CONTROLLING SESAME CHARCOAL ROT INCITED BY *MACROPHOMONA PHASEOLINA* UNDER FIELD CONDITIONS BY USING RESISTANT CULTIVARS AND SOME SEED AND SOIL TREATMENTS

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ABSTRACT:

Applying Benlate or Rizolex-T at the rate of 3 g/kg seeds gave the best results (90.0-96.7% survived seedlings; 3.3-6.7% rotted plants and 93.3% and 83.3% healthy mature plants). While, Rizolex-T and Vitavax-T used at rate of 2 Kg/feddan as soil treatments had no significant effect on disease incidence at seedling stage and produced the lowest significant effect at maturity stage (46.7% and 43.3% healthy mature plants, respectively. Meanwhile, under field conditions all tested seed, soil and seed/soil treatments were significantly effective in reducing charcoal rot disease incidence and increasing sesame seed yield production. However, the combined seed/soil treatments Rizolex-T + Amconil , Rizolex-T + Rizolex-T, Benlate + Vitavax-T and Benlate + Amconil gave the best results in this respect.

Sesame entries responded differently throughout the different stages of disease development under greenhouse conditions. Whatever, the sesame entries (at maturity stage) that produce < 50%; 50 to < 60%; 60 to < 70%; 70 to < 80%; 80 to < 90%; > 90.0% survived seedlings (at seedling stage) or healthy mature plants were classified as highly susceptible "HS"; susceptible "S"; moderate susceptible "MS"; moderately resistant "MR"; resistant "R" and highly resistant "HR", respectively. Percentages of healthy mature plants were 3.3-40.0% in the HS entries (strain 806, strain 792, strain 779, strain 799, B11, strain 772, Giza 32, and Toushka 2) meanwhile it was increased to 80.0-83.3% in the R entries (strain 771, Toushka 3, Adnan 1(5/91), and Taka 2). At seedling stage, amounts of free and total phenols and reducing and total sugars, in general, were obviously higher in the HR and R than the S and HS sesame entries. Based on protein bands, the similarity between 15 sesame entries represented the above categories was discussed in light of their disease reactions.

Under field conditions, Aceteru-M, Adnan 1 (5/91), Taka 2 and Mutation 48 were the most resistant while, strain 806 and Giza 32 were the most susceptible. Taka 2, Mutation 48 and Adnan 1 (5/91) produced the highest seed yield. Meanwhile, strain 806, B 11, strain 779, Giza 32, Tushka 1, Aceteru-M and strain 773, Taka 1 produced the lowest seed yield. The seed yield of Tushka 2 "S" was significantly higher than the "R" entries Shandaweel 3, Strain 787 and Aceteru-M. Shandaweel 3, Mutation 48 and Giza 32 at Tahrir locality and Taka 3 and Tushka 2 at Sids locality showed the lowest reduction in oil content due to charcoal rot infection (2.53-4.66%) while, the highest reduction was associated with strain 806 (10.93-11.79%).

Key words: Fungicides, *Macrophomina phaseolina*, sesame cvs, charcoal rot disease and protein bands.

INTRODUCTION

The soilborne diseases affecting sesame plants including charcoal rot (*Macrophomina phaseolina*) could be controlled by fungicidal treatments. **El-Khadem *et al.* (1991)** stated that, Benlate as seed dressing was the most effective against artificial infection of sesame root rot and wilt diseases and produced the highest survival plants. The combined treatment (Ronilan + Benlate) was the best for minimizing root rot and wilt diseases under field conditions followed by soil treatment with Ronilan and Homai or Vitavax /thiram for seed treatment. **Khalifa (1997)** reported that, Benlate and Rizolex-T were the best for controlling *M. phaseolina* and *F. oxysporum* and increasing healthy mature plants of sesame in greenhouse. The combined seed ans soil treatments of Rizolex T or Benlate + chloroyhecieb as soil treatment were superior for controlling root rot and wilt diseases and increased seed yield of sesame under field conditions. In pot experiments, **Gabr *et al.* (1998)** found that Benlate and Rizolex T as soil treatments decreased the incidence of wilt and root rot diseases of sesame plants. Benlate was very effective in decreasing infection by *M. phaseolina* and *F. oxysporum* when applied at 0.5 g/hill under field conditions.

