

Peculiarities of *Phoma lingam* epidemiology and occurrence on winter and spring oilseed rape (*Brassica napus* var. *oleifera*) in Lithuania

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Abstract

Spring oilseed rape is more common in Lithuania than winter oilseed rape (winter rape accounts for one fourth of the total area sown with oilseed rape). Until the year 2001 phoma stem canker in Lithuania was not a grave problem either in winter or spring rape crops. However, recently the disease has progressed considerably, especially in winter rape.

Epidemiological studies of *Leptosphaeria* spp. (anamorph *Phoma lingam*) were started in 2004. Studies of the concentration of ascospores in the air using a Burkard spore trap in relation to the main meteorological indicators and appearance and variation of visual symptoms of phoma stem canker during the growing season of oilseed rape were carried out. The abundance of ascospores in the air depended on the weather factors, especially amount and frequency of rainfall.

Detailed studies revealed differences in blackleg susceptibility in relation to oilseed rape type (winter, spring) and varietal peculiarities. At the end of maturity stage (BBCH 85) on different cultivars of winter oilseed rape there were found 75.5 – 100 % of phoma-affected stems and on different cultivars of spring rape there were found 21.0 – 76.0% stems with phoma stem canker symptoms. Diseased stems of winter oilseed rape were mostly with double phoma symptoms – on the crown and on the stems 5 cm above the crown. Diseased stems of spring oilseed rape were mainly with phoma symptoms 5cm above the crown. Spring oilseed rape cultivars were more tolerant of phoma stem canker, compared with winter oilseed rape cultivars.

Key words: winter and spring oilseed rape cultivars, *Phoma lingam*, disease incidence, disease severity index

Introduction

Phoma stem canker (blackleg), caused by *Phoma lingam* (teleomorph – complex of *Leptosphaeria maculans* and *L. biglobosa*) is a very common and harmful disease of oilseed rape (*Brassica napus* spp. *oleifera*) in many countries despite the fact that different types (winter, spring) and cultivars of oilseed rape are cultivated and these countries differ in climatic conditions and cultivation technologies (West et al., 2001).

Epidemics of phoma stem canker are initiated by air-borne ascospores released from infected debris (Hall, 1992). Differences in disease severity occur between sites and seasons, and may be partially attributed to differences in weather conditions favourable for infection of leaves by ascospores of the fungus (Biddulph et al., 1999a, 1999b). The conditions for the spread of blackleg in Western European countries are favourable throughout the whole winter period, however, the conditions are less conducive in Eastern European part where winters are much more severe (West et al., 2001).

The best way to control various plant diseases is to cultivate resistant varieties, however the currently Lithuania-grown oilseed rape varieties are not always sufficiently resistant to diseases, especially to phoma stem canker. This paper describes the seasonal dispersal of ascospores by *L. maculans* and *L. biglobosa* species complex in the air per seasons of 2004 and 2005 in relation to the rainfall and of phoma stem canker spread on different cultivars of winter and spring oilseed rape.

Materials and methods

Naturally released ascospores of the fungus were collected using a Burkard 7-day volumetric spore trap (Burkard Manufacturing Company Ltd., Rickmansworth, UK). Spore trap was operated in the oilseed rape field from April to December in 2004 and in the centre of inoculated area in 2005. Spore concentration in the air per day was calculated. Automatic weather station (Metpole) was installed in an oilseed rape field near the Burkard 7-day volumetric spore trap. The weather data were collected every 30 minutes and averaged over each day during the oilseed rape growing season. Phoma stem canker observations before harvest (BBCH 85) were made on the stems of WOSR (20 and 11 cultivars) and SOSR (12 and 16 cultivars) in 2004 and 2005. The severity of basal stem canker was assessed using a 1-6 scale provided by H. Brun, INRA, Le Rheu, France. The mean disease incidence (DI) and disease severity index (DSI) were calculated.

Results and discussion

The first ascospores of *Leptosphaeria* spp. were found in the samples from 1st May in 2004 and 9th April in 2005. The abundance of ascospores in the air depended on the weather factors, especially amount and frequency of rainfall. During the period with no rainfall ascospores either did not spread at all or only sporadic ones were identified. In 2004 the peaks of ascospore release were recorded after heavier rainfall on 12-16 of June (max. 420 ascospores per day) and 16-20 of July (max. 593 ascospores per day) (Fig. 1). In August the release of ascospores by *Leptosphaeria* spp. was very intensive too, there were found more than 570 ascospores in the sample on the 2nd of August, 390 and 455 ascospores – on the 9th and 15th of August, respectively.

