PHOMOPSIS SCREENING OF SUNFLOWER GERMPLASM IN THE USDA *HELIANTHUS* COLLECTION

Masirevic, S. and T.J. Gulya
Institute of field and vegetable crops Novi Sad Yugoslavia and USDA-ARS North Dakota USA

ABSTRACT
The USDA-ARS sunflower germplasm collection is located at the North Central Regional Plant Introduction Station, Ames Iowa. The collection consists of 3608 accessions with 2163 wild and 1445 cultivated accessions. A cooperative project between the Institute of Field & Vegetable Crops and the USDA was initiated to evaluate the entire USDA sunflower germplasm collection for Phomopsis resistance under conditions of natural infection in Yugoslavia. Evaluation of the first 500 cultivated accessions identified germplasm with as little as 5% or as much as 67% infection. P.I. accessions 162454, 170426, 219649, 250085 and 377530 all had <10% plants infected.

Key words: Sunflower, Phomopsis, grey-brown stem spot

INTRODUCTION:

The cousal agent of grey brown stem spot (Phomopsis spp. Diaporthe sp) is relatively new disease of sunflower first discovered in early 1980 in Yugoslavia and now considered the most devastating sunflower disease in Europe. Symptoms include large stem cankers and subsequent wilt.(Maric & Masirevic 1980, Mihaljcevic et al., 1980., Masirevic and Gulya, 1992). The disease is also reported in Romania (Iliescu et al., 1985), Hungary (Voros et al., 1983), USA (Herr et al., 1983; Yang et al., 1984, Masirevic et al., 1988), France (Regnoult, 1985), Iran (Madjideh - Ghossemi, 1988), Bulgaria, Turkey, Australia, USSR (Acimovic, 1988).
Selection for Phomopsis resistance was initially conducted under intensive natural infection in the field. This type of testing may give a quite good results.
The USDA-ARS sunflower germplasm collection has 3608 accessions with 2163 (60%) wild and 1445 (40%) cultivated accession. These are cultivated accessions represented from 49 different countries and representative population accessions of all 49 extant wild species of Helianthus. An informational database called PCGRIN (Germplasm Resources Information Network) is available which contains characterization and evaluation data about the collection. The first 500 cultivated accessions were tested.

MATERIALS AND METHODS:

Evaluation of the first 500 entries were done in field trials in Novi Sad, Yugoslavia. Each line was planted in single row plots, of 25 plants each, 7 m long on 70 cm centres, and replicated four times. Natural infection with both Sclerotinia sclerotiorum and Phomopsis was aided by placing diseased stalks (which had overwintered in the field) in between rows after planting.

Disease evaluations of every plant in a row was made after flowering and again at physiological maturity.

RESULTS:
The severity of Phomopsis stem spot of 500 entries measured as the percent of plants with symptoms under conditions of natural infections ranged from 3.4% to 75%(Table 1). Eleven entries (2% of total) had less than 10% infections while 54 entries (4% of total)had >50% plants infected.

Distribution of Phomopsis resistance was:

11	entries	had	from	3-9.9%	infections	or	2.2% of total
93	- do -			10-19.9%	- do -		19% - do -
145	- do -			20-29.9%	- do -		29% - do -
124	- do -			30-39.9%	- do -		25% - do -
74	- do -			40-49.9%	- do -		15% - do -
33	- do -			50-59.9%	- do -		7% - do -
21	- do -			60-75%	- do -		4% - do -

In statistical analysis highly significant differences between entries were estimated. Coefficient of variation was 16.9 and LSD 0,05=7.2 and LSD 0,01=9.5%.

In comparison, when 85 USDA released inbreds were screened in the same year, they ranged from 2% to 40 infection.

Best entries for Phomopsis, followed by Sclerotinia %:

PI #	Origin	Cultivar Name	Phomopsis	Sclerotinia
162784	Argentina	No.167	3.4	11.7
162454	Uruguay	Sunrise	5.0	21.7
170393	Turkey	No.2008	6.7	25.0
377530	Kenya	White	3.1	41.7
170426	Turkey	No.3447	8.4	10.0
171656	Turkey	No.6874	8.4	46.7
250085	Egypt	No.K998	8.4	18.4
170385	Turkey	No.1397	8.4	13.3
174217	Turkey	No.8149	8.4	31.7
181769	Lebanon	No.9971	8.4	36.7
219649	Austria	Bols 3	8.4	15.0

