

REACTION OF SUNFLOWER GENOTYPES TO *Alternaria helianthi* IN THE STATE OF PARANÁ, BRAZIL

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Received: April 12, 1998

Accepted: February 15, 1999

SUMMARY

Sunflower (*Helianthus annuus* L.) can be affected by leaf blight and stem spot disease caused by *Alternaria helianthi*. Genotypes with genetic resistance to this disease are highly desirable for reducing yield losses. The reaction of 28 sunflower genotypes to *Alternaria* leaf spot disease was evaluated in the state of Paraná, Brazil, during the 1995-96 and 1996-97 growing seasons. Disease occurrence, under natural conditions, was evaluated at the flowering stage with reference to a diagrammatic scale of severity, varying from 0 to 5 according to the area of diseased leaf tissue. High *Alternaria* disease intensity was observed in eight field trials. The genotypes Contiflor 3, Contiflor 15 and Cargill 9401 showed an intermediate level of resistance to the *Alternaria* disease.

Key words: *Alternaria helianthi*, *Alternaria* leaf spot, *Helianthus annuus*, sunflower, disease resistance, Brazil

INTRODUCTION

Sunflower (*Helianthus annuus* L.) has been used as an option for crop rotation in the Brazilian grain production area (Castro *et al.*, 1996). The potential for increasing the area of sunflowers can be limited by leaf blight and stem spot diseases caused by *Alternaria helianthi* (Hansf.) Tubaki and Nishihara. This disease has been reported in Brazil (Aquino *et al.*, 1971; Ribeiro *et al.*, 1974) and is very common in North America, Africa, Argentina, India, Japan, Australia, Yugoslavia, Romania and France (Anahosur, 1978; Zimmer and Hoes, 1978; Davet *et al.*, 1991; Pereyra and Escande, 1994).

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The disease is reported to affect leaves, stem and sunflower heads, causing necrotic lesions brown to black in color and round or angular in shape (Anahosur, 1978; Almeida *et al.*, 1981; Davet *et al.*, 1991).

Three species of *Alternaria* are reported to infect sunflowers in Brazil: *A. helianthi* (sin. *Helminthosporium helianthi* Hansf.), *A. zinniae* Ellis and *A. alternata* (Fr.) Keissler (sin. *A. tenuis* Nees) (EMBRAPA, 1982), but *A. helianthi* is most common. Due to the frequent occurrence of climatic conditions favorable for the disease epidemics, i.e., high relative humidity and temperatures between 25°C and 30°C, *Alternaria* leaf blight is the most important sunflower disease in Brazil.

Effective control is very difficult after the occurrence of the disease in the field. The use of genotypes with genetic resistance to the *Alternaria* disease is highly desirable, because it is the most economical way of reducing yield losses (Davet *et al.*, 1991). Species of wild *Helianthus*, like *H. hirsutus*, *H. rigidus* and *H. tuberosus*, show resistance to *A. helianthi* (Morris *et al.*, 1983; Lipps and Herr, 1986; Davet *et al.*, 1991; Ravikumar *et al.*, 1995). Parental lines of *H. annuus*, such as the male sterile line CMS 821A and the restorer line RHA 6D-1, are considered to be resistant to *A. helianthi* (Nagaraju *et al.*, 1992) and can be used as a source of resistance for hybrid seed production.

Information about the response to *A. helianthi* are available for sunflower hybrids and open-pollinated varieties from other sunflower-producing countries (Agrawat *et al.*, 1979; Velazhahan *et al.*, 1991; Nagaraju *et al.*, 1994; Velazhahan and Narayanasamy, 1994; Mirza and Hoes, 1996), but not from Brazil. The objective of this study was to evaluate the reaction of sunflower genotypes to the *Alternaria* leaf spot disease, under natural infection, in the state of Paraná, Brazil.