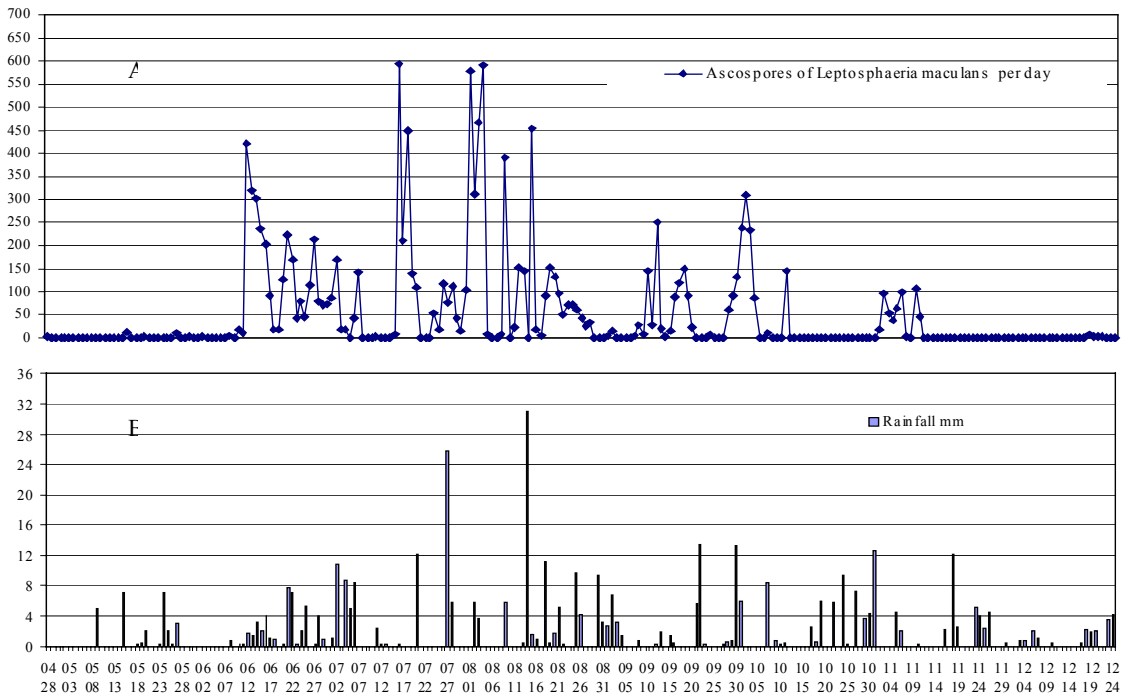


Fig. 1 Seasonal dispersal of ascospores by *Leptosphaeria maculans* from a natural field inoculum (A) and rainfall (B) in 2004

