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A NEW RACE OF THE FUNGUS PLASMOPARA HELIANTHI Novot. IDENTIFIED IN ROMANIA

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Summary

A new race of Plasmopara helianthi (Fundulea race) was identified in 1975 within the frame of downy mildew testing nursery existing at the Research Institute for Cereals and Industrial Crops of Fundulea. The inbred line AD-66 which contains the gene Pl_1 has become susceptible when inoculated with this new race, while HA-61 as well as other lines carrying the gene Pl_2 show an absolute resistance both to the old European race and to the new race "Fundulea".

The new race of Plasmopara helianthi has not yet spread in sunflower fields, being confined only to the infection nursery. Investigations carried out last three years revealed a quite low expansion rate of this new race, so that the present sunflower hybrids containing the gene Pl_1 can be further grown in commercial fields.

The isolation of the two races in phytotron has permitted the adequate testing of the breeding material and the manipulation of the resistance genes correspondingly.

Introduction

Downy mildew incited by Plasmopara helianthi Novot. is the most harmful disease of sunflowers in Romania, causing substantial yield reduction in favorable years.

Open-pollinated cultivars, both obsolete and with high oil content, are susceptible to Plasmopara, the only possibility to prevent or limit its extension being the phytosanitary measures and an adequate crop rotation. The genetic resistance of the host is therefore the most promising way to control this pathogen.

The first gene conferring resistance to downy mildew in Europe was discovered by Vranceanu (1967,1970) in the Romanian inbred AD-66 and noted with the symbol Pl_1. Soon after Zimmer and Kinman (1971) communicated the presence of a second gene Pl_2 in the genotype of the American line HA-61. They established that Pl_1 does not confer resistance to the American race of Plasmopara (the race Red River), this race being much more aggressive than the European race (Zimmer and Kinman, 1972).

In 1975, we observed the first diseased plants on AD-66 in our downy mildew nursery, a heavy infected field where sunflower has been grown as a monoculture for nine years.

The investigations carried out in this field and in phytotron revealed the presence of a new race of the pathogen, much more virulent than the present European race.

Materials and Methods

Investigations were conducted at Fundulea Research Institute for Cereals and Industrial Crops under controlled environmental conditions in phytotron and in a special testing nursery for downy mildew. The well known differentials AD-66 and HA-61 were used, along with the inbred line S-1358, susceptible both to the European and American race.

Artificial inoculations were performed with spores collected from the diseased leaves of AD-66 and also from various infected commercial fields. The germinated seeds were introduced in a suspension of 10,000-15,000 zoospranges/ml, at 18°C, for 10 hours. The infected seeds were planted in small pots and kept 12 days in phytotron at 20°C.

In order to induce sporulation and facilitate the noting of resistance, the seedlings were kept 24 hours at 18°C and 95% air moisture.

Results and Discussion

The initial proportion of the infected plants within the inbred linie AD-66 was 1.6% in 1965. Next year, in the same testing nursery for resistance to downy mildew, the frequency of the diseased plants within the genotypes carrying the gene Pl_1 increased to 9.8-12.5% (Table 1). In 1977, the attack was more reduced (3.2-4.5%), due to the less favorable natural conditions for the pathogen. In 1978, a slight increase of the frequency of the attack has been noticed again (12.7-14.6%), but still remaining at a much lower level than the natural infection observed on genotypes lacking factors for resistance. The inbred lines HA-61 and RHA-271, which contain the gene Pl_2, proved to be very resistant in all three years.

Supposing that a new virulence of the fungus has appeared we checked the reaction to infection of three differentials, HA-61, AD-66, and S-1358, in phytotron, where very severe and accurate artificial infections were performed using inoculum taken both from the infection nursery and from a neighboring sunflower field (Table 2).

The inoculum prepared from the diseased plants of AD-66 gave rise to an absolute infection on AD-66 (Pl_1 Pl_1) and S-1358, while HA-61 was totally resistant. The inoculum from the susceptible differential S-1358 coming from the infection nursery proved to be a mixture of the two Plasmopara races, with a porportion of the new race of 12.8%. The Pl_1 differential line AD-66 was on the other hand completely resistant when infected with inoculum taken from the diseased plants of the open-pollinated variety Record cultivated nearby, which is a proof that the new race appeared in the infection nursery and has not yet spread outside it.

A careful survey has been established in order to study the expansion of the new race. Starting from 1976, inoculum from the country has been collected

every spring and infections performed in phytotron using a range of differentials. Inoculum is taken both from the neighborhood of the Institute and from different Research Stations placed in the main sunflower zones.

The study of virulence of 8 sources of Plasmopara helianthi (Table 3) confirms the fact that the new race F (Fundulea) has not yet spread in sunflower production fields, being limited to the infection nursery of the Institute.