MATERIALS AND METHODS

The resistance of several hybrids and one open-pollinated variety (EMBRAPA 122 - V2000) to the *Alternaria* disease was evaluated in eight field trials conducted in the state of Paraná, Brazil, during the 1995-96 and 1996-97 growing seasons. The trials were designed in randomized complete blocks, with three or four replications. Each plot consisted of four 6 m long rows, spaced at 0.8 m, with 22 plants per row. Cultural and agronomic practices were regularly applied, as recommended for the crop in Brazil (Castro *et al.*, 1996).

The severity of the disease, occurring under natural conditions, was evaluated when sunflower plants were at the flowering stage. The evaluation was carried out visually for each plot, according to the diagrammatic scale of severity, taking in account the levels of leaf area diseased (LAD): 0=no *Alternaria* disease; 1=0.3% of LAD; 2=3.0% of LAD; 3=12.0% of LAD; 4=25.0% of LAD; 5=40.0% or more of LAD.

Data were submitted for statistical analysis and Duncan's multiple range test was performed to detect significant differences among the genotype means.

RESULTS AND DISCUSSION

High *Alternaria* disease intensities were observed during the 1995-96 and 1996-97 growing seasons, showing that sunflower genotypes could be effectively evaluated for disease resistance under natural conditions. Resistance to the *Alternaria* disease in the cultivated sunflower is expressed quantitatively, as a reduction in the percentage of leaf area affected (Block, 1990), so it could be useful to evaluate sunflower genotypes using a diagrammatic scale of severity.

Table 1: Reaction of nine sunflower genotypes to the *Alternaria* disease during the 1995-96 growing season in two locations in the state of Paraná, Brazil

Genotype	Disease severity mean *		Mean
	Londrina	Pato Branco	
EMBRAPA 122 - V2000	2.75 a	3.50 a	3.13 a
GR 16	2.75 a	3.25 a	3.00 a
Cargill 11	3.00 a	2.75 a	2.88 a
M 737	3.00 a	2.75 a	2.88 a
DK 180	2.00 a	3.00 a	2.50 a
M 703	2.00 a	3.00 a	2.50 a
M 736	2.00 a	3.00 a	2.50 a
M 738	1.75 a	3.25 a	2.50 a
M 735	1.75 a	2.75 a	2.25 a
Mean	2.33	3.03	2.68
C.V. (%)	33.37	16.20	24.28

* mean of four replications; scale: 0 = no *Alternaria* disease; 1 = 0.3% of leaf area diseased (LAD); 2 = 3.0% of LAD; 3 = 12.0% of LAD; 4 = 25.0% of LAD; 5 = 40.0% or more of LAD; the means followed by the same letter do not differ significantly according to Duncan's multiple range test ($p=0.05$)

During the 1995-96 growing season, nine and twenty-two genotypes were evaluated for their resistance to *A. helianthi*, in two field trials conducted in the counties of Londrina and Pato Branco, respectively. No significant differences were observed among the nine genotypes evaluated both in Londrina and in Pato Branco (Table 1). However, reduced disease severity was observed in genotypes Contiflor 15 and Cargill 9401, among the 22 genotypes (Table 2).

The evaluation of nineteen genotypes during the 1996-97 growing season in four counties in the state of Paraná (Londrina, Pato Branco, Campo Mourão and Palotina) showed significant differences among the genotypes (Table 3). The genotypes with low disease severity under natural conditions were Contiflor 3 and Contiflor 15 in Londrina and Cargill 9402 in the counties of Pato Branco and Campo Mourão. The combined analysis of the data from these four trials showed that no significant difference existed among the genotypes evaluated during the 1996-97 growing season (Table 3).

