

Survey of Downy Mildew on Sunflower in France

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Summary

Following the appearance of two new races of downy mildew (DM), a survey has been carried out each year. This survey and an analysis of diseased samples aim at i) following the extent of the races, ii) identifying other new races and iii) detecting resistance to metalaxyl seed treatment. Some rare cases of resistance to phenylamide fungicides have been observed. The early detection of this phenomenon allowed us to find genetic and/or chemical control before we noticed severe damage in the crops.

Key-words : *Plasmopara halstedii*, races, *Helianthus annuus*, resistance.

Introduction

Downy mildew of sunflower is one of the most important diseases bringing about severe yield losses in France. To prevent such an event, the different oilseed organizations have tried to keep an eye on the evolution of DM races and to deal with the problem to minimize damage.

History of DM in France

Until 1988, only one race of *Plasmopara halstedii*, Race 1 or the European Race, was known in France. This race occurred in the south of France for the first time in 1966. INRA (National Institute for Agricultural Research) developed lines resistant to Race 1 which were used for the production of resistant hybrids. The first one was registered in 1978. The use of resistant hybrids had protected cultivated sunflower for 10 years. During this period, sunflower increased by 10 to reach about one million hectares.

But in 1988 a new race named Race A was first found in commercial fields in the central region of France where 15 % to 50 % plants were affected. The following year, in 1989, another race B was identified in the South-West region.

Annual survey

Because of the appearance of both new races, it was decided to monitor their extent and to detect other possible new races. Since 1990, a survey has been conducted each year. Between 200 and 800 fields located in all the different sunflower production areas in France could be studied. The presence of symptoms of DM is recorded. About 150 samples are collected and races identified (Lafon S. & al, 1996 ; Delos M. & al, 1997).

In 1997, the prevalence of DM was low, less than 25 % in all regions. The disease incidence ranged from 1 % to 4 % of stunted plants (Pilorgé E., 1997). 130 samples were collected and races were identified using a set of differentials (Table 1).

Since 1990, Race A has been the predominant race in the eastern, northern and central parts of France while Race B could be mainly observed in the South-West. However, Race B is more and more associated with Race A which seems to be more aggressive. In 1995, two other races, Race C and Race D were identified respectively in a south-western department and in the central region, but since then both races could not be recognized again.

Table 1 : Genotypes of sunflower for downy mildew race determination

Differentials	Race 1	Race A	Race B	Race C	Race D
Peredovik no treated	S	S	S	S	S
CR 2	R	S	S	S	S
RHA 274	R	S	S	S	R
PM I3	R	S	R	R	R
HAR 5	R	R	S	R	R
YEQ	R	R	R	R	R
Peredovik treated with metalaxyl	R or S	R or S	R or S	R or S	R or S

Managing the new races

The management of the new races has included some regulations for seeds, a compulsory seed treatment and the development of resistant hybrids.

Regulations

The French Plant Protection Service of the Ministry for Agriculture issued three decrees to limit the risk of introduction and spread of DM by seeds. One decree (9/12/93) concerns seeds for sowing : all sunflower seeds to be sown must be treated, except hybrids which were recognized by official tests as resistant to the new French races. The second one (2/9/93) governs importation : seeds can be imported without treatment from healthy areas. On the contrary, they must be treated, except hybrids resistant to the new French races. The third decree (6/3/96) reinforced the previous regulation on the trade level : all sunflower seeds for sale must be treated whatever the geographic origin, except hybrids resistant to the new French races.

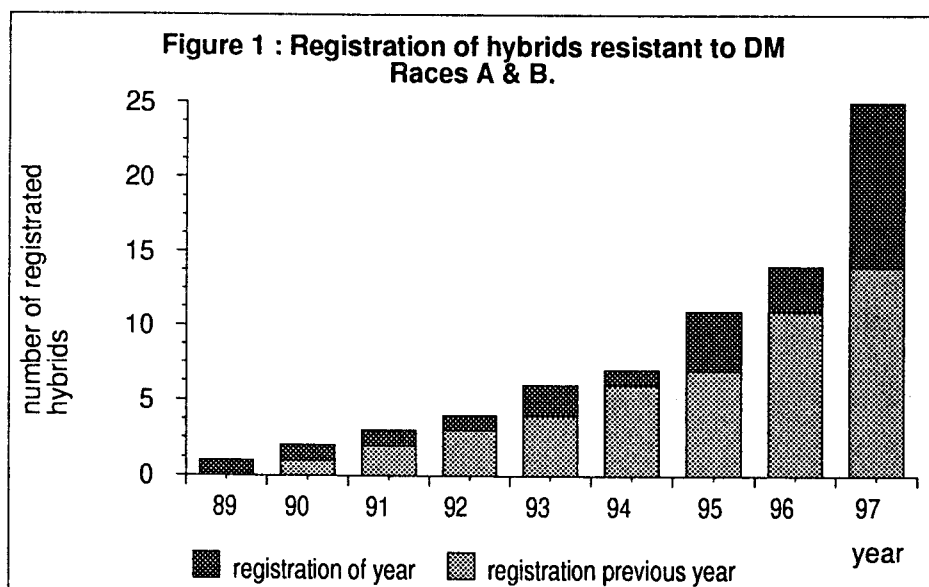
Seed treatment

Presently, seed treatment is compulsory. It is carried out with metalaxyl fungicide (210 g a.i./100 kg seeds). The protection given by metalaxyl is against early infections of DM which take place during the month after sowing. However a fungus like *P. halstedii* is able to develop resistance to metalaxyl. Another objective of the annual survey was to watch for the first signs of resistance. Collected samples were tested on a susceptible line with seed treated with metalaxyl. The first isolate of DM less susceptible to metalaxyl was detected in 1994. Since then the number of resistant isolates has increased.

Last year, we could observe some relationships between disease incidence and resistant isolates to metalaxyl for the first time. These results suggest an early beginning of a lack of efficacy of metalaxyl in field conditions. Other studies have been carried out to evaluate other effective products with different modes of action which could be mixed with metalaxyl or used as a substitute for metalaxyl (Lafon S., 1998).

Development of resistant hybrids

The best way to control DM and to avoid the spread of resistance to metalaxyl will be the use of resistant hybrids. For several years, most seed companies have been working to incorporate Race A and B resistance into new hybrids but also into registered commercial hybrids such as Albena RM. These hybrids have kept all their qualities (earliness, high yield, oil contents and resistance to other diseases like *Phomopsis* or *Sclerotinia*). The number of resistant hybrids has been increasing for three years. In 1997, more than 10 hybrids were registered. Twenty commercial resistant hybrids are now available for producers (figure 1). It is an important progress because these hybrids do not need any seed treatment against DM and they could contribute to decrease the selection pressure inducing resistance to seed treatment in a short cropping system.



In conclusion, even if four races have appeared in France over the last decade, regulations were applied to avoid important damage due to DM. Seed treatment with metalaxyl has always been an alternative but because of the occurrence of resistance, it would be necessary to find other compounds not related to metalaxyl. Fortunately, seed companies are developing resistant hybrids. In view of these points, farmers are advised to choose resistant hybrids. In contrast, they have to use treated seeds and also to apply cultural practices to minimize the spread of the inoculum, including rotation, and a minimum delay of 3 years between sunflower crops and destruction of volunteers.

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