SCLEROTINIA STEM ROT OF SPRING RAPESEED IN WESTERN CANADA

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Introduction

Spring rapeseed (canola) was introduced to western Canada in the 1940's and has since extended to occupy an annual average of about 1.8 million ha. Both *Brassica napus* (rape) and *B. campestris* (turnip rape) are widely grown, with the latter species being more common in northern regions with a shorter growing season. Frequent changes in prevalent cultivars have occurred, especially since the late 1960's and have provided steady improvements in yield and quality. However, the changes have had little effect on diseases, as pathogen resistance has only recently become a major breeding objective. Sclerotinia stem rot, a destructive disease caused by *Sclerotinia sclerotiorum* (Lib.) deBary that is well known in other rapeseed growing regions of the world, has occurred since the 1940's in western Canada. In the province of Saskatchewan, and probably elsewhere, it has become gradually more widespread as rapeseed cultivation has expanded (3, 11).

Sclerotinia sclerotiorum overwinters in the form of sclerotia which germinate in spring or summer to produce apothecia that in turn release airborne ascospores. Ascospores normally infect susceptible plants only if a saprophytic food base is available in the infection court, typically provided during flowering by fallen petals lodged in leaf axils (8, 10). Infection causes bleaching and weakening of the stem. Crop losses result from shrivelled grain, shattering during harvesting and contamination of grain by sclerotia, which increases dockage. Losses from shattering are probably higher in western Canada than elsewhere because of the normal practice of swathing (cutting the crop and placing it in windrows) to speed up drying before combining. All Canadian cultivars of both rapeseed species seem to be equally susceptible to the disease.

Distribution of disease

Although reports of heavy infestations have been common since about 1970 in western Canada, sclerotinia stem rot is still erratic in distribution. In any one year some major areas of production show severe losses while others remain little affected. Disease intensity also varies greatly from year to year and, more surprisingly, in the same year within relatively small areas (Table 1) and even between adjacent fields. Such variations strongly suggest complex interactions between the presence of sclerotia, soil

Table 1. Percentage of rapeseed fields in a 250 km^2 area of central Saskatchewan in 1982 in relation to apothecia and infection.

Infection class	Apothecium density class*				
	0	Trace	Slight	Moderate	Abundant
0	2	1			
0.3 - 5%	15	7	2		
5.3 - 10%	8	6	2	1	
10.3 - 15%	5	8	5	3	
15.3 - 20%	6	1	2	1	1
20.3 - 25%	4	2		1	1
25.3 - 30%	1	3			1
30%	4	3	1	2	1

*Classes based on sampling at four widely separated sites in each field when at full bloom. Search conducted for 5 min. by one person at each site. Classes refer to mean no. of apothecia per site as follows; 0; trace = 1 or less; slight = 1.1-2; moderate = 2.1-4; abundant = more than 4.

type, weather conditions favoring sclerotium germination, crop phenology and weather conditions favoring ascospore germination and infection. The precise interaction determines how much disease develops in a field. Because the growing season is short and plant development is rapid the phenologic period during which a plant is susceptible may be brief and not coincide with when the environment favours apothecium development. This is probably less true of winter rapeseed that matures more slowly.

Epidemiology and crop phenology

In western Canada rapeseed planting begins in early May. Even though modern equipment permits farmers to plant more than 100 ha in a day, late seeding and reseeding of poorly emerged stands is common until June 5, especially using *B. campestris* cultivars. If moisture conditions are favorable apothecia begin to appear in late June, either in early seeded crops once they have reached the bud stage or in nearby fields of cereals which have reached the flag leaf stage (10). Infections may appear from early July on, but never before a crop is in full bloom because of the association with dead petals. By harvest time in late August or early September up to 60% of plants in commercial fields may be diseased.

