

PHOMA LEAF SPOT AND STEM CANKER (*LEPTOSPHAERIA SPECIES COMPLEX*) DEVELOPMENT IN WINTER OILSEED RAPE

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Abstract

Leptosphaeria species complex (mainly *Leptosphaeria maculans* and *Leptosphaeria biglobosa*) causes phoma stem canker, the most harmful disease in winter oilseed rape (*Brassica napus*) in many European countries. This paper describes *Leptosphaeria* spp. ascospore release, phoma leaf infection, the development of phoma leaf spot and stem canker in 2004/05, 2005/06, and 2006/07 seasons on winter oilseed rape in Lithuania. The first circular phoma leaf spots with visible pycnidia developed on 10–28 October, 53–78 days after sowing of winter oilseed rape. In November 2004 there were 48.0%, in 2005 and 2006 – 28.0% plants with phoma leaf spots (mainly only one spot/plant). In 2005, before harvesting 72.0% of the assessed winter rape plants had symptoms of phoma stem canker of different severity on the crown, in 2006 and 2007 – 48.0 and 58.0% plants, respectively. Phoma stem canker before harvesting was found on 50.0–78.6% of plants with phoma leaf spot symptoms in the autumn, and only 1/3 of the plants with phoma leaf spots in the autumn were with severe (score 6) phoma stem canker on the crown before harvesting in 2005 and 2007 (in 2006 – 14.3%). Phoma stem canker on the crown was estimated on 47.2–88.5% of plants without clear symptoms of phoma leaf spot in the autumn, 16.7–26.9% of plants were with severe canker before harvesting. The average phoma stem canker severity index in 2005 was 4.04, in 2006 and 2007 – 2.24 and 2.22, respectively.

Key words: *Leptosphaeria maculans*, epidemiology, winter oilseed rape.

Introduction

Phoma stem canker (blackleg), caused by *Phoma lingam* (teleomorph – complex of *Leptosphaeria maculans* and *Leptosphaeria 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., 1999 a; 1999 b/. 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/. In

Lithuania, during 1996–1999 rape plants developed in the autumn for 60–70 days. At the beginning of November the days get markedly shorter, the air temperature drops to 0° C or below and vegetation of oilseed rape stops. Phoma stem canker infection in the autumn (pseudiothecia formation and ascospore release) can occur only for about 60 days (September–October) /Brazauskiene, Petraitiene, 2004/. Nevertheless, the incidence and severity of phoma stem canker have considerably increased in winter rape crops in Lithuania over the recent years.

From the autumn – infected leaves of winter oilseed rape, phoma stem canker infection passes into the stem and develops the rot of stem base - crown canker. From the spring-infected leaves later in the growing season, phoma spots develop on the stem at various heights /Hammond, Lewis, 1986; Sun et al., 2000/. These spots appear on the stem at flowering or even post flowering and have a certain effect on rape seed yield /Zhou et al., 1999; Jedryczka et al., 1999/.

This paper describes dispersal of ascospores by *L. maculans* and *L. biglobosa* species complex in the air in the autumn, the development of phoma leaf spot and stem canker in 2004/05, 2005/06 and 2006/07 seasons on winter oilseed rape in Lithuania.

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 August to December in 2004, 2005 and 2006. Ascospore concentration of *Leptosphaeria* spp. in the air per day was calculated. Automatic weather station (Metpole) was installed in an oilseed rape field near the Burkard spore trap. The weather data were collected every 30 minutes and averaged over each day.

The spread of phoma leaf spots was assessed on 50 marked plants of winter oilseed rape (WOSR) cv. 'Libea' weekly in the autumn 2004, 2005 and 2006. Leaf spots were examined for the presence of pycnidia. Plants with phoma spots and number of phoma spots per plant were determined. Phoma stem canker observations before harvest (BBCH 85) were made on the same plants, they were uprooted for assessment of incidence and severity of phoma stem canker on the crown and phoma spots on the stem 5 cm above the crown. The severity of basal stem canker was assessed using a 1–6 scale /Kuusk et al., 2002/. The mean disease incidence and disease severity index were calculated. Plant growth stages were recorded using the BBCH identification key /Lancashire et al., 1991/.

