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Screening of the Resistance Levels of 26 Sesame Breeding Lines to *Fusarium* Wilt Disease

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Abstract: Resistance levels of 26 sesame breeding lines derived from 3 different provinces within South-eastern Anatolia district of Turkey were screened against sesame wilt disease caused by *Fusarium oxysporium* fsp. *sesami*. Pathogen was isolated from the roots of infected plants. Pathogenicity tests were performed on two local line under controlled condition. Resistance levels of genotypes were assessed in field experiments established on an area known contaminated by *F. oxysporium* fsp. *sesami* for the last five years. Associated with the resistance levels great differences were observed on breeding lines. According to the mean data of two years, Sanliurfa-63189 was the most resistant genotype with the 6.6% infection rate and the 1st scale value. Half of the breeding lines displayed this disease at the level of below of 20% infection rate and was recognized in the resistant category. Infection rates of five lines within this group was lower than 10%. The most susceptible genotype was Sanliurfa-63283 local line with the average of 40.8% infection rate and the 3rd scale value. It is considered breeding lines in resistant category may include the resistance genes of the sesame to the *Fusarium* wilt disease.

Key words: Sesame genotypes, resistance levels, sesame wilting, *Fusarium oxysporium* fsp. *sesami*

INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the most important oilseed plant cultivated in tropical and subtropical parts of the world. It is grown in mostly irrigated and somewhere non irrigated areas in Turkey. With 20.886 ha farmland and 6810 tone/year crop production, Şanlıurfa province accounts the 75% of all sesame yield in Turkey (Anonymous, 2003). Climatic conditions and the usage of water in sesame agriculture are two most important factors limiting sesame yield in regions. In addition, the variability in cultural practices like irrigation types and intervals, sowing intervals, variety properties etc. (Avila *et al*., 1992; Majumdar and Roy, 1992) are important abiotic factors affecting sesame production in fields.

Miscellaneous fungal disease infecting on root, stem root, stem and foliar components are other important biotic factors that cause yield losses on sesame production (Abd-El-Ghany *et al*., 1974; Pramod *et al*., 1992; Dinakaran *et al*., 1994; Bahkali and Moslem, 1996). *Fusariým oxysporium* fsp. *sesami* (*Fos*) is one of them and reported as a most important soil borne disease causing economic losses on sesame in different countries (Pineda and Avila, 1988; Kang and Kim, 1989; Chung and Choi, 1990; Chung and Hong, 1991; Wasnikar *et al*., 1991; Javed *et al*., 1995; El-Shazly *et al*., 1999). To our investigates, there is no document reporting this disease on sesame in Turkey until last decade. It was detected on sesame plants for the first time in 1996 during surveys conducted throughout the sesame fields of Harran plain, Turkey (Kavak, 1996, unpublished data). According to surveys conducted from earlier years, it has been seen that *Fusarium* is a common and permanent pathogen of sesame plants particularly in irrigated areas of district. At present, contaminated fields are important sources of disease. Considerable variability in reactions of sesame germplasm to *Fusarium* were reported and research has concentrated on the evaluation of resistant variety within germplasms (Bakheit *et al*., 1988; Raghuwanshi *et al*., 1992; Xiao *et al*., 1992; El Shazly *et al*., 1999).

The aim of this study was to screen the resistance levels of 26 sesame breeding lines to *Fusarium* wild disease.

MATERIALS AND METHODS

Breeding lines, field treatments and site properties: Twenty six breeding lines (genotypes) of sesame derived from Adıyaman, Gaziantep and Şanlıurfa provinces were

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Table 1: Temperature (°C) and rainfall (mm) data for the sesame growing season, Harran plain, Turkey 2002, 2003

	June	July	August	September	October
2002 growing season					
Min-temp°C	16	20.8	19.5	17.5	9.6
Max-temp°C	35.4	43	43.1	38	36.4
Mean-temp°C	28.7	32	30.5	26.9	21.8
Total-rain mm	0.3	4.6	0.0	0.7	6.6
2003 growing season					
Min-temp°C	14.1	22.9	21.5	15.7	13.8
Max-temp°C	39	44.3	40.3	41	35.5
Mean-temp°C	28.6	32.6	32.7	26.4	21.5
Total-rain mm	5.2	0.0	0.0	0.1	23.1

Records were obtained from the Şanlıurfa meteorological station

used in this study with the following numbers 12, 6 and 8, respectively. Resistance levels of them were screened against Fusarium wilt disease in field treatments established on experimental station of agricultural faculty, Harran university in 2002 and 2003 growing season. Treatments were established on an area known as contaminated with *Fos* for the five years. Breeding lines were sown in plots as Randomised Complete Bloc Design with four replicate. Each plot was 2×5 m dimension and included four rows while each row contained 25 plants. All rows in plots were irrigated by irrigation trench weekly.

