Occurrence of dark leaf and pod spot on spring oilseed rape and fungi composition on harvested seeds depending on differentiated fertilization with sulphur

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ABSTRACT

The aim of the research was to examine the influence of sulphur on *Alternaria* spp. occurrence on leaves, stems and pods of spring oilseed rape and after harvest fungi on seeds. 20 and 60 kg·ha^{-1} of sulphur was applied with foliar, soil fertilization as elementary or ionic. *Alternaria* spp. was noted every year in high intensity and the main species was *A. brassicae*. Sulphur fertilization significantly decreased intensity of disease symptoms on leaves, less on stems and pods. Dose of 60 kg·ha^{-1} resulted in better plant health. Form and the way of sulphur application had not any significant importance. Among pathogenic fungi isolated from seeds *A. brassicae* dominated, and non-pathogenic were: *C. herbarum*, *Penicillium* spp and *A. alternata*.

Key words: rapeseed, fertilization**,** sulphur, *Alternaria*

INTRODUCTION

In Poland in last years the interest in spring oilseed rape cultivation increased. The bigger cultivation area is especially after more severe winters causing freezing the winter form.. Spring form, similarly to winter one, has high needs for sulphur. Fertilization with this element in the conditions of its low content in the soil results in better seed yield, fat content and sulphuric aminoacids in seed proteins. Now, because of the lower sulphur emission into environment, rape fertilization with this element increased. However, sulphur fertilization may increase glucosinolate content. The role of glucosinolates in plant defense system against fungal pathogens is not exactly known so far (**Wallsgrove at al. 1999, Zhao et al. 1999, Drozdowska at al. 2002)** There are not many reports on lower plant infestation by some fungal pathogens after S application (Schnug at al. 1995, Sadowski at al.2002)..

MATERIALS AND METHODS

The split-plot design plot experiment was set up in 1997-1999 under field conditions. There were 4 replications. The content of SO_4 in the soil amounted to 1.84 mg in 100g of the soil. Dose of 20 and 60 kg·ha^{-1} of S was applied with foliar or soil fertilization as elementary and ionic form. Total sulphur dose into the soil was applied prior to sowing of seeds. Foliar treatments were applied as follows: 20 kg·ha^{-1} of sulphur at rosette stage; 60 kg·ha^{-1} at three doses of 20 kg each, over the rosette, stem elongation and flowering.

The plant health was examined twice; leaves were assessed at the end of flowering and stems and pods at seed ripening. Dark leaf, stem and pod spot were the main diseases observed and infections were evaluated with 0-4º scale. Mean degree of plant infection was transferred to disease index (DI). After harvest seeds were analysed for fungal infection. The blotting paper assay, described by Capelli et al. (1998) was used.

Results

Dark leaf and pod spot (*Alternaria* spp.) was noted every year in high intensity. Its symptoms were observed on leaves, stems and pods.

Disease was noted in high intensity during flowering on leaves and then on stems and pods. In every year less symptoms were observed on leaves of plants fertilized with sulphur compared with control ones. Disease index (DI) in each year was as follows: 23,0 and 34,7%, 23,1 and 38,6% and 18,8 and 28,5% and these differences were always significant. It should be also

indicated that in every year lower DI was noted after dose of sulphur at 60kg·ha^{-1}. Form and the way of application did not influence disease intensity.

Stem infestation was also lower on the plots fertilized with sulphur, but dose, form and the way of application had no effect on disaese intensity.

Pod infestation in every year was high. Mean DI from all years calculated for control plants was 49,1% and for those fertilized with sulphur – 42,6%, but there were no significant differences, however there was significance in 1998 and 1999. There was no effect of dose, form and the way of sulphur application on disease intensity. Sulphur application caused increase of mean seed yield in every combination (Szulc 2002).

Table 1. Occurrence of *Alternaria* spp. on spring oilseed rape

		1997	1998	1999	1997 - 1999
Leaves	S	23,0 b*	23,1 b	18,8 b	21,7 b
	S_0 (control)	34,7 a	38,6 a	28,5 a	33,9 a
	Dose				
	20kg·ha^{-1}	24,6 a	26,9 a	20,6 a	24,0 a
	60kg·ha^{-1}	21,7 a	19,3 b	16,9 b	19,3 b
	Form				
	Elementary	23,5 a	25,4 a	19,1 a	22,7 a
	Ionic	22,8 a	20,8 a	18,5 a	20,7 a
	Method of application				
	Soil	24,2 a	23,5 a	18,5 a	22,0 a
	Foliar	22,1 a	22,7 a	19,0 a	21,3 a
Stems	S	24,4 b	42,5 b	30,7 a	32,6 a
	S_0 (control)	30,0 a	53,2 a	30,2 a	37,8 a
	Dose				
	20kg·ha^{-1}	25,7 a	44,4 a	32,2 a	34,1 a
	60kg·ha^{-1}	23,3 a	40,8 a	29,4 a	31,1 a
	Form				
	Elementary	24,8 a	40,9 a	31,6 a	32,4 a
	Ionic	24,3 a	44,2 a	30,0 a	32,8 a
	Method of application				
	Soil	24,3 a	42,7 a	31,6 a	32,8 a
	Foliar	24,7 a	42,4 a	30,1 a	32,4 a
Pods	S	22,0 a	51,6 b	54,2 b	42,6 a
	S_0 (control)	26,0 a	61,3 a	59,9 a	49,1 a
	Dose				
	20kg·ha^{-1}	22,3 a	52,9 a	55,3 a	43,5 a
	60kg·ha^{-1}	21,7 a	50,5 a	53,2 a	41,8 a
	Form				
	Elementary	22,6 a	53,0 a	55,2 a	43,6 a
	Ionic	21,4 a	50,4 a	53,3 a	41,7 a
	Method of application				
	Soil	22,1 a	51,3 a	54,8 a	42,7 a
	Foliar	32,6 a	52,1 a	53,6 a	46,1 a

