GENETIC VARIABILITY OF SUNFLOWER REACTION TO THE ATTACK OF *PHOMOPSIS HELIANTHI* MUNT.-CVET. *ET AL.*

A. V. VRÂNCEANU [1], **N. CSÉP** [2], **N. PÎRVU** [1], and **F. M. STOENESCU** [1]
(Romania)

Stem canker caused by *Diaporthe helianthi* Munt.-Cvet. et al. *(Phomopsis helianthi* Munt.-Cvet. et al.) reported firstly by Mihaljčević et al. (1980) and Muntañola-Cvetković et al. (1981), has become one of the most important diseases of sunflower in the western part of Romania, where the meteorological conditions were very favourable for the disease outbreak in 1981—1982. A similar situation was encountered in the neighbour regions of Yugoslavia and Hungary (Ačimović and Štraser, 1981).

In order to know the genetic response of sunflower breeding material to the attack of this new parasite, a special testing nursery was organized in one of the most naturally infected area from the western plain of Romania, and the preliminary results are presented in this paper.

MATERIALS AND METHODS

The screening tests were organized at the Agricultural Research Station of Oradea, in the period of 1981—1983.

The influence of genotypes and years on the degree of *Phomopsis* infection was evaluated using the observations recorded in a two-year block design trial with 3 replications, comprising 20 single and three-way hybrids developed at the Research Institute for Cereals and Industrial Crops of Fundulea. Beside this trial, a large collection of 150 hybrids and 50 parental inbred lines was also tested in three replications, with 66 plants per plot and a plant population of 40,800 plants per hectare.

The intensity of infection was evaluated on the scale from 0 to 4 and the mean value of the intensity of infection occurrence on the diseased plants was calculated by McKinney's formula (Ačimović, 1979). The extent of damage or the infection degree was calculated by the formula $\frac{F \times I}{100}$, in which F=frequency of infected plants (%) and I=intensity of infection (%).

RESULTS AND DISCUSSION

Data presented in Table 1 revealed a different response of sunflower hybrids to the attack of this new pathogen. A clear cut resis-

Table 1

The reaction of 20 sunflower perspective hybrids to the attack of *Phomopsis helianthi* (Oradea, 1981—1982)

Hybrids	1981			1982			Two-year mean of infection degree (%)
	frequency of infected plants (F %)	intensity of infection (I %)	infection degree $\left(\frac{F \times I}{100}\right)$	frequency of infected plants (F %)	intensity of infection (I %)	infection degree $\left(\frac{F \times I}{100}\right)$	
HS-44 (FELIX)	50.0	8.0	4.0	50.2	10.0	5.0	4.5
HS-40	40.2	12.0	4.8	42.3	10.0	4.2	4.5
HS-130 (SELECT)	25.4	18.0	4.6	65.1	16.0	10.4	7.5
HS-42	33.0	20.3	6.7	64.2	25.0	16.0	11.4
HS-99	55.2	22.5	12.4	64.2	24.5	15.7	14.0
HS-824	51.4	26.4	13.5	62.3	28.2	17.7	15.6
HS-110	44.2	28.2	12.5	75.0	26.4	19.8	16.1
HS-17	36.0	28.2	10.2	76.0	32.5	24.7	17.5
HS-134	56.3	26.6	15.0	76.3	26.4	20.1	17.6
HS-131	69.1	26.0	18.0	61.0	28.0	17.1	17.6
HS-109	61.2	26.0	15.9	74.2	28.3	21.0	18.6
HS-135	45.6	42.5	19.4	51.2	40.5	20.7	20.1
HT-654	50.3	36.5	18.3	76.0	34.5	26.2	22.3
HS-25	69.2	30.5	21.1	83.1	28.5	23.6	22.4
HS-19	61.4	32.0	19.6	90.0	30.5	27.4	23.5
HS-85	69.2	35.0	24.2	81.2	32.2	26.1	25.2
HT-73	57.3	36.5	20.7	90.0	34.5	31.0	25.8
HS-70	64.0	42.5	27.1	83.0	46.3	38.4	32.8
SOREM -82	69.5	46.0	32.0	92.0	42.2	38.8	35.4
HS-88	65.4	52.5	34.3	90.0	48.4	43.6	39.0

[1] Research Institute for Cereals and Industrial Crops, 8264 Fundulea, Romania.
[2] Agricultural Research Station, Oradea, Romania.

tance was found at the single hybrids HS-44, HS-40 and HS-130, with means of the infection degree of 4.5%, 4.5% and 7.5% respectively, while a high infection degree of 39.0% was noted at the most susceptible hybrid.

The single hybrids HS-44 and HS-130 were licensed in 1982 and 1983 respectively under the names of Felix and Select, and presently they are cultivated mostly in the western regions of Romania, not only because of their resistance to stem canker, but also due to their high yielding capacity and very high oil content (54—55%).

The analysis of variance for the data regarding the degree of infection recorded in the biennial trial 1981—1982 expressed very significant effects of genotypes and years and of their interaction (Table 2). The mean square value for genotypes was much higher than the others, suggesting thus the possibility to select successfully for resistance to stem canker. Years influenced significantly the infection degree, but at the same time hybrids reacted quite differently from year to year.

Table 2

Analysis of variance for the infection degree (*Phomopsis helianthi*) of 20 sunflower perspective hybrids (Oradea, 1981—1982)

Source of variation *	Degrees of freedom	Mean square
Replications	2	2.05
Genotypes	19	273.14**
Years	1	81.42**
Genotipes × Replications	39	1.33
Genotypes × Years	19	18.45**
Error	42	5.33

* Only sources of variation required for the present discussion are given.

** Significant at the level of 1%.

The results represented graphically in Figure 1 point out that the most part of hybrids and inbred lines tested in 1983 showed a satisfactory resistance, presenting a medium infection degree of 11—30%. Of a special importance are the genotypes included in the first class (0—10% infection degree).

In comparison with Sorem 82, which is one of the most spread sunflower hybrid in Romania, some of the newest hybrids obtained at Fundulea manifested a good genetic resistance, even superior to the resistance of the previous hybrids Felix and Select (Table 3). Data from Table 4 show that some of the inbred lines from the Fundulea Institute's collection could be used successfully in the breeding programmes for developing new hybrids, synthetic varieties or source-populations with improved resistance to the attack of *Phomopsis helianthi*.

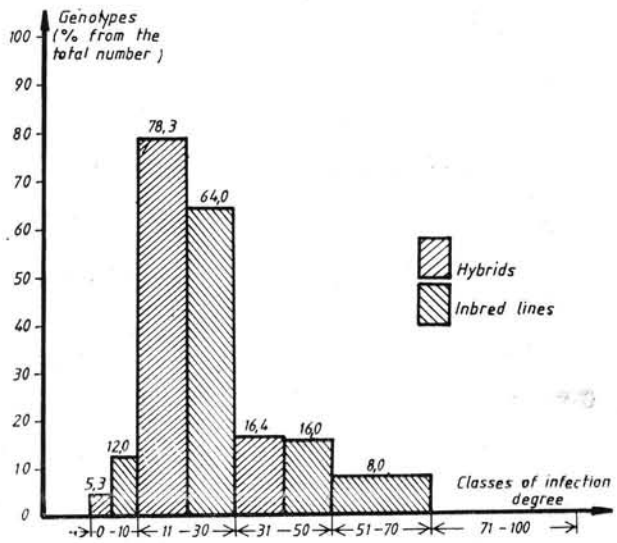

Fig. 1 — The groupement of 150 sunflower hybrids and 50 inbred lines according to their response to the attack of *Phomopsis helianthi* (Oradea, 1983)

Table 3

The reaction of 6 sunflower experimental hibrids to the attack of *Phomopsis helianthi* (Oradea, 1983)

Hybrids	Frequency of infected plants (F %)	Intensity of infection (I %)	Infection degree $\left(\frac{F \times I}{100}\right)$
H-5-10-83	8.6	25.2	2.2
H-5-9-83	10.5	25.3	2.6
HI-82-950	12.4	25.2	3.1
HI-82-941	12.5	25.4	3.2
H-5-12-83	21.5	25.1	5.4
HI-82-907	20.3	30.7	6.2
FELIX	23.0	30.5	7.0
SELECT	32.0	30.0	9.6
SOREM 82 (Check)	82.1	70.1	57.5

Table 4

The reaction of 6 sunflower inbred lines to the attack of *Phomopsis helianthi* (Oradea, 1983)