The fact that apothecia never appear before specific phenologic stages are attained in rapeseed or cereal crops can be attributed to wide fluctuations of moisture and temperature that occur at the soil surface before it is shaded. Such fluctuations prevent sclerotium germination. The result is that seeding date has a marked effect on when apothecia first appear in a crop. Two adjacent crops planted on different dates may become phenologically conducive to sclerotium germination at different times (Fig. 1); thus, although in the same locality, ascospore release in the two crops may begin under different weather conditions, which may or may not be favorable for germination and infection.

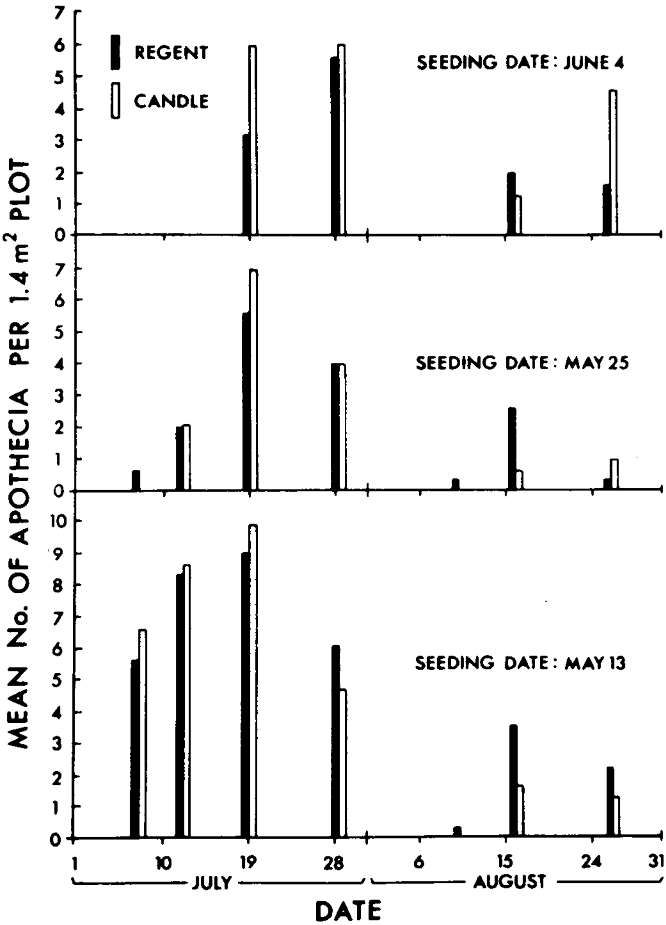

Fig. 1. Influence of seeding date on apothecia in two cultivars in plots at Saskatoon, in 1982 (values are means of 3 reps.).

Inoculum within the field cannot be the only source of infection of rapeseed crops. The data from 1982 shown in Table 1 are typical of western Canada and indicate that there is little or no correlation between abundance of apothecia and final percentage infection (see also 10). Williams and co-workers in Alberta (12, 13) have demonstrated how ascospores may move into rapeseed crops from extrinsic sources and Abawi and Grogan (1) have shown that infection of beans with white mould in New York sometimes results from ascospores released by apothecia outside the field. The data in Table 1 also indicate that fields where abundant apothecia are found at full bloom may fail to become heavily infected; presumably this is because of unfavorable weather for ascospore germination even when the crops are phenologically conducive to sclerotium germination and infection. The duration of leaf wetness necessary for infection has been shown to vary widely in other crops that are attacked by S. sclerotiorum (1, 9).

Crop rotation and disease incidence

A traditional rotation in most rapeseed growing areas of western Canada is: cereal; cereal; bare summerfallow; rapeseed. In recent years farmers have been reducing the practice of summerfallowing to conserve soil organic matter and rapeseed is now increasingly being grown in rotation with two or three years of cereals. Very occasionally other crops which are susceptible to S. sclerotiorum, such as field peas, are included in the rotation. In any event, there is abundant evidence from various parts of the world that populations of sclerotia in the soil, and, therefore, apothecia in fields, can remain high for four or more years (2, 10, 14). A survey of over 100 fields in one area of Saskatchewan in 1982 (Table 2) showed that most of the fields with the greatest density of apothecia at full bloom had not been planted to a susceptible crop

Table 2. Percentage of rapeseed fields in a 250 km^2 area of central Saskatchewan in 1982 relative to rotation and apothecia.

