

Complex of major fungal diseases in winter and spring oilseed rape in Lithuania

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Abstract

This research was designed to identify the complex of major fungal diseases in winter and spring oilseed rape crops and to estimate their incidence and severity on stems and pods. Observations had been done for nineteen years in the experimental fields of the Institute of Agriculture in winter and for fourteen years in spring oilseed rape stands. During the experimental period, the incidence of the following fungal diseases was the highest in winter and spring rape: phoma stem canker (*Leptosphaeria maculans*), dark leaf and pod spot (*Alternaria brassicae*), Sclerotinia stem rot (*Sclerotinia sclerotiorum*), and Verticillium wilt (*Verticillium longisporum*). The incidence and severity of the diseases varied considerably between years and among crops. Assessments of dark spot revealed, that disease incidence on winter rape pods in 13 experimental years exceeded 90 % and in 6 years disease severity was higher than 10 %. However, in 2002, 2004, 2006, 2008 and 2009 disease spots covered less than 2 % of the pod surface in winter rape and in 1997, 2002, 2003 and 2006 – in spring rape. The incidence of dark spot on stems was also very high in winter and spring rape (in average 87.1 and 97.9 %, respectively), however disease severity on stems varied greatly among the years. The average incidence of phoma stem canker during experimental period amounted to 50 % in winter rape and 31.7 % in spring rape. The incidence of phoma stem canker in winter rape has increased twice since 2002, to compare with period of 1991-2001. Epidemics of Sclerotinia stem canker in winter rape arised only once during period of 1991-2006, in 1997. In recent 2007-2010 years very severe epidemics of this disease occured in winter rape, the affected plants accounted up to 90 % and now the risk of disease epidemics is very high both in winter and spring rape. Research evidenced increasing spread of Verticillium wilt in recent years in winter and spring rape crops. Average yield loss due to diseases was estimated to be in the range 5.7 – 25.9 % in winter and 4.2 – 38.5 % in spring oilseed rape.

Introduction

Oilseed rape is the main oil crop in Lithuania, and presently one of the most promising crops whose production area is increasing annually. Over the last 19 years the production area of oilseed rape in Lithuania has increased more than 23 times. The largest area sown with oilseed rape and the highest yields are produced in the Central paof Lithuania. However, oilseed rape productivity is still insufficiently high and part of rapeseed yield is lost annually to diseases.

Dark pod spot, caused by *Alternaria brassicae* is a very widespread and economically important disease on oilseed rape (*Brassica napus*) in many countries where this crop is important. The fungus causes substantial losses in the field (Brazauskiene and Petraitiene, 2003; Meena et al., 2010). Phoma stem canker, caused by *Leptosphaeria maculans* and *L. biglobosa* is a very common and harmful disease of oilseed rape in many countries. 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. Usually seed losses from phoma stem canker reaches 10 %, but in some years it can reach 30 - 50 % (West et al., 2001; Fitt et al., 2006). *Sclerotinia sclerotiorum* is a cosmopolitan fungal plant pathogen with a broad host range. It causes Sclerotinia stem rot, a serious disease of oilseed rape and economically important disease in many countries (Boland and Hall, 1994; Pearse et al., 2006). In the years when epidemic of *S. sclerotiorum* occur, oilseed rape grower losses 1/3 of the seed yield (Wallenhammar et al., 2007). *Verticillium longisporum* is a devastating vascular pathogen on rapeseed crops causing wilt disease and is responsible for yield losses in many countries (Steventon et al., 2002; Eynck et al., 2009).

The aim of this research was to identify fungal diseases in winter and spring oilseed rape crops, to estimate their incidence and severity on pods and stems and effect on winter and spring oilseed rape seed yield and seed yield losses.

Material and methods

This research was designed to identify fungal diseases in winter and spring oilseed rape crops in the experimental fields of the Institute of Agriculture. Observations had been done for nineteen years (1991-1992, 1994-2010) in winter and for fourteen years (1997-2010) in spring rape. Both crops were grown following the conventional technology. Assessments of diseases were carried out at ripening (GS 85) in the plots (100 m²) where disease control measures were not applied. The seed yield was estimated in unsprayed and sprayed with fungicides plots. The seed yield loss in percent was calculated according to Walker, 1990.

