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RESEARCH ON GENETICS AND BREEDING FOR SUNFLOWER RESISTANCE TO *PLASMOPARA HALSTEDII*

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Abstract

Sunflower is attacked by more than 40 different diseases of which only a certain number causes serious reduction of seed yield. One of the most damaging diseases is downy mildew which is caused by Plasmopara halstedii fungus (Farl.) Berl.et de Toni (syn. Plasmopara helianthi Novit.). Sunflower downy mildew has a great economic importance in all countries where sunflower is grown. When the meteorological conditions during the vegetation period of sunflower become favorable for disease development, the damages produce considerable reducing of the seed yield and the oil content.
The best way of controlling the fungus is to grow resistant cultivates and because that the major objective of this study was to developed sunflower genotypes genetically resistant to dominant races of downy mildew in Romania. During this work two co-dominant markers for Pl-6 and Pl-8 gene. For introduction of these genes in breeding program marker assisted selection (MAS) was used. Developed commercial sunflower inbred lines exhibit resistance to all known races of downy mildew in Romania indicated incorporation of resistance to downy mildew in well-known and widely produced hybrids. Except that, Pl-genes were introduced to large number of new inbred lines and new downy mildew resistant hybrids.

Key words: *downy mildew, hybrid, inbred line, race, sunflower.*

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important source of vegetable oils and it keeps gaining popularity because of its high oil percentage and quality, short duration and thermophotinsensitiveness.
More than 30 diseases have been identified on sunflower (Gulya et al., 1994). Among these, downy mildew caused by *Plasmopara halstedii* (Farl.) Berl. and de Toni is the most destructive one (Kolte, 1985). Existence of physiologic races in *Plasmopara halstedii* is evident from reports of several workers from different parts of the world (Abdullah, 1983; Patil and Mayee, 1990). Sunflower downy mildew is caused by the fungus *Plasmopara halstedii* Farl.Berl. & de Toni, an obligate parasite which infects seedlings during the early stages of development, usually from sowing to two leaves. Systemic infection is characterized by symptoms of chlorotic mosaic bordering the veins of the leaves as well as stunting of the plants. Optimum conditions for the disease, such as high inoculums concentrations, abundant rain and temperatures of 15-18°C can cause preemergence or postemergence damping off of the young plants.
The incorporation of genes of resistance to *Plasmopara halstedii* is a common way to control the disease. These genes are effective against one or more races of the fungus, but they are overcome by more virulent races of the fungus after continuous crop of resistant hybrids.
Over the last 20 years there have been great changes in the pathogen population in almost all sunflower growing countries in the world, except Australia. In Europe, there was an increase in the number of path types of pathogens, each with a distinct virulence structure. In Romania have been identified five path types of the pathogen, until 2006 (Pacureanu et al., 2006) and in the last 3 years are still identified another two path types. For the vast diversity in the pathogen influence both disease epidemic and improve the sunflower resistance to the *Plasmopara*

Halstedii is necessary to identify local populations and monitor their changes over time.

MATERIALS AND METHODS

To achieve experiments on identifying pathogen races present in sunflower crop in Romania was used following set of differentiators: HAR-304 who is sensitive for all downy mildew races; RHA-265 and RHA-266 who are resistant for race 100 and sensitive for races 300, 310, 330, 700, 710 and 730 downy mildew races; RHA-274 who is resident for races 100, 300, 330, undefined for 310 race and sensitive for races 700, 710, 730 downy mildew races; PMI 3 who is resistant for races100, 300, 330,700, undefined for 310 races and sensitive for 330, 710 and 730 races; PM 17 who is resistant for races 100, 300, 700, 710, undefined for 310 races and sensitive for 330 and 730 races; 803-1, RHA-340 and HAR-4 who are resistant for all downy mildew races; HA-335 who is resistant for races 100, 300, 330, 700, 710, 730, undefined for races 310 and sensitive for 304 races; DM-2 who is resistant for races 100, 300, 304, 700 and sensitive for races 330, 710 and 730. To identify the spectrum of races of the pathogen were collected sunflower plants attacked by mildew from following areas cultivated sunflower in the country: Movilita – Ialomita, Tamadau – Calarasi, Peciu Nou – Timis, Farcasele – Olt, Perieti – Ialomita, Mihail Kogalniceanu – Constanta, Ianca – Braila, Dor Marunt – Calarasi. These samples were kept in the freezer and multiplied on the susceptible cultivar “Peredovic” using the radicle inoculation method and then subsequently used to obtain suspensions of zoospores for making artificial infection. Identify races of *Plasmopara halstedii* study was done in the laboratory, in 2012.