Table 2: Reaction of 22 sunflower genotypes to the *Alternaria* disease during the 1995-96 growing season in the state of Paraná, Brazil

Genotype	Disease severity mean *		Mean
	Londrina	Pato Branco	
GR 16	4.00 a	3.33 a	3.67 a
AS 603	3.33 a	2.33 b	2.83 ab
EMBRAPA 122 - V2000	2.67 a	3.00 a	2.83 ab
AS 90491	3.00 a	2.33 b	2.67 abc
Contiflor 3	3.00 a	2.33 b	2.67 abc
GV 37017	2.67 a	2.67 a	2.67 abc
AS 470	2.67 a	2.33 b	2.50 abc
DK 180	2.67 a	2.33 b	2.50 abc
AS 238	2.00 b	2.67 a	2.33 bc
Cargill 9402	2.67 a	2.00 b	2.33 bc
Cargill 9403	1.67 b	3.00 a	2.33 bc
AS 227	2.00 b	2.33 b	2.17 bc
AS 243	1.67 b	2.67 a	2.17 bc
C 11	1.33 b	3.00 a	2.17 bc
Rumbosol 90	2.00 b	2.33 b	2.17 bc
AS 226	1.33 b	2.67 a	2.00 bc
Contiflor 7	2.00 b	2.00 b	2.00 bc
Contiflor 8	2.00 b	2.00 b	2.00 bc
Contiflor 9	1.67 b	2.33 b	2.00 bc
Rumbosol 91	1.67 b	2.00 b	1.83 bc
Cargill 9401	1.00 b	2.00 b	1.50 c
Contiflor 15	1.00 b	2.00 b	1.50 c
Mean	2.18	2.44	2.31
C.V. (%)	33.78	20.18	27.13

* mean of three replications; scale: 0 = no *Alternaria* disease; 1 = 0.3% of leaf area diseased (LAD); 2 = 3.0% of LAD; 3 = 12.0% of LAD; 4 = 25.0% of LAD; 5 = 40.0% or more of LAD; the means followed by the same letter do not differ significantly according to Duncan's multiple range test ($p=0.05$)

No hybrid or open-pollinated variety was found to be either immune or highly resistant to the *Alternaria* disease, as reported before (Agrawat *et al.*, 1979; Velazhahan *et al.*, 1991; Nagaraju *et al.*, 1994; Mirza and Hoes, 1996). Although all genotypes were susceptible, this study revealed that some hybrids, such as Contiflor 3, Contiflor 15 and Cargill 9401, were less affected by the disease than the other genotypes. Thus, they can be used to minimize yield losses due to the disease.

Table 3: Reaction of 19 sunflower genotypes to the *Alternaria* disease during the 1996-97 growing season in the state of Paraná, Brazil

Genotype	Disease severity mean *				Mean
	Londrina	Pato Branco	Campo Mourão	Palotina	
M 735	4.75 ab	3.50 ab	3.25 cd	2.38 ab	3.47 a
EMBRAPA 122 - V2000	3.25 cdef	3.50 ab	4.13 a	2.88 a	3.44 a
M 737	3.75 abcd	3.50 ab	3.75 abc	2.75 a	3.44 a
Cargill 11	5.00 a	3.25 abc	3.00 d	2.38 ab	3.41 a
M 734	3.75 abcd	3.50 ab	3.63 bc	2.75 a	3.41 a
AS 243	3.50 bcde	3.63 a	3.63 bc	2.63 a	3.34 a
M 703	4.25 abc	3.13 abcd	3.38 cd	2.63 ab	3.34 a
Cargill 9402	4.75 ab	2.50 d	3.00 d	2.88 a	3.28 a
Contiflor 8	3.25 cdef	2.88 bcd	3.75 abc	2.88 a	3.19 a
AS 603	2.75 def	3.38 abc	3.88 ab	2.50 ab	3.13 a
AS 227	3.75 abcd	3.13 abcd	3.38 cd	2.00 b	3.06 a
GV 37017	3.25 cdef	3.00 abcd	3.63 bc	2.38 ab	3.06 a
M 738	2.50 def	3.38 abc	3.63 bc	2.75 a	3.06 a
AS 238	2.75 def	3.38 abc	3.38 cd	2.67 ab	3.04 a
Contiflor 7	2.75 def	3.00 abcd	3.25 cd	2.75 a	2.94 a
Contiflor 9	3.25 cdef	2.75 cd	3.50 bc	2.25 ab	2.94 a
DK 180	2.25 ef	3.50 ab	3.50 bc	2.50 ab	2.94 a
Contiflor 3	2.00 f	2.88 bcd	3.50 bc	2.63 ab	2.75 a
Contiflor 15	2.00 f	2.75 cd	3.38 cd	2.88 a	2.75 a
Mean	3.34	3.18	3.50	2.60	3.15
C.V. (%)	23.38	12.60	8.37	14.68	15.87

