Post-harvest surveys of blackleg on stubble of rapeseed/canola crops in Saskatchewan, 1981-1991

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In an area northeast of Prince Albert, Saskatchewan, the average incidence of the virulent strain of Leptosphaeria maculans (blackleg) on stubble in post-harvest surveys of rapeseed/canola crops increased from 14.5% in 1989 to 52.6% in 1991. Over the same three year period its average incidence west of Saskatoon increased from 59.4% to 92.6%. In both areas there was also a substantial increase in the frequency of fields with over 50% blackleg incidence. In the relatively remote areas west of Prince Albert and near Meadow Lake, the average incidence of virulent blackleg in 1990 was 25 and 21%, respectively. Since virulent blackleg was initially found in Saskatchewan in 1975, its prevalence and incidence have increased at a slower rate in northern growing areas than in those farther south.

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Dans une region au nord-est de Prince Albert, en Saskatchewan, l'incidence moyenne de la souche virulente de Leptosphaeria maculans (jambe noire) sur le chaume, lors des relevés en poste-récolte des cultures de colza/canola, a augmente de 14,5 % en 1989 a 52,6 % en 1991. Durant cette même période de trois ans, son incidence moyenne a l'ouest de Saskatoon a augment6 de 59,4 % a 92,6 %. Dans les deux regions, on a remarqué que beaucoup plus de champs presentaient une incidence de la jambe noire a un taux de plus de 50 %. Dans les regions eloignees a l'ouest de Prince Albert et près de Meadow Lake, l'incidence moyenne de la jambe noire virulente en 1990 était de 25 et 21 %. Depuis que la jambe noire virulente a ete trouvee pour la premiere fois en Saskatchewan en 1975, sa prédominence et son incidence ont augmente beaucoup plus lentement dans les regions de croissance au nord que dans celles plus eloignees au sud.

Introduction

The weakly virulent Puget Sound strain (LM-PS) of *Leptosphaeria maculans* (Desm.) Ces. & De Not. [anamorph = *Phoma lingam* (Tode:Fr.) Desm.] (14) was first found in Saskatchewan in 1957 in seed samples of rapeseed [*Brassica napus* L. and *B. rapa* L. (= *B. campestris* L.)] (16). Its occurrence on adult plants in commercial fields was confirmed four years later (17). Apart from one field north of North Battleford in crop district (C.D.) 9b (18), LM-PS was restricted to the southern half of crop district 8 from 1963 to 1967. However, during these five years its prevalence increased from less than 25% to 83% of the fields examined (10, 11, 12). By 1967, LM-PS had spread northeast to Melfort and by 1969, farther northeast to Aylsham (C.D. 8a) and into the far northwest near Meadow Lake (C.D. 9b). It was also detected on seed from south-central Manitoba and central Alberta (13).

A virulent strain of *L. maculans* (LM-VIR) was discovered in central Saskatchewan on stubble of the 1975 rapeseed crop (4, 6). Its subsequent spread in western Canada was reminiscent of that of LM-PS in the years following its discovery. By 1982, LM-VIR had become a serious problem in crop district 6 and 8b (7). From 1984 to 1990, it was more prevalent in crop districts 6 and 8b than farther north and east in crop districts 8a and 9a (1, 3, 8). LM-VIR was first observed in the Meadow Lake area (C.D. 9b) in 1985 (R. Gugel, pers. comm.), although it had been present farther south in the North Battleford area in 1979 (9). This paper compares the results of post-harvest blackleg surveys conducted in Saskatchewan between 1981 and 1991 around Prince Albert (C.D. 9a) and Saskatoon (C.D. 6 & 8b), and includes the results of a 1990 survey of the Meadow Lake area (C.D. 9b).

Material and methods

Crops of rapeseed/canola were sampled after harvest by pulling a stubble plant every five paces while walking through a field until at least 50 were obtained. Blackleg incidence was recorded, isolations made on V8 agar *(5)* and the proportions of LM-VIR and LM-PS present determined (4).

The following five areas, also illustrated in Figure 1, were surveyed in two or more years between 1989 and 1991: (1) Saskatoon west (STOON-W.): that part of crop district 6b consisting of the rural municipalities (R.M.) 345, 403, 404, and the western part of R.M. 344; (2) Saskatoon east (STOON-E): the area where crop district 6a, 6b and 8b converge, consisting of R.M. 343, 372, 373, and the eastern

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part of R.M. 344; (3) Prince Albert northeast (P.A.-NE): that part of crop district 9a consisting of R.M. 488, 490, 491, and 520; (4) Prince Albert south (P.A.-S): that part of crop district 9a between the North and South Saskatchewan Rivers (R.M. 461); and (5) Prince Albert west (P.A.-W): that part of crop district 9a consisting of R.M. 493, 494, and 496. The part of the Meadow Lake area surveyed in 1990 was in R.M. 588 in crop district 9b (Fig. 1).

Results and discussion

Results of a 1981 survey from Wakaw (C.D. 8b) north to Meath Park (C.D. 9a) are in Table 1. Severe infections of LM-VIR occurred that year around Domremy and Wakaw. Virulent blackleg was seen at trace levels farther north near St. Louis and Birch Hills, but was not detected near Prince Albert and Meath Park. Table 2 contains the results of a 1985 survey that serves as an early Comparison of the extent of blackleg infestation in the area around Prince Albert with that west of Saskatoon. The incidences of infection were similar until the only heavily infected field near Shellbrook in R.M. 493 (Fig. 1), was removed from the data for crop district 9a. Then blackleg incidence in crop district 9a was much less than in crop district 6b. Two of the 12 remaining fields in crop district 9a were lightly infected.

Results of the 1989, 1990 and 1991 surveys are in Table 3. In Prince Albert north east, the mean incidence of LM-VIR increased from 14.5% in 1989 to 32.5% in 1990, and to 52.6% in 1991. The corresponding values for Saskatoon west were 59.4%, 60.5%, and 92.6%, and for Saskatoon east, 55.7%, 36.9%, and 94.7%. Prince Albert south had relatively high incidences of LM-VIR of 60.6% in 1990 and 73.3% in 1991. The drop in LM-VIR in Saskatoon east to 36.9% in 1990 was accompanied by an increase in LM-PS (Table 3). Prince Albert west was surveyed extensively only in 1990. The mean incidence of LM-VIR in Prince Albert west that year was only 25%, but the distribution of infestation in the area was suggestive of a spread north and west from the Shellbrook area, which had a severe localized infestation in 1985. Three fields near Debden, the northernmost locality surveyed in R.M. 494, had 0.0 – 3.0% LM-VIR and 14.6 – 51.1% LM-PS. Fields around Shellbrook were heavily infested by LM-VIR, but infections in the three fields farthest west (R.M. 496) ranged from 5.9 – 8.3% LM-VIR. The incidence of LM-PS in these three fields ranged from 5.0 – 66.3%.

Between 1989 and 1991, a steady increase in incidence levels of both strains of *L. maculans* occurred in Prince Albert northeast (Table 4). By 1991, all of the fields had 76 – 100% of the plants infected by either LM-VIR or LM-PS. In 1989, 6.0% of the fields in Prince Albert northeast had an LM-VIR incidence of over 50%; by 1991, this had increased to 47.7% of the fields. There also was a dramatic increase in the incidence of LM-VIR in fields near Saskatoon between 1990 and 1991. In the 1990 survey, 65.2% of the fields near Meadow Lake had 25% or less LM-VIR (Table 4), and 56.5% had 25% or less of any blackleg strain. Upon isolation, an average 65.5% of the isolates were of the virulent type. The mean incidence of LM-VIR in surveyed crops in the Meadow Lake area was only 21.0% (Table 3).

There is persuasive evidence that LM-VIR and LM-PS are different species rather than variants of a single species (15). The two appear to be in direct competition. During the last ten years, in areas in which LM-VIR has become prevalent, the incidence of LM-PS has remained at a low level or declined. However, LM-PS still predominates in many northern fields and may suddenly increase in areas where levels of LM-VIR decline sharply, as in Saskatoon east in 1990. Conditions required by the two strains for sexual reproduction appear to differ (2), which may explain the preponderance of one or the other in different locations.

Survey data collected in Saskatchewan since 1981 clearly indicate a much slower increase in prevalence and incidence of virulent blackleg in a south to north direction than in an east-west direction. This is an apparent anomaly, as the moisture regime around Saskatoon would appear to be less favorable for blackleg development than that northeast of Prince Albert. Ascospores are the most important inoculum source for *L. maculans*. Ascocarps develop on stubble from the previous year's crop and, in the Saskatoon area, continue to produce spores for several years. Dry surface soil conditions, such as those that have prevailed around Saskatoon for a number of years, tend to conserve blackleg inoculum. Frequent showers and prolonged periods of high moisture under the crop canopy are an immediate stimulus to ascospore production and release, but the ultimate result is an accelerated decline in long-term sporulation potential (Petrie, unpublished). There is evidence that old canola stubble residue does not persist as long in northern areas as it does farther south. Moisture conditions farther north permit growers to cultivate summerfallow fields more frequently, accelerating the breakdown of infected canola taproots.

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Table 1. Results of 1981 blackleg survey of rapeseed/canola stubble crops in Saskatchewan crop districts 9a and 8b.

