne pour toute la province a été estimee à 6%. On a retrouvb de la pourriture des racines (***Rhizoctonia solani*** et ***Fusarium roseum***) dans 79.3% des 53 champs Bchantillonnbs en juillet et en moyenne chez 8.5% des plants. La rouille blanche (***Albugo candida***) btait prbsente dans 71.4% des 7 champs de ***B. campestris*** mais son incidence moyenne btait relativement basse, 24.6%. Les autres maladies inventoriées en juillet furent de peu de conséquence. La pourriture des racines, les taches grises et noires (***Alternaria brassicae*** et ***A. raphani***), la pourriture sclérotique (***Sclérotinia sclerotiorum***), et la tombée des siliques (cause inconnue) Btaient présents dans les 17 champs échantillonnés au mois d'août, toutefois ils n'ont causé que des dommages mineurs. La jaunisse de l'aster et la tige grise (***Pseudocercosporellacapsellad*** furent rarement observbes.

Introduction

Surveys of rapeseed/canola[2] fields (*Brassica* napus L. and *B.* campestris L.) in Saskatchewan from 1975 to 1981 revealed an increasing trend in the prevalence and incidence of the virulent strain of Leptosphaeria *maculans* (Desm.) Ces. and de Not., the cause of blackleg or basal stem canker (10, 12). Although substantial yield reductions occurred in a few fields, losses of the magnitude of those reported in parts of Australia (3, 8) and England (5, 6) were not observed. A more serious outbreak of blackleg occurred in central Saskatchewan in 1982, however.

Methods

Fifty-three rapeseed/canola fields made up the principal survey which was conducted between July 7 and 21. Survey and disease rating procedures were as previously described (12), with the exception of stem canker ratings, where McGee's method was used (7). In some fields sampled in July, basal stem canker appeared to have the potential to become severe. Therefore 13 fields that had more than 10% incidence of the disease in July were sampled again in August, along with four additional fields not previously sampled.

Severity of basal stem canker was assessed on 60 plants per field, with ten plants pulled at each of six sites. Plants with over 50% of the stem circumference cankered were considered severely infected when estimating yield loss (8). The 13 fields sampled in July and August were again sampled in September following harvest, and blackleg severity reassessed. Presence and severity of other diseases were routinely recorded only in the July and August surveys.

Results and Discussion

In the July survey (Table 1), as earlier years (12), fields in western (Cutknife) and north-central (Meath Park) areas had less blackleg than those in northeastern (Melfort) and central (Rosthern and Humboldt) areas. The overall prevalence and inci-

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1 Contribution No. 882, Agriculture Canada Research Station, 107 Science Crescent, Saskatoon, Saskatchewan S7N0X2

2 "Canola" refers to cultivars of rapeseed low in erucic acid and glucosinolates.

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Table 1. Prevalence and incidence of blackleg and footrot, July 1982

Areas surveyed and no. fields	Virulent strain of blackleg					Footrot	
	Mean % fields infected	Mean % plants with lesions on				Mean % fields infected	Mean % plants infected
		any part	leaves	upper stems	stem bases		
Rosthern (11)	72.7	13.8	12.4	1.5	0.7	81.8	5.7
Humboldt (10)	100.0	20.1	18.8	0.8	1.2	90.0	7.0
Cutknife (10)	50.0	1.0	0.9	0.1	0.2	70.0	7.7
Meath Park (11)	36.4	6.6	6.6	0.4	0.7	63.6	3.7
Melfort (11)	81.8	13.6	12.1	0.4	1.1	90.1	18.2
All areas (53)	67.9	11.0	10.2	0.6	0.8	79.3	8.5

Table 2. Blackleg development from July to September, 1982, in selected fields heavily infected by the virulent strain.

Area	No. fields	Dates sampled	Mean % plants with					Mean % virulent strain found on isolation
			lesions on any part	leaf lesions	upper stem lesions	basal stem lesions	girdling basal stem lesions	
Rosthern	6	7 July	22.7	21.3	2.0	0.7	0.0	100.0
		11 Aug.	47.7		16.1	40.9	2.2	100.0
		20 Sept.*	83.2		83.2	75.0	37.9	91.0
Humboldt	7	12 July	35.4	33.7	1.7	3.3	0.0	100.0
		17 Aug.	80.7		41.5	76.9	15.7	100.0
		22 Sept.*	94.8		94.8	78.9	55.9	84.2

*Stubble plants only.

dence of the virulent strain were considerably greater than in 1981 (12). Leaf infections were much more common than stem infections in the July survey (Table 2), as ascospores infected the leaves in June and July and the disease only subsequently spread to the lower stem to cause cankers near soil level.

By mid-August, basal stem cankers, which are the major cause of yield loss from blackleg, were more common than upper stem lesions. However in a field at Laird, north of Saskatoon, 96% of the plants had small upper stem infections at this time, and none had detectable basal cankers. Estimated yield losses in the sampled fields varied from 0 to 56% (Table 3). The mean **loss** for the Humboldt fields was 29.9%. On the basis of random surveys of stubble crops, it appeared that a yield **loss** figure for Saskatchewan as a whole would be close to six percent.

