SUNFLOWER GENETIC RESISTANCE TO PHOMOPSIS HELIANTHI ATTACK

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SUMMARY

Stem canker induced by Diaporte helianthi Munt.Čvet.et al. (Phomopsis helianthi Munt. Čvet.et al.) reported for the first time in Romania in 1981, was identified in 1984 in all sunflower cropping zones of the country. Investigations conducted at Fundulea since 1988, concerning the behaviour of sunflower hybrids, and studies on heredity of resistance carried out by diallel crosses have revealed the phenomenon of partial dominance and prevailing additivity of resistance.

The heavy natural infection in 1991 at Fundulea and the experimental design suitable for the genetic control of quantitative characters permitted to appreciate the number of genes involved and to estimate the parameters of genetic variance in the frame of the analysed system.

INTRODUCTION

Since 1984 the stem canker induced by Diaporte helianthi Munt.Čvet.et al. (Phomopsis heliantni Munt.Čvet.et al.) has been the most damaging disease of sunflower crop in Romania. When the metheorological conditions during the vegetation period of sunflower become favourable for disease development the damages produced are considerable reducing seed yield and oil content.

As shown in a previous paper (VRANCEANU et al.,1990), the studies on heredity of resistance to Phomopsis helianthi carried out by diallel crosses among 7 inbred lines and with F_1 hybrids revealed the phenomenon of partial dominance and prevailing additivity of resistance. In that case the coefficient of regression had values not significantly different from 1, thus demonstrating the absence of non-allelic interactions. The results of the genetic analysis folowing JINKS and HAYMAN (1953), JINKS (1954) and HAYMAN (1954) model should be taken into consideration only in the frame of the analysed system and under the particular environmental conditions of the year.

MATERIAL AND METHODS

After 1988, 1991 was a very favourable year for the development of natural infections with Phomopsis helianthi. In such a situation we had the opportunity to check the reaction of sunflower genotypes against this pathogen. The experimental design was the diallel crosses and the genetic analysis was made following the model of JINKS (1954) and HAYMAN (1954). This method comports the graphic analysis of variance (Vr) and covariance (Wr), and the estimation of components of genetic variance D, H_1 H_2, F and h^2.

The experiment included two diallel systems: the first group was composed of 10 sunflower inbred lines, usually utilized as females of commercial hybrids produced on cytoplasmic male sterility basis. The crosses were made using the maintainers of A lines. The second group was composed of 10 sunflower inbred lines, usually utilized as males of commercial hybrids, these lines containing Rf genes. The diallel crosses of both groups were performed in 1990. In 1991, the 45 hybrids issued of each group, the inbred lines utilized as parents as well as some of the F_1 hybrids having as females the cms lines (first group) and as males the Rf lines (second group) were tested in a randomized bloks design.

First group			Second group		
1. LC 1004 A	6. LC 998 A		11.LC 1083 C	16.LC 1081 C	
2. LC 1020 A	7. LC 1010 A		12.LC 1066 C	17.LC 1053 C	
3. LC 1048 A	8. LC 997 A		13.LC 1064 C	18.LC 1090 C	
4. LC 1050 A	9. LC 1003 A		14.LC 1054 C	19.LC 1091 C	
5. LC 1049 A	10. LC 996 A		15.LC 1059 C	20.LC 1075 C	

The weather conditions of 1991 were favourable for natural infection with the pathogen, resulting in a high percentage of lodged plants. The susceptibility and the resistance of the genotypes were noted using a scale from 1 to 5: 1-very susceptible, 2-susceptible, 3-midle resitant, 4- resistant, 5-very resistant.

RESULTS

In the first group of 10 inbred lines (graph 1) used as females in commercial hybrids, the lines with the highest number of favourable alleles for resistance were numbers 1 (LC 1004 A) and 2 (LC 1020 A). These two inbred lines were situated on the graph no.1 close to the intersection of the axes Vr and Wr. The lines with the lowest number of favourable alleles (susceptible to Phomopsis) were no 9 and 10,the other genotypes having an intermediate reaction. The coefficient of regression (b) had values not significantly

different from 1, demonstrating the validity of the additive-dominant model and the absence of non-allelic interactions.

These findings permitted to continue the analysis and to estimate the components of genetic variance (Table 1).

Table 1

Genetic variance components value for resistance to Phomopsis helianthi - Fundulea 1991

Parameters and ratio between genetic parameters	Values
D	252,66 ± 4,49
H_1	104,23 ± 12,33
H_2	107,30 ± 4,92
F	0,46 ± 11,30
h^2	351,50 ± 7,43
E	4,38 ± 1,93
$(H_1/D)^2$	0,64
VILI/WOLOI	0,71
$\frac{(4\ DH_1)^{\frac{1}{2}} + F}{(4\ DH_1)^{\frac{1}{2}} - F}$	1
$H_2/3\ H_1$	0,25
h^2/H_1	3,18
h^2	0,12

The rather high and significant value of D confirmed the additivity of the genes for Phomopsis resistance.