Reaction of some USDA lines & YU hybrids to Phomopsis & Sclerotinia

USDA lines	Phomopsis %	Sclerotinia %
HA 113	2.5	0.8
HA 234	3.3	1.8
HA R2	2.0	10.0
HA 850	3.3	8.0
HA 853	2.3	11.0
NS-H-45	0.0	6.8
NS-H-26	58.0	10.8

DISCUSSIONS :

This project is an attempt to gather information on the Phomopsis reaction first on the cultivated accessions within the germplasm collection, and later on the wild annual and perennial Helianthus species. It is encouraging to find a small percentage of entries with high levels of resistance among the cultivated Plant Introductions. Whether these entries have the same resistance genes is unknown at present, but will be the subject of future studies. It is encouraging that germplasm has been identified with high levels of resistance both to Phomopsis stem canker and to Sclerotinia wilt, both diseases of worldwide importance. Since this germplasm is available free of charge to researchers from any country, the disease resistance identified in this study may be used to produce disease resistant hybrids around the world.

REFERENCES:

* Acimovic, M., 1988. Sunflower disease mapping in Europe and some countries outside Europe in the period 1984-1986. Helia, 11:41-49.
* Herr,L.J., Lipps, P.E. and Walters, B.H., 1983. Diaporthe stem canker of sunflower. Plant Dis., 67:911-913.
* Iliescu, H.,Jinga, V.,Ciurea, A. and Ionita, A., 1985. Investigations related to the prognosis of sunflower stem canker (Diaporthe helianthi). Helia, 8:51-56.
* Madjidieh-Ghassemi, S.H., 1988. A new sunflower disease in Iran caused by Phomopsis helianthi. In:Proc.12 Int. Sunflower Conf.,20-25 July 1988, Novi Sad, Yugoslavia. Int. Sunflower Assoc., Toowoomba, Australia, Vol.II, pp.108-109.
* Maric, A. and Masirevic, S. 1980. Pojava sive pegavosti stabla (Phomopsis sp.) do sada nepoznate bolesti suncokreta. Glasn. Zast.Bilja, 12:421-423.
* Masirevic, S., Gulya, T. and Lay.C., 1988. Phomposis-Diaporthe stemspot of sunflower in the United States during 1987. In: Proc.Sunflower Research Workshop, 25 January, Bismarck, ND. National Sunflower Assoc., Bismarck, ND, p.9.
* Masirevic, S. and Gulya, T.J., 1992. Sclerotinia and Phomopsis - two devastating sunflower pathogens. Field Crops Res., 30:271-300.
* Regnault, Y., 1985. Premieres observations sur le Phomopsis du tournesol. Inform. Tech. CETIOM, 92:13-20.
* Voros, J., Leranth, J. and Vajna, L., 1983. Overwintering of Diaporthe helianthi a new destructive pathogen of sunflower in Hungary. Acta Phytopathol. Acad. Sci.Hung., 18:303-305.
* Yang, S.M., Berry, R.W., Luttrell, E.J. and Vonkaysone, T., 1984. A new sunflower disease caused by Diaporthe helianthi in Texas. Plant Dis., 68:254-255.