Reaction of sesame genotypes as well as their seed yield production as affected differently by charcoal rot infection was greatly varied (**El-Deeb *et al.*, 1998; Rajput *et al.*, 1998**). **Ragab *et al.* (2002)** evaluated some sesame varieties against charcoal rot (*M. phaseolina*) under field and greenhouse trials. Under greenhouse conditions, Taka varieties were resistant. Reductions in yield components (seed yield and % oil content) due to infection_of Taka vars. were significantly lower than of those of Giza 32. The development of disease resistance was found to be correlated with the accumulation of host synthesized new polypeptides (**Broglie *et al.*, 1986**). The new protein contents depended on host genotype and virulence genes of the pathogens (**Hlinkova and Sykora, 1996)**. The changes of proteins depended on the host genotype and sensitivity to infection **(Radwan, 2000)**.

The present work aimed to evaluate several fungicidal treatments and sesame cultivars and entries under greenhouse and field conditions to find the superior one for controlling incidence of charcoal rot infection and increasing seed yield production of two sesame cultivars. The correlation between disease resistance and the synthesized protein was also investigated.

MATERIALS AND METHODS

1- Effect of different seed and soil treatments on disease control under greenhouse and field conditions:

In the greenhouse experiment, Benlate 50% 50% wp, (Benomyl); Rizolex, 50% and Vitavax-T (75%) were used as seed treatments at the rate of 3 g/kg seed. As well as Maxim AP (3.5%) at the rate of 3 ml/kg seed, Plant guard at rate of 5 ml /kg seed and Rizo-N at rate of 5 g/kg seed. Meanwhile, Arabic gum solution (1%) was used for improving the compounds coverage on the seeds. While, the fungicides Amconil (75%), Rizolex-T and Vitavax-T were used as soil treatments in pots (3 kg soil/pot) infested with *M. phaseolina* just before sowing at the rates equivalent to 5, 2 and 2 kg/fed, respectively. The treated or untreated potted soils were sown with treated or non-treated sesame seeds at the rate of 10 seeds/pot, 3 replicate pots for each treatment. Percentage of pre- & post-emergence damping off were determined 15 and 45 days after sowing while, charcoal root rot and healthy mature plants were estimated 90 days after sowing. All estimations were elucidated as percentage to the number of sown seeds/pot.

In the field experiment, the above seed and soil treatments were used in similar way. While, in soil treatment, the fungicides Rizolex-T, Vitavax-T and Amconil were added to soil 30 days after sowing at the rate of 2, 2 and 5 kg/fed., respectively. The desired amount of each soil fungicide was thoroughly mixed with appropriate amount of fine sand to facilitate fungicide distribution. Untreated seeds and/or fungicides free soil were used as control. Two sesame cultivars i.e. Giza 32 and Mutation 48 were used in this study. Percentages of charcoal rot disease incidence and healthy plants as well as seed yield were determined 20 days after harvesting.

2- Reaction of some sesame cultivars and strains against the charcoal rot infection under greenhouse and field conditions:

In the greenhouse experiment, surface sterilized seeds of the tested 30 sesame entries were sown in potted *M. phaseolina*-infested soil at the rate of 10-seeds/pot (25 cm) and 3 pots were used for each treatment. Disease assessment was estimated as mentioned before. Phenolic compounds and sugars contents were determined in leaves of 60 days-old healthy sesame plants according to the methods applied by **Snell** and **Snell (1953**) and **Thomas** and **Dutcher (1924**), respectively. Change in soluble proteins due to infection with *M. phaseolina* was determined in 15 sesame entries according to the techniques described by **Borglie *et al.* (1986)**, **Ekramoddoullah** and **Davidson** (**1995**), **Hochstrasser** *et al.* (**1988**) and **Matsudaira** (**1987**). The electrophoretic protein patterns of the tested sesame entries were clustered by average linked technique (**Joseph *et al.*, 1992**). Results were expressed as phenograms, while, cluster analysis was performed with a computerized program.

Sixteen sesame entries were evaluated under field conditions for their susceptibility to charcoal rot disease. Disease assessment was measured as percentages of mature plant showing charcoal rot symptoms 90 days after planting. Seed yield was determined 20 days after harvest. Oil content in seeds of healthy and diseased plants was extracted and determined according to the method described by **A.O.A.C. (1965)**. Data were subjected to the analysis of variance according to **Snedecor** and **Cochran** (**1989**).

All field experiments were performed in heavily *M. phaseolina*-infested soil at Sids-Farm (Beni-Suef governorate) during 1999 and 2000 seasons in a complete randomized block design with three replicates for each treatment. The field plot was 3.0 x 3.5 m^2 (10.5 m^2 = 1/400 feddan) with four rows. The distance between sowing holes about 20 cm. Each plot included about 100-120 plants (25-30 plant/row). The recommended agricultural practices and irrigation were used.