RESULTS AND DISCUSSIONS

In Romania, the pathogen *Plasmopara halstedii* evolved in increasing virulence, especially in recent years, during which identified five new races of it. If a very long time, about thirty five years ago, there were only two races of the pathogen in the sunflower crop in Romania, but the pathogen has developed new races.

The results obtained (Table 1 and Table 2) show that in Movilita were infected the differentiators HAR-304, RHA-266 and RHA-266, in Tamadau were infected the differentiators HAR-304, RHA-266, RHA-274, PMI 3, PM 17, DM-2 and DHA-265, in Ianca were infected HAR-304, RHA-266, RHA-274, PMI 3, DM-2 and DHA-265, in Dor Marunt were infected HAR-304, RHA-266, RHA-274, PMI 3, PM 17, DM-2 and DHA-265.

Table 1. Results of testing of the sunflower differentials set, for resistance to the pathogen first four location

Differentiators	Izolate			
	Movilita	Tamadau	Ianca	Dor Marunt
	Degree of infection (%)			
HAR-304	78.1	80.4	71.4	79.2
RHA-266	53.5	61.2	55.8	57.1
RHA-274	0.0	52.2	54.5	51.1
PMI 3	0.0	61.5	51.9	64.4
PM 17	0.0	59.3	0.0	52.0
803-1	0.0	0.0	0.0	0.0
RHA-340	0.0	0.0	0.0	0.0
HA-335	0.0	0.0	0.0	0.0
DM-2	4.1	57.4	59.1	62.4
HAR-4	0.0	0.0	0.0	0.0
RHA-265	54.4	56.3	57.2	51.2

Table no. 2 shows that in Peciu Nou were infected differentiators HAR-304, RHA-266, RHA-274, PMI 3, PM 17, DM-2 and DHA-265, in Farcasele were infected differentiators HAR-304, RHA-266, RHA-274, PMI 3, DM-2 and DHA-265, in Perieti were infected differentiators HAR-304, RHA-266, RHA-274, PMI 3, PM 17, DM-2 and DHA-265, and in Mihail Kogalniceanu were infected differentiators HAR-304, RHA-266, RHA-274, PMI 3, PM 17, DM-2 and DHA-265.

The results show that in Romania races 100 and 300 are prezent in all studied locations, race 700 is prezent in Movilita and Tamadau locations, race 730 is prezent in Peciu Nou, Perieti, Mihail Kogalniceanu and Dor Marunt locations, race 310 is prezent in Tamadau, Peciu Nou, Perieti, Ianca and Dor Marunt locations, race 330 is prezent in Tamadau, Perieti and Dor Marunt locations, race 710 is prezent in Tamadau, Peciu Nou, Farcasele and Ianca locations.

The sunflower crop in Romania have been identified in recent years several new races of the pathogen *Plasmopara halstedii*, it developing in a relatively short period about ten years, five new races. New races are present in different areas of southern, western and eastern countries.

Table 2. Results of testing of the sunflower differentials set, for resistance to the pathogen last four location

Differentiators	Izolate			
	Peciu Nou	Farcasele	Perieti	Mihail Kogalniceanu
	Degree of infection (%)			
HAR-304	58.2	64.5	52.7	72.2
RHA-266	52.3	58.8	54.9	52.1
RHA-274	56.9	63.1	24.2	54.2
PMI 3	57.1	56.6	67.6	51.8
PM 17	59.8	0.0	55.8	62.0
803-1	0.0	0.0	0.0	0.0
RHA-340	0.0	0.0	0.0	0.0
HA-335	0.0	0.0	0.0	0.0
DM-2	59.1	52.8	54.0	61.2
HAR-4	0.0	0.0	0.0	0.0
RHA-265	55.1	67.2	61.8	56.2

Table 3. The patotypes of the pathogen *Plasmopara halstedii*, identified in the sunflower crop, in seven locations

Location	1	2	3	4	5	6	7
Downy mildew race	100	300	700	730	310	330	710
Movilita	x	x	x				
Tamadau	x	x	x		x	x	x
Peciu Nou	x	x		x	x		x
Farcasele	x	x					x
Perieti	x	x		x	x	x	
Mihail Kogalniceanu	x	x		x			
Ianca	x	x			x		x
Dor Marunt	x	x		x	x	x	

CONCLUSIONS

The use of hybrids with genetic resistance to new races of *Plasmopara halstedii* developed in Romania.

Using the seed treatment with chemicals (fungicides) that can prevent infection by the fungus *Plasmopara halstedii* developed.

Identifying new sources of resistance and their use in creating new hybrizi resistant to fungus infections.

Monitoring the evolution in time and space developed by fungus *Plasmopara halstedii* races.

To achieve the research is essential establish a differentiator assortment created of inbred lines and hybrids with reaction known to the pathogen, with the participation of private companies and research institutes.

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