TABLE 1 REACTION OF SUNFLOWER GERMPLASM IN THE USDA HELIANTHUS COLLECTION TO PHOMOPSIS

Helianthus annuus		Phomopsis %	Helianthus annuus		Phomopsis %	Helianthus annuus		Phomopsis %	Helianthus annuus		Phomopsis %
PI-NO	SOURC		PI-NO	SOURC		PI-NO	SOURC		PI-NO	SOURC	
162453	URUG	11.7	170424	TURKY	26.7	176972	TURKY	16.7	223370	IRAN	31.7
162454	URUG	5	170425	TURKY	25	176973	TURKY	10	223671	IRAN	26.7
162675	ARGN	31.7	170426	TURKY	8.4	176974	TURKY	13.3	226465	IRAN	21.7
162784	ARGN	3.4	170427	TURKY	31.7	176975	TURKY	30	226466	IRAN	31.3
165087	TURKY	18.3	170428	TURKY	18.3	177394	TURKY	35	228345	IRAN	20
167387	TURKY	11.7	170429	TURKY	15	177395	TURKY	30	229610	IRAN	15
170385	TURKY	8.4	170430	TURKY	30	177396	TURKY	15	232903	HUNG	36.7
170386	TURKY	20	170431	TURKY	23.4	177397	TURKY	28.3	232904	HUNG	28.4
170387	TURKY	15	171655	TURKY	21.7	177398	TURKY	30	232905	HUNG	16.7
170388	TURKY	16.7	171656	TURKY	10	177399	TURKY	26.7	232906	HUNG	15
170389	TURKY	35	174657	TURKY	18.3	177400	TURKY	33.3	240660	GANA	20
170390	TURKY	35	172903	TURKY	25	177401	TURKY	16.7	243071	JORDN	23.4
170391	TURKY	21.7	172904	TURKY	23.4	177402	TURKY	15	243072	JORDN	18.3
170392	TURKY	23.4	172905	TURKY	18.3	177403	TURKY	28.4	243073	JORDN	21.7
170393	TURKY	6.7	172906	TURKY	23.4	177404	TURKY	26.7	243074	JORDN	10
170394	TURKY	25	172907	TURKY	28.4	177405	TURKY	28.3	243075	JORDN	21.7
170395	TURKY	23.4	172908	TURKY	30	177406	TURKY	16.7	243076	JORDN	15
170396	TURKY	25	173704	TURKY	31.7	177407	TURKYSYR	20	243077	JORDN	20
170397	TURKY	20	173706	TURKY	16.7	181768	IA	26.7	243078	JORDN	10
170398	TURKY	31.7	174216	TURKY	10	181769	LEBN	8.4	243079	JORDN	20
170399	TURKY	23.4	174217	TURKY	8.4	181881	SYRIA	48.3	243080	JORDN	16.7
170400	TURKY	43.4	174218	TURKY	40	181994	TURKY	30	245716	TURKY	26.7
170401	TURKY	15	174219	TURKY	20	182776	TURKY	38.3	250019	IRAN	23.4
170402	TURKY	23.4	174220	TURKY	20	182777	TURKY	26.7	250085	EGYPT	8.4
170403	TURKY	35	175721	TURKY	46.7	182778	TURKY	35	250542	EGIPT	11.7
170404	TURKY	31.7	175722	TURKY	30	184048	YUGO	33.3	250612	EGYPT	36.7
170405	TURKY	20	175723	TURKY	23.4	184049	YUGO	16.7	250726	IRAN	16.7
170406	TURKY	15	175724	TURKY	38.3	185034	TURKY	15	250850	IRAN	23.4
170407	TURKY	20	175725	TURKY	40	192943	CHINA	31.7	250851	IRAN	21.7
170408	TURKY	15	175726	TURKY	33.3	193775	ETHI	20	250852	IRAN	15
170409	TURKY	23.4	175727	TURKY	21.7	195573	ETHI	25	250853	IRAN	28.4
170410	TURKY	28.4	175728	TURKY	25	195574	ETHI	16.7	250854	IRAN	-
170411	TURKY	13.3	175729	TURKY	20	195945	ETHI	10	250855	IRAN	40
170412	TURKY	18.3	175730	TURKY	36.7	195946	ETHI	26.7	250856	IRAN	23.4
170413	TURKY	35	175731	TURKY	23.4	196839	ETHI	35	251464	TURKY	38.3
170414	TURKY	43.4	175732	TURKY	35.3	201812	GANA	23.4	251456	TURKY	25
170415	TURKY	40	175733	TURKY	38.3	203819	GER	25	251466	TURKY	38.3
170416	TURKY	28.3	176570	TURKY	21.7	204578	TURKY	-	251901	USSR	30
170417	TURKY	23.4	176571	TURKY	30	213175	GBE	18.3	251902	USSR	10
170418	TURKY	11.7	176572	TURKY	23.4	219649	AUTR	8.4	251990	TURKY	26.7

TAB 1 - cont (second part)

170419	TURKY	20	176573	TURKY	15	219650	AUTR	21.7	251991	TURKY	36.7
170420	TURKY	40	176574	TURKY	16.7	219651	GER	11.7	251992	TURKY	13.3
170421	TURKY	21.7	176575	TURKY	28.3	221441	AFGH	11.7	251993	TURKY	20
170422	TURKY	18.3	176576	TURKY	23.3	221693	INDON	26.7	253414	ISRL	36.7
170423	TURKY	23.4	176971	TURKY	31.7	222991	IRAN	16.7	253415	ISRL	33.3
253416	SPAIN	16.7	287231	USSR	35	307832	URUG	40	343798	IRAN	46.7
253417	SPAIN	33.3	287232	USSR	46.7	307834	SAFR	33.3	343799	IRAN	33.3
253418	IRAQ	18.3	287233	USSR	31.7	307835	URUG	16.7	343800	IRAN	28.3
253771	IRAQ	10	289622	FRAN	35	307934	USSR	43.3	343801	IRAN	21.7
253772	IRAQ	18.3	289623	FRAN	31.7	307935	USSR	56.7	343802	IRAN	30
253773	IRAQ	21.7	289624	FRAN	46.7	307936	USSR	30	343803	IRAN	20
253774	IRAQ	30	289625	FRAN	43.4	307937	USSR	48.4	343804	IRAN	25
253775	IRAQ	25	289626	FRAN	45	307938	USSR	51.7	343805	ROMAN	18.3
253776	IRAQ	28.4	289627	FRAN	26.7	307940	USSR	36.7	343806	IRAN	30
253777	IRAQ	23.4	291401	HUNG	43.4	307941	USSR	46.7	343807	IRAN	28.4
253778	IRAQ	16.7	291402	HUNG	31.7	307942	USSR	55	343808	IRAN	38.3
253931	IRAQ	28.4	291403	HUNG	21.7	307944	USSR	31.7	343809	IRAN	28.3
253932	IRAQ	20	291404	HUNG	48.4	307945	USSR	33.3	343810	IRAN	35
256334	W PAK	21.7	291405	HUNG	35	307946	USSR	38.3	343811	IRAN	23.4
256335	W PAK	16.7	291406	HUNG	36.7	311743	POLAN	60	343812	IRAN	48.4
257640	USSR	26.7	291407	HUNG	40	318468	BRAZ	31.7	345610	USSR	10
257641	USSR	26.7	291408	HUNG	40	318600	USSR	46.7	345611	USSR	21.7
257642	USSR	31.7	291410	HUNG	26.7	323279	PAK	-	345612	USSR	26.7
257643	USSR	25	291411	HUNG	30	323281	PAK	13.3	345613	USSR	28.3
262515	POLAN	23.4	294658	USTAX	38.3	340780	USSR	61.7	354905	IRAN	31.7
262516	POLAN	23.4	294659	USTAX	35	340781	USSR	40	354906	IRAN	30
262517	POLAN	20	294660	USTAX	25	340782	USSR	31.7	364860	S AFR	40
262518	POLAN	30	296285	S AFR	30	340783	USSR	58.3	369357	USA	20
262519	POLAN	31.7	296287	S AFR	35	340784	USSR	33.3	369358	USA	13.3
262520	POLAN	25	296288	S AFR	16.7	340785	USSR	31.7	369360	USA	31.7
262521	POLAN	40	296289	S AFR	25	340786	USSR	45	369818	AGRN	21.7
263178	TANZ	21.7	296290	S AFR	33.3	340787	USSR	56.7	371933	USSR	20
265099	USSR	10	296291	S AFR	58.3	370788	USSR	-	371934	USSR	28.4
265100	USSR	21.7	296292	S AFR	11.7	340789	USSR	58.3	371935	USSR	40
265101	USSR	30	296293	S AFR	20	340790	USSR	15	371936	USSR	40
265102	USSR	45	297475	FRAN	31.7	340791	USSR	40	371937	USSR	16.7
265103	USSR	43.4	297476	FRAN	58.3	343784	IRAN	23.4	371938	USSR	13.3
265104	USSR	16.7	297477	FRAN	41.7	343785	IRAN	26.7	371939	USSR	30
265499	COLO	21.7	297478	FRAN	23.3	343786	IRAN	33.3	372172	USSR	33.3
265500	COLO	11.7	297479	FRAN	43.4	343787	IRAN	20	372173	USSR	38.3
265501	CHILE	16.7	297480	FRAN	58.3	343788	IRAN	31.7	372174	USSR	58.3
265502	USSR	26.7	297481	FRAN	53.3	343789	IRAN	31.7	372175	USSR	61.7
265503	USSR	20	298632	USSR	38.3	343790	IRAN	33.3	372176	USSR	60
267665	URUG	21.7	299991	S AFR	16.7	343791	IRAN	20	372177	USSR	55
284862	POALN	48.3	299992	S AFR	20	343792	IRAN	28.4	372178	USSR	50

