Biological control of *Sclerotinia sclerotiorum* by *Coniothyrium minitans* in crops rotations including OSR in France

Annette Penaud[1], D. Chollet[2], L. Jung[3]
[1] CETIOM,Service Innovations, B.P. 4, 78850 Thiverval-Grignon, France. penaud@cetiom.fr
[2] CETIOM, BP 506, 69125 Lyon-St Exupery Aeroport, France. chollet@cetiom.fr
[3] CETIOM, 54 , France. jung@cetiom.fr

ABSTRACT

Suspensions of conidia of *C. minitans* have been applied in different crop rotations over the last three years. Due to lack of disease, assessments have been made on sclerotia. Indeed samples of sclerotia of *S. sclerotiorum* were buried into soil in autumn, then recovered several months later for assessment. *C.minitans* has been shown to decay sclerotia but sometimes its application failed The use of this biological control is discussed.

Key words: oilseed rape, *Sclerotinia sclerotiorum*, *Coniothyrium minitans*, biological control.

INTRODUCTION

Sclerotinia sclerotiorum can cause severe damage on oilseed rape. Yields can be significantly reduced due to shrivelling. Moreover, the systematic use of benzimidazoles fungicides (MBC) has led to the occurence of fungi which are resistant to these chemicals (Penaud & al, 2003). Therefore it is important to look for new means of crop protection with alternative systems. Experiments have been carried out with a biological control agent, *Coniothyrium minitans,* which is able to destroy sclerotia buried into the soil (Whipps & Gerlagh, 1992). And for three years, the effectiveness of *C. minitans* has been studied in crop rotation.

MATERIALS AND METHODS

Four trials were carried out for three years in oilseed rape - wheat rotations in two different regions: Lorraine (54) and Auvergne (03). Because of the dispersal of *S. sclerotiorum* ascospores, plots were more than 2500 m² in size. Due to the large surfaces of the plots, the experimental design was a couple of treated and non treated strips with no replication.

The first year (2000-2001), *C.minitans* formulated as Contans® was sprayed at the rate of 2kg/ha in two fields on infected stubble of oilseed rape before winter wheat sowing and in two other fields just before winter oilseed rape sowing. The second year (2001-2002), the previously treated plot was sprayed again at the rate of 1kg/ha when the crop was winter wheat or barley and at 2 kg/ha when it was winter oilseed rape.

Each year, 180 field or culture-grown sclerotia were placed in tulle bags which were buried into the soil treated or not by *C.minitans*. Sixty sclerotia were recovered at the end of winter, at the flowering period and at harvest, and assessed for infection by the mycoparasite.

The efficacy of biological control was measured 5 weeks before harvest by counting sclerotinia stem rot in a sample of 4 x 50 plants from each plot.

RESULTS

In the first year 2001, the attack of sclerotinia stem rot was too low for significant differences between treatments. However, differences occurred between sclerotia buried into treated and untreated soil. Indeed, the amount of decayed sclerotia increased 4 to 10 times when they were buried into soil treated by *C.minitans* at the rate of 2 kg/ha (Table 1).

The following year in Lorraine, in spite of a new treatment at the rate of 1 kg/ha, there were very few decayed or missing sclerotia at the flowering period of the rapeseed, both in untreated and treated plots. In Auvergne at the location of LeTheil-A, less than 10% of sclerotia were naturally decayed under oilseed rape canopy, but twice to three times more sclerotia were decayed when treated by *C. minitans* respectively at 1 and 2 kg/ha. These results suggest an effect of the dose of the biological agent. Under wheat canopy (LeTheil-B), the trend was the

same as under rapeseed canopy. In both fields where the soil was treated respectively at the rate of 2kg/ha in 2001 and 1 kg/ha in 2002, twice more decayed sclerotia were observed.

Table 1. Incidence of infected and/or decayed sclerotia according to the crop rotation.