District conducted this study has an arid climate in which summer is hot, dry and long (Table 1) and the winter is generally warm with few quite cold. Almost all rainfall occur during winter period. The altitude of the research field from sea level is approximate 464-467 m and is located at 37°-08 N and 38°-46 E (Table 1).

Identification, isolation and inoculation processes: *Fos* was identified according to macroscopic and microscopic symptoms. Isolations were made from main or lateral root pieces of infected plants. Roots infected were washed in tap water to remove the soil particles attached. After root segments were surface sterilised by immersion for 3 min in 5% sodium hypochlorite and 70% ethyl alcohol for 1 min, rinsed several times with sterile distilled water and blotted with the sterile paper towels. These segments were then placed on PDA medium and incubated 27°C for 7-10 days. A macro conidia was placed on a fresh PDA medium and incubated in same temperature until forming colony. Mycelium segments derived from one colony was streaked on fresh PDA medium to obtain the sub culture of this pathogen.

To prepare of the inoculum, approximately 1 cm^2 discs from PDA including *Fos* mycelia and conidia were cut out and plated on autoclaved barley grains placed in glass bottles. Bottles were plugged by cotton wool and incubated at 25°C for twenty days. Seventy five gram inoculum was mixed with the 2 kg sterilised soil and prepared for each pot before sowing.

Pathogenicity tests were performed on seedlings of two sesame lines, Şanlıurfa-63283 and Gaziantep-27236. Seeds of them were sown in pots including soil and inoculum mixtures described. For controls, seeds were sown in pots including sterilised soil only. Four and two replicates per breeding line were established as infected and controls, respectively. Seven seeds per pot were sown. Pots were irrigated every five days and hold under observation daily. After wilting symptoms were detected on seedlings, re-isolation and re-inoculation procedures were completed.

Infected plants derived from plots were tested for confirmation. Plant segments excised from roots and stems were surface sterilised and plated on petri dishes including humid filter paper with sterilised distilled water. They were then incubated at 25°C until 72 h. Secondly, plant segments described were plated on petri dishes including PDA agar and incubated at the same temperature and period. Cultures giving mycelia growths with conidia of *Fusarium* pathogen were accepted as this disease.

Evaluation and test procedure: To evaluate the resistance levels of local lines, 1- 5 scales were formed based on the infection percent as follow; 1-20% = 1, 20.01-40% = 2, 40.01-60% = 3, 60.01-80% = 4, 80.01-100 = 5. The comments of this scale values were [1 = resistant (R), 2 = mean resistant (MR), 3 = mean susceptible (MS), 4 = susceptible (S) and 5 = highly susceptible (HS)].

All plots were screened from 20 days to 100 days after sowing. The number of infected plant in each row was counted in determined time period. Then, total number was transformed into percent value for each plot.

The variance analyse were performed on plots (replicates) and genotypes. Mean values displayed were subjected to Duncan multiple range test and grouped. After tested, comparisons were made between mean value and scale value and then scored the resistance level of each breeding line.

RESULTS AND DISCUSSION

In the current study Fusarium wilt disease was detected on infected sesame plants. Macroscopic and microscopic symptoms identified it clearly. Complete dried

Table 2: Sesame genotypes, mean infection rates, scale values and resistance levels

