Effects of integrating cultivar resistance and fungicide application on control of phoma stem canker, growth parameters and yield of winter oilseed

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Introduction

Phoma stem canker (blackleg) caused by *Leptosphaeria maculans* or *L. biglobosa* (anamorph: *Phoma lingam*), is one of the most damaging diseases of oilseed rape worldwide.

The present study was conducted to evaluate the effect of selected triazole fungicides with plant growth regulatory activity (alone or in combination) on growth parameters of oilseed rape, fungal disease development, plant wintering and plant yield. As cultivar resistance is essential to the integrated control of phoma leaf spot and stem canker, the interaction of these fungicides with cultivars differing in resistance to Phoma was also investigated.

Figure 1. Symptoms of phoma leaf spot (left) and phoma stem canker (right)

Materials and methods

Field trials were carried out over three consecutive years in 2012/2013, 2013/2014 and 2014/2015. Four winter oilseed rape cultivars were chosen due to their varying levels of resistance to phoma stem canker (Table 1).

Table 1. Winter oilseed rape varieties (German Plant Variety Catalogue, 2012)

Variety	Type	Plant height	Development before winter	Winter killing	Susceptible to Phoma
Elektra	Hybrid	4	5	4	6
Genie	Hybrid	5	5	4	4
PR 46W20	Hybrid	6	4	3	6
Vitara	Line	4	5	4	4

The description of characters is based on a 1-9 scale. A high figure indicates that the variety shows the character to a high degree and a low figure indicates that the variety shows the character to a low degree. 5 stands for a medium expression.

Different fungicide treatments were applied as foliar spray twice, first before winter at growth stage 14–18 and again after winter at BBCH 30–39 (Table 2). All fungicides were applied at 75% recommended dose with a four nozzle precision sprayer.

Table 2. Fungicides treatments, dose and time of application

Treatments	BBCH 14-18	BBCH 30-39	a.s.	g a.s. L^{-1}	Application rate
1	Untreated control				
2	Ampera	Ampera	prochloraz tebuconazole	267 133	1.5
3	Carax	Carax	mepiquat metconazole	160.2 30	1.4
4	Folicur	Folicur	tebuconazole	50	1.5
5	Tilmor	Tilmor	tebuconazole prothioconazole	160 80	1.2
6	Imbrex+Folicur	Imbrex+Folicur	fluxapyroxad tebuconazole	62.5 50	1.5

Visual scoring such as growth parameters like plants per m^2 and plant height, yield parameters like number of side branches, pods and seeds per plant, thousand grain weights and seed yield as well as evaluation of phoma leaf spots and basal stem canker were performed using standard procedures.

Results and discussion

Plant height and winter killing (%) were significantly affected by cultivars and fungicide treatments. Application of epiquat/metconazole reduced the winter killing below 10% compared to the untreated control (Table 3).

Table 2. Effect of fungicides with plant growth regulatory activity (alone or in combination) on root neck diameter, plant height, number of plants per m^2 and winter killing (%) without considering cultivars

Treat.	RND (mm)	PH (cm)			No. of Plants m^{-2}		Winter killing (%)
	BBCH 18	BBCH 18	BBCH 60	BBCH 70	November	March	
T1	6.7 a	28.1 a	121.3 a	162.2 a	44.9 a	38.4 a	14.8 a
T2	6.8 a	27.1 ab	119.4 ab	157.5 a	45.2 a	39.6 a	12.5 ab
T3	6.6 a	25.3 c	114.9 b	141.9 b	44.9 a	40.5 a	9.7 b
T4	6.6 a	26.2 bc	119.0 ab	151.7 ab	47.8 a	41.4 a	13.3 a
T5	6.5 a	25.8 c	120.9 a	155.5 a	47.5 a	42.0 a	11.7 ab
T6	6.8 a	25.5 c	119.2 ab	152.9 a	45.5 a	40.3 a	11.6 ab

RND: Root neck diameter; PH: Plant height

Fungicides and cultivars affected development of phoma stem canker. At the final rating date (BBCH 81), the moderately resistant cultivars, Genie and Vitara, exhibited less disease severity than the susceptible cultivars, Elektra and PR 46W20, in untreated controls. Fungicide treatments were more effective in reducing the disease in moderately resistant cultivars than in susceptible ones. The lowest percentage of disease severity was achieved when fluxapyroxad/tebuconazole combination was applied to plants (Fig. 1).

