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DOWNY MILDEW IN SUNFLOWER - THE MANAGEMENT OF *Plasmopara halstedii* PATHOGEN

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Abstract

The virulence of the downy mildew pathogen increased during the last period and new virulent races of this fungus appear. Thus it is essential to know data about the presence and distribution of the pathotypes. In Europe, an increasing number of the pathotypes, have been identified.
In Romania we identified eight races of the pathogen. They are not present in all areas cultivated with sunflower, in some areas being present only five races, in other six or seven.
Using the sources of resistance to Plasmopoara halstedii pathogen, for the most virulent races present now in Europe we have introduced genes of resistance in the best lines from our germplasm collection.
The testing of some sunflower hybrids with different degree of resistance to downy mildew has showed that there is difference in the pathogen attack degree, depending on the climatic conditions in the years and locations.

Key words*: sunflower, downy mildew, Plasmopa halstedii.*

INTRODUCTION

The sunflower downy mildew, caused by *Plasmopara halstedii* (Farl.) Berl. and de Toni is one of the most devastating diseases for this crop, over the world. However, this pathogen could be controlled by the resistant hybrids or treatments with different fungicides. There are some factors that make difficult this disease control: pathogen variability (Gulya et al., 1998) and pathogen resistance or tolerance to fungicides, as metalaxyl - mefenoxam (Albourie et al., 1998; Molinero-Ruiz et al., 2000).
The virulence of the downy mildew pathogen increased lately and new virulence races of this fungus appear. Thus it is essential to know data about the presence and distribution of the pathotypes. In Europe, an increasing number of the pathotypes, each with a distinct virulence structure, have been identified. In Romania, five pathotypes of the pathogen have been identified, before 2006 year (Pacureanu et al., 2006), in the last years, being identified other two. Since fungal diversity of this kind has consequences in both disease epidemiology and breeding for resistance, there is a need to identify the virulence of the local fungal populations and to monitor the changes over the time. Currently, there are at least 36 pathotypes of *Plasmopara halstedii* worldwide (Gulya, 2007) but number is increasing rapidly (Viranyi and Spring, 2011; Türkmen and Çalışkan, 2016), considering the fact that in most sunflower producing countries, just 12 well distinguished virulence pathotypes exist. Planting downy mildew-resistant hybrids is very important to manage downy mildew. However, due to the development of new races, resistance may not be a sufficient management in all fields (Virányi et. all, 2015).
Crop rotation has a minimal effect on downy mildew management. Overwintering oospores could survive in the soil up to 10 years, rendering crop rotation practices inefficient for

downy mildew (Friskop, 2009). Downy mildew races in our growing region are assessed by the resistance screening program conducted by NARDI Fundulea and some seed companies.

This paper presents the data about the *Plasmopara halstedii* pathogen virulence in Romania and the management of its control by genetic resistance.

MATERIALS AND METHODS

In order to study the pathogen races infecting Romania fields, the international sunflower differential set has been used. Several sunflower lines with good agronomic traits, which have been introduced into conversion process for resistance to downy mildew, have been used. The behaviour of some sunflower hybrids have been studied in natural infection conditions, during four years, in two locations. Infected sunflower plants from different fields placed in all important areas of sunflower cultivation, in Romania, have been collected and used for artificial infections. Pathogen inocula were directly recovered either from infected leaves, by brushing the fungal structures, either from infected leaves pre-incubated in humid chambers at 18 to 20°C in the dark for 24 to 48 h.

Thirty to forty pregerminated seeds of each differential line (three replicates per line) were inoculated by the whole-seedling immersion technique. After 12 days, plants were maintained at 20°C and 100% relative humidity for 24 to 48 h, in order to enhance pathogen sporulation and evaluate its susceptibility (sporulation on cotyledons and/or first true leaves) or resistance (absence of sporulation or weak sporulation only on cotyledons) reactions.

RESULTS AND DISSCUTION

For the identification of thepathogenic races, eight isolates coming from eight areas cultivated with sunflower in Romania have been used. The results presented in table 1 are showing that all isolates have attacked the differentials carrying the Pl1 and Pl5 genes. The differential carrying the gene Pl2 was not attacked by isolates coming from Constanta, Iasi and Tulcea areas. The differentials PM 13 and PM 17 were attacked by isolates coming from Fundulea, Craiova and Timis.

Table 1. Results from the sunflower differentials set testing for resistance to *Plasmopara halstedii* pathogenraces, Fundulea, 2016

Differentials	Isolates							
	Braila	Slobozia	Fundulea	Craiova	Constanta	Iasi	Tulcea	Timis
	Infection degree (%)							
HA 265 (Pl1)	56.0	47.4	45.7	57.9	36.6	49.7	38.3	59.4
AD 66 (Pl1)	51.3	44.1	52.7	24.4	33.9	41.4	32.2	42.7
DM2 (Pl5)	49.0	35.4	33.7	31.8	35.4	48.7	36.4	47.3
RHA-274 (Pl2)	33.6	24.8	11.3	2.9	0.0	0.0	0.0	31.5
PM 13 (Pl?)	0.0	0.0	4.0	7.9	0.0	0.0	0.0	6.0
PM 17 (Pl?)	0.0	0.0	1.9	2.0	0.0	1.3	0.0	2.0
803-1 (Pl?)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RHA 419 (Pl?)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RHA 340 (Pl8)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5
HA-335 (Pl6)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HA 304	74.7	58.4	51.7	64.3	38.9	43.8	42.4	65.7

The *Plasmopara halstedii* pathotypes, from different areas of sunflower crop in Romania are presented in table 2. In case of Fundulea, Craiova and Timis isolates, 8 pathogen races are present.

