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# RESISTANCE OF SUNFLOWER TO DOWNY MILDEW RACES 1, 3 AND 4

Ilona Walcz[1] & F. Virányi [2*]

[1] *Pannon Agricultural University, Research Institute for Forage Crops, Iregszemcse-Bicsérd, and* [2]
*Gödöllő University of Agricultural Sciences, 2103 Gödöllő Páter K.u.1., Hungary*

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SUMMARY

A total of twenty experimental hybrids of sunflower were tested for their resistance to three pathogenic races of *Plasmopara halstedii*. The experiments were conducted in a plastic house where WSI-inoculated seedlings were grown and evaluated for disease reactions twice in a 4-week period. As control, a universal suscept (cv. GK-70) and a few (both compatible and incompatible) differential lines were used to ascertain that the reaction to the races was correct.

All the sunflowers tested under plastic tunnel were resistant to race 1 with only two entries showing some infection. As for race 3 resistance, they varied greatly. Three entries exhibited good resistance (% infection <20), two others were moderately resistant (% infection 20-50), and fifteen showed susceptibility. A similar segregation was found with race 4 resistance where, besides three resistant entries and 11 susceptible ones, there were six hybrids with intermediate reaction (% infection 20-50).

The results obtained suggest that sunflowers with resistance to downy mildew races 3 and 4 are available and may be released soon.

**Key words: Downy mildew, resistance, sunflower.**

## INTRODUCTION

The recent appearance of *Plasmopara halstedii* (DM) races new to Hungary and also to Europe (Virányi & Maširević, 1990; Gulya et al., 1991b) has prompted sunflower breeders to increase their efforts to look for new sources of resistance that might be effective against those new pathogenic forms. In Hungary, six different pathogenic races of the fungus have been identified with races 1, 3 and 4 being predominant (Gulya et al., 1991b; Virányi & Gulya, 1993, 1995). Since sunflower hybrids commercially grown are possessing resistance to

* Corresponding Author.

sonal communication), a research programme has been initiated at the Research Institute for Forage Crops of the Pannon Agricultural University, Iregszemcse-Bicsérd, Hungary, to see if new breeding materials are resistant to the prevalent DM races (race 1 and 2 resistance has long been considered as a substantial criterion for a sunflower cultivar to be registered).

## MATERIALS AND METHODS

The pathogen. *P. halstedii* races 1, 3 and 4 originating from field collections in Hungary were stored deep-frozen at -70°C (Virányi, 1985) prior to testing. After an increase on a susceptible cultivar they were re-checked for virulence performance, fresh inoculi of each were prepared and the spore number adjusted to 20,000-30,000 pro ml.

The host. For resistance tests, twenty experimental hybrids from the sunflower collection of the Research Institute for Forage Crops, designated as H-1 to H-20 in this article, were tested and approximately 40 seeds of each were pregerminated. A universal suscept (cv. GK-70) having no resistance gene against DM, and four differential inbred lines, designated RHA-265, RHA-274, DM-2 and 803-1, were used to check disease reaction.