* mean of four replications; scale: 0 = no *Alternaria* disease; 1 = 0.3% of leaf area diseased (LAD); 2 = 3.0% of LAD; 3 = 12.0% of LAD; 4 = 25.0% of LAD; 5 = 40.0% or more of LAD; the means followed by the same letter do not differ significantly according to Duncan's multiple range test ($p=0.05$)

Efforts to find genetic sources with more complete resistance should be continued. Within *H. annuus*, resistance under natural conditions is present in some CMS and restorer lines (Nagaraju *et al.*, 1992). It is known that the cultivated sunflower has a relatively restricted germplasm base and consequently new sources of variability for disease resistance will probably be needed (Morris *et al.*, 1983). The resistance of wild sunflower species to *A. helianthi* (Morris *et al.*, 1983; Lipps and Herr, 1986; Davet *et al.*, 1991; Ravikumar *et al.*, 1995) may be transferable to cultivated sunflower by backcross breeding of the inbred lines with the resistant perennial species (Morris *et al.*, 1983).

CONCLUSIONS

The genotype Contiflor 3, Contiflor 15 and Cargill 9401 showed an intermediate level of resistance to the *Alternaria* disease and can be used for cultivation in areas where the disease is important, or can be used as sources of resistance in sunflower breeding programs. Larger breeding efforts should be directed towards finding sources of resistance to *Alternaria* leaf spot disease.

ACKNOWLEDGEMENTS

This paper was approved for publication by the Technical Director of EMBRAPA Soja as manuscript number 023/97 - 004/98.

REFERENCES

- Agrawat, J.M., Chhipa, H.P. and Mathur, S.J., 1979. Screening of sunflower germplasm against *Alternaria helianthi*. Indian J. Mycol. Plant Pathol., 9: 85-86.
- Almeida, A.M.R., Machado, C.C. and Carrão-Panizzi, M.C., 1981. Doenças do girasol, descrição de sintomas e metodologia para levantamento. Londrina, EMBRAPA-CNPSo, p. 24. (Circular técnica, 6).
- Anahosur, K.H., 1978. *Alternaria helianthi*. CMI Descriptions of Pathogenic Fungi and Bacteria, 582, p. 2.
- Aquino, M.L.N., Bezerra, J.L. and Lira, M.A., 1971. Ocorrência do crestamento do girasol (*Helianthus annuus* L.) em Pernambuco. Revista de Agricultura, 46: 151-156.
- Block, C.C., 1990. Screening of sunflower germplasm for *Alternaria helianthi* resistance. In: Proc. of the 12th Sunflower Res. Workshop, National Sunflower Association, Bismarck, ND, pp. 22-24.
- Castro, C. de, Castiglioni, V.B.R., Balla, A., Leite, R.M.V.B.C., Karam, D., Mello, H.C., Guedes, L.C.A. and Farias, J.R.B., 1996. A cultura do girasol. Londrina, EMBRAPA-CNPSo, p. 38. (Circular técnica, 13).
- Davet, P., Péres, A., Regnault, Y., Tourvieille, D. and Penaud, A., 1991. Les maladies du tournesol. Paris, CETIOM, p. 72.
- EMBRAPA, Centro Nacional de Pesquisa de Soja (Londrina, PR), 1982. Ata da II Reunião Nacional de Pesquisa de Girasol, Londrina, 31 Aug. - 2 Sep. 1982. Londrina, EMBRAPA-CNPSo, p. 51.
- Lipps, P.E. and Herr, L.J., 1986. Reactions of *Helianthus annuus* and *H. tuberosus* plant introductions to *Alternaria helianthi*. Plant Dis., 70: 831-835.
- Mirza, M.S. and Hoes, J.A., 1996. Screening for resistance in sunflower against *Alternaria helianthi*. Helia, 19: 87-92.
- Morris, J.B., Yang, S.M. and Wilson, L., 1983. Reaction of *Helianthus* species to *Alternaria helianthi*. Plant Dis., 67: 539-540.
- Nagaraju, A.J., Janardhan, A., Puttarangaswamy, K.T. and Channakrishnaiah, K.M., 1994. Evaluation of sunflower populations and hybrids against leaf spot caused by *Alternaria helianthi*. Current Research University of Agricultural Sciences, Bangalore, 23: 115-116.
- Nagaraju, A.J., Jagadish, B.N. and Virupakshappa, K., 1992. Reaction of cytoplasmic male sterile and restorer lines of sunflower to *Alternaria helianthi*. Indian Phytopathology, 45: 372-373.
- Pereyra, V. and Escande, A.R., 1994. Enfermedades del girasol en la Argentina: manual de reconocimiento. Balcarce, INTA, p. 113.
- Ravikumar, R.L., Doddamani, I.K. and Kulkarni, M.S., 1995. Reaction of selected germplasm lines and *Helianthus tuberosus* derived introduction to *Alternaria helianthi*. Helia, 18: 67-71.
- Ribeiro, I.J.O., Paradela Filho, O., Soave, J. and Corvellini, G.S., 1974. Ocorrência de *Alternaria helianthi* (Hansf.) Tubaki and Nishihara sobre girasol. Bragantia, 33: 81-85.