Locations	Year	Crop rotation	Incidence of infected and/or decayed sclerotia at the flowering stage of OSR		
			untreated	Contans 2 kg/ha	Contans 1 kg/ha
54-Juvrecourt	2001	Oilseed rape	1,7	16,7	-
	2002	Wheat	5	-	4
	2003	Oilseed rape			
54-Gezoncourt	2001	Wheat	11,7	61,7	-
	2002	Barley	0	-	1,7
	2003	Oilseed rape			
03-LeTheil-A	2001	Wheat	6,6	23,3	-
	2002	Oilseed rape	8,3	23,3	15,4
	2003	Wheat			
03-LeTheil-B	2001	Oilseed rape	20	35	-
	2002	Wheat	5	-	11,8
	2003	Wheat			

DISCUSSION

C.minitans is well known to contaminate and to destroy sclerotia of *S. sclerotiorum*. But several months are required for an inhibition of sclerotia's carpogenic germination and ascospore release (Penaud & al, 2000). So for its best activity, *C. minitans* must be applied in autumn and incorporated into the soil to reduce the primary inoculum in following spring and consequently to decrease the infection of oilseed rape (Lüth, 1995). Due to unfavourable weather conditions during the first two years of our experiments, the incidence of sclerotinia stem rot was too low to demonstrate the effectiveness of *C.minitans* in such an use in rapeseed.

However *C. minitans* was shown effective on sclerotia collected in infected stems and buried in treated soil the first year of experiments. The second year, because of a lack of field sclerotia in Lorraine, tests were carried out with culture-grown sclerotia and very few of them were decayed. This lack of results in 2002 could be explained firstly by the origin of sclerotia. Previous results indicated that culture-grown sclerotia are less susceptible to infection by *C.minitans* than natural sclerotia (Trutmann & al, 1980). The failed activity of *C. minitans* could be also due to very hot temperatures (> 30°C) just after spraying and low temperatures (-10°C) during the winter. Such conditions are not optimal for germination, growth and infection of sclerotia by the biological agent (Trutmann & al, 1980). In both years in Auvergne *C. minitans* allowed to reduce the population of viable sclerotia, but the more concentrated the suspension of *C. minitans* is, the more sclerotia. are decayed These results are in agreement with the results of P. Lüth (1995).

Furthermore, all the sclerotia of infested fields cannot be destroyed just after only one spray of *C.minitans.* Most of the population of sclerotia is buried too deep to be contaminated by conidia but it can be removed in the upper soil layer the following year and produce primary inoculum. Indeed, apothecia are produced in oilseed rape as well as in cereals and the susceptible crops can be infected by ascospores of *S. sclerotiorum* coming from these different sources of inoculum. So the use of *C.minitans* must be included in an integrated scheme; taking into account of agricultural practices and crop rotation.

Since *C.minitans* is able to reduce the primary inoculum, (e.g. apothecia) but knowing that it could take several years before a good effectiveness can be assessed, in short term it could be

useful not to give up the chemical control but to add the biological one to a crop protection system using also forecasting model and decision rules in order to apply fungicide only if need.

ACKNOWLEDGEMENTS

The authors wish to thank the farmers and the partners of Chambre d'Agriculture de l'Allier for their field assistance.

REFERENCES

Lüth P., 1995. Biological control of *Sclerotinia sclerotiorum* in oilseed rape and sunflower with *Coniothyrium minitans* the fungal antagonist and improvement ot its use. IOBC Bull. 18(3), 18-25.

Penaud A., Huguet B., Wilson V. and P. Leroux, 2003: Fungicide resistance of *Sclerotinia sclerotiorum* in French oilseed rape crops. Proc. 11th Int. Rapeseed Congr., Copenhagen.

Penaud A., Bammé B. and G. Drolon, 2000: Lutte biologique contre *Sclerotinia sclerotiorum* à l'aide de *Coniothyrium minitans*. Proc. 6ème Conf. Int. Maladies des plantes. AFPP Tours, 2, 582-589.

Trutmann P., Keane P.J. and P. Merriman, 1980: Reduction of sclerotial inoculum of *Sclerotinia sclerotiorum* with *Coniothyrium minitans*. Soil Biol. Biochem. 12, 461-465.

Whipps J.M. and M. Gerlagh M.,1992: Biology of *Comiothyrium minitans* and its potential for use in disease control. Mycol. Res. 96, 897-907.