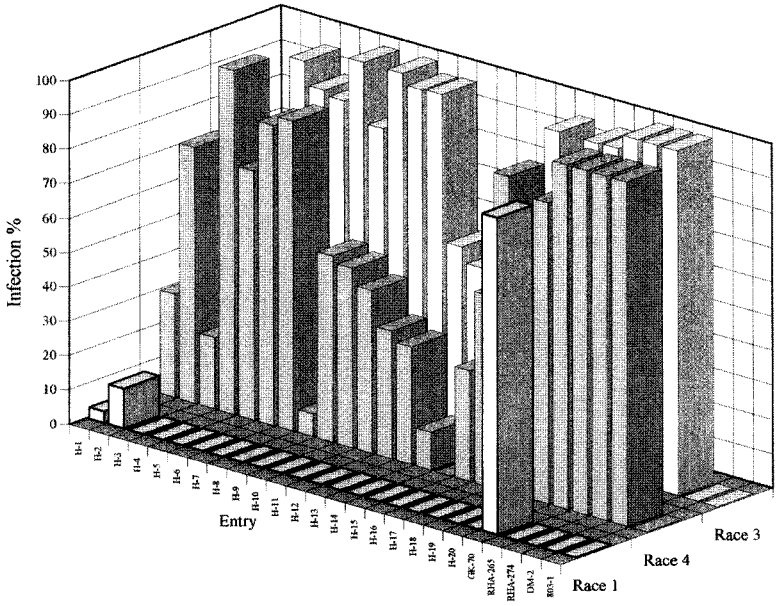


*Figure 1: Susceptibility to Plasmopara halstedii races 1, 3 and 4 of sunflower hybrids 2 weeks after WSI inoculation*

Resistance testing. Inoculation was made by using the whole seedling immersion (WSI) method according to Cohen and Sackston (1973). The seedlings were then planted into nylon bags filled with a horticultural mixture of soil and were grown in a plastic house under normal conditions, the day/night temperature being 24/18±3°C. Disease assessment was carried out as described earlier (Gulya et al., 1991a). The degree of resistance was determined by using a 1-3 scale of percentage infection of plants with values of <20%, 20-50%, and >50%, respectively.

## RESULTS

All the sunflower hybrids tested in the plastic house were resistant to race 1 of DM, with only two showing some infection (3 and 11 percent, respectively)(Table 1). As for resistance to races 3 and 4, however, the hybrids reacted differently (Figure 1). Two weeks after inoculation there were three entries with small or no infection (resistant), some others showed moderate resistance (segregated), and the majority of hybrids were more or less uniformly susceptible.

By the time the second evaluation was made (i.e., four weeks after inoculation), one hybrid, designated as H15, was found to exhibit equally high level of resistance to races 3 and 4. With some other hybrids tested, the number of infected plants has increased over time. For example, hybrids designated as H8 and H14 showed significantly higher disease rate 4 weeks after inoculation with race 4 and with races 3 and 4, respectively.

## DISCUSSION AND CONCLUSIONS

Resistance of sunflower to downy mildew has been recovered as early as in the 1960s and, as a result, successful breeding programmes have been initiated to produce resistant cultivars (cf. Sackston, 1992). However, with the appearance of new pathogenic races, first in the United States then in several European countries (Gulya et al., 1991b), those sunflower hybrids known to carry resistance against DM races 1 and 2 showed significant downy mildew incidence. Intensive breeding work has started again to look for new sources of resistance in order to cope with the altered downy mildew situation. Much success in that work so far has been achieved by Americans who have released a series of USDA public lines, some of which carrying Pl genes effective against a number of known DM races (cf. Sackston, 1992). However, to our best knowledge, just a few hybrids resistant to DM races rather than races 1 and 2 have been released yet. In a research programme, the Research Institute for Forage Crops, Iregszemcse has achieved success in producing new sunflower breeding material. Apart from the resistance in sunflower to race 1 of DM that was uniform among the 20 sunflower hybrids tested, in a few cases resistance to races 3 or 4 also occurred. In

Table 1: Susceptibility to *Plasmopara halstedii* races 1, 3 and 4 of sunflower hybrids 2 weeks after WSI inoculation