- Velazhahan, R. and Narayanasamy, P., 1994. Resistance in sunflower genotypes to rust and leaf spot. Madras Agricultural Journal, 81: 43-44.
- Velazhahan, R., Narayanasamy, P. and Jeyarajan, R., 1991. Evaluation of sunflower germplasm for field resistance to *Alternaria helianthi*. Madras Agricultural Journal, 78: 143-144.
- Zimmer, D.E. and Hoes, J.A., 1978. Diseases. In: Carter, J.F. (ed.). Sunflower Science and Technology. Madison, American Society of Agronomy, pp. 225-262.

REACCIÓN DE GENOTIPOS DE GIRASOL A *Alternaria helianthi* EN EL ESTADO DE PARANÁ, BRASIL

RESUMEN

El girasol (*Helianthus annuus* L.) puede ser afectado por la enfermedad causada por el hongo *Alternaria helianthi*. La utilización de genotipos con resistencia genética a esta enfermedad es muy deseable para la reducción de las pérdidas de rendimiento. La reacción de 28 genotipos de girasol a la mancha provocada por *Alternaria* fué evaluada en el estado de Paraná, Brasil, en los ciclos agrícolas de 1995-96 y 1996-97. La manifestación de la enfermedad en condiciones naturales fué evaluada en el estado de florecimiento, de acuerdo con una escala arbitraria de severidad, variando de 0 a 5, teniendo en cuenta el área foliar afectada. Fué observada alta intensidad de la enfermedad en ocho experimentos de campo. Los genotipos Contiflor 3, Contiflor 15 y Cargill 9401 presentaron niveles intermediarios de resistencia a la enfermedad.

RÉACTION DE GENOTYPES DE TOURNESOL A L'*Alternaria helianthi* DANS LE DEPARTEMENT DU PARANA, BRÉSIL

RÉSUMÉ

Le tournesol (*Helianthus annuus* L.) peut être affecté par la maladie provoquée par *Alternaria helianthi*. L'utilisation de génotypes résistants à cette maladie est fortement souhaitable pour la réduction de pertes. La réaction de 28 génotypes de tournesol à l'*A. helianthi* a été évaluée dans le département du Parana, Brésil, dans les périodes 1995-96 et 1996-97. La présence de la maladie sous des conditions naturelles a été évaluée à la floraison selon une échelle d'agressivité variable de 0 à 5, en tenant compte la surface de la feuille attaquée. La maladie a été fortement observée sur huit essais au champ. Les génotypes Contiflor 3, Contiflor 15 et Cargill 9401 ont montré des niveaux intermédiaires de résistance à la maladie.

