

Races of Sunflower Downy Mildew Pathogen (*Plasmopara halstedii*) in Yugoslavia

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Introduction

Plasmopara halstedii (Farl) Berl. de Toni is the causal agent of cultivated sunflower (*Helianthus annuus*) which appears on volunteer plants in commercial fields in Yugoslavia every year. Until 1992, only one race was known and it was race 1. Later, commercial fields in the Vojvodina Province, the main sunflower growing area, were found to be infected by race 4. In 1996, two isolates could be identified as race 3. This is the first occurrence of race 3 in Yugoslavia. All our hybrids had resistance to race 1, but a very small to race 4 and race 3.

In this study, we will report the occurrence of races in Yugoslavia.

Until 1981, two races of *Plasmopara halstedii* were known in the world : race 1 and race 2. In 1981 Carson, and Gulya and Urs (1985) identified races 3 and 4 in USA. Gulya et al. (1991) described two new races (race 6, race 7) and Ljubich et al. (1988) race 5 also in North America. In France, race 4 and race 6 were identified. Mouzeyar et al. (1994) isolated two races which were named race A and race B. Three years later, two races named C and D were isolated in France and they were equal to races 2 and 3 (Roedel-Druvet et al., 1997).

Materials and Methods

Isolates of *P. halstedii* in Yugoslavia were collected in 55 fields throughout the Vojvodina Province in 1996. That year, a lot of fields were heavily affected by this pathogen.

Individual infected sunflower plants with sporulation were collected from different locations and from different hybrids over the last 10 years. Sporangiospores from each plant were used to inoculate mildew suscept IS-003 and 1,-3 (local Yugoslav control) to save and increase the isolates separately before the preservation at low temperatures.

Race Identification

A series of sunflower differentials were inoculated using the method which had been proposed by Gulya et al. (1991). About 100 seedlings of each genotype were inoculated in every test and all tests were repeated at least two or three times. After about 12 to 14 days, when the first true leaves were approximately 2 cm long, the flasks were transferred to a moist chamber. The susceptibility of the seedlings on differentials was determined by the presence of sporulation on the plants. Inoculated seedlings were planted in flasks and grown in a sand perlite mixture (2:3, v/v). The sand was not sterilized. We just used ordinary "concrete sand".

The identification of races was made in series of 12 differential lines in 4 sets of each in the following order :

IS 003, RHA 265, RHA 274

DM2, PM17, 803-1

HAR-4, HAR-5, HA 335

RHA 295, RHA 325, RHA 340

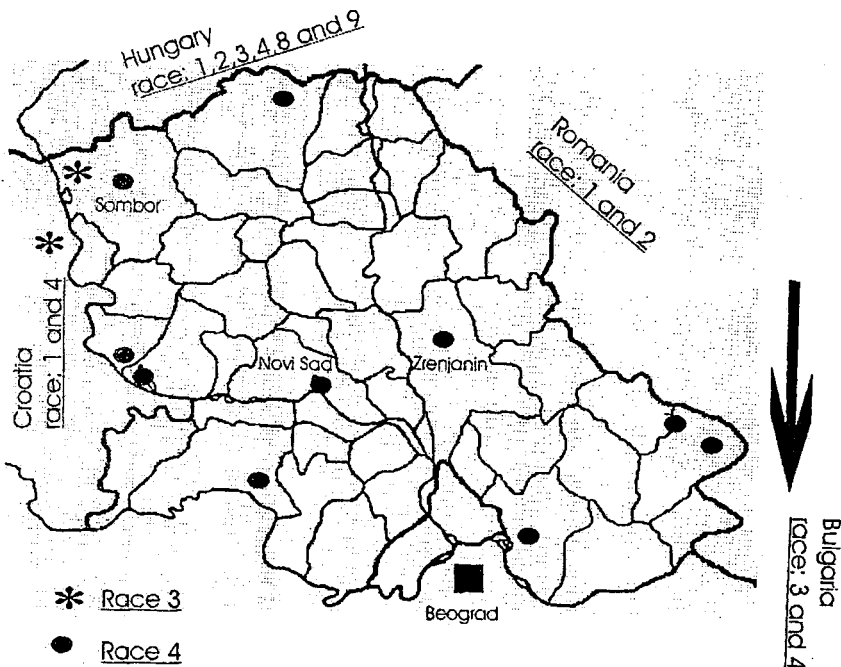
Most isolates were sent to Dr. Thomas Gulya in Fargo, USA, for identification. The same set was also forwarded to Denis Tourvieille in Clermont-Ferrand, France, for the same purpose, but in 80 % alcohol (ethanol) solution for safety reasons. Just to reconfirm the identification of races and to show how the system of inoculation can work somewhere else.

Results

Most isolates collected in Yugoslavia before 1990 were confirmed as race 1. Even one isolate called NS - 2, which showed some more aggressiveness to some genotype isolated in 1989, was race 1.

The samples collected in 1991 (NS 912) were identified as race 4. In that year, about 10 % of all isolates were race 4. Isolates of race 4 from Yugoslavia were much more aggressive than US isolates (Gulya, personal communication). In 1996, this race was present in about 50 % of all isolates. In the same year, race 3 was identified in the locality of Bezdan (30 km from Sombor) from hybrid NS H 26. Also, race 3 was found in the locality of Vukovar. About 20 % of all isolates were race 3. This is the first report of race 3 in Yugoslavia (patterns 7003). The geographical distribution of races 4 and 3 in the Vojvodina Province is given in Fig. 1.

Fig. 1 : Geographical distribution of race 4 and race 3 in Vojvodina Province



Conclusions

We tested a relatively low number of isolates, so we cannot say which races are prevalent in Yugoslavia. However, it is apparent that, like in some other neighboring countries and in Europe, local downy mildew populations in Yugoslavia have been diversified with new races arising indigenously rather than being imported from outside. The mildew race evaluation has been speeded up in Europe and America. Why this is so, we cannot answer this question now because it is not clear to us yet. With the intensification of sunflower production, particularly confectionery types, and with seed export, came the appearance of so many new races in Europe.

In Europe so far eight races (1, 2, 3, 4, 5, 6, 8 and 9) have been reported (Viranyi and Gulya, 1993 ; Spring et al. 1994). So the great diversity is evident in Europe. Race 3 in Europe has been reported in Hungary, France and Bulgaria. So it is not a new race for Europe and it is the fourth report of that race on this continent. Independently of the USA, race 3 has been reported in China (1990) and in Argentina.

Most hybrids are susceptible to race 4 which are now in wide production. So because of that all commercial hybrids seeds are treated with metalaxil rate of 350 g of final products (35 % of metalaxil) on 100 kg of sunflower seed. So far this is the most effective control. Just a few hybrids have a multi-race resistance. One of them is the new hybrid NS-H-444, which is resistant to all known races (Gulya, personal communication).

The rate of metalaxil in the production is high so even the isolates with different levels of metalaxil sensitivity were detected none will tolerate the rates at which seeds are widely commercially treated.

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