| Entry | % infection with race | | |
|---|---|---|---|
| | 1 | 3 | 4 |
| H-1 | 3.3 | 3.7 | 30.0 |
| H-2 | 11.5 | 54.5 | 74.2 |
| H-3 | 0.0 | 43.3 | 20.6 |
| H-4 | 0.0 | 95.5 | 100.0 |
| H-5 | 0.0 | 88.5 | 72.2 |
| H-6 | 0.0 | 87.1 | 87.2 |
| H-7 | 0.0 | 100.0 | 90.0 |
| H-8 | 0.0 | 82.1 | 6.7 |
| H-9 | 0.0 | 100.0 | 54.3 |
| H-10 | 0.0 | 96.8 | 52.4 |
| H-11 | 0.0 | 97.1 | 47.4 |
| H-12 | 0.0 | 54.5 | 37.2 |
| H-13 | 0.0 | 50.0 | 34.2 |
| H-14 | 0.0 | 20.0 | 11.1 |
| H-15 | 0.0 | 0.0 | 0.0 |
| H-16 | 0.0 | 62.5 | 32.1 |
| H-17 | 0.0 | 95.7 | 55.6 |
| H-18 | 0.0 | 84.6 | 91.7 |
| H-19 | 0.0 | 95.5 | 65.8 |
| H-20 | 0.0 | 95.8 | 87.5 |
| GK-70 | 92.3 | 100.0 | 100.0 |
| RHA-265 | 0.0 | 100.0 | 100.0 |
| RHA-274 | 0.0 | 100.0 | 100.0 |
| DM-2 | 0.0 | 0.0 | 100.0 |
| 803-1 | 0.0 | 0.0 | 0.0 |

addition, one particular entry, designated H15, showed resistance to both races 3 and 4. Unfortunately, except for H15, there was no correlation found between reactions to either race 3 or race 4. The increase in time of infection observed with some of the sunflower entries is quite interesting and suggests that different (qualitative and quantitative) type of resistance mechanisms may co-exist in this pathosystem.

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## RESISTENCIA DEL GIRASOL A LAS RAZAS 1, 3 Y 4 DE MILDIU

RESUMEN

Un total de 20 híbridos experimentales de girasol fueron evaluados para resistencia a tres razas patogénicas de *Plasmopara halstedii* (PH). Los experimentos fueron llevados a cabo en invernadero de plástico donde las plantas inoculadas fueron crecidas y evaluadas para reacción a la enfermedad dos veces en un periodo de 4 semanas. Como control fueron usadas un susceptible universal (cv. GK-70) y unas pocas líneas diferenciales (tanto compatibles como incompatibles) para comprobar que reacción a las razas fue la correcta.

Todos los girasoles evaluados bajo el túnel de plástico fueron resistentes a la raza 1 con solo dos entradas mostrando alguna infección. Al igual que para raza 3, variaron grandemente. Tres entradas mostraron buena resistencia (% infección<20), otras dos fueron moderadamente resistentes (% infección 20-50) y quince mostraron susceptibilidad. Una situación similar se encontró para resistencia a la raza 4 donde además de las tres entradas resistentes y 11 susceptibles, hubo seis con reacción intermedia (% infección 20-50).

Los resultados obtenidos sugieren que los girasoles con resistencia a las razas 3 y 4 de PH están disponibles y pueden ser liberados pronto.

## RESISTANCE DU TOURNESOL AUX RACES 1, 3 ET 4 DE MILDIOU

RÉSUMÉ

Au total de vingt hybrides expérimentaux ont été testés pour leur résistance à trois races pathogènes de *Plasmopara halstedii* (PH). Les expérimentations ont été conduites sous serre plastique dans laquelle les plantules WS1 inoculées se sont développées et ont été évaluées pour la réponse à la maladie deux fois en 4 semaines. Comme témoins, un matériel sensible (cv. GK-70) et quelques lignées différentielles (compatibles ou incomptatibles) ont été utilisées pour s'assurer que la réponse des races était correcte.

La totalité des tournesols testés sous tunnel plastic étaient résistants à la race 1, seulement deux numéros ont montré des symptômes. Beaucoup de variation a été notée vis à vis de race 3. Trois numéros ont montré une bonne résistance (% d'infection<20), deux autres ont été modérément résistants (% d'infection: 20-50), et 15 se sont révélées sensibles. Un schéma similaire a été observé pour la résistance à la race 4, où à côté de trois numéros résistants et 11 sensibles, on en a trouvé six avec des réponses intermédiaires (% d'infection compris entre 20 et 50).

Les résultats obtenus suggesrent que des tournesol possédant la résistance aux racè de mildiou 3 et 4 sont disponibles et pourraient être bientôt distribués.