RESULTS

Efficiency of some fungicides and commercial bioagents on controlling sesame charcoal rot under artificial inoculation in the greenhouse conditions:

Data in **Table (1)** indicated that, seed treatment has reduced disease incidence better than soil treatments. Treating sesame seeds with Benlate and Rizolex-T produced the best results as they reduced charcoal rot to 3.3% and 6.7% and increased healthy mature plants to 93.3% and 83.3%, respectively. Amconil used as soil treatment and Rizo-N used as seed treatment caused slight improvement in disease control meanwhile, Rizolex-T or Vitavax-T used as soil treatment had no significant effect on disease incidence at seedling stage and produced the lowest significant effect on controlling the disease incidence at maturity stage.

Table (1): Effect of some seed and soil treatments on the incidence of damping off and charcoal rot diseases caused by *M. phaseolina* at seedling and maturity stages

Fungicides and bioagents	Method of application	% Disease incidence				
		At seedling stage			At maturity stage	
		% Pre-	% Post-	% Survival	% Rotted plants	% Healthy plants
Rizolex-T	Seed treatment	3.3	6.7	90.0	6.7	83.3
Vitavax-T	Seed treatment	13.3	10.0	76.7	13.3	63.3
Benlate	Seed treatment	0.0	3.3	96.7	3.3	93.3
Maxim	Seed treatment	6.7	13.3	80.0	10.0	70.0
Rizolex-T	Soil treatment	23.3	16.7	60.0	13.3	46.7
Vitavax-T	Soil treatment	20.0	23.3	56.7	13.3	43.3
Amconil	Soil treatment	13.3	16.7	70.0	20.0	50.0
Plant guard	Seed treatment	16.7	3.3	80.0	16.7	63.3
Rhizo-N	Seed treatment	16.7	16.7	66.7	13.3	53.3
Control		26.7	23.3	50.0	23.3	26.7

	Pre	Post	Survival	Rot	Healthy
L.S.D at 0.05:	8.61	9.53	11.5	9.29	11.77

Efficacy of combination between seed and soil fungicides and commercial bioagents treatments on sesame charcoal rot disease incidence and seed yield:

1- Incidence of sesame charcoal rot:

Data presented in Table (2) indicated that, all tested seed and soil treatments as well as their combinations were significantly effective in reducing charcoal rot disease incidence and increasing seed yield of sesame cultivars Giza 32 and Mutation 48. The improvement in disease control and seed yield production was more obvious and significantly better when seed and soil treatments were combined together compared with each one alone. Concerning seed treatments, Rizolex-T and Benlate in both 1999 and 2000 seasons caused the highest significant decrease in incidence of charcoal rot disease on both sesame cvs. Giza 32 and Mutation 48 compared with their check treatments.

Table (2): Effect of treating seeds and/or soil with fungicides or bioagents on charcoal rot incidence on sesame cultivars Giza 32 and Mutation 48

Seed treatment	Soil treatment and Season								Mean	
	Rizolex-T		Vitavax-T		Amconil		Control			
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Giza 32										
Rizolex-T	7.3	6.4	9.4	12.7	15.1	14.8	21.0	22.7	13.2	14.2
Vitavax-T	17.2	20.8	13.1	21.3	12.9	18.3	23.1	27.3	16.6	21.9
Benlate	10.4	13.6	8.7	7.5	11.7	8.9	21.9	16.2	13.2	11.6
Maxim	12.7	16.4	9.1	8.3	14.0	19.1	23.9	29.7	14.9	18.4
Rizo-N	23.0	26.5	16.9	14.7	21.8	28.2	31.4	33.3	23.3	25.7
Plant guard	16.3	18.2	19.0	21.7	20.3	21.1	26.5	28.5	20.5	22.4
Control	34.2	37.0	31.6	38.5	36.0	40.6	37.6	41.9	34.9	39.5
Mean	17.3	19.8	15.4	17.8	18.8	21.6	26.5	28.5		
Mutation 48										
Rizolex-T	4.7	6.0	7.6	5.1	6.7	4.8	13.1	14.7	8.0	7.7
Vitavax-T	8.0	13.3	13.4	11.8	11.3	5.9	19.4	18.3	13.0	12.3
Benlate	7.9	9.8	11.2	7.7	8.9	10.7	15.5	14.2	10.9	10.6
Maxim	10.5	11.1	11.0	9.4	12.8	14.4	18.9	17.6	13.3	13.1
Rizo-N	15.3	12.5	15.3	13.0	12.5	12.0	22.1	21.0	16.3	14.6
Plant guard	13.4	13.0	15.8	11.4	11.8	12.5	20.9	20.0	15.5	14.2
Control	20.8	21.7	23.2	25.0	22.3	20.0	27.1	26.7	23.4	23.4
Mean	11.5	12.5	13.9	11.9	12.3	11.5	19.6	18.9		