Inbred lines	Generation	Frequency of infected plants (F %)	Intensity of infection (I %)	Infection degree $\left(\frac{F \times I}{100}\right)$
VZ-11189	I_{12}	12.6	23.1	2.9
O-13705	I_8	12.6	24.4	3.1
ADV-946	I_{12}	16.5	25.3	4.2
H-13088	I_8	20.2	25.1	5.1
A-1566	I_{10}	28.2	30.5	8.6
A-6181	I_{10}	30.6	30.2	9.2
SOREM 82 (Check)	F_1	82.1	70.1	57.5

The preliminary observations available so far indicate a small number of genes involved in the genetic control of resistance to *Phomopsis* attack and their partial dominance, so that selection pressure for this character shoul be applied to both parental forms, in order to obtain the highest resistance in F_1 hybrids. Also, it seems that the phenotypical expression of resistance is associated with the "stay green" character of sunflower stems.

CONCLUSIONS

The existence of an important genetic variability with respect to the host reaction to the attack of *Phomopsis helianthi* allows to foresee the possibility to control successfully the expansion of this new and harmful disease of sunflowers by genetic means. Although this resistance seems to be of a general or horizontal type, it would be much easier to handle it in comparison with the same type of sunflower resistance to white and gray rots incited by the fungi *Sclerotinia sclerotiorum* and *Botrytis cinerea,* primarily because the genetic factors for resistance to stem canker have been identified in the cultivated sunflower germplasm.

The character "stay green" stem, to which the resistance to *Phomopsis helianthi* is associated, could play a positive role in the physiology of seed and oil yield formation, but at the same time it is supposed to make more difficult the seed cleaning during and after sunflower harvesting, due to the remaining stem debris with higher moisture in the mass of seeds.

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LA VARIABILITÉ GÉNÉTIQUE DE LA RÉACTION DU TOURNESOL À L'ATTAQUE DE *PHOMOPSIS HELIANTHI*

Résumé

La maladie des taches brunes des tiges causée par *Phomopsis helianthi* est depuis quelques années l'une des plus dangereuses maladies du tournesol en Roumanie.

Les déterminations effectuées en conditions de forte infection naturelle ont révélé une variabilité génétique importante des lignées autofécondées et des hybrides essayés pour la réaction vis-à-vis de l'attaque de cet agent. A coté des effets du facteur génétique on a aussi remarqué l'influence des conditions climatiques annuelles, ainsi que l'interaction significative entre les génotypes et l'année.

L'hybride Felix créé à l'Instiut de Recherches pour Céréales et Plantes Industrielles-Fundulea et introduit en culture en 1983 a manifesté la meilleure résistance par rapport aux autres hybrides commerciaux de tournesol de provenance locale ou étrangère.

Les essais conduits avec un grand nombre d'hybrides et de lignées autofécondées obtenues à Fundulea ont mis en évidence l'existence d'une résistance satisfaisante dans le cadre de la germoplasme actuelle, ce qui permet d'entrevoir de nouveaux progrès dans l'amélioration génétique de la résistance du tournesol à l'attaque causé par *Phomopsis helianthi.*

LA VARIABILIDAD GENÉTICA DE LA REACCIÓN DEL GIRASOL AL ATAQUE DEL HONGO *PHOMOPSIS HELIANTHI*

Resúmen

El manchado bruno de los tallos producido por el hongo *Phomopsis helianthi* ha llegado ha ser en los últimos años una de las más peligrosas enfermedades del girasol en Rumanía.

En las determinaciones efectuadas en condiciones de grave infección natural, se notó una importante variabilidad genética de las líneas consanguinizadas y de los híbridos testados en cuanto a la reacción al ataque de este patógeno. A parte de los efectos del factor genético, se destacó también la influencia de las condiciones climáticas anuales, así como la interacción significativa entre genotipos y años.

El híbrido Félix, creado en el Instituto de investigaciones de cereales y plantas téchnicas de Fundulea, e intoducido en la producción en el año 1983, manifestó mejor resistencia en comparación con los demás híbridos comerciales de girasol, de proveniencia autóctona o extrangera.

Después de testar una gran variedad de híbridos y líneas consanguinizadas a Fundulea se puso de relieve la existencia de una gran resistencia satisfactoria dentro del germoplasma existente, cual permite entreverse nuevos progresos en el mejoramiento genético de la resistencia del girasol al ataque producido por el hongo *Phomopsis helianthi.*