

## SCREENING SUNFLOWER AGAINST SCLEROTINIA WILT

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### SUMMARY

Comparison of artificial and natural basal stem rot infection tests showed significant correlations between the two traits, indicating that the toothpick method is suitable for developing genotype resistance. Since the results of the tests are reliable, the expression of inbred resistance in hybrids could also be followed. In the case of the material tested, no correlation could be found between inbred and hybrid reaction. Further research will be needed to find causes and develop new inbreds which transfer their resistance to the hybrids.

**Key words:** sunflower, *Sclerotinia sclerotiorum*, basal stem rot, resistance, tolerance.

### INTRODUCTION

*Sclerotinia sclerotiorum* Lib. de Bary is one of the most important pathogens of sunflower in Hungary. Among its infection forms the basal stem rot is the most prominent one. Therefore, a breeding program for resistance against this form of the disease was indispensable.

The sclerotia germinate in the soil with infecting mycelium attacking the roots of the plant, and cause wilting (Adams and Tate 1976). Therefore, the number of sclerotia and their position in respect to the germinating seedling influences and strongly determines the infection severity developing later in the stand (Huang and Hoes, 1980). Differences in susceptibility were reported first by Putt (1958). Since that time many attempts have been made to identify differences in resistance of tolerance, but mainly the most sensitive genotypes could be discarded. A stable source of resistance has not been found yet (Hoes and Huang, 1976; Vear and Tourvielle, 1984; Grauert, 1979; Pirvu et al., 1985).

In this paper we develop further the work presented earlier (Mesterházy and Gulyás, 1988) indicating the possibilities of a more reliable estimation of resistance and giving access to data about the inheritance of resistance to the disease.

### MATERIALS AND METHODS

Isolates were prepared from flame sterilized sclerotia from different locations in the country and propagated on liquid Czapek-Dox medium by means of bubble breeding method of Mesterházy (1983). When the pathogenicity was acceptable, the suspension was poured over toothpicks. It was kept on them for about one hour, after which it was removed for 1 cm thick suspension on the bottom of the Erlenmeyer flasks. In three days the mycelium covered the toothpicks and was ready for inoculation (Mesterházy and Gulyás, 1988).

Inoculation was made at soil level in the developmental stage R2, when a hole was made on the stalk base and a toothpick inserted. In the case of most pathogenic isolates the wilting occurred in 3-5 days after inoculation, when the genotype was susceptible. Beside wilting, the percentage of infected plants was also calculated.

Table 1. Susceptibility of genotypes to Sclerotinia wilt

Code	a.)	b.)	c.)	d.)
	Natural	Infection	Artificial	Overinfection
	1988 (%)	1989 (%)	1988 (%)	1988 (%)
1. Gms-1	11.4	7.14	31.34	60
2. Cms-1	10.45	17.81	44.84	80
3. Cms-2	18.91	1.39	24.73	81.1
4. Cms-3	7.98	6.94	4.52	25
Mean of mothers	12.19	8.32	26.36	61.53
5. R-1	9.87	5.47	21.59	45
6. R-2	16.8	11.9	24.83	66.7
7. R-3	17.3	10.47	38.75	56.5
8. R-4	18.74	7.37	42.95	85.4
9. R-5	8.62	14.53	21.25	30
10. R-6	22.59	5.63	14.81	23.5
11. R-7	13.19	2.82	15.75	57.1
Mean of restorers	15.26	8.31	25.69	52.03
12. Gms-1xR-1	27.87	17.2	66.73	86.6
13. Cms-1xR-1	32.4	7.41	63.3	86.8
14. Cms-1xR-3	48.26	16.42	73.07	96.2
15. Cms-1xR-4	32.76	17.86	26.98	88.8
16. Cms-1xR-5	36.67	25.35	33.4	79.1
17. Cms-1xR-8	36.64	29.33	46.22	84.3
18. Cms-2xR-1	19.3	19.58	47.54	97.7
19. Cms-2xR-2	32.88	15.87	36.79	94.7
20. Cms-2xR-3	41.85	22.61	65.59	76.7
21. Cms-2xR-4	39.76	9.6	30.87	46.6
22. Cms-2xR-7	29.89	21.05	33.98	68.4
Mean of hybrids	34.39	18.37	47.66	82.35
Mean of trials	24.27	13.35	36.79	68.92
L.S.D. 5%	22.86	15.3	21.64	17.2

The sunflower genotypes were sown at spaces 70 x 20 cm, one plot consisting of 5 rows, of which 1 served as control, and the other four for artificial inoculation by four different isolates. Three plot replications were included in the test. Because of the sunflower monoculture, the natural infection of the soil was high. In the next test the spacing and design was the same, but in the case of the 2 most pathogenic isolates only every second plant was inoculated to gain data about the spreading of infection through the root system. In 1989 and 1990 we could compare the level of natural infection with the artificial inoculation data from the earlier years.

Visible symptoms were evaluated every second week; the highest numbers will be presented here. Also, yielding ability was measured and related to the control. Before harvest, head diameter was measured to gain data for comparison of the levels of tolerance. The results were evaluated by variance and correlation analyses.

RESULTS

The artificial and natural infection data for basal stem rot are presented in Table 1. For natural infection the mothers and restorers have about the same value, but the hybrids are much more sensitive. This is valid also for the inoculation data. There is, however, a variability within each group, but the hybrids have the lowest variability.

The superior susceptibility of the hybrids is also similar to that found before. Since the hybrids are produced from the lines tested, the inheritance of resistance can be followed.