LSD at 5% for	Giza 32		Mutation 48	
	1999	2000	1999	2000
Seed treatment	1.33	1.98	1.54	1.65
Soil treatment	1.01	1.49	1.17	1.25
Interaction	2.67	3.95	n.s.	3.30

In case of soil treatments, Vitavax-T was the best for controlling charcoal rot on cv. Giza 32 during both seasons followed by Amconil and Rizolex-T. On cv. Mutation 48, Rizolex-T and Amconil were the best in this respect during 1999 season whereas, the three soil fungicidal treatments were significantly equal during 2000 season.

Regarding interaction between seed + soil treatments, the lowest disease incidence on cv. Giza 32 was induced by Rizolex-T + Rizolex-T (7.3%), Benlate + Vitavax-T (8.7%), Maxim + Vitavax-T (9.1%) and Rizolex-T + Vitavax-T (9.4%) in 1999 season, but Benlate + Vitavax-T (7.5%), Maxim + Vitavax-T (8.3%), and Benlate + Amconil (8.9%) were the best and significantly equal in controlling the disease in 2000 season. As for cv. Mutation 48, disease incidence was not significantly affected by seed + soil fungicide interaction in 1999 season. Meanwhile, in 2000 season, Rizolex-T + Amconil (4.8%), Rizolex-T + Vitavax-T (5.1%), Vitavax-T + Amocnil (5.9%), Rizolex-T + Rizolex-T (6.0%) and Benlate + Vitavax-T (7.7%) were the best and were significantly equal in controlling the disease.

2- Sesame seed yield production:

Data in Table (3) indicate that, Benlate and Rizolex-T applied as seed treatments were significantly equal and produced the highest increase in seed yield of sesame cv. Giza 32 (307.1 kg/fed) and Mutation 48 (412.2 kg/fed), respectively. On the other hand, the other side, the lowest increase in seed yield of both sesame cvs. was produced by the commercial bioagents Plant guard and Rizo-N, respectively compared with control treatment (un treated seeds). As for soil treatments and their effect on seed yield productionm Vitavax-T was the best of all on cv. Giza 32 during seasons 1999 (276.5 kg/fed) and 2000 (267.3 kg/fed). However, the highest seed yield of cv. Mutation 48 was produced by Rizolex-T (358.6 kg/fed) and Amconil (357.1 k/fed) in seasons 1999 and 2000, respectively.

Table (3): Effect of treating seeds and/or soil with fungicides or bioagents on the total seed yield (kg/fed.) of sesame cultivars Giza 32 and Mutation 48

Seed treatment	Soil treatment and Season								Mean	
	Rizolex-T		Vitavax-T		Amconil		Control			
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Giza 32										
Rizolex-T	366.7	390.3	346.0	319.7	253.4	282.3	215.9	186.2	295.5	294.6
Vitavax-T	229.7	206.8	277.1	198.8	286.6	223.9	195.4	174.3	247.2	201.0
Benlate	339.9	292.7	358.1	385.2	320.7	368.1	209.8	253.8	307.1	325.0
Maxim	294.4	261.7	351.7	377.5	263.5	217.0	190.4	159.4	275.0	253.9
Rizo-N	202.3	178.6	231.5	280.3	211.0	168.1	147.3	130.5	198.0	189.4
Plant guard	238.6	229.0	221.6	193.2	216.5	200.4	177.3	162.8	213.5	196.4
Control	134.3	125.6	149.8	116.5	127.0	111.8	118.8	106.7	132.5	115.2
Mean	258.0	240.7	276.5	267.3	239.8	224.5	179.3	167.7		
Mutation 48										
Rizolex-T	449.3	429.4	433.7	435.8	438.9	446.0	326.9	293.9	412.2	401.3
Vitavax-T	426.5	317.7	346.7	361.1	372.7	430.3	225.8	255.4	342.9	341.1
Benlate	432.6	403.6	396.2	420.5	414.7	396.5	278.2	303.7	380.4	381.1
Maxim	399.3	379.0	391.0	406.0	336.2	298.1	238.2	269.4	341.2	338.1
Rizo-N	290.3	345.2	289.7	321.1	345.1	350.5	177.1	211.5	275.6	307.1
Plant guard	321.7	322.3	266.7	369.2	337.5	338.2	189.8	234.3	278.9	316.0
Control	190.6	205.7	163.5	179.2	176.6	239.9	153.3	168.6	171.0	198.4
Mean	358.6	343.3	326.8	356.1	346.0	357.1	227.0	248.1		