*/values in the same column separated with the lines followed by different letters are significantly different

Phytopathological analysis of seeds conducted both on PDA medium and on blotting paper showed that the main pathogenic species was *Alternaria brassicae* and very rarely *A. brassicicola, A. consortiale, Fusarium avenaceum, spp., Fusarium sp., Rhizoctonia solani*. Non-pathogenic species for rape like *A. alternata, Cladosporiumm herbarum, Penicillium* spp were isolated very often. *Gonatobotrys simplex, Mucor spinosus, Aurobasidium pullulans, Aspergillus niger, Aspergillus* spp*., Cylindrocarpon* spp*., Trichoderma* spp*.,Stachobotrys sp., Chaetomium* spp*.* was observed in trace amounts.

There was differentiation of *Alternaria* spp. occurrence on seeds in respective years, however there were no clear influence of sulphur in investigated combinations.

DISCUSSION

Alternaria spp. was the main pathogen of spring oilseed rape in all years of our investigations. It confirms previous observations on high threat of *Alternaria* occurrence on this form of rape in Poland. Many authors report on high incidence of this species occurrence both on winter and spring form of rape (Tewari 1991, Sadowski 2002).

After sulphur application disease severity was lower. Sulphur is widely known in plant protection as fungicide, but so far there is not many reports on influence of fertilization with sulphur on stimulating of biochemical reactions in the primary and secondary metabolism (Schnug at al.1995). Some authors inform about positive influence of sulphur on decrease of some disease occurrence (Schnug and Ceynowa 1990). According to Johnston et al. (1999) sulphur is the third macroelement, after nitrogen and phosphorus, in rape cultivation and its content in plant is very important form the beginning of vegetation. Drozdowska et al. (2002) observed the influence of sulphur on total glucosinolate content and their differentiation.

CONCLUSIONS

1. Dark leaf and pod spot was the main disease during 3 years of investigations.
2. Sulphur application while its lack in the soil decreased intensity of dark leaf and pod spot, however dose of 60 kg had higher influence on disease intensity than 20 kg.
3. Disease intensity did not depend on form and the way of sulphur application.

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REFERENCES

Cappelli, C., W. Winter and V.H. Paul. 1998: Detection of seed-transmitted pathogens of rape (*Brassica napus* ssp. *oleifera* D.C.). IOBC/wprs Bulletin, 21 (5),1-13.

Drozdowska, L., P. Szulc, A. Lukanowaki and C. Sadowski. 2002: Glucosinolate content and pathogenic fungi occurrence in seeds of spring rape fertilised with sulphur. Pland Breeding and Seed Science (in press).

Johnston A.M., C.A. Grant and G.W. Clayton.1999: Sulphur management of canola. 10th Int. Rapeseed Congr. Canberra, Australia CD ROM Doc.No.353:1-9.

Sadowski C., K. Jankowski K., A. Lukanowski and J. Trzcinski. 2002: Health status of spring rape plants as affected by the sowing date and fertilisation with sulphur, boron and magnesium. IOBC/wprs Bulletin, Vol. 25 (2). 93-102.

Schnug E. and J.Ceynowa. 1990: Phytopathological aspects of glucosinolates in oilseed rape. J. Agron.& Crop Science, 165,319-328.

Schnug E., S. Haneklaus, E. Booth and K.C. Walker. 1995: Sulphur suupplay and stress resistance in oilseed rape. 9th Int. Rapeseed Congr. Cambridge, UK, Vol.1. 229-231.

Szulc, P.,R. Piotrowski, L. Drozdowska and Z. Skinder. 2000: The influence of sulphur fertilization on yield and accumulation of sulphur compounds in seeds of spring oilseed rape cv. Star. Folia Univ. Agric. Stetin. 204 Agricultura (81), 157-162.

Tewari, J.P. 1991: Resistance to *Alternaria brassicae* in Crucifers. IOBC/wprs Bulletin, Vol. XIV (6),154-161.

Wallsgrove R., R Bennett, G. Kidle, E, Barlet and J. Ludwig-Mueller. 1999: Glucosinolate biosynthesis and pest/disease interaction. 10 Int. Rapeseed Congr. Canberra, Australia CD ROM, Doc.No.393:1-5.

Zhao, F.J., M.M.K. Blake-Kalff, N. Riley, M.J. Hawkesford and S.P. McGrath, 1999. Sulphur Utilisation Efficiency In Oilseed Rape. 10th Int. Rapeseed Congress, Canberra,Australia CD-ROM, Doc.No.301:1-5.

Attia, T. and G. Röbbelen, 1986: Cytogenetic relationship within cultivated *Brassica* analyzed in amphihaploids from the three diploid ancestors. Can. J. Genet. Cytol. 28, 323-329.

Baetzel, R., W. Friedt, A. Voss, and W.W. Lühs, 1999: Development of yellow-seeded high-erucic acid rapeseed (*Brassica napus* L.). Proc. 10th Int. Rapeseed Congr., Canberra, Australia. CD room.

Downey, R.K., A.J. Klassen and G.R. Stringam, 1980: Rapeseed and mustard. In: W.R. Fehr and H.H. Hadley (eds.), Hybridization of Crop Plants, pp. 495-509. American Society of Agronomy – Crop Science Society of America, Wisconsin.

Raghavan, V., 1976: Experimental embryogenesis in vascular plants. Academic Press, New York.