Subdivision of area surveyed & localities	Proportions of blackleg strains isolated (%)		Incidence of blackleg strains on stems in surveyed fields (%)	
	LM-VIR[1]	LM-PS[1]	LM-VIR	LM-PS
North (C.D. 9a)				
E. Meath Park	0.0	100.0	0.0	50.0
S. Meath Park	0.0	100.0	0.0	46.0
N.E. Prince Albert	0.0	100.0	0.0	60.0
S. Prince Albert	0.0	100.0	0.0	2.0
N. St. Louis	0.5	99.5	0.2	38.0
Averages (North)	0.1	99.9	0.04	39.2
Central (C.D. 8b)				
N. Birch Hills	33.3	66.7	4.0	8.0
S.E. Birch Hills	0.5	99.5	0.1	20.0
N. Hoey	0.5	99.5	0.1	10.0
Averages (Central)	11.4	88.6	1.4	12.7
South (C.D. 8b)				
Crystal Springs	90.3	9.7	87.3	9.4
Domremy	78.6	21.4	76.0	20.7
Wakaw	63.9	36.1	46.0	26.0
Averages (South)	77.6	22.4	69.8	18.7

[1] LM-VIR = virulent strain, LM-PS = weakly virulent Puget Sound strain.

Table 2. Results of 1985 blackleg survey in rapeseed/canola stubble crops in Saskatchewan crop district 9a near Prince Albert and crop district 6b near Saskatoon.

Sector and crop district	No. of fields	% fields with plants infected		Mean % plants/field infected		
				on any part		at stem base
		on any part	at stem base	all fields	infested fields	infested fields
North (9a)	13	23	23	7	29	19
	121	17	17	2	10	6
South (6b)	26	62	58	15	24	17

1 Heavily infested Shellbrook field atypical of the district has been omitted (see text).

Table 3. Results of blackleg surveys in canola stubble crops near Saskatoon, Prince Albert and Meadow Lake, Saskatchewan, 1989-1991.

Year Surveyed areas' No. fields ( )	Proportions of blackleg strains isolated (%)		Mean incidence of blackleg on stems in surveyed fields (%)	
	LM-VIR[2]	LM-PS[2]	all strains	LM-VIR[2]
1989				
STOON-W. (11)	82.1	17.7	72.3	59.4
STOON-E. (9)	84.5	15.1	65.9	55.7
P.A.-W. (3)	60.6	39.5	69.3	42.0
P.A.-NE. (13)	34.1	65.6	42.5	14.5
1990				
STOON-W. (9)	88.0	12.0	68.7	60.5
STOON-E. (13)	64.2	35.6	57.5	36.9
P.A.-W. (19)	58.2	42.4	42.9	25.0
P.A.-NE. (7)	44.1	55.6	73.6	32.5
P.A.-S. (13)	90.2	9.4	67.0	60.6
MEADOW L. (23)	65.5	34.2	32.0	21.0
1991				
STOON-W (22)	93.6	6.4	98.9	92.6
STOON-E. (18)	95.8	7.6	98.8	94.7
P.A.-NE. (15)	54.1	45.9	97.3	52.6
P.A.-S. (10)	73.8	26.2	99.3	73.3

1 See text for description of survey areas.
2 LM-VIR =virulent strain, LM-PS = weakly virulent Puget Sound strain of *Leptosphaeria maculans*.

Table 4. Results of blackleg surveys in canola stubble crops near Saskatoon, Prince Albert and Meadow Lake, Saskatchewan, 1989-1991.

Year, strains, areas', and No. fields ( )		Percent of fields in five incidence categories				
		0-10%	11-25%	26-50%	51-75%	76-100%
1989. all strains						
P.A.-NE & W	(16)	12.5	18.8	25.0	31.3	12.5
STOON-W & E	(20)	0.0	5.0	15.0	25.0	55.0
1989, virulent strain						
P.A.-NE & W	(16)	*50.0*	31.3	12.5	0.0	6.3
STOON-W & E	(20)	*0.0*	15.0	30.0	20.0	35.0
1990, all strains						
P.A.-W	(19)	5.3	21.1	42.1	15.8	15.8
P.A.-NE	(7)	0.0	0.0	28.6	14.3	57.1
STOON-W & E	(22)	0.0	4.6	31.8	27.3	36.4
MEADOW L	(23)	43.5	13.0	17.4	17.4	8.7
1990, virulent strain						
P.A.-W	(19)	42.1	10.5	36.8	0.0	10.5
P.A.-NE	(7)	57.1	0.0	14.3	0.0	28.6
STOON-W & E	(22)	0.0	27.3	36.4	18.2	18.2
MEADOW L.	(23)	47.8	17.4	8.7	21.7	4.4
1991, all strains						
P.A.-NE	(15)	*0.0*	*0.0*	*0.0*	*0.0*	100.0
STOON-W & E	(40)	*0.0*	*0.0*	*0.0*	*0.0*	100.0
1991, virulent strain						
P.A.-NE	(15)	*0.0*	20.0	33.3	13.4	33.3
STOON-W & E	(40)	*0.0*	0.0	0.0	7.5	92.5

1 See text for description of survey areas.

Figure 1. Parts of Saskatchewan where post-harvest surveys for blackleg were conducted in rapeseed/canola crops from 1989 to 1991. Larger units numbered 6a to 9b are crop districts and smaller areas in bolder outline numbered 343 to 588 are those rural municipalities surveyed.