LSD at 5% for Giza 32 Mutation 48

	1999	2000	1999	2000
Seed treatment	4.28	5.33	7.63	7.74
Soil treatment	3.23	4.03	5.77	5.85
Interaction	8.55	10.66	15.27	15.47

With regard to the combined seed/soil treatments, the highest significant increase in seed yield of cv. Giza 32 was produced by Rizolex-T + Rizolex-T (366.7 & 390.3 kg/fed), Benlate + Vitavax-T (358.1 & 385.2 kg/fed), Maxim + Vitavax-T (351.7 & 377.5 kg/fed) in 1999 and 2000 seasons, respectively. In case of cv. Mutation 48, the highest seed yield was produced by Rizolex-T + Rizolex-T (449.3 kg/fed) and Rizolex-T + Amconil (438.9 kg/fed) in 1999 season and Rizolex-T + Amconil (446.0 kg/fed) and Rizolex-T + Vitavax-T (435.8 kg/fed) in 2000 season.

The above results proved that, the fungicides Rizolex-T, Vitavax-T and Amconil were more effective in controlling sesame charcoal rot and increasing sesame seed yield when used as seed treatments than as soil treatments. However, the best results were obtained when they were used in dual combinations. The combined seed + soil treatments of Rizolex-T + Amconil, Rizolex-T + Rizolex-T, Benlate + Vitavax-T and Benlate + Amocnil were successful in reducing the incidence of charcoal rot disease and increased seed yield in sesame plantation.

Reaction of sesame entries against charcoal rot infection under greenhouse conditions and phenols and sugars contents in their leaf extracts:

Data in **Table (4)** proved that the tested 30 sesame cultivars and strains (entries) reacted differently throughout the different stages of disease development (Pre-, post-emergence damping off, survived seedlings, charcoal rotted, and healthy mature plants). Based on percentage of healthy mature plants, the screened sesame entries could be classified as follows:

1 – Highly resistant entries produced > 90% seedling survival [Adnan 1 (5/91), strain 771 and Tushka 3].

2 – Resistant entries produced < 90.0 to 80.0% seedling survivals [Aceteru-M, B35, Mutation 48, Shandaweel 3, strain 785, strain 787, strain 791, Taka 2 and Taka 3].

3 – Moderately resistant entries produced < 80.0 to 70.0% seedling survivals [strain 774, strain 775, strain 783, strain 794, strain 797 and Taka 1].

4 – Moderately susceptible entries produced < 70.0 to 60.0% seedling survivals [strain 773, strain 786, strain 796 and Tushka 1].

5 –Susceptible entries produced < 60.0 to 50.0% seedling survivals [B11, Giza 32, strain 772, strain 779, strain 799 and Tushka 2].

6 – Highly susceptible entries produced < 50.0% seedling survivals [strain 806 and strain 792].

Biochemical changes of sesame entries differing in their reaction to M. phaseolina infection:

Data in **Table (5a)** indicate that, the amount of free phenols, total phenols, reducing and total sugars, in general, were obviously higher in the leaf extracts of the highly resistant "HR" and resistant "R" more than the susceptible "S" and highly susceptible "HS" sesame entries. The highest amounts of free and total phenols were detected in Tushka 3 "R" and Aceteru-M "R". While, the highest amount of conjugated phenols was detected in strain 771 "HR" and Taka 2 "R. On the contrary, the lowest amounts were detected in strain 806 "HS" followed by Tushka 1 "MS" and strain 792 "HS" entries. Moreover, the sesame entries B 35 "R" and Mutation 48 "R" showed the highest amounts of reducing and total sugars followed by Tushka 3 "HR", Adnan 1 (5/91) "HR". While the lowest amounts of reducing and total sugars were found in strain 806 "HS", strain 773 "MS" and Giza 32 "S", respectively.

Similarity of protein pattern of different sesame entries:

Based on the protein bands derived from the gel electrophoretic (SDS-PAGE) of soluble proteins the 15 tested entries were found to belonged to 2 main separate

Table (4): Reaction of different sesame cultivars and entries against infection with the charcoal rot pathogen under greenhouse conditions and phenols and sugars contents of healthy plant leaves 60 days after sowing