TAB 9 - cont.: Hired work

287181	CHILE	35	301059	TURKY	58.3	543793	IRAN	20	372254	USSR	40
287182	CHILE	33.3	301060	TURKY	31.7	543794	IRAN	25	372255	USSR	41.7
287183	CHILE	46.7	304518	TURKY	48.4	543795	IRAN	25.3	372256	USSR	38.3
287184	CHILE	26.7	306587	USSR	61.7	543796	IRAN	33.3	372257	USSR	56.7
287230	USSR	36.7	307831	BRAZ	20	543797	IRAN	23.4	372258	USSR	35
372259	USSR	36.7	383384	YUGO	31.7	431506	POLAN	45	431551	YUGO	40
372260	USSR	35	386096	ISRL	23.4	431507	POLAN	26.7	431552	YUGO	35
372261	FRAN	25	386228	USSR	50	431508	POLAN	40	431553	YUGO	48.3
376215	FRAN	16.7	386230	USSR	41.7	431509	RODEZ	16.7	431554	YUGO	43.4
376216	FRAN	18.3	386231	USSR	25	431510	RODEZ	48.3	431555	YUGO	63.4
377517	IRAN	20	386232	USSR	20	431511	RODEZ	48.3	431556	YUGO	43.3
377518	IRAN	50	386234	USSR	15	431512	ROMAN	23.4	431557	YUGO	45
377519	IRAN	33.3	386235	USSR	45	431513	ROMAN	-	431558	YUGO	33.3
377520	IRAN	11.7	386236	USSR	56.7	431514	ROMAN	13.3	431559	YUGO	23.4
377521	IRAN	45	386237	USSR	21.7	431515	ROMAN	40			
377522	IRAN	36.7	386238	USSR	58.3	431516	ROMAN	61.7	323588	PORT	45
377523	IRAN	30	386237	USSR	48.3	431517	ROMAN	53.3	331174	ARGE	18.3
377524	IRAN	45	386316	USSR	43.3	431518	ROMAN	16.7	331175	ARGE	31.7
377525	IRAN	28.4	386317	USSR	51.7	431519	ROMAN	33.3	331176	ARGE	51.7
377526	KENYA	25	386318	USSR	40	431520	ROMAN	45			
377527	KENYA	33.3	386319	USSR	20	431521	ROMAN	63.4			
377528	KENYA	23.3	386320	USSR	40	431522	ROMAN	60			
377529	KENYA	25	386321	USSR	21.7	431523	USSR	35			
377530	KENYA	8.4	386322	USSR	51.7	431524	USSR	66.7			
378893	ARGN	33.3	386323	USSR	15	431525	USSR	63.3			
378894	ARGN	30	386324	USSR	38.3	431526	USSR	46.7			
378895	ARGN	21.7	386327	USSR	38.3	431527	USSR	70			
378896	ARGN	35	386328	USSR	43.4	431528	USSR	41.7			
379601	YUGO	41.7	386329	USSR	41.7	431529	USSR	33.3			
379609	POLAN	28.3	402584	USAMN	21.7	431530	USSR	21.7			
380558	KENYA	-	402585	USAMN	33.3	431531	USSR	21.7			
380559	KENYA	31.7	402586	USAMN	48.3	431532	USSR	55			
380560	KENYA	40	406022	IRAN	46.7	431533	USSR	31.7			
380562	KENYA	26.7	406644	AUSTL	58.3	431534	YUGO	46.7			
380563	KENYA	50	406645	AUSTL	30	431535	YUGO	51.7			
380564	KENYA	40	406646	AUSTL	28.4	431536	YUGO	41.7			
380565	KENYA	35	408726	FRAN	55	431537	YUGO	40			
380566	KENYA	45	420138	AUSTL	21.7	431538	YUGO	66.7			
380567	KENYA	55	424926	S AFR	33.3	431539	YUGO	41.7			
380568	KENYA	26.7	426200	AFGH	23.4	431540	YUGO	46.7			
380569	KENYA	26.7	426755	PAK	-	431541	YUGO	38.3			
380570	KENYA	20	430537	USSR	31.7	431542	YUGO	43.3			
380571	USAMN	45	430538	USSR	61.7	431543	YUGO	41.7			
380572	USAMN	38.3	430539	USSR	60	431544	YUGO	36.7			
380573	USAMN	21.7	430540	USSR	43.4	431545	YUGO	28.4			
380574	USSR	43.3	430541	USSR	53.3	431546	YUGO	43.4			
380575	USSR	50	431502	POLAN	53.3	431547	YUGO	61.7			
380576	AGRN	36.7	431503	POLAN	58.3	431548	YUGO	55			
380577	IRAN	28.4	431504	POLAN	65	431549	YUGO	45			
380874	IRAN	20	431505	POLAN	58.3	431550	YUGO	25			