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FUNGICIDE USE EFFICIENCY FOR DISEASE CONTROL IN WINTER RAPE

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Abstract

Development of rape diseases becomes one of the most important risk factors in oilseed rape cultivation. Investigations on rape diseases and efficacy of fungicide treatments were started in the autumn of 2005 and continued in 2006 and 2007. Field trials were carried out in the Study and Research farm “Vecauce”. Different cultivars and different schemes of fungicide application were used. The incidence and severity of diseases and yield of rapeseed depending on fungicide application were determined. Severity of blackspot disease (caused by *Alternaria* spp.) did not exceed 1% in autumn and yield losses had no economic importance. Sclerotinia stem rot (caused by *Sclerotinia sclerotiorum*) was detected very seldom in 2006, but the incidence of this disease fluctuated in the range of 15–30% in 2007. Fungicide treatment decreased the incidence of the disease significantly and all treatments showed good economic efficiency in 2007. The incidence of stem canker (caused by *Leptosphaeria* spp.) on plant leaves was low in autumn (below 10%), but high at harvest (12–74% in 2006 and 49–86% in 2007). Efficacy of fungicide treatment depends on varieties. Further investigations are needed to work out reasonable strategy for oilseed rape disease control.

Key words: winter rape, fungicide application, disease, blackspot, *Sclerotinia* stems rot, phoma stem canker, yield.

Introduction

The increase of rape diseases becomes one of the most important risk factors in oilseed rape cultivation. *Sclerotinia sclerotiorum* (Lib) de Bary, causing stem rot in oilseed rape, has been recorded as a pathogen on more than 400 plant species, including many important crop species. Sclerotinia stem rot of oilseed rape has become one of the most serious disease problems in oilseed rape- growing areas in Latvia. Our preliminary experience suggests that with the increase of rape proportion in crop structure rape growers in Latvia have to pay attention to Sclerotinia stem rot. Different opinions exist regarding economic importance of Sclerotinia stem rot. The disease causes yield losses of up to 50% /Hu et al., 1999/ however some findings suggest that at least half of fungicide applications were unnecessary /Young et al., 2007/. Investigations on harmfulness of Sclerotinia stem rot under conditions of Latvia are required.

Phoma stem canker, otherwise known as blackleg, caused by complex of *Leptosphaeria* spp. (anamorph *Phoma* lingam) is a world-wide rape disease, causing serious losses in all regions /Huang et al., 2005/. Recently, the increasing incidence of stem canker has been observed in Latvia /Bankina et al., 2007/. Phoma stem canker is well investigated over the world. This disease mostly was described as monocycle disease with asco spores as source of infection; nevertheless conidia also can be inoculum /Ghanbarnia, Fernando, 2007/. Leaf lesion infections are followed by systemic growth of pathogen to stem /West et al., 2002/. Most frequently winter rape was treated with fungicides in autumn to prevent infection of leaves. Efficacy and time of this treatment need to be clarified, because poor relationships between severity of leaf blotch and stem canker were observed /Hood et al., 2007/.

Blackspot disease (caused by *Alternaria* spp.) is a most widespread disease in Latvia. Disease incidence was observed from 30 to 90% and more in previous years in Latvia /Treikale et al., 2004; 2006/. The incidence of blackspot disease can significantly decrease rape yield /Treikale et al., 2005; Brazauskiene, Petraitiene, 2006/. Little information is available in the scientific literature concerning rape disease incidence and caused damage /Treikale et al., 2006/.

The aim of our research was to investigate the possibility of managing risk factors in winter rape growing, especially winter-hardiness and disease development in agro-ecological conditions of Latvia.