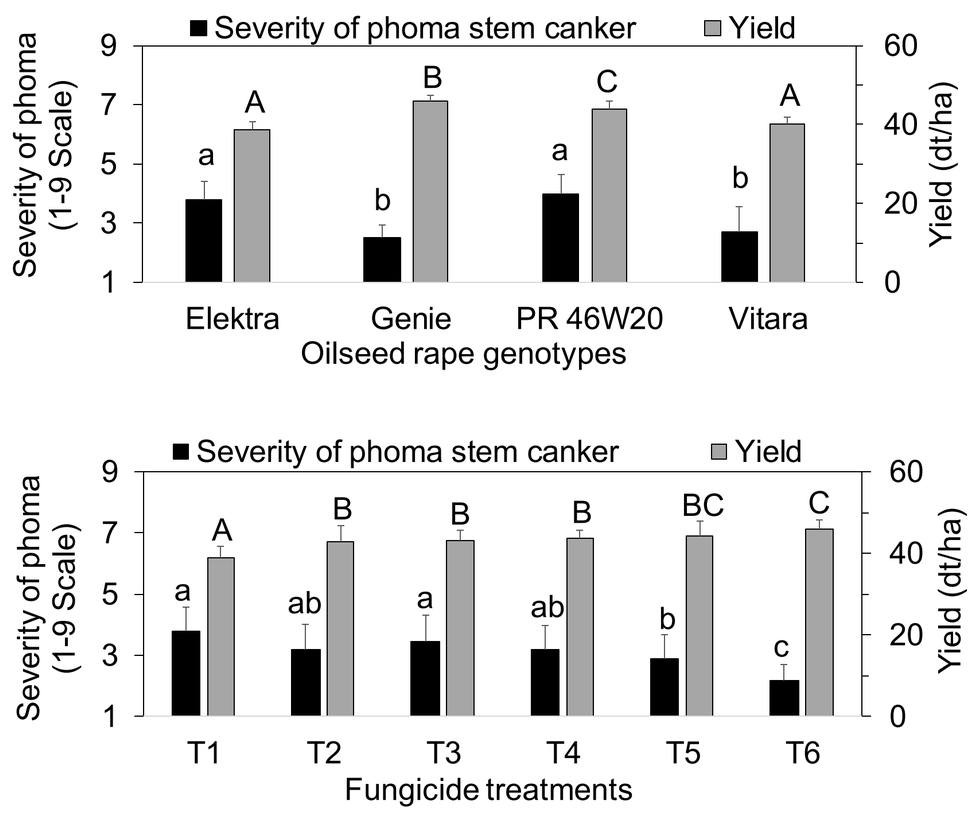

Figure 1. Disease severity of phoma stem canker and yield of four winter oilseed rape cultivars (above) and in untreated plants (T1) and treated with prochloraz/tebuconazole (T2), mepiquat/metconazole (T3), tebuconazole (T4), tebuconazole/prothioconazole (T5) and fluxapyroxad/tebuconazole (T6) (down). Same letters are not significantly different at $p \leq 0.05$.

Furthermore, cultivars exhibited significant differences in seed yield (Fig. 1). Additionally, significant differences between fungicidal treatments were observed between seed yield (Fig. 1). The lowest value of seed yield (41.0 dt/ha) was recorded from untreated plots and was significantly lower than all other treatments.

In conclusion, this study suggests that a combination of cultivar resistance and fungicide management will reduce basal stem canker to acceptable levels. Cultivars represented a significant source of variability, and there was a significant cultivar–fungicide interaction. Improved winter killing resistance together with the control of basal stem canker can significantly increase the seed yield. This study will contribute to an improved knowledge about appropriate management in combination of fungicides.

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