Results and Discussion

Our experimental evidence showed that the highest number of ascospores of *Leptosphaeria* spp. in the air after WOSR sowing was determined in 2004 – in the autumn there were recorded 11 days with more than 150 ascospores/day and the first rape plants with clear signs of phoma stem canker on leaves were recorded on October 28, i. e. 78 days after sowing (DAS) of WOSR (Figure 1). In 2005 and 2006 significantly fewer fungus ascospores were identified in the air, and the first symptoms of phoma stem canker on leaves were spotted 63 and 53 DAS, respectively (Figures 2

and 3). The number of ascospores in the air was influenced by heavier precipitation in the autumn of 2004.

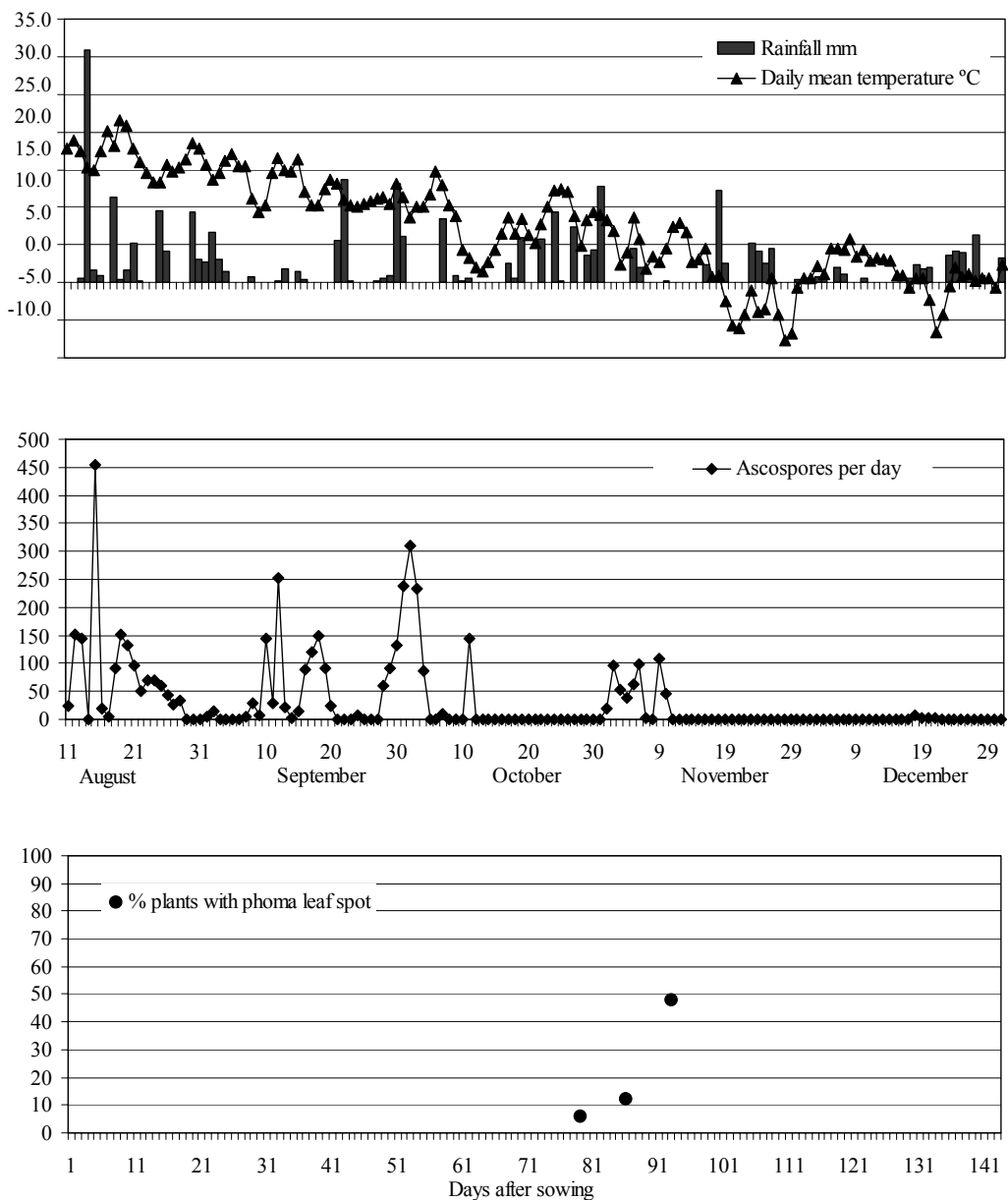


Figure 1. The main meteorological data (A), dispersal of ascospores by *Leptosphaeria* spp. (B) and the development of phoma leaf spot (C) on WOSR in the autumn 2004

In November 2004 there were 48.0%, in 2005 and 2006 – 28.0% WOSR plants with clear phoma leaf spots, but the number of spots per plant was very low (mainly only one spot/plant). Phoma stem canker on the crown before harvesting was found on 54.2–78.6% of plants with phoma leaf spot symptoms in the autumn, and only 1/3 of this plants in 2005 and 2007 were with severe (score 6) phoma stem canker on the crown (in 2006 – only 14.3%) (Table 1). Our experimental evidence did not confirm the proposition of other authors suggesting that from the autumn-infected rape leaves a severe phoma stem canker develops on the crown of diseased plants /Sun et al., 2000/. Our country's conditions are not optimal for the development of fungus, causing phoma stem canker, in the autumn – in 2004, in the 3rd ten-day period of November the air temperature had dropped below 0 and remained such for more than 10 days. In 2005 subzero air temperatures were recorded for 19 days in December, in 2006 – for several days in the first ten-day period of November. In December, in all experimental years the air temperature did not exceed 5–7° C, the fungus developed slowly, therefore not in all the cases the infection spread from leaves onto leafstalks and root neck.

Table 1. Phoma stem canker development on the crowns of WOPSR (plants with phoma leaf spots in the autumn)

Year	Plants assessed	Plants with phoma leaf spots in the autumn		Plants with phoma stem canker on the crown before harvesting		Plants with severe phoma stem canker on the crown before harvesting	
		number	%	number	%	number	%
2004/05	50	24	48.0	13	54.2	7	29.2
2005/06	50	14	28.0	7	50.0	2	14.3
2006/07	50	14	28.0	11	78.6	4	28.6

Assessments on the incidence of phoma leaf spots in the autumn during the period 1996–1999 showed that determination of phoma canker incidence on leaves both in the autumn and later stages and identification of phoma leaf spots visually were complicated, since lesions on WOSR leaves in most cases did not have distinctive features – pycnidia in leaf spots /Brazauskiene, Petraitiene, 2004/. However, with autumn weather becoming warmer, the situation changed, and our research done during the autumns of 2004–2006 showed that clear distinctive phoma spots with pycnidia develop on WOSR leaves in the autumn, like in southern European countries, and this character can be considered as a biological indicator of the disease spread.

It was reported that ascospores of the fungus *L. maculans* can sprout on rape leaves and infect them in the temperature range of 5–20° C. The temperature influences the length of the disease incubation period (the period from infection to appearance of the first disease symptoms on leaves), with increasing air temperature, the disease incubation period becomes shorter /Biddulph et al., 1999 a; Toscano-Underwood et al., 2001/.