Materials and Methods

Two- factor field trials were carried out at the Study and Research farm "Vecauce" of the Latvia University of Agriculture starting with the autumn of 2005 and continuing in 2006 and 2007. Five different winter rape cultivars in 2006 and in 2007 (factor A) (see names in Table 1) and different fungicide treatments (factor B) were used: B1 – control, free from fungicide; B2 – split fungicide application. Fungicide application scheme: 1st dose (0.5 L ha^{-1}) of fungicide Juventus 90 s. c. (metconasol 90 g L^{-1}; September 22 in 2005 and 2006) was applied at the 4–6 leaf stage and the 2nd dose (0.5 L ha^{-1}) – at the growth stage 63–64 (date in 2006 and 2007 depends on cultivar). Treatments were arranged in four replications in randomised block, plot size was 7 m^2 in 2005; 10m^2 in 2006.

All agronomic requirements were considered in trials. Sowing was done at optimal time (till 20 August) for our conditions and the seed rate used was 5.0 kg ha^{-1} in 2005 and 4.0 kg ha^{-1} in 2006. Yield was harvested by direct combining (plot combine HEGE-140) on 3–4 August, 2006 and on19 July, 2007 and adjusted to 100% purity and 8% moisture.

Development of diseases was evaluated in autumn (4–6 leaf stage of development) and directly after harvest. The incidence and severity of diseases (expressed in percent) was determined for leaf blotch and incidence for stem and pod damage.

Twenty-five plants per plot were evaluated for leaf diseases and 50 randomly selected stems per plot for stem damages, *Alternaria* pod spot (was not evaluated in 2007) was evaluated taking 10 pods in 10 places per plot.

Precise identification of pathogens was carried out at the Institute of Soil and Plant Sciences. Size and shape of fruiting bodies were examined and described.

ANOVA procedures were used for experimental data processing.

Summarizing meteorological conditions of the trial years, one could say that the season of 2005/2006 was characterized by severe winter. Mild winter with hard frost at the end of the season was observed in 2006/2007. Late spring and extremely hot and dry summer characterized season 2006. Such extremely dry weather conditions with high air temperatures affected disease incidence. Early spring and mild summer with sufficient rainfall characterized season 2007.

Results and Discussion

Disease incidence and fungicide use efficiency

Fungal diseases, such as *Alternaria* leaf spot (*Alternaria* spp.) and *Phoma* leaf spot (*Leptosphaeria* spp.), were detected in autumn in both trial years.

Incidence of *Phoma* leaf spot on leaves up to 1% was detected in 2005, but in 2006 the incidence of this disease was detected up to 8% in trial free from fungicide treatment and also up to 1% in the part of trial treated with fungicide.

Incidence of *Alternaria* blight on plant leaves was similar in both years in untreated part of trial (89% in 2005, 81% in 2006), but differed in fungicide-treated part: 63% on the average in 2005 and 41% in 2006.

The severity of *Phoma* and *Alternaria* leaf spot did not exceed 2% in both trial years, being a typical situation in agro-climatic conditions of Latvia (Table 1). O. Treikale (2006) reported similar results on poor severity of both diseases in autumn in Latvia.

Table 1. Effects of fungicide Juventus 90 application on severity of *Phoma* leaf spot *and Alternaria* blight on plant leaves in autumn 2005 and 2006

Cultivar	*Phoma* leaf spot severity %				*Alternaria* leaf spot severity %			
	2005		2006		2005		2006	
	C*	F**	C	F	C	F	C	F
Excalibur	0.00	0.01	0.09	0.00	1.01	0.62	0.85	0.45
Californium	0.03	0.00	0.08	0.00	1.14	0.53	0.86	0.43
Elixir	0.03	0.00	0.08	0.00	1.23	1.01	0.81	0.38
Orkan	0.00	0.00	0.02	0.04	1.14	0.61	0.84	0.36
Falstaf	0.01	0.02	0.10	0.00	1.30	0.60	0.85	0.45
Average	0.014	0.006	0.07	0.008	1.16	0.67	0.84	0.41

*C – check without fungicide treatment; **F – with fungicide Juventus 90 treatment in autumn

In such conditions, fungicide use in disease control is disputable. Research results obtained in the countries with more mild climatic conditions, such as England, show that fungicide treatment in autumn is effective not only for *Phoma* leaf spot control, but also for prevention of *Phoma* stem canker incidence in the following spring; consequently follows also seed yield increase /West et al., 2002/. In fact, agro-climatic conditions in autumn 2005 and 2006 were untypical for Latvia: long and mild autumn with lack of frost and snow. On the other hand, research results obtained in Poland show that development of *Phoma* stem canker in colder climatic conditions could be completely different /Huang et al., 2005/, and thus another pattern for disease control is needed.