	Disease incidence %					Phenols content			Sugars content		
	Seddling stage			Mature stage							
Cultivars and strains	% Pre-	% Post-	* Reaction	% Rot	% Healthy	Fre	Conjugated	Total	Reducing	Non-Reducing	Total
Adnan 1(5/91)	10.0	0.0	HR	6.7	83.3	14.26	0.29	14.54	5.06	1.76	6.83
Strain 771	6.7	3.3	HR	10.0	80.0	8.99	6.18	15.18	5.32	0.96	6.28
Toushka 3	0.0	3.3	HR	16.7	80.0	21.33	0.99	22.32	7.18	1.19	8.38
Aceteru-M	10.0	10.0	R	13.3	66.7	18.78	0.84	19.61	2.63	0.59	3.22
B35	10.0	6.7	R	13.3	70.0	14.26	0.65	14.90	7.81	4.07	11.88
Mutation 48	10.0	10.0	R	10.0	70.0	11.52	1.42	12.94	8.01	3.79	11.79
Shandaweel 3	13.3	6.7	R	10.0	70.0	11.21	2.65	13.86	4.28	2.16	6.44
Strain 785	6.7	6.7	R	16.7	70.0	7.06	4.36	11.42	2.22	0.64	2.86
Strain 787	13.3	6.7	R	3.3	76.7	6.86	0.98	7.85	3.32	0.10	3.42
Strain 791	6.7	6.7	R	26.7	60.0	12.46	0.97	13.44	5.10	1.66	6.76
Taka 2	10.0	6.7	R	0.0	83.3	9.08	4.92	14.00	4.39	2.03	6.43
Taka 3	10.0	10.0	R	13.3	66.7	7.71	3.02	10.73	2.61	1.23	3.84
Strain 774	16.7	10.0	MR	16.7	56.7	6.88	2.22	9.10	2.89	1.69	4.58
Strain 775	13.3	13.3	MR	16.7	56.7	3.82	4.22	8.04	4.29	0.33	4.61
Strain 783	16.7	13.3	MR	10.0	60.0	6.79	1.12	7.92	1.52	0.32	1.83
Strain 794	16.7	13.3	MR	3.3	66.7	13.21	1.30	14.52	3.14	0.28	3.42
Strain 797	16.7	10.0	MR	16.7	56.7	3.98	2.72	6.70	2.73	0.12	2.85
Taka 1	13.3	10.0	MR	10.0	66.7	6.78	1.38	8.16	1.25	0.22	1.48
Strain 773	23.3	13.3	MS	13.3	50.0	7.07	0.85	7.92	1.04	0.10	1.14
Strain 786	23.3	16.7	MS	10.0	50.0	6.86	0.27	7.13	1.25	0.28	1.53
Strain 796	20.0	13.3	MS	10.0	56.7	8.27	1.95	10.22	1.75	1.52	3.27
Toushka 1	23.3	10.0	MS	16.7	50.0	2.83	2.30	5.13	2.39	0.24	2.63
B11	26.7	16.7	S	23.3	33.3	3.99	4.42	8.41	2.21	0.11	2.33
Giza 32	23.3	20.0	S	16.7	40.0	4.80	1.70	6.51	1.06	0.11	1.18
Strain 772	23.3	20.0	S	23.3	33.3	4.22	3.13	7.35	3.21	0.17	3.38
Strain 779	23.3	20.0	S	26.7	30.0	4.21	1.99	6.20	2.80	0.22	3.02
Strain 799	26.7	23.3	S	20.0	30.0	3.64	2.71	6.35	2.52	0.25	2.77
Toushka 2	26.7	16.7	S	16.7	40.0	6.19	1.24	7.44	3.46	0.51	3.97
Strain 792	33.3	20.0	HS	16.7	30.0	3.05	1.99	5.05	3.52	0.14	3.67
Strain 806	30.0	26.7	HS	40.0	3.3	2.42	2.93	5.35	0.94	0.04	0.98
L.S.D. 5%	7.84	7.34		7.80	6.41						

HR = Highly resistant
R = Resistant
MR = Moderate resistant
MS = Moderate susceptible
S = Susceptible
HS = Highly susceptible

clusters with similarity 57.01% (Fig. 1-A & 1-B). The first cluster consists of 3-sub clusters. The first sub cluster includes strain 806 "HS" alone. The second sub cluster included 2 sub-sub cluster with similarity 87.0%. The first sub-sub cluster includes Giza 32 "S" and strain 779 "S" with similarity 91.73% while the second sub-sub cluster includes B11 "S", Touska2 "S" and Toushka1 "MS with similarity 96.23% between Toushka1 and Toushka2 and 91.91% between these 2 entries and the entry B11. The third sub cluster consists 2 sub sub clusters. The first sub-sub cluster includes Shandaweel 3 and Taka 2 with similarity 90.13%. While, the second sub-sub cluster includes the 3 highly resistant entries Adnan 1(5/91), strain 771 and Toushka 3 with similarity 94.53% between Adnan 1(5/91) and strain 771 and 89.99% between the later 2 entries and Toushka 3. Similarity between the later 2-sub-sub cluster (HR and R entries) was 81.9%. The similarity between second sub-sub cluster (susceptible entries) and third sub-cluster (resistant entries) were 69.72% and between these 2 sub-cluster and the first sub-cluster (highly susceptible strain 806) were 65.03%. The second main cluster include the resistant and moderately resistant entries strain 787, Mutation 48, Aceteru M., and strain B35. The similarity between Aceteru M and B 35 was 76.13% and between the later entries and Mutation 48 (67.67%) and between the above three entries and strain 787 was 62.52%.