In the September survey a high incidence of basal stem lesions was observed in the 13 fields (Table 2). These lesions, which generally showed little vertical development in August, often had developed considerably upward from soil level on the stubble plants. The upper portions of the decapitated stalks had also been colonized by L. *maculans*. This represented the post-harvest flush of saprophytic growth also noted by others (5). Consequently the August estimates of yield **loss** were considered to be more reliable than the September estimates. A very high proportion of the isolates from stubble represented the virulent strain (Table 2). This is not always so when samples taken at this time of year are plated out.

Infection of the young plant is a prerequisite for severe stem canker development (9). Cool, wet conditions in the spring of 1982 delayed seeding arid retarded crop growth over much of the province. A severe snow and rainstorm occurred at the end of May, and frost damage necessitated reseeding of some fields. Canola development by mid-June lagged well behind that in 1981 (1). On the other hand the onset of ascospore production by the virulent strain of blackleg on stubble of the previous year occurred sooner in 1982 than in 1981, and many more spores were produced early in the growing season (Petrie, unpublished data). Precipitation remained above normal for most of the summer, with mean temperatures near or slightly below normal (2). This combination of factors, which favored infection of young plants, probably explains the heightened severity of blackleg in 1982.

The introduction of stem canker (blackleg) resistant cultivars of French origin has eliminated at least temporarily a threatening problem in England (5, 6). Resistant cultivars are currently

Table 3. Estimated loss in yield due to the virulent strain of blackleg in selected fields in central Saskatchewan, August, 1982.

Area and field no.	Mean % of plants with basal stem infections	severe basal* cankers	% loss in yield**
Rosthern			
Ros-1	28.2	8.1	3.0
Ros-2	6.7	0.0	0.0
Ros-3	35.9	3.4	2.0
Ros-4	56.7	8.3	3.0
Ros-6	51.7	20.0	13.0
Ros-9	65.9	22.6	16.0
Means	40.9	10.4	6.2
Humboldt			
Hum-I	33.3	10.0	8.0
Hum-2	76.7	53.2	39.0
Hum-3	60.0	5.0	3.0
Hum-6	80.0	40.0	29.0
Hum-7	100.0	50.9	47.0
Hum-9	90.0	36.7	27.0
Hum-I0	98.3	78.0	56.0
Means	76.9	39.1	29.9
Prud'homme			
Prud-9	68.0	24.0	17.0
Prud-8	12.0	0.0	0.0
Prud-7	20.0	4.0	2.0
Means	33.3	9.3	6.3

*>50% of the stem girdled.
**Estimated from Fig. 1(a), McGee and Emmett (1977).

being developed at Saskatoon and elsewhere in western Canada, but will not be ready for release to growers for at least a few years. In Canada, at present, producers must rely upon crop rotation, burial of infected stubble, and seed treatment for blackleg control (4, 11).

Other diseases. Footrot (*Rhizoctonia solani* Kühn and *Fusarium roseum* Lk. Snyder and Hansen) was more prevalent in July, 1982 (Table 1) than in July, 1981 (12), although the mean incidence was similar. Compared to the 1978-81 period (12) there was a relatively high number of fields (32.1%) having over 10% footrot incidence in 1982. The disease was common in the 17 selected fields in August but was not severe (Table 4).

Alternaria black spot (*Alternaria brassicae* (Berk.) Sacc. and A. *raphani* Groves and Skolko) was recorded in five of the 53 fields in July; its highest incidence was 32%. Despite being very prevalent in August it did not cause severe infections (Table 4). A similar situation prevailed in August with regard to pod drop (Table 4), the cause af which is unknown. In July, white rust (*Albugo candida* (Pers. ex Lév.) Ktze.) occurred in 71.4% of seven fields of *Brassica campestris* with a mean incidence of 24.6% and highest incidence of 68% in a field in the Cutknife area. Sclerotinia stem rot (*Sclerotinia sclerotiorum* (Lib.) de Bary) occurred in 47.1% of the 17 selected fields, with a mean incidence of 3.3%. Aster yellows and grey stem (*Pseudocercosporella capsellae* (Ell. & Ev.) Deighton) were rarely observed (Table 4).

Table 4. Prevalence and incidence of secondary diseases in 17 fields selected for high incidence of blackleg, August 1982

Area and no. fields	Disease or pathogen and mean prevalence and incidence of infection: Footrot* % fields	Footrot* % plants	Alternaria** % fields	Alternaria** % plants	Pod Drop** % fields	Pod Drop** % plants	Sclerotinia* % fields	Sclerotinia* % plants	Aster yellows % fields	Grey stem %fields
Rosthern (6)	100.0	9.4	100.0	62.3	100.0	48.3	50.0	4.9	0.0	0.0
Humboldt (7)	100.0	3.3	100.0	97.4	100.0	80.5	57.1	1.0	0.0	14.3
Other areas (4)	50.0	2.0	50.0	8.0	0.0	0.0	25.0	5.0	25.0	0.0
All areas (17)	88.2	5.2	88.2	64.0	76.5	50.2	47.1	3.3	5.9	5.9

*Mean severity ratings for 17 fields (0-3 scale) = 0.1
**Mean severity ratings for 17 fields (0-3 scale) = 0.5

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