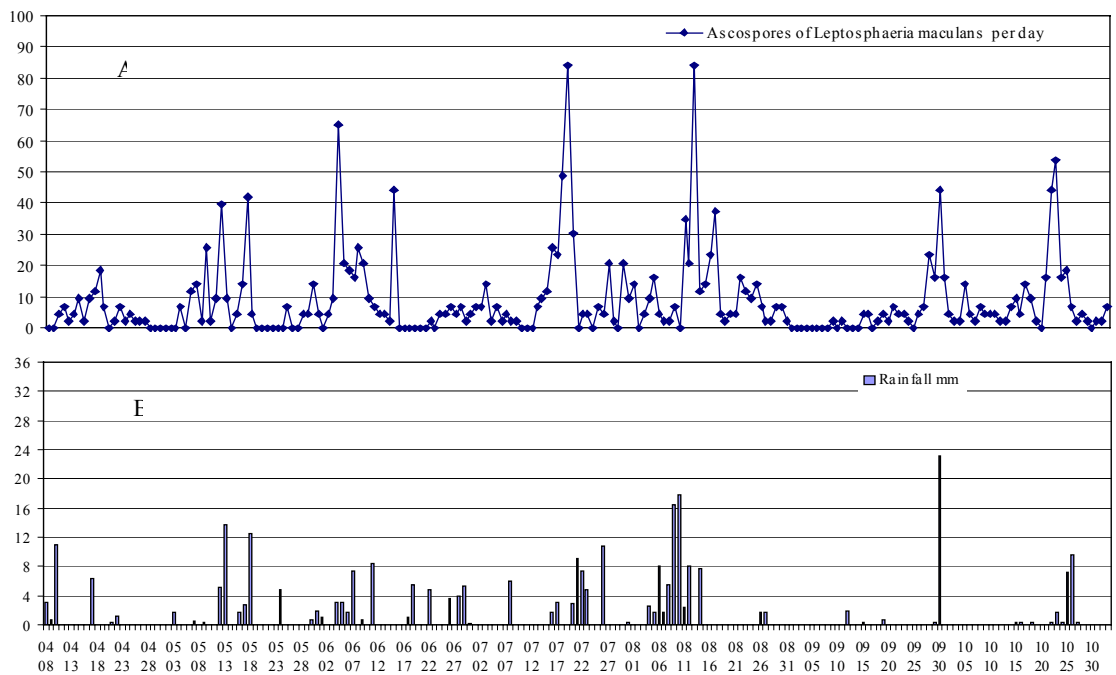


Fig. 2 Seasonal dispersal of ascospores by *Leptosphaeria maculans* from a natural field inoculum (A) and rainfall (B) in 2005

Only the ascospores that were released in the air during the May-June period could have a more marked effect on phoma stem canker infection on WOSR sown in 2003. It is likely that the ascospores released in June-July infected SOSR. The ascospores released in the autumn infected WOSR sown in August 2004.

Similar data were obtained in the second experimental year (2005), the abundance of ascospores in the air was also largely dependent on the amount of rainfall (Fig. 2). It was estimated, that during the whole season of 2005, the release of ascospores was very weak, to compare with season 2004, due to the lower amount and frequency of precipitation. Foreign researchers have also reported that maturation of pseudothecia, ascospore germination of the fungus *L. maculans* as well as plant infection are determined by many factors, rainfall being one of the most decisive ones (West et al., 1999). Ascospores of *Leptosphaeria* spp. in 2004 were found in the air until the middle of December, but in 2005 – only until the beginning of November due to the early frosts.

In Lithuania, over a period before 2001, the weather conditions were not very favourable for the development of phoma

stem canker. At the beginning of November the day gets markedly shorter, the air temperature usually drops to 0°C or below and vegetation of oilseed rape stops. In the autumn rape plants grow and develop for 60-70 days. Phoma stem canker infection in the autumn (pseudiothecia formation and ascospore release) can occur only for about 60 days (September – October). For an intensive *Phoma lingam* infection within a short period conditions close to optimal are necessary (20°C temperature and wet leaves for 48 hours) (Biddulph et al. 1999a).

In recent 5 years the climate is warming and the weather conditions in autumn – winter period became more mild and the conditions for release of ascospores are conducive until the middle – end of December. The conditions are suitable for development of phoma lesions on the leaves for 90-120 days in the autumn. We think it is one of the reasons, why the disease has progressed in Lithuania after 2001.

After the samples of stems had been analysed, it was found that phoma stem canker was more common on WOSR, to compare with SOSR. The incidence of phoma stem canker on different cultivars of WOSR amounted over 90 % in 2004. In 2005 in the samples from 6 different fields it was found up to 90 % of stems with phoma stem canker symptoms and in the samples from 11 fields – over 90 % of diseased stems was recorded and in average amounted to 92.9 % (Table 1).

Table 1. Phoma stem canker infections on the stems of different cultivars of WOSR in 2004 – 2005

Cultivar	DS %	% of DS			DSI	Cultivar	DS %	% of DS			DSI
		A	B	C				A	B	C	
		2004					2005				
Banjo	90.0	42.0	42.0	6.0	2.13	Alaska (1)	75.5	27.8	61.6	10.6	2.07
Casino (1)	83.2	19.2	78.4	2.4	5.33	Alaska (2)	86.0	23.2	60.5	16.3	3.92
Casino (2)	84.0	59.5	32.1	8.4	1.69	Alaska (3)	88.5	52.0	43.5	4.5	5.14
Casino (3)	96.0	53.1	40.6	6.3	2.14	Alaska (4)	100	2.0	98.0	0	7.60
Celsius	96.0	43.8	53.1	3.1	2.53	Atila	88.5	22.6	65.0	12.4	3.36
Kasimir F1 (1)	95.0	38.9	51.6	9.5	2.12	Celsius	100	n. a.	n. a.	n. a.	5.02
Kasimir F1 (2)	97.0	37.1	58.8	4.1	2.51	Courage	98.0	24.5	73.5	2.0	6.12
Kronos F1 (1)	96.0	32.3	61.5	6.2	2.26	Digger	100	32.0	64.0	4.0	7.72
Kronos F1 (2)	99.0	31.3	61.6	7.1	2.58	Ibex	92.0	n. a.	n. a.	n. a.	4.82
Libea	98.0	28.6	62.2	9.2	2.35	Kasimir F1	81.0	35.1	57.0	7.9	4.22
Libomir	99.0	31.3	59.6	9.1	2.12	Kronos F1	100	n. a.	n. a.	n. a.	4.94
Librett F1	95.0	25.3	65.3	9.4	2.14	Libea	94.0	n. a.	n. a.	n. a.	4.54
Liclassic	93.0	38.7	54.8	6.5	2.33	Milena	96.0	4.2	93.7	2.1	7.06
Liprima	94.0	46.8	45.7	7.5	2.33	Ryder	98.0	n. a.	n. a.	n. a.	6.90
Lirajet	95.0	24.2	69.5	6.3	2.25	Silvia	96.0	n. a.	n. a.	n. a.	3.36
Lisek	95.0	42.1	53.7	4.2	2.21	Sunday	96.0	n. a.	n. a.	n. a.	3.22
Silvia	96.5	37.6	58.4	4.0	2.38	Triangle F1(1)	82.9	37.3	44.8	17.9	2.65
Valesca	98.0	24.5	72.4	3.1	2.83						7.92
In average	94.4	36.7	56.9	6.4	2.46	Triangle F1 (2)	92.9	25.0	68.0	7.1	5.03