Evaluation of susceptibility and seed yield production of certain sesame entries under field conditions:

Data in **Table (5a)** revealed that, the sesame entries Aceteru-M "R", Adnan 1 (5/91), Taka 2 in both seasons and Mutation 48 in season 2000 only were the most resistant to charcoal rot infection without significant differences only in season 1999. On the contrary, the sesame entry strain 806 exhibited the highest infection percentage under field conditions during both seasons. It is interesting to state that, Tushka 2, which classified as susceptible sesame entry under greenhouse conditions, was significantly comparable to Adnan 1 (5/91) "HR", Aceteru-M "R", B35 "R", Mutation 48 "R", and Taka 2 "R" during season 1999.

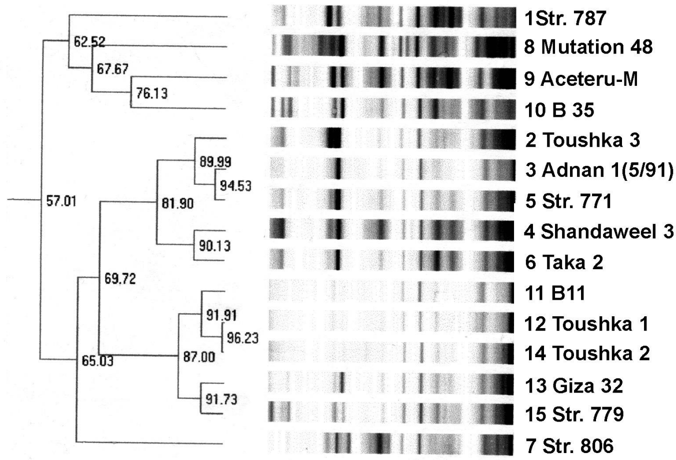
The tested sesame entries were significantly variable in their seed yields. The highest seed yield was produced by Mutation 48 followed by Taka 2 with significant differences only in season 1999. However, the highly susceptible entry strain 806 "HS" produced the lowest seed yield followed by strain 773 "MS", Giza 32 "S", B11 "S" and and strain 779 "S" during season 1999 and Giza 32 "S", strain 779 "S", Taka 1 "MR", and strain 773 "MS" during season 2000. It could be also noticed that, the seed yield produced by the susceptible sesame entry Tushka 2 was significantly higher during both seasons than that produced by some resistant entries such as Shandaweel 3, Strain 787 and Aceteru-M.

Data presented in Table (5-a) show that, oil content has considerably varied in the tested sesame entries either in seeds of healthy (52.9-62.9%) or of diseased (48.2-59.4%) plants. The oil content in seeds of infected plants was significantly lower than those of healthy plants of all entries. The healthy plants of Adnan 1 (5/91), strain 806 and B35 produced the highest % oil content during both seasons. Meanwhile, The lowest oil content was detected during both seasons in those of Shandaweel 3, strain 779, Taka 1 Tushka 1 and Aceteru-M without significant differences in between. The seeds of diseased plants of cvs. Taka 1, strain 779,

a

M 1 2 3 4 5 6 7 8 M 9 10 11 12 13 14 15

Marker "M" 1-15 sesame cultivars M



(b)

Fig. (1): SDS-PAGE protein patterns of 15 tested sesame cultivars (a) and Phonogram showing similarity between any pair of tested cultivars and strains (b).

Shandaweel 3, Aceteru-M, Tushka 1, Giza 32 and Taka 2 produced the lowest % oil content during both seasons without significant differences in between especially in season 2000.

Table (5a): Charcoal rot percentage on different sesame entries and their total seed yield productivity, oil content in seeds of either healthy (H) or diseased (D) plants under natural field infection.