The effects of dominance expressed by the parameters H_1, H_2 and h^2 were high and significative, but smaller than D, indicating the importance of dominance in the heredity of resistance. The values $(H_1/D)^{\frac{1}{2}}$ and VILI/WOLOI indicate the partial dominance. $(4\ DH_1)^{\frac{1}{2}} + F$ divided by $(4\ DH)^{\frac{1}{2}} - F$, representing the total number of dominant genes against the recessives ones to all the parents, shows the equal share of the genes among the parents. Three genes or gene groups are supposed to control the resistance to Phomopsis attack.

For the second group (graph 2) of 10 inbred lines utilized as males (Rf) in commercial hybrids, the graph analysis of variance (Vr) and covariance (Wr) showed the nonallelic interactions (b had values significantly different from 1) demonstrating the nonvalidi of the additive dominant model, so that the analysis could not be continued. In any case, the highest resistance among the studied line showed no 11, 12 and 15.

DISCUSSION

The genetic analysis of resistance to Phomopsis helianthi showed that in a system of diallel crosses utilizing inbred lines wich usually are females (cms) in commercial hybrids, the partial dominance could be utilized to transfer the resistance in F_1 hybrids In the frame of 10 inbred lines analysed we found three genes or gene groups involved in resistance, which is valid only for this system and under the mentioned environmental conditions. In any case, there are a few genes (3-7) wich could transmit the resistance to the hybrids.

In the frame of 10 Rf inbred lines, the nonallelic interactions made unadequate the JINKS and HAYMAN analysis model.

The partial dominance is confirmed by the F_1 hybrids having as females some of the cms lines (first group) and as males the Rf lines (second group).

For instance the hybrid 1 x 13 is the very known Roumanian hybrid SELECT which is Phomopsis resistant. The present study confirmed the first assertion made by VRANCEANU et al. (1985) that the "stay green" character is associated with the resistance to Phomopsis helianthi, because all hybrids involving LC 1 and LC 2 have a "stay green" colour of the stem at maturity.

CONCLUSIONS

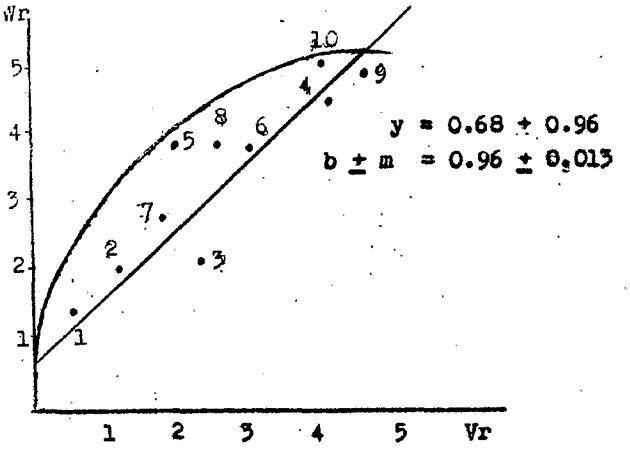
1. Studies on heredity of resistance to Phomopsis helianthi carried out by diallel crosses in sets of 10 inbred lines and with F_1 hybrids revealed the phenomenon of partial dominance and prevailing additivity of resistance.

2. In the first set of 10 inbred lines used as females (cms) in commercial hybrids the model additive-dominant was suitable, were not nonallelic interactions, fact which permitted to estimate the components of genetic variance. In the analysed system there are three genes or gene groups involved in resistance. This analysis was a particular case, but anyway there is a small number of genes or gene groups which controls the resistance.

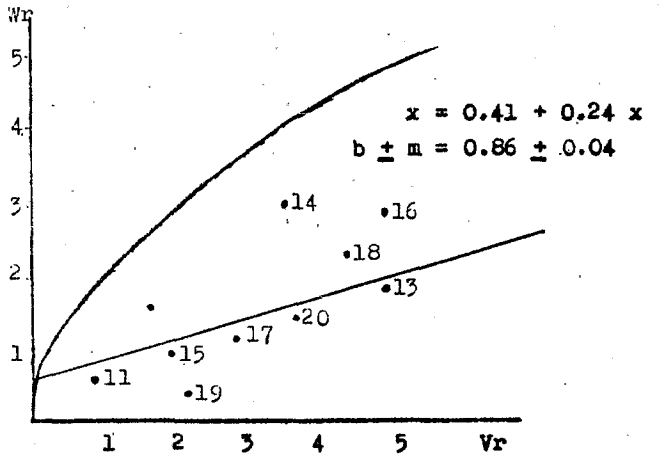
3. In the second set of 10 inbred Rf lines the model additive-dominant was not suitable.

4. Among the F_1 commercial hybrids, those containing the inbreds no 1 and 2 showed a good resistance to Phomopsis helianthi. The hybrid LC 1004 A x LC 1064 C which is known under the name of SELECT, confirms our results.

5. The "stay green" colour of the stem at maturity is associated with the resistance to Phomopsis helianthi.



Graph 1. The analysis of variance (Vr) and covariance (Wr) for 10 inbred lines used as female in commercial sunflower hybrids.



Graph 2. The analysis of variance (Vr) and covariance (Wr) for 10 inbred lines used as males in commercial sunflower hybrids.

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