The assessment of infection caused by pathogens was done on 500 pods and 100 stems. Pod samples were picked - 5 siliques from the main stem of 100 plants. Stem samples were collected from 100 randomly selected plants (25 plants per 4 places). The number of fungal disease-affected pods and stems was determined. The severity of dark spot on the pods and stems was assessed using percent scale (Conn et al, 1990). The mean disease incidence (% of plants with dark spot, phoma stem canker, Sclerotinia stem rot and Verticillium wilt) was calculated. Fisher's Protected Least Significant Difference method was used to determine significant differences between the means of seed yield from unsprayed and sprayed plots.

Results and Discussion

Long-term experimental evidence indicates that dark spot occurs on winter and spring rape pods at the growth stages 79-81, when the weather conditions are especially conducive to the disease development on pods. In all experimental years the incidence of dark spot on pods was 4.8 – 100 % in winter and 20.0 – 100 % in spring rape at the GS 87 (Tables 1, 2). Assessments of dark spot revealed, that disease incidence on winter rape pods in 13 experimental years exceeded 90 % and in 6 years disease severity was higher than 10 %. However, in 2002, 2004, 2006, 2008 and 2009 disease spots covered less than 2 % of the pod surface in winter rape and in 1997, 2002, 2003 and 2006 – in spring rape. The maximum disease severity was 25.0 in winter and 20.5 % in spring rape. The incidence of dark spot on stems was also very high in winter and spring rape (in average 87.1 and 97.9 %, respectively), however disease severity on stems varied greatly among the years.

During the period 1991-2001, the conditions were not suitable for the occurrence of phoma stem canker and the disease incidence in winter rape was low, up to 37.9 % (Table 1). However during the recent 9 years, the conditions for release of ascospores are conducive until December (Brazauskiene et al., 2007). At the end of maturity stage (GS 85), on winter rape there were found 50.0 - 95.0 % of phoma-affected stems. On spring rape the disease-affected stems were lower and accounted to 35.2 -66.0 % (Table 2). The average incidence of phoma stem canker during experimental period amounted to 50 % in winter rape and 31.7 % in spring rape. The incidence of phoma stem canker in winter rape has increased twice since 2002, to compare with period of 1991-2001.

During the recent years, Sclerotinia stem rot has become one of the most important and devastating fungal diseases in oilseed rape crops in Lithuania. In 2007, an epidemics of this disease occurred in winter rape, the affected plants accounted up to 90.0 %. An enormously high number of fungal sclerotia have fall down into the soil during crop harvesting. The incidence of Sclerotinia stem rot on winter rape stems in 2008-2010 was high. The highest disease incidence on spring rape stems was estimated in 2010. Verticillium wilt occurred in WOSR and SOSR crops only in separate experimental years. Research evidenced increasing spread of Verticillium wilt (*Verticillium longisporum*) in recent years in winter and spring rape crops.

Table 1. The incidence and severity of fungal diseases on pods and stems of winter oilseed rape in 1991-1992, 1994-2010

Year	Pods		Stems				
	dark spot		dark spot		phoma stem canker	Sclerotinia stem rot	Verticillium wilt
	DI %	DS %	DI %	DS %	DI %		
1991	97.5	16.1	n.a.	n.a.	25.0	0.0	0.0
1992	31.2	3.4	n.a.	n.a.	34.2	0.0	0.0
1994	97.5	11.1	n.a.	n.a.	8.9	0.0	0.0
1995	100.0	9.6	n.a.	n.a.	4.2	0.0	0.0
1996	95.5	8.2	n.a.	n.a.	30.0	0.0	0.0
1997	91.0	12.5	85.8	19.6	37.9	29.2	0.0
1998	100.0	25.0	100.0	33.8	36.5	4.2	5.0
1999	100.0	15.5	100.0	19.5	35.4	1.5	0.0
2000	55.8	6.1	100.0	4.7	18.2	5.0	0.8
2001	100.0	8.2	100.0	9.6	36.7	0.0	0.1
2002	65.8	1.7	97.5	1.4	83.2	2.5	0.0
2003	99.2	2.1	100.0	2.0	81.0	0.0	0.0
2004	76.4	1.5	86.6	0.9	76.4	0.0	0.0
2005	100.0	4.7	100.0	1.0	81.0	0.0	0.1
2006	4.8	0.1	61.0	0.6	66.0	0.0	0.0
2007	100.0	15.0	100.0	12.3	92.0	90.0	0.2
2008	56.7	0.9	55.0	0.6	50.0	72.0	0.0
2009	95.0	1.8	47.0	0.5	95.0	44.0	56.0
2010	100.0	8.4	87.0	1.6	59.0	50.8	44.0
Average	82.4	8.0	87.1	7.7	50.0	15.7	5.6