Genotypes	2002		2003			
Local line	Mean	Scale value and levels	Mean	Scale value and levels	Mean combined	Scale value and levels
Adıyaman-0263	10.25	1-R	6.00	1-R	8.1	1-R
Adıyaman-0281	16.75	1-R	24.50	2-MR	20.6	2-MR
Gaziantep-27224	8.50	1-R	11.00	1-R	9.8	1-R
Şanlıurfa-63108	28.00	2-MR	15.00	1-R	21.5	2-MR
Şanlıurfa-63283	44.00	3-MS	37.25	2-MR	40.6	3-MS
Gaziantep-27206	9.25	1-R	12.00	1-R	10.6	1-R
Şanlıurfa-63189	8.25	1-R	5.00	1-R	6.6	1-R
Adıyaman-0201	26.75	2-MR	33.00	2-MR	29.9	2-MR
Adıyaman-0288	14.25	1-R	18.25	1-R	16.3	1-R
Adıyaman-0238	5.75	1-R	9.25	1-R	7.5	1-R
Gaziantep-27241	12.50	1-R	19.00	1-R	15.8	1-R
Şanlıurfa-63135	10.75	1-R	8.00	1-R	9.4	1-R
Adıyaman-0241	11.00	1-R	20.50	2-MR	15.8	1-R
Adıyaman-0236	14.50	1-R	9.50	1-R	12	1-R
Şanlıurfa-63175	16.00	1-R	25.50	2-MR	20.8	2-MR
Şanlıurfa-63117	23.25	2-MR	17.00	1-R	20.1	2-MR
Adıyaman-0260	22.00	2-MR	34.75	2-MR	28.4	2-MR
Şanlıurfa	25.75	2-MR	30.25	2-MR	28	2-MR
Gaziantep-27234	12.00	1-R	21.50	2-MR	16.8	1-R
Adıyaman-0250	20.25	2-MR	33.50	2-MR	26.9	2-MR
Adıyaman-0220	13.75	1-R	7.75	1-R	10.8	1-R
Şanlıurfa-63275	27.25	2-MR	33.75	2-MS	30.5	2-MR
Gaziantep-27236	35.00	2-MR	42.00	3-MS	38.5	2-MR
Adıyaman-0252	7.75	1-R	9.25	1-R	8.5	1-R
Gaziantep-27285	25.00	2-MR	10.75	1-R	17.9	1-R
Adıyaman-0202	18.00	1-R	25.73	2-MR	21.9	2-MR
Total average	17.96		19.99		18.97	

1 = Resistant (R), 2 = Mean resistant (MR), 3 = Mean susceptible, (MS), 4 = Susceptible (S), 5 = highly susceptible (HS). $p<0.05$

plants and partially infected branches were two frequent symptoms of it. The partial wilted branches were limited to one side of the stem and plants having these symptoms were killed completely in different time periods. Dark brown or black discoloration of the vascular tissue were the another distinctive symptoms. Whitish mycelia growths with macro and micro conidia were specific for this pathogen and produced on infected roots. Macro conidia were three to five-septate with commonly four septate, slightly curved or sickle shaped and 2.5-4.5 μm×26-39 μm in dimensions. Micro conidia with two septate were 12×18 μm in lengths. Pathogenecity tests conducted on Şanlıurfa-63283 and Gaziantep-27236 local lines confirmed the real agency of *Fos* on dried sesame plants.

Associated with the resistance levels to *Fusarium* wilt disease, significant differences were displayed by sesame breeding lines tested. The local line Şanlıurfa 63189 was the most resistant genotype with average 6.6% infection rate and the 1st scale value. Genotypes, viz., Adıyaman-0263, Gaziantep-27224, Adıyaman-0238, Şanlıurfa-63135 and Adıyaman-0252 were the other resistant local lines. Their infection rates were lower than 10% and described in the 1st scale value. The max infection rate was 40.8% and displayed by the Şanlıurfa-63283 local line. With its infection rate, this was the only genotype determined in the 3rd scale. Infection levels of breeding lines differed dependently in years (Table 2).

Germplasm having perfect resistance (without symptom) to Fusarium wilt disease, was reported (El-Shazly *et al*., 1999). In this study, however, there was no any local line similar to reported above. However, it is considered that genotypes within scale value 1 may carry the resistance gene of the sesame against this infection. Stability levels displayed during two years may have been evidence of their resistant levels. If more resistant variety is not obtained, their sowing in agricultural fields may be recommended.

Miscellaneous studies associated with our study were previously conducted by researches in different country (Abd-El-Ghany *et al*., 1974; Raghuwanshi *et al*., 1992; Xiao *et al*., 1992; Dinakaran *et al*.,1994; El-Shazly *et al*., 1999). They conducted their researches in sesame populations and almost all aim of them was to detect the perfect resistant genotypes, breeding lines or germplasms of sesame against *Fusarium* wilt disease.