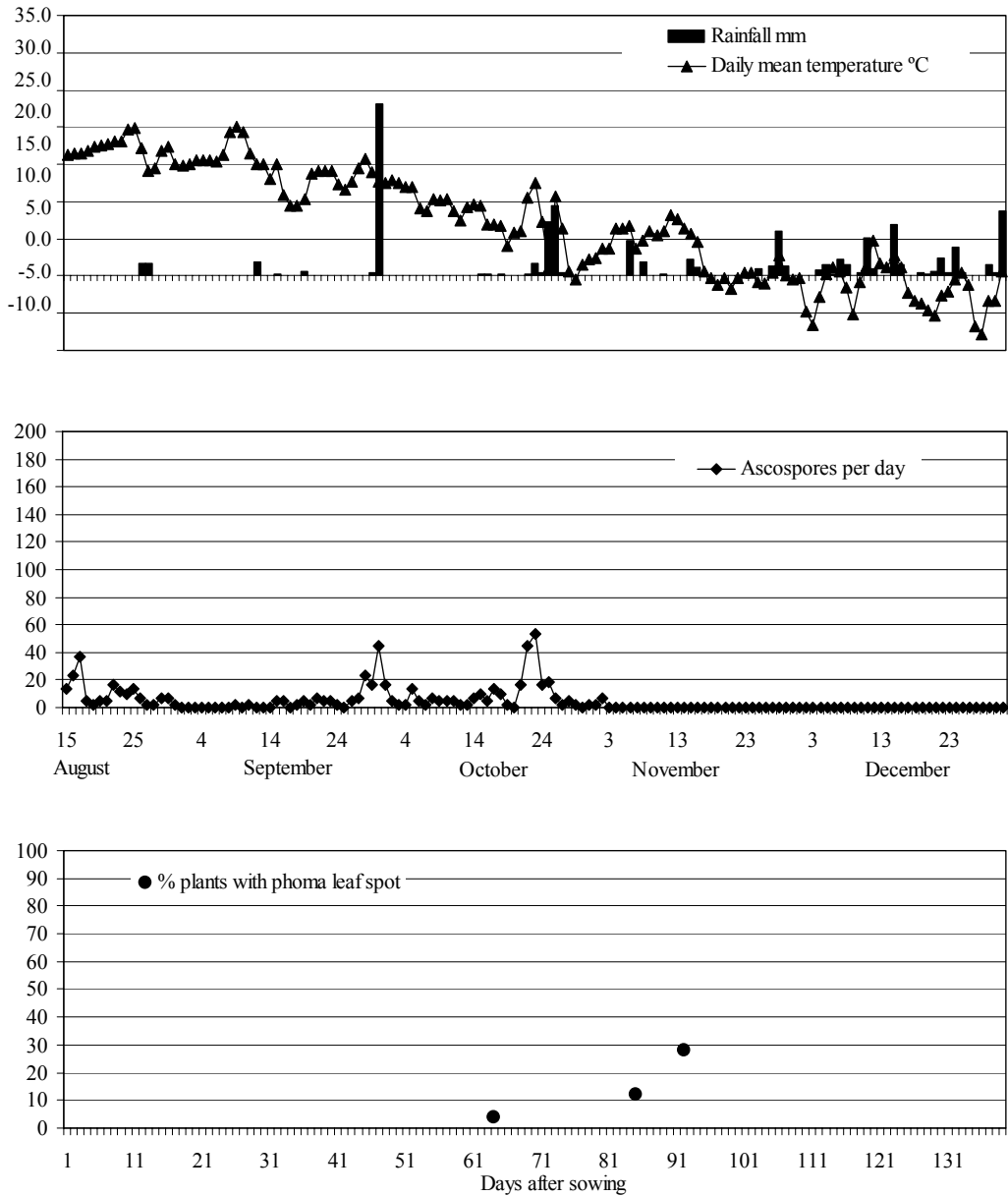


Figure 2. The main meteorological data (A), dispersal of ascospores by *Leptosphaeria* spp. (B) and the development of phoma leaf spot (C) on WOSR in the autumn 2005

Phoma stem canker on the crown was estimated on 47.2–88.5% of WOSR plants without clear symptoms of phoma leaf spot in the autumn, 16.7–26.9% of those plants were with severe canker before harvesting (Table 2). According to our data, severe

phoma stem canker on the crown can develop not only on the autumn infected WOSR plants but also on the plants infected later in the season.

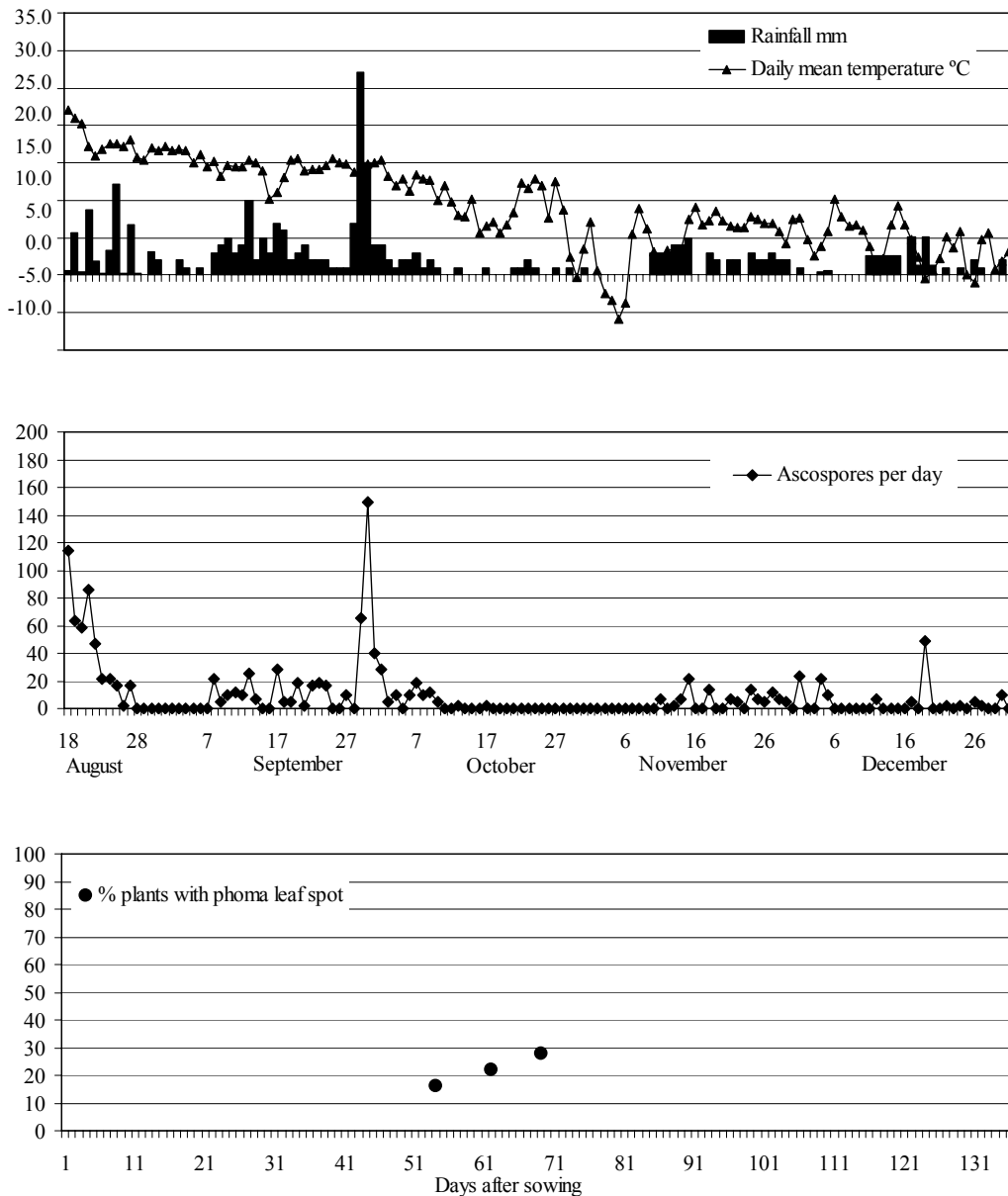


Figure 3. The main meteorological data (A), dispersal of ascospores by *Leptosphaeria* spp. (B) and the development of phoma leaf spot (C) on WOSR in the autumn 2006