Table 2. The incidence and severity of fungal diseases on pods and stems of spring oilseed rape in 1997-2010

Year	Pods		Stems				
	dark spot		dark spot		phoma stem canker	Sclerotinia stem rot	Verticillium wilt
	DI %	DS %	DI %	DS %	DI %		
1997	94.5	1.5	100.0	10.0	0.0	0.0	0.0
1998	99.0	18.6	100.0	19.5	27.8	0.0	0.0
1999	100.0	13.9	100.0	12.4	22.3	0.0	0.0
2000	100.0	13.4	100.0	4.3	30.0	7.5	0.0
2001	100.0	20.5	100.0	14.0	2.5	0.8	0.0
2002	64.2	0.8	100.0	2.2	13.4	0.0	0.0
2003	99.8	1.8	90.0	0.9	37.5	0.0	0.0
2004	100.0	11.0	100.0	24.6	35.2	0.0	0.0
2005	100.0	6.4	100.0	2.4	44.0	0.0	0.0
2006	20.0	0.2	86.0	0.9	66.0	0.0	0.0
2007	99.0	5.9	100.0	11.4	47.0	34.0	0.0
2008	84.4	2.1	100.0	7.6	36.9	17.0	39.1
2009	100.0	4.0	100.0	11.2	38.3	24.0	55.0
2010	100.0	7.8	95.0	14.8	42.5	67.0	36.5
Average	90.1	7.7	97.9	9.7	31.7	10.7	9.3

The average seed yield of winter and spring rape was significantly higher in sprayed than in unsprayed plots (Table 3). The average seed yield loss of winter rape was up to 27.0 % and of spring rape was up to 38.5 % during experimental period.

Based on our observations, we can suggest that dark spot, phoma stem canker, Sclerotinia stem rot and Verticillium wilt are very important fungal diseases of winter and spring oilseed rape in Lithuania. The risk of spread of these diseases is increasing.

Table 3. The seed yield and yield loss % due to fungal diseases in winter rape in 1991-1992, 1994-2010 and spring oilseed 1997-2010

Year	Winter oilseed rape seed yield t ha			Spring oilseed rape seed yield tha		
	unsprayed	sprayed	yield loss, %	unsprayed	sprayed	yield loss, %
1991	3.09	3.34*	7.5	n.a.	n.a.	n.a.
1992	1.63	2.20**	25.9	n.a.	n.a.	n.a.
1994	2.96	3.34**	11.4	n.a.	n.a.	n.a.
1995	3.12	3.76**	17.0	n.a.	n.a.	n.a.
1996	2.86	3.08**	7.1	n.a.	n.a.	n.a.
1997	2.56	3.22**	20.5	2.28	2.63**	13.3
1998	2.65	3.63**	27.0	2.33	3.02**	22.8
1999	2.77	3.43**	19.2	2.32	2.58**	10.1
2000	2.06	2.25*	8.4	1.95	2.18*	10.6
2001	2.29	2.74**	16.4	1.20	1.95**	38.5
2002	2.25	2.95**	23.7	1.00	1.30**	23.1
2003	2.63	2.79*	5.7	1.54	1.90**	18.9
2004	2.59	3.24**	20.1	3.06	3.32*	7.8
2005	3.38	3.80**	11.0	3.33	3.92**	15.0
2006	2.00	2.29**	12.7	1.42	1.63**	12.9
2007	2.03	2.50**	18.8	2.68	3.11**	13.8
2008	4.08	4.41*	7.5	3.46	3.61*	4.2
2009	4.28	4.74**	9.7	2.80	3.56**	21.3
2010	3.73	4.30**	13.3	3.20	3.36**	4.8

*,** seed yield signify significantly to compare with unsprayed plots at $p = 0.05$ and 0.01 , respectively according F-test

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