

# Prospects for an integrated crop protection against clubroot *Plasmodiophora brassicae*

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## ABSTRACT

Clubroot is a soil borne disease which has been increasing in the oil seed rape (OSR) fields of some French regions for the 1990's, in accordance with the reduction of crop rotation length and with the simplification of cropping systems. A survey was performed in 17 fields of the main regions. Its principle was a comparative analysis of two sites inside each field (with and without clubroot symptoms on OSR roots) with soil analysis, OSR clubroot symptom observation and soil infectivity (SI) assessment through a biological test. The results show that clubroot on OSR occurs mainly in acid soils. The statistical data analysis shows that the SI is very dependent of the soil pH. 80% of the plots with high SI have a soil pH below 6.1. And 80% of the plots with low SI potential show a soil pH above 6.1. Soil acidification below pH 6.1 seems to be a frequent condition for the clubroot development into the soil. Soil acidification generates other problems for OSR: reduction of nitrogen mineralization, reduction of soil permeability and risks of anoxia. In order to prevent these problems in the OSR fields, an integrated crop protection (ICP) has been designed to control clubroot in acid soils.

**Key words : clubroot – *Plasmodiophora brassicae* – soil acidification – basic conditioner - oil seed rape**

## INTRODUCTION

Clubroot is a soil borne disease which has been increasing in the oil seed rape (OSR) fields of some french regions for the 1990's, in accordance with the reduction of crop rotation length (down to 2 years long rotation), with the simplification of cropping systems or with the development of cropping systems with OSR on acid soils in position of the feed growing for stock farming in some regions after the Bovine Spongiform Encephalopathy crisis.

Rouxel *et al.* (1988) studied clubroot disease in cropping systems with cauliflower crop, showing the importance of crop rotation and the performance of liming in order to reduce clubroot severity on cauliflower.

Consequently, a survey and several experiments have been realized to test the relation between soil estate and development of clubroot, in order to design an integrated crop protection of OSR against this disease.

Nowadays, the only available results come from the survey.

## MATERIAL AND METHODS

The survey was realized in 17 fields of the main regions of OSR production. It was composed by a comparative analysis of two sites inside each field : with and without clubroot symptoms on OSR roots. The analysis concerned soil analysis (24 datas), clubroot symptom notation on OSR roots (galls) and assessment of soil infectivity (SI) via a biological test with *Brassica campestris pekinensis*, cultivar "Grannat".

The data collected were analysed through an ACP analysis (Allard, 2001).

## RESULTS

The statistical data analysis shows that galls on OSR is highly dependant of soil infectivity (Table). While soil infectivity is mainly dependant of four variables characterizing basic estate of the soil : pH H<sub>2</sub>O, pH KCl, CaO and cations sum.

Table : Extract from the ACP correlation matrix obtained with 26 variables for 17 pairs of plots

Correlation coef.	Gall	Soil infectivity	pH KCl	pH H2O	CaO	Cations sum
Gall	+ 1.00	+ 0.96	- 0.39	- 0.47	- 0.32	- 0.32
Soil Infectivity	+ 0.96	+ 1.00	- 0.49	- 0.55	- 0.40	- 0.40

These results show that clubroot on OSR occurs mainly in acid soils : 80% of the plots with high SI have a soil pH H2O below 6.1. And 80% of the plots with low SI have a soil above 6.1.

### DISCUSSION

Soil acidification below the 6.1 pH seems to be a frequent condition for the development of *Plasmodiophora brassicae* into the soil.

Soil acidification generates other problems for OSR : reduction of nitrogen mineralisation, reduction of soil permeability, and risks of anoxia (Pernes-Debuyser & Teissier, 2002). Consequently, prevention of soil acidification seems very important for OSR in order to improve potential yields of OSR.

Rouxel *et al* (1988) proved the efficiency of liming to control galls of clubroot on cauliflower. In order to test the efficiency of liming on OSR, several experiments are being realized :

- an experimentation in controlled conditions, to test the efficiency of date and dose of liming from an infected soil, on soil infectivity.
- 4 multilocal experiments to test in field conditions the efficiency of liming on soil infectivity, galls on OSR and OSR potential yield.

With these experiments, we are assessing an integrated crop management (ICM) to prevent clubroot on OSR. Indeed, nowadays available with actual cultivars genetic resistance does not seem to be sustainable. And there is no chemical solutions profitable for farmers nowadays. This ICM relies on a strategic management of the soil, and a tactical choice of the cultivars. It is based on the soil pH control and management in order to reach pH 6.1 using basic conditioner, and maintain the SI at a low level, in the hope of preventing the clubroot disease on long term. In the plots where clubroot disease is present, there is a delay to reduce the pH and therefore SI using soil conditioner, and it seems necessary to add a tactical solution to control the disease, using clubroot tolerant cultivars. In order to maintain the sustainability of the cultivar resistant on a long term, use of these cultivars would be recommended only during the first years, after the beginning of the soil pH improvement. This ICM is being tested to reduce clubroot problems in infested fields, as well as to prevent clubroot development in fields where it could be introduced.

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