As for the question whether this race emerged under the local conditions or it was introduced from the North America, the answer is not yet clear. The new virulence could be a consequence of the selection pressure placed upon the pathogen in a heavy infected nursery dominated by resistant genotypes. At the same time, taking into consideration the fact that downy mildew is not only a soilborne but also a seedborne disease, even in a very low population, the probability that the new race could be identical with the North American race Red River is not excluded because of the presence in the infection nursery of certain North American inbreds and hybrids.

Considering the low expansion rate of this race, a new breeding strategy has been adopted, based on the idea of avoiding the erosion of the gene Pl_2 as long as the European race is prevalent in sunflower areas and the gene Pl_1 is still effective. Therefore sunflower hybrids containing the gene Pl_1 can be safely grown in Romania for a quite long period. Isogenic inbred parents are being bred and multiplied, so that, when necessary, the gene Pl_2 will be introduced in the existing commercial hybrids. The isolation of the two races in separate modules in phytotron permits the testing and breeding for both the old and new race of Plasmopara.

Literature Cited

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TABLE 1. Resistance of sunflower genotypes to the attack of Plasmopara helianthi (natural infection in testing nursery, 1976-1978).

Cultivars	Genotypes	Resistance genes	1976 Total analysed Plants	1976 Frequency of the Attack %	1977 Total analysed Plants	1977 Frequency of the Attack %	1978 Total analysed Plants	1978 Frequency of the Attack %
AD-66	Inbred line	Pl_1Pl_1	200	12.3	320	4.5	310	14.6
S-1358	Inbred line	Pl_1Pl_1	182	9.8	280	3.8	220	12.8
S-1358	Inbred line	--	154	94.2	180	68.6	170	97.3
Romsun 52 RM	Single hybrid	Pl_1Pl_1	115	10.4	200	3.2	210	13.8
Romsun 52	Single hybrid	--	124	87.1	190	59.4	180	91.6
Romsun 53 RM	Single hybrid	Pl_1Pl_1	120	10.8	160	3.6	190	12.7
Romsun 53	Single hybrid	--	131	84.7	170	61.0	160	89.4
HA-61	Inbred line	Pl_2	130	0	100	0	90	0
RHA-271	Inbred line	Pl_2	134	0	120	0	80	0
Record	Open-pollinated variety	--	116	60.3	210	48.5	180	75.4

TABLE 2. Frequency of the attack of Plasmopara helianthi on different differentials (artificial infections in phytotron, 1976).

Source of Inoculum	Location	Differentials								
		AD-66 (Pl_1Pl_1)			S-1358 (susceptible check)			HA-61 (Pl_2Pl_2)		
		Analysed Plants	Diseased Plants	Percent	Analysed Plants	Diseased Plants	Percent	Analysed Plants	Diseased Plants	Percent
AD-66 (Pl_1Pl_1)	Infection Nursery	158	158	100	114	114	100	108	0	0
S-1358	Infection Nursery	118	15	12.8	130	130	100	96	0	0
Record	Cap. Margureni	119	0	0	103	103	100	114	0	0

TABLE 3. Reaction of sunflower differentials to the attack of the fungus Plasmopara helianthi collected from different locations (artificial infection in phytotron, 1976-1978)

Source of Inoculum	District	Frequency of the attack*														
		HA-61 (Pl_2Pl_2)			AD-66 (Pl_1Pl_1)			Romsun 53 RM (Pl_1Pl_1)			Romsun 53			S-1358		
		1976	1977	1978	1976	1977	1978	1976	1977	1978	1976	1977	1978	1976	1977	1978
ICCPT-Fundulea (infection nursery)	Ilfov	0	0	0	12.7	4.5	14.6	10.8	3.6	15.2	97.6	96.6	98.2	100.0	98.4	100.0
CAP-Fundulea	Ilfov	0	0	0	0	0	0	0	0	0	95.5	97.2	96.8	99.1	99.8	100.0
CAP-Margureni	Ilfov	0	0	0	0	0	0	0	0	0	96.2	95.8	97.4	98.3	100.0	99.2
SCA-Caracal	Olt	0	0	0	0	0	0	0	0	0	98.1	97.4	99.0	99.5	98.9	99.6
SCA-Marculesti	Ialomitza	0	0	0	0	0	0	0	0	0	93.3	96.2	95.8	98.4	99.0	100.0
SCA-Valul Traian	Constanza	0	0	0	0	0	0	0	0	0	96.4	96.3	97.2	99.4	100.0	100.0
SCA-Braila	Galatzi	0	0	0	0	0	0	0	0	0	95.7	96.0	97.0	98.9	99.4	100.0
SCA-Podu-Iloaiei	Iashi	0	0	0	0	0	0	0	0	0	96.8	97.2	98.7	99.0	98.8	99.5

* The number of the analysed plants varied between 130-150.