Table 2. Phoma stem canker development on the crown of WOSR (plants without visible phoma leaf spots in the autumn, spring infection)

Year	Plants assessed	Plants without phoma leaf spots in the autumn		Plants with phoma stem canker on the crown before harvesting		Plants with severe phoma stem canker on the crown before harvesting	
		number	%	number	%	number	%
2004/05	50	26	52.0	23	88.5	7	26.9
2005/06	50	36	72.0	17	47.2	7	19.4
2006/07	50	36	72.0	17	47.2	6	16.7

In 2005, before harvesting 72.0% of the assessed WOSR plants had symptoms of phoma stem canker of different severity on the crown, in 2006 and 2007 – 48.0 and 58.0% plants, respectively (Table 3). Phoma spots on the stems had developed on 40.0–52.0% of assessed WOSR plants. The average phoma stem canker severity index in 2005 was 4.04, in 2006 and 2007 – 2.24 and 2.22, respectively. The disease severity index in 2005 harvesting year was nearly twice as high as that in the other experimental years, which is likely to have been caused by markedly higher concentration of *Leptosphaeria* spp. ascospores in the air in the autumn of 2004 and more conducive conditions to the infection – heavier and more frequent rainfall than in the other experimental years. As other authors indicate, the differences in the severity of phoma stem canker between seasons are mostly dependent on the weather conditions favourable for the infection of plants by *Leptosphaeria maculans* ascospores, especially on the differences in rainfall and temperature /Hammond, Lewis, 1986; Gladders and Symonds, 1995/.

Table 3. Phoma stem canker development on WOSR before harvesting in 2005, 2006 and 2007 harvesting year

Harvesting year	Plants assessed	Disease severity index	Plants affected		Plants with phoma on the crown		Plants with phoma spots on the stem 5 cm above the crown	
			number	%	number	%	number	%
2005	50	4.04	38	76.0	36	72.0	26	52.0
2006	50	2.24	31	62.0	24	48.0	20	40.0
2007	50	2.22	36	72.0	29	58.0	20	40.0

The incidence and severity of phoma stem canker have considerably increased in WOSR crops over the recent years. With changing climate (warming) the conditions for maturation of *L. maculans* pseudothecia and ascospore dispersal and infection of WOSR crops in the autumn have become much more favourable in our country than in the previous years. Ascospore dispersal and plant infection occurs until late December and even longer. The conditions for plant infection and disease development in the autumn are favourable for 120–140 days, i. e. twice as long as until the year 2001. Research designed to study the spread of phoma stem canker on WOSR and SOSR as

well as to identify the optimum timing of disease control measures against this disease and their efficacy is being continued.

Conclusions

1. The conditions for WOSR infection and phoma disease development in the autumn 2004–2006 in Lithuania were favourable. The highest number of ascospores of the fungus *Leptosphaeria* spp. in the air after WOSR sowing was identified in the autumn of 2004. During the experimental period, the first circular phoma leaf spots with visible pycnidia developed on the 10th–28th of October, 53–78 days after sowing of WOSR. In November 2004, there were 48.0%, in 2005 and 2006 – 28.0% WOSR plants with clear phoma leaf spots, but the number of spots per plant was very low.

2. Phoma stem canker on the crown before harvesting was found on 54.2–78.6% of WOSR plants with phoma leaf spot symptoms in the autumn and on 47.2–88.5 % of plants without clear symptoms of phoma leaf spot in the autumn. Nevertheless, before harvesting, 48.0–72.0% of the assessed WOSR plants had symptoms of phoma stem canker of different severity on the crown, and on 40.0–52.0% of the assessed plants phoma spots developed on the stems 5 cm above the crown. The average phoma stem canker severity index in 2005 was 4.04, in 2006 and 2007 – 2.24 and 2.22, respectively.

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