In free from fungicide treatments, 48–74% stems were affected by *Phoma* stem canker at harvest in 2006 and 74–86% stems in 2007 depending on the cultivar (Figure 1). Split fungicide treatment somewhat reduced disease incidence almost in all cultivars in 2006 except ‘Californium’. It is interesting to note, that the incidence of *Phoma* stem canker was increased in fungicide treated plots in 2007.

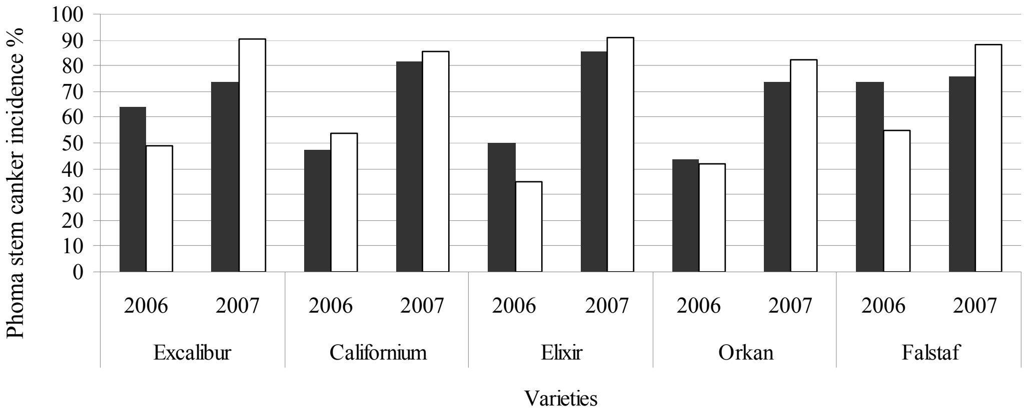

Figure 1. Effect of fungicide application on *Phoma* stem canker of winter oilseed rape in 2006 and 2007 (■ – control with no fungicide; □ – split application of fungicide Juventus 90)

Insignificant correlation was established between infection in autumn and severity of stem canker in 2007 (unpublished data). Location of stem necroses is an important symptom for *Leptosphaeria* genus identification. Necroses on the upper and lower parts of stem and slightly different symptoms on leaves demonstrate the possible *L. maculans* and *L. biglobosa* existence in Latvia. Discrepant results were obtained regarding fungicide application in autumn. Further investigations are necessary for more detailed studies of *Leptosphaeria* spp. life cycle.

Table 2. Effect of fungicide Juventus 90 application on incidence of *Alternaria* pod spot and *Sclerotinia* stem rot in seasons 2006 and 2007

Cultivar	*Alternaria* pod spot %		*Sclerotinia* stem rot %			
	2006		2006		2007	
	C*	F**	C	F	C	F
Excalibur	2	2	0	0	15	2
Californium	7	2	0	0	14	4
Elixir	6	2	0	0	30	9
Orkan	3	1	0	0	19	4
Falstaf	4	2	0	0	15	2
Average	4	2	0	0	21	5
$LSD_{0.05}$	1.09		p=1.00		2.93	

The incidence of *Alternaria* pod spot was insignificant (in average in control – 4%, after fungicide treatment – 2%) in 2006. Development of the fungus *Alternaria* spp. on siliques is equally influenced by the air temperature and moisture content in July when winter rape silique ripening period occurs. Due to rainfall deficiency in summer 2006, particularly in July in Vecauce, the incidence and the severity of the *Alternaria* pod spot was very low.

