Studies on indicators to control stem canker of winter oilseed rape

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ABSTRACT

Rapeseed stem canker due to *Leptosphaeria maculans* is the origin of severe attacks and yield losses. The contaminations by ascospores occur during autumn. Some fungicides revealed to be effective when applied at the time of the infection. Several treatment indicators are studied in order to adjust fungicide treatments timing : a weather indicator based on the number of rainy days after rapeseed sowing, and three biological indicators which are based respectively on the percentage of mature pseudothecia, on the occurrence of the first ascopores release and the first leaf spots. A threshold value for the number of spores trapped per day is adjusted in order to characterize significant spore release periods.

Key words: *Leptosphaeria maculans*, stem canker, chemical control, weather indicator, biological indicators.

INTRODUCTION

Stem canker caused by *Leptosphaeria maculans* is a major disease of winter oilseed rape in France. Severe epidemics can be responsible for important yield losses according to the tolerance of cultivars and agro-climatic conditions. For several years, the crop protection has been focusing on different ways : i) genetics to improve the level of resistance, ii) proplylactic practices to reduce the impact of the disease (Aubertot, 2002) and iii) chemical control.
Previous studies on chemical control showed a good efficacy when applied in autumn at the time of contamination (Penaud & al, 1995). These results led us to investigate for indicators of infection in order to spray only when necessary.

MATERIALS AND METHODS

Five indicators for a best timing to control blackleg were tested :1) MP = a threshold of 50% of mature pseudothecia , 2) ADYN = a threshold of at least 10 ascospores per day during two successive days by using a volumetric spore trap (Peres & al, 1999), 3) ASCO = a threshold of at least 20 ascospores per slide of a passive trap observed twice a week, 4) 7D = a climatic indicator based on seven days of rainfall superior to 1mm, and 5) SPOT = the occurrence of the first leaf spots with less than 10% of plants showing at least one leaf spot.
To compare these different indicators, experiments were carried out for three seasons in a randomised block design with four replications. Both indicators ADYN and SPOT were compared over two seasons in 9 and 6 trials, respectively. Four indicators – ADYN, ASCO, MP and 7D- were tested during the last season in 4 trials. Moreover, three indicators 7D, ASCO and MP were also tested in networks for three years in more than 64 locations.
When the threshold of each indicator was reached, a foliar spray was applied with Eria 2 l/ha (difenoconazole 62.5 g/l + carbendazim 125 g/l). Disease assessments were made three weeks before harvest using the disease index G2, whose values vary from 0 (no canker) to 9 (very severe stem canker) (Pierre & al, 1982).

RESULTS

Among 15 field experiments carried out over two seasons, only four experiments showed a sufficient level of disease (index G2 ≥ 4) to compare indicators(Table 1). In spite of a difference of more or less 8 days between indicators, the indicator based on leaf spot observations (SPOT) gave results as similar as those based on ascospores trapping (ADYN). Both indicators allowed to apply a fungicide and to reduce the severity of stem canker.

Table 1.Timing of spraying and stem canker severity according to studied indicators in 1996 and 1997.

| Experiments | Date of threshold | | Deviation | Disease index G2 | | |
	ADYN	SPOT	ADYN-SPOT	untreated	SPOT	ADYN
96LPH77	3 oct	9 oct	3d	6.7a	5.3ab	6.5 a
96LPH28	19 oct	26 oct	7d	4.1a	2.9 b	2.8 b
96LPH54	26 sept	2 oct	6d	4.7	5	5
97LPH18	21 oct	18 oct	-3d	4 a	1.6 b	1.7 b

In the last season, the climatic conditions were similar in the different locations and the release of ascospores followed the same kinetics with ascospore trapping at three periods : the second fortnight of September, the second period of ten days in October and at the beginning of November. Under these conditions, the indicator ADYN was the first to indicate some risk of infection according to the first period of ascospore release (Table 2).

But when the chemical control was applied at this time, the severity of the disease was not different compared with the untreated check. In the same way, the fungicide application 3 weeks after spraying was unable to protect the crop against the second dispersal of ascospores in October. In contrast, the climatic indicator 7D took place between 16 and 22 October in the various locations. At this period, the fungicide protection led to reduce significantly the severity of the canker in three experiments.

The indicator MP appeared to be very variable and took place before or after the indicator ASCO. When the indicator MP was after ASCO, the risk indication was finally too late. About the indicators based on ascospore trapping, there was a time period of about one month. The indicator ASCO allowed a better reduction of canker severity than ADYN. When the threshold of trapped ascospores was reconsidered from 10 to at least 50 ascospores, ADYN was put off from 2 to 27 days. Then this new indicator $ADYN_{50}$ was very similar to the indicator 7D.

Table 2. Timing of spraying and stem canker severity according to chosen indicators in 1998.

| Indicators | Experiments | | | | | | | |
| | 98LPH18 | | 98LPH77 | | 98LPH54 | | 98LPH17 | |
	date	G2	date	G2	date	G2	date	G2
untreated		3.3 a		1.9 a		6.2		4.8 a
MP	24 oct	1.6 b	24 nov	3 a	17 nov	5.5	12 nov	4.2 ab
ADYN	6 oct	3.2 a	17 sept	2.9 a	30 sept	5.9	30 oct	2.8 b
ASCO	14 nov	1.4 b	22 oct	1.8 a	22 oct	4.5	12 nov	-
7D	16 oct	1.1 b	16 oct	1.8 a	14 oct	5.2	22 oct	3.5 ab

In the network, the pressure of disease was low and the severity of canker in treated plots according to various indicators was reduced by less than one point compared with the disease index in controls (Table 3). The comparison of the indicators showed similar results but no significant differences for controlling the disease.

Table 3: Comparison of stem canker severity between treated plots according to various indicators.

N° of locations	Indicators	Mean Disease index G2			
		control	treated	Mean deviation	Prob > T
64	7D	3.24	2.41	0.83	0.0001
65	ASCO	3.24	2.56	0.71	0.0001
19	MP	3.87	2.10	0.76	0.0049
	Comparison i vs i	i	j		
64	7D vs ASCO	2.52	2.41	0.11	0.2438
19	7S vs MP	1.93	2.56	0.17	0.1690
19	ASCO vs MP	2.31	2.10	0.20	0.3091

[1]T : Student Test

DISCUSSION

These results show that the use of indicators to apply fungicide only in case of need could be part of an integrated forecasting system for controlling the incidence and the severity of stem canker. Among the tested indicators, the 7D indicator seems to be the most reliable but it could be improved by taking temperature into account, which also plays a part in epidemic phenomena, such as maturation of pseudothecia (Poisson & al, 1999). The indicator MP showed a lot of variability but it strongly depends on infected stubble from the previous harvest, likely the sampling itself of this stubble and the sampling of the pseudothecia to be observed. The indicators based on ascospore trapping are very dissimilar according to the method of trapping. Beside the quality of the stubble near the trap, the threshold of trapped ascospores need to be improved for a better risk assessment.

In practice, some indicators such as 7D and SPOT may be used directly by farmers. The others such as ADYN or MP would need to be used in network for advice.

In addition, work aimed at identifying parameters for risk assessment according to agronomic practices (e.g. residue management) and agro-climatic conditions is in progess. There is a need to manage the chemical control in a scheme of integrated control including the use of resistance to stem canker and the improvement of agronomic practices.

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