Sesame entry and reaction at seedling stage						Seed oil content (%)			
		% Charcoal rot		Seed yield (kg/fed.)		1999		2000	
		1999	2000	1999	2000	H	D	H	D
Aceteru-M	R	3.9	6.8	150.0	141.3	54.0	51.0	54.6	51.5
Adnan 1 (5/91)	HR	6.8	9.6	214.2	182.7	62.9	56.5	59.2	55.7
B 11	S	21.7	19.4	127.5	145.8	59.6	55.7	58.8	54.3
B 35	R	5.7	5.3	194.4	176.1	57.7	53.2	56.6	52.5
Giza 32	S	16.2	19.6	123.3	121.5	54.8	51.8	54.0	51.7
Mutation 48	R	4.3	8.6	277.5	195.6	58.4	55.1	58.6	55.4
Shandaweel 3	R	15.3	14.7	160.8	149.4	53.6	50.9	53.7	51.2
Strain 773	MS	22.4	19.3	120.9	128.4	60.0	56.5	61.0	57.2
Strain 779	S	20.5	22.3	137.1	121.8	53.	50.	53.	51.

						4	3	9	8
Strain 787	R	12.9	14.1	183.5	159.6	55.6	52.4	56.3	53.3
Strain 806	HS	28.5	26.7	84.0	82.4	61.1	54.2	61.3	54.6
Taka 1	MR	11.8	13.0	152.1	124.8	53.7	48.2	54.5	50.6
Taka 2	R	4.6	4.2	259.2	208.5	56.4	52.9	55.2	51.3
Taka 3	R	9.1	11.3	190.8	161.2	56.0	54.4	56.8	55.0
Tushka 1	MS	19.7	20.5	148.8	126.3	54.1	51.6	54.4	50.9
Tushka 2	S	6.3	11.8	199.8	173.4	57.1	54.5	59.2	57.7
LSD at 5%		3.34	3.18	10.01	10.29	1.05		1.19	

Dealing with % reduction in seed oil content as affected by charcoal rot infection and sesame entry, the data in Table (5-b) prove that, the average reduction in oil content in seeds of diseased plants ranged between 3.95% in Tushka 2 “S” to 11.28% in strain 806 “HS”. Percentages of reduction were considerably variable according to season and sesame entry. The lowest reduction in oil content during both seasons was associated with the sesame entries Taka 3 (2.86-3.17%) and Tushka 2 (2.53-4.55%). On contrast, the highest reduction in oil content was recorded in seeds of strain 806 “HS” (10.93-11.79%) during both seasons, Adnan 1 (5/91) “HR” (9.44-10.17%) during season 1999 and Taka 1 “MR” during both seasons (7.16-10.24%).

Table (5-b): Percentage of reduction in seed oil content of different tested sesame entries due to the natural infection with charcoal rot disease under field conditions

Sesame entry and reaction at seedling stage		Sids		
		1999	2000	Mean
Aceteru-M	R	5.56	5.68	5.620
Adnan 1 (5/91)	HR	10.17	5.91	8.040
B 11	S	6.54	7.65	7.095
B 35	R	7.80	7.24	7.520
Giza 32	S	5.47	4.26	4.865
Mutation 48	R	5.65	5.46	5.555
Shandawee l 3	R	5.04	4.66	4.850
Strain 773	MS	5.83	6.23	6.030
Strain 779	S	5.81	3.90	4.855
Strain 787	R	5.76	5.33	5.545
Strain 806	HS	11.29	10.93	11.110
Taka 1	MR	10.24	7.16	8.700
Taka 2	R	6.21	7.07	6.640
Taka 3	R	2.86	3.17	3.015

Tushka 1	MS	4.62	6.43	5.525
Tushka 2	S	4.55	2.53	3.540
Mean		6.463	5.851	

*Percentage reduction in seed oil = % H-D/H x 100
While: H healthy sesame plants and D diseased sesame plants

DISSCUSSION

Treating seeds with fungicides was significantly better than treating soil for controlling charcoal rot disease incidence either under greenhouse or field conditions. Under field conditions, the combined seed/soil treatments Rizolex-T + Amconil, Rizolex-T + Rizolex-T, Benlate + Vitavax-T and Benlate + Amconil gave the best results as they minimized disease incidence and maximized seed yield production. *M. phaseolina* might be considered as seed borne rather than soil borne pathogen. Then, cpmbination between seed and soil disinfectants may provide maximum protection to sesame plants for longer time. Preliminary *in vitro* studies (not recorded) revealed that these fungicides reduced growth and sclerotial production of *M. phaeolina*. **El-Khadem *et al.* (1991)** found that Benlate used as seed dressing was the most effective, produced the highest survival plants in soils artificially infested with *F. oxysporum, R. solani* or *M. phaseolina*. In case of combined (seed + soil) treatment Ronilan + Benlate was the best for minimizing the incidence of root rot and wilