

Resistance to Albugo tragopogonis in Sunflower

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Abstract

Trials were conducted at the Oil and protein Seed Centre Potchefstroom, South Africa in order to assess resistance to Albugo tragopogonis infection of sunflower inbred lines and hybrids. Significant genetic differences were recorded for percentage leaf infection and seed yield. A diallel analysis indicated that crossing combinations amongst the inbred lines of sunflowers for resistance to A. tragopogonis was primarily expressed in the hybrids by general combining ability.

KEY WORDS: Sunflower, white blister rust, resistance

Introduction.

In South Africa sunflowers (Helianthus annuus) are cultivated mainly for the extraction of oil and for oil cake used for animal feed. Approximately 400,000 - 600,000 tonnes of sunflower seed are produced per annum. The most prevalent diseases in South Africa are caused by Sclerotium sclerotiorum, Puccinia helianthii, Sclerotium rolfsii and Albugo tragopogonis (white blister rust).

According to Holtzhauzen (1977), white blister rust can assume serious proportions in South Africa without actually adversely affecting seed yield. Since 1993 the occurrence of A. tragopogonis has increased in South Africa. Symptoms include both leaf infections and greying of the petiole and main stem. The disease causes premature senescence of leaves and is eventually responsible for lodging (Van Wyk, personal communication). The aim of this study was to investigate possible genetic variation in susceptibility to A. tragopogonis, manifested as leaf infections, and to develop possible resistant inbreds and hybrids.

Materials and methods

Two trials were planted at the Oil and Protein Seed Centre at Potchefstroom during 1994/95. Firstly a diallel cross was conducted with five selected sunflower inbred lines, consisting of three male lines (RHA801, H1185 and RO20) and two female lines (H52 and H53). RHA801 was obtained from the USA, the remaining lines were of local origin. A randomized block design with three replications was used. The percentage of leaves effected by natural infection of A. tragopogonis was recorded. A diallel analysis of the % leaf infection was carried out using Griffing's analysis (1956).

A second trial was conducted with hybrids from three male- and ten female inbred parents. The male lines were RHA274 (from the USA), RO20 and O25 and the ten female lines were selected from a population originating from a cross between Helianthus annuus (cv.HA89) and H. debilis sps cucumerifolius (DC). A randomized block design with three replications and 30 hybrids was used. Hybrids were obtained from crosses in all combinations between the three male lines and the 10 female (DC) lines. A 3x10 factorial analysis was carried out on yield and the percentage A. tragopogonis infection.

Results

Differences in the percentage of leaf infection caused by A. tragopogonis on hybrids from crosses between the inbreds were highly significant. The results for the hybrids and inbreds are presented in Table 1. The inbred line RO20 was the least effected (5% leaf infection) and RHA801 was the most effected (53,5% infection). The combination (RO20 X H1185) showed the lowest infection (21%).

The general combining ability (GCA) of the inbred lines was highly significant but the specific combining ability (SCA) was not significant. GCA accounts for the major component of the total variation in infection (58%), compared to 11% for SCA and over 30% for residual effects (Table 2). RO20 was the best general combiner followed by H1185 (Table 3).

Results from the second trial are presented in Tables 4 and 5. Significant differences occur between the male inbred lines (Table 4). The line O25 was superior to RO20. The former outyielded RO20 and was less effected by white blister rust (Table 4). RHA274 was the most susceptible, showing 38% infection.

There were no significant differences in yield between the DC female lines. However DC44-6 and DC37-7 were more resistant and gave higher yields (Table 5). The lines showed significant differences in percentage infection.

Conclusion

Results of this study indicate that significant genetic variation exists in the Potchefstroom and American germplasm as regards susceptibility to A. tragopogonis. In general the lines originating from the USA (RHA801 and RHA274) were more susceptible, possibly because the disease was recorded for the first time in the USA only approximately three years ago (Gulya, personal communication). No opportunity was therefore available to select for resistance to white stem rust.

The diallel analysis indicates that the GCA is the most important combining component for resistance to A. tragopogonis. As the SCA is not significant, it can be predicted that the best progeny in a breeding programme will be produced by crossing parents having the highest general combining abilities. According to Sprague and Tatum (1942) the significant GCA provides an indication of the importance of genes which are largely additive in their effects. In this respect resistance to A. tragopogonis resembles many other sunflower characteristics.

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TABLE 1 Diallel table showing the mean percentage Albugo tragopogonis leaf infection of a 5 X 5 diallel cross with Helianthus annuus, made at Potchefstroom, 1994/95.

Inbred lines	RHA801	H1185	RO20	H53	H52
RHA801	53,5	39,0	25,6	36,6	41,6
H1185		40,0	21,6	41,6	31,6
RO20			5,0	41,0	31,6
H53				45,0	39,6
H52					

TABLE 2 The variance components accounting for combining ability.

Source	Variance component
GCA	58,44**
SCA	11,32
Residual	30,23

G ** Significant (0,01%)

TABLE 3 General combining ability effects of inbred lines.

Inbred lines	GCA effect
RHA801	-6,047
H1185	1,142
RO20	10,571
H53	-5,762
H52	0,095

TABLE 4 The average yield and percentage leaves infected by Albugo tragoponis of hybrids from three males crossed with 10 female inbreds of Helianthus annuus obtained at Potchefstroom, 1994,95.

Males	Yield in kg/ha	% <u>Albugo</u> infection
RHA274	1590	37,6
RO20	1845	30,2
O25	2217	23,5
<hr/> Average	<hr/> 1884	<hr/> 30,4
F. Value	—	—
L.S.D.	38,42**	22,32**
	72,0	2,12

** Significant (0,01%)

TABLE 5 Average yield and percentage leaf area covered by lesions caused by Albugo tragoponis from 10 females crossed with three male inbreds of Helianthus annuus obtained at Potchefstroom, 1994/95.

Females	Yield in kg/ha	% <u>Albugo</u> infection
DC21-1	1779	39,4
DC21-8	1682	35,3
DC23-7	1853	31,7
DC28-0	1811	29,4
DC28-7	1797	28,9
DC31-7	1943	34,4
DC37-7	2028	28,7
DC38-1	2039	24,4
DC41-9	1877	30,6
DC44-6	2031	22,6
Average	1884	30,54
F- Value	1,75	3,44**
L.S.D	---	3,86

** Significant (0,01%)