Table 2. Correlation between columns of Table 1.

	a	b	c	d
a	1	0.538 <sup>++</sup>	0.616 <sup>++</sup>	0.512 <sup>+</sup>
b		1	0.468 <sup>+</sup>	0.467 <sup>+</sup>
c			1	0.715 <sup>+++</sup>
d				1

L.S.D.                    5%: +  
                               1%: ++  
                               0.1%: +++

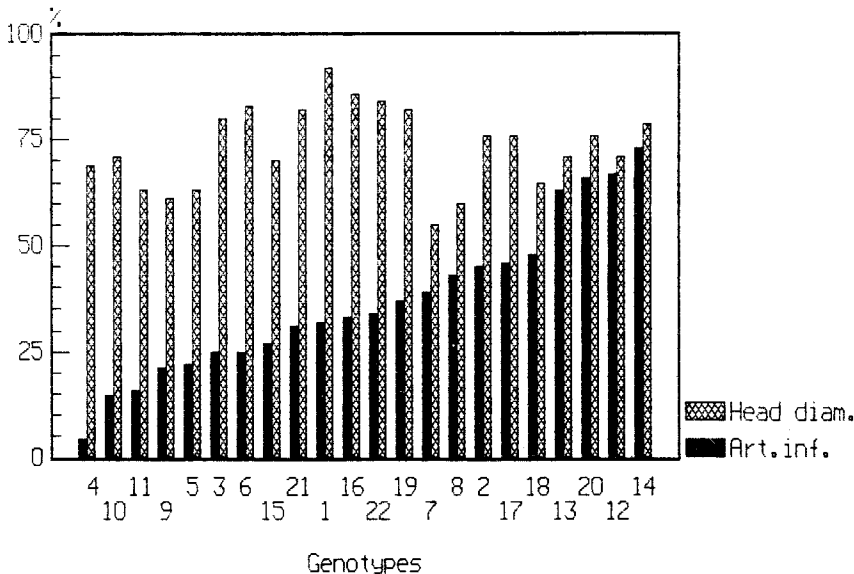


Figure 1. Comparison of head diameter and resistance level

The mother lines cms-1 and cms-2 differed significantly in the inoculation tests, but the hybrids with these lines did not show differences. The opposite case was observed with restorers R3 and R4 having similar per se performance, but significantly differing hybrids, those with R4 being the best.

In the column 4 the infection percentages are listed for the test, where only every second plant has been inoculated, and the overinfection for the non-inoculated plants was observed. The data indicate a strong spreading of the fungus through the root system. The overinfection was lowest in the most resistant genotypes (cms-3, R-5, R-6).

In Table 2 the correlation coefficients for the data of Table 1 are shown. All relationships are significant, e.g., the artificial inoculation tests give an insight in the resistance expression of sunflower against *S. sclerotiorum* also under natural conditions. The overinfection from diseased plants to the non-inoculated shows a similar picture, the order of resistance being similar.

Also, head diameter (as a percentage related to the non-inoculated control) and resistance levels were compared (Figure 1). The low infection severity does not always mean lower losses. We consider tolerance in genotypes, where the infection severities are similar, but head diameters are highly different. Here the infection severity will be followed by a higher head diameter.

## CONCLUSIONS

In spite of the fact that artificial inoculation methods may neglect forms of resistance being active under natural conditions, we received a good agreement between natural and artificial infection data. This means that the decisive factor of resistance is the physiologic one, other factors are seemingly of secondary importance. As the tests were made under dry conditions, we hope that under irrigation the resistance results will be even more expressed, as it would be possible to differentiate the reaction from water stress.

The overinfection through root system allows an insight in the mechanism of spreading of the fungus in the soil. It seems to be the major factor of epidemic and explains the spreading of infection in stands. This susceptibility correlates with the stalk base infection, that intensity of spreading will be shown also by the head diameter of plants overinoculated by the root system. Where this process was very rapid and intensive, the head diameter remained small, while in the other cases they could come closer to the control.

The literature sources are also confusing in the evaluation of inheritance. The results support this picture, since no correlation was found between inbred and hybrid reaction. Even the best lines produce susceptible or very susceptible hybrids. We think therefore that the type of resistance working in inbreds is to such an extent specific that it works only in the inbred. We suppose also that some morphological traits may be responsible for this. The lines have different growing type, as compared with the hybrids, this may also be an explanation.

The most important question is now to find resistance factors, being active in both inbreds and hybrids, and to specify them. This work is mostly finished, but the methods developed and the high variability of plant material in the nursery enabled us to develop materials with higher resistance.

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EVALUACION DE GIRASOL CONTRA LA PODREDUMBRE CAUSADA POR *Sclerotinia*

## RESUMEN

Los ensayos de comparación de infecciones artificiales y naturales de podredumbre de la base del tallo mostraron correlaciones significativas entre ambos métodos, indicando que el método del mondadientes es válido para el desarrollo de resistencia genotípica. Dado que los resultados de los ensayos son fiables, también podría deducirse la expresión de resistencia de líneas en los híbridos. En el material ensayado no pudo encontrarse correlación entre las reacciones de líneas puras e híbridos. Se necesitará más investigación para encontrar las causas y desarrollar nuevas líneas que transfieran su resistencia a los híbridos.

SCREENING DU TOURNESOL À *Sclerotinia Sclerotiorum*

## RÉSUMÉ:

La comparaison de tests d'infection artificielle et naturelle de la tige montre une corrélation significative entre ces deux caractères, indiquant que la méthode du cure dent est souhaitable pour la création de génotypes résistants. Dès que la fiabilité des tests sera déterminée, l'expression d'une résistance inbred chez les hybrides pourra être suivie. Dans le cas du matériel que nous avons testé, aucune corrélation n'a pu être trouvée entre la réaction des lignées et des hybrides. Des recherches ultérieures sont nécessaires pour en définir la cause et développer de nouvelles lignées inbred et transférer leur résistance aux hybrides.