As a result, present study is the first beginning position in Turkey and some local lines were detected in resistant category. However, it is considered that investigations should be maintained in the current district or other regions to detect the most resistant genotypes. Because it is known that more virulent

races will be produced by the future populations of the *Fos*.

REFERENCES

Abd-El-Ghany, A.K. M.B. Seoud, M.W. Azab, B.K. Mahmoud, K.A.A. El-Alfy and M.A., Abd-El-Gwad, 1974. Tests with different varieties and strains of sesame for resistance to root rot and wilt diseases. Agric. Res. Rev., 52: 75-83.

Anonymous, 2003. Agricultural Structure (Production, Price, Value). State Institute of Statistics, Prime Ministry, Republic of Turkey, Ankara, Turkey.

Avila, J., J. Hernandez and T. Acevedo, 1992. Effect of sowing distance between rows on performance of four sesame (*Sesamum indicum*) cultivars. Agron. Trop. Maracay, 42: 307-320.

Bakheit, B.R., M.Z. El Hifny, E.E. Mahdy, N.R. Gurguis and A. El Shimy, 1988. Evaluation of sesame genotypes for relative tolerance to root rot disease. Assuit J. Agri. Sci., 19: 255-264.

Bahkali, A.H. and M.A. Moslem, 1996. Seed-borne fungal contaminants of sesame (*Sesamum indicum*) seed in Saudi Arabia. Arab Gulf J. Sci. Res., 14: 155-167.

Chung, H.S. and W.B. Choi, 1990. Biological control of sesame damping off in the field by coating seed with antagonistic *Trichoderma viride*. Seed Sci. Technol., 18: 451-459.

Chung, B.K. and K.S. Hong, 1991. Biological control with *Streptomyces* sp. on *Fusarium oxysporium* fsp vasinfectum and Phytopthora nicotianae var. parasitica causing sesame wilt and blight. Korean J. Mycol., 19: 231-237.

Dinakaran, D., V. Manoharan and V. Dharmalingam, 1994. Screening of Sesame cultures against major diseases. Sesame end Safflower Newsletter, 9: 4-6.

El-Shazly, M.S., O.A. Abdul Wahid, M.A. El-Ashry, S.M. Ammar and M.A. El Barmawy, 1999. Evaluation of resistance to Fusarium Wilt disease in sesame germplasm. Intl. J. Pest Manag., 46: 207-210.

Javed, M.S., A. Wahid and M. Idrees, 1995. Fungi associated with sesame seed and their frequency. Pak. J. Phytopathol., 7: 174-176.

Kang, S.W. and H.K. Kim, 1989. Gliocladium virens, a potential biocontrol agent against damping-off and Fusarium wilt of sesame (*Sesamum indicum* L.) in problem fields in Korea. Research reports of the Rural Development Administration, Crop Prot., Korea Republic, 31: 19-26.

Majumdar, D.K. and S.K. Roy, 1992. Response of Summer sesame (*Sesamum indicum*) to irrigation, row spacing and plant population. Indian J. Agron., 37: 758-762.

Pineda, P.J.B. and M.J.M. Avila, 1988. Alternativas para el control de *Macrophomina phaseolina Fusarium oxysporium*, patogenos del ajonjoli (*Sesamum indicum* L). Agron. Trop. Maracay, 38: 79-84.

Pramod, K., V.S. Mishra and P. Kumar, 1992. Diseases of *Sesamum indicum* in Rohilkhand: Intensity and yield loss. Indian Phytopathol., 45: 121-122.

Raghuwanshi, K.S., N.N. Khune, C.D. Deokar, D.M. Veer. and R.W. Bharud, 1992. Screening of sesame germplasm against *Fusarium oxysporium* fsp. *sesami*. Sesame end Safflower Newslett., 7: 24-25.

Wasnikar, A.R., M.R. Deshmukh and S.M. Sharma, 1991. Toxicity of fungal metabolites on germination and growth of sesame. Current-Research University of Agricultural Sciences Bangalore, 23: 185-186.

Xiao, T.H., X.Y. Feng and X.R. Zhang, 1992. Evaluation of introduced sesame germplasm. Crop Genetic Resources, 4: 38-39.