Apothecium density class*	No. of years since previous susceptible crop				
	2	3	4	>4	Unknown
0	3	19	9	11	3
Trace	4	7	11	4	5
Slight	1	6	4	1	
Moderate			5	2	2
Abundant			3	1	

*See Table 1 for definition of apothecium density classes for four or more years. The fact that fields with a more recent history of rapeseed cultivation actually contained fewer apothecia is anomalous and probably related to a series of dry years from 1979 to 1981, which resulted in little infection of crops in the region and little regeneration of sclerotium populations. Hence, apothecia were abundant mainly in those fields which most recently had heavily infected crops of rapeseed in them, i.e. in 1978 or before.

In the 1982 survey no correlation was evident between crop history and final disease incidence. This was not surprising in view of the lack of relationship between apothecium density and disease incidence (Table 1). In short, the long-term survival of populations of sclerotia, the movement of ascospores into rapeseed fields from extrinsic sources and the constraints of weather on plant infection even when ascospores are present, make crop rotation almost irrelevant to control of sclerotinia stem rot and make epidemics difficult to predict.

Chemical Control

The difficulty of predicting disease, not to mention the technical knowledge required to observe apothecia in or adjacent to rapeseed fields, make chemical control by foliar application of fungicides financially risky. Nevertheless, interest among growers is high because of the losses they suffer and chemical companies are aware of the use of fungicides to control stem rot in other countries. Since 1978 tests in Saskatchewan and Alberta have been performed in small replicated plots and on a field scale using fixed wing aircraft for application. Most of the work has been with Benlate but other fungicides such as Rovral and Ronilan have also been tested. Single applications at early bloom at 0.5 kg a.i. per ha have often greatly decreased disease intensity and given spectacular yield improvements (Table 3). However, yield increases have been variable and sometimes very poor. This is probably partly a reflection of the need to refine techniques of application, but it is also due to wasted application when disease intensity was low even in the check. The breakeven point in most years for a single application of Benlate at 0.5 kg. a.i. per ha is probably about 200 kg per ha yield increase. Economics dictates that, in future, spraying will generally be commercially feasible in disease-prone regions (those with high sclerotium populations and a history of stem rot) when rainfall is abundant in mid to late June and provided that the crop is uniform and has a high yield potential. However, some failures will have to be tolerated.

References

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Table 3. Summary of tests in Saskatchewan and Alberta on control of stem rot by single foliar applications of fungicides at early bloom.

Year	Type of test	Cultivar/s	Chemical/s used	Rate/s in kg a.i. per ha	% decrease in disease Range	% decrease in disease Mean	% yield increase Range	% yield increase Mean	Ref.
1978	Small plot	Regent	Benlate Rovral Ronilan Sumisclex	0.25 to 1.50	46 to 99	80	n.d.*	n.d.	5
1978	Field scale	Regent	Benlate Rovral	0.50 to 1.50	75 to 98	79	2 to 15	10	4
1980	Small plot	Midas Candle	Benlate Rovral Ronilan Dyrene	0.25 to 1.00	-29 to 81	46	n.d.	n.d.	7
1980	Field scale	Altex	Benlate Rovral	0.50 to 1.00	12 to 73	43	26 to 39	32	6
1981	Field scale	Altex Candle	Benlate Rovral	0.55 to 0.65	54 to 97	86	-18 to 177	36	**
1982	Field scale	Altex Candle Tobin Andor	Benlate Rovral Ronilan	0.50 to 0.75	76 to 98	85	7 to 130	36	**

* n.d. = no data. ** J.R. Williams (personal communication)

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