Sclerotinia stem rot did not occur in winter rape crop in trial year 2006 because weather conditions were unfavourable for crop infection with *Sclerotinia sclerotiorum* during rape flowering stage. The incidence of *Sclerotinia* stem rot disease ranged from 14% to 30% in 2007. Significant impact ($p<0.05$) of fungicide application during flowering time for the incidence of *Sclerotinia* stem rot (in average in control – 21%; and in fungicide treated plots – 5%) was observed.

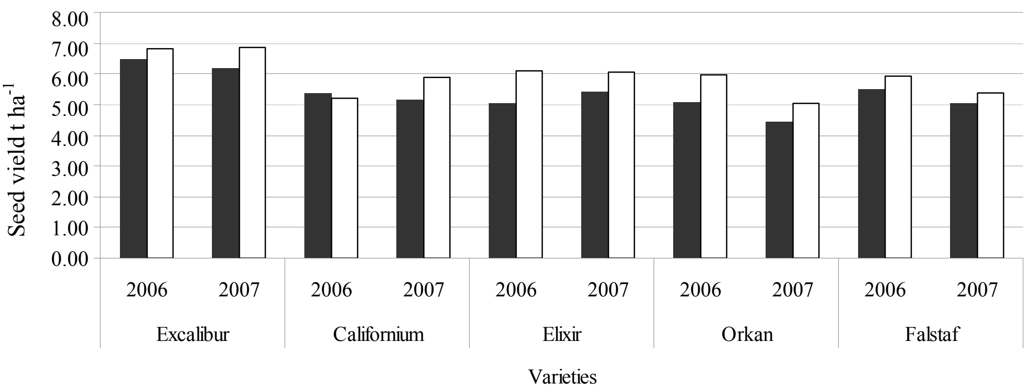

Figure 2. Seed yield of winter rape depending on cultivar and fungicide application, t ha^{-1} in 2006 and 2007 (■ – control with no fungicide; □ – split application of fungicide Juventus 90)

High average seed yields (check – 5.50 t ha^{-1}, with fungicide – 5.99 t ha^{-1} in 2006 and in 2007: check – 5.25 t ha^{-1}, with fungicide 5.86 t ha^{-1}) were obtained in both trial years (Figure 2). Significant impact ($p<0.001$) of fungicide application was observed on seed yield in both years (2006: increase + 0.49 t ha^{-1}, $LSD_{0.05}$ = 0.31 t ha^{-1}, 2007: increase + 0.61 t ha^{-1}, $LSD_{0.05}$ = 0.17 t ha^{-1}). This is in agreement with reported research results that fungicide application during summer vegetation period (at full flowering) can also improve seed yield /Treikale et al., 2006/. The influence of cultivar (by 44% in 2006 and by 70% in 2007) on seed yield was also significant ($p<0.001$). On the average, the most productive cultivar was 'Excalibur' (6.48 t ha^{-1} in 2006, 6.19 t ha^{-1} in 2007). Seed yield was significantly increased by fungicide application for almost all cultivars in both years. Seed yield increase with fungicide application was not observed for the cultivar 'Californium' in 2006.

Conclusions

Research results clarified the impact of fungicide application on the incidence of *Phoma* stem canker only in 2006 and on *Sclerotinia* stem rot in 2007 concluding that it is a highly important way of increasing rapeseed yield in agro-ecological conditions of Latvia. Although split fungicide application increased rapeseed yield as well as showed positive effect on *Alternaria* leaf spot and *Phoma* leaf spot incidence, it decreased in autumn in both trial years and that of *Sclerotinia* stem rot in season 2007. Fungicide application reduced incidence of stem canker (caused by *Leptosphaeria* spp.) in 2006, but its life cycle is being investigated under Latvian conditions and, depending on the results, better fungicide application scheme will be developed. Further research is needed to clarify all the mentioned problems more deeply.

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