In case of Constanta and Tulcea isolates, there were present only 5 races, missing the 310, 330 and 314 races.

In case of Iasi isolates, there were present 6 races of the pathogen, however 310 and 330 races were missing. In case of Braila and Slobozia isolates there were present 7 races of *Plasmopara halstedii.*

Using different sources of resistance to the attack of *Plasmopara halstedii*, specially carrying the gene Pl6, we have introduced resistance to this pathogen, in some of our best sunflower inbred lines.

The results are presented in table 3.

Table 2. The patotypes of the pathogen *Plasmopara halstedii*, identified in the sunflower crop, in Romania

Pathotypes								
Races / Location	100	300	714	703	310	330	710	314
Braila	X	X	X	X	X	X	X	
Slobozia	X	X	X	X	X	X	X	
Fundulea	X	X	X	X	X	X	X	X
Craiova	X	X	X	X	X	X	X	X
Constanta	X	X	X	X			X	
Iasi	X	X	X	X			X	X
Tulcea	X	X	X	X			X	
Timis	X	X	X	X	X	X	X	X

Table 3. Results of the improvement for resistance to downy mildew, for some sunflower genotypes

CMS lines resistant to *Plasmopara halstedii*	
Source of resistance	Number of resistant lines
HA 335	21
AS - 110	12
Populations	78
Restorer lines resistant to *Plasmopara halstedii*	
Source of resistance	Number of resistant lines
CRF- 821	27
RHA 340	9
Populations	109

Testing some experimental sunflower hybrids, regarding the resistance to *Plasmopara halstedii*, in two locations and four years, showed that the attack degree is depending on the climatic conditions of the years and locations, as it is presented in figures 1 and 2.

In the years 2015 and 2016, when the air temperatures were low and it was enough rain in the beginning of sunflower development, there have been good conditions for the pathogen development. This it could to be seen in the values of the infection degree with this pathogen.

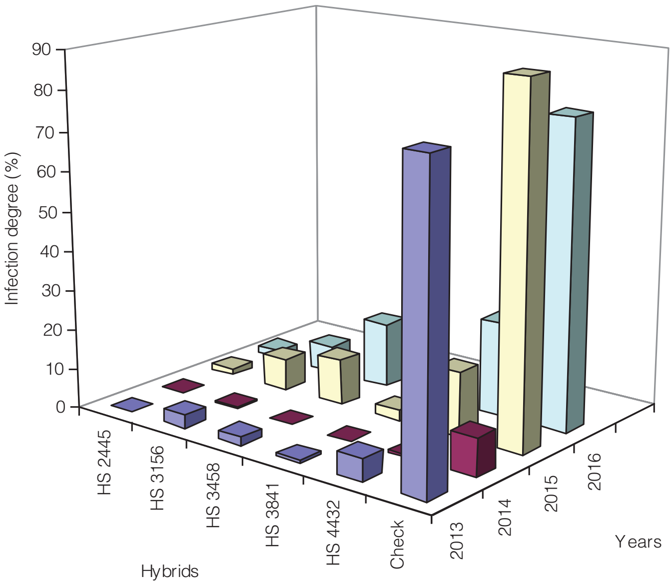

Figure 1. The behaviour of some sunflower hybrids, regarding the resistance to the attack of *Plasmopara halstedii* pathogen (Fundulea location)

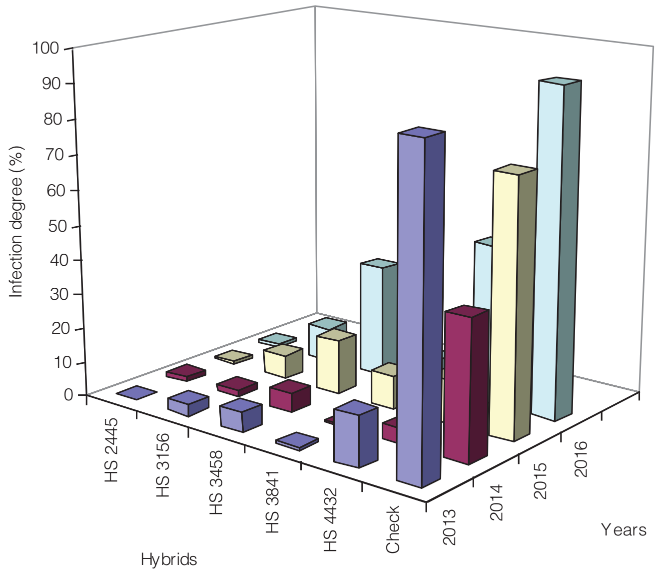

Figure 2. The behaviour of some sunflower hybrids, regarding the resistance to the attack of *Plasmopara halstedii* pathogen (Braila location)

Regarding the hybrids, HS 2445 hybrid was the most resistant, in all years and in both locations. In Braila area the attack degree of the pathogen was higher in all years, comparing with Fundulea location. Braila area gave more suitable conditions for the development of *Plasmopara halstedii*.

CONCLUSIONS

The downy mildew has become very dangerous for sunflower crop in almost all areas cultivated with sunflower over the world.

It is of a great importance to identify the races of the pathogen in the important areas cultivated with sunflower as well as to identify the sources of resistance.In the sunflower crop in Romania there have been identified eight races of this pathogen. In some areas are present only five races.

Using the sources of resistance to the new races of this pathogen it has been transferred genes for resistance in the best sunflower inbred lines from our institute germplasm collection.

The attack degree of the pathogen which produces downy mildew in sunflower is high influenced by the climatic conditions in the years and in different locations.

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