DS - diseased stems; A – stems with phoma symptoms only on the crown; B – stems with double symptoms (on the crown and on the stems 5 cm above the crown); C – stems with phoma symptoms only 5 cm above the crown; DSI - disease severity index on the crown; n.a. – not assessed; (1) – samples from different regions

Disease severity index on the stems of different cultivars of WOSR was twice higher in 2005, to compare with 2004 (DSI in average 2.46 and 5.03 in 2004 and 2005, respectively). The highest disease severity index (7.06 – 7.92) was recorded on the cvs. Alaska (4), Digger, Milena and Triangle F1 (2). Diseased stems of WOSR were more often with double symptoms of phoma stem canker – on the crown and on the stems 5 cm above the crown, in average 56.9 % in 2004 and 68.0 % in 2005. Also, in WOSR in average there were identified 36.7 % and 25.0 % of diseased stems with phoma symptoms only on the crown in 2004 and 2005, respectively. Phoma symptoms on the crown usually develops from the leaves, infected in the autumn. This indicates that over 90 % of WOSR plants were infected with phoma stem canker already in the autumn of the sowing year, which agrees with the findings of other authors (Kuusk et al., 2002). The level of infection in the same cultivar varied between the fields, probably due to differences in weather, and this agrees with other researchers (Sosnowski et al., 2004).

The disease incidence on different cultivars of SOSR was in average 8.3 and 39.4 % in 2004 and 2005, respectively, with a very low disease severity index (Table 2.). Mostly tolerant to phoma stem canker cvs. Sponsor, Liaison, Forte, Griffin and Ural were recorded. Diseased stems of different cultivars of SOSR were mainly with phoma stem canker symptoms only 5 cm above the crown (in average 77.5 % of diseased stems in 2005). SOSR was more tolerant to phoma stem canker, compared with WOSR.

Table 2. Phoma stem canker infections on the stems of different cultivars SOSR in 2004 – 2005

Cultivar	DS %	Cultivars	DS %	% of DS			DSI
				A	B	C	
2004				2005			
Griffin	14.0	Forte	33.0	3.0	00	97.0	0.03
Heros	2.0	Griffin	48.0	2.1	6.2	91.7	0.04
Landmark	6.0	Heros	34.0	0	23.5	76.5	0.08
Liason	2.0	Landmark (1)	30.1	20.6	7.5	71.9	0.12
Mascot (1)	2.0	Landmark (2)	34.5	14.3	44.7	41.0	0.72
Mascot (2)	35.2	Liaison	76.0	0	1.3	98.7	0.01
Sponsor	4.0	Mascot	41.0	14.3	43.5	42.2	0.62
Star	0	Plenty	26.0	15.4	19.2	65.4	0.27
Summit	8.0	Sponsor	21.0	0	4.8	95.2	0.01
SW Partisan	8.0	Star	48.0	4.2	12.5	83.3	0.21
Terra F1	8.0	SW Partizan	39.0	0	30.8	69.2	0.54
Ural	10.0	Terra F1	49.0	4.0	8.2	87.8	0.06
			32.0	0	12.5	87.5	0.04
In average	8.3	Ural	39.4	6.0	16.5	77.5	0.21

DS - diseased stems; A – stems with phoma symptoms only on the crown; B – stems with double symptoms (on the crown and on the stems 5 cm above the crown); C – stems with phoma symptoms only 5 cm above the crown; DSI - disease severity index on the crown; n.a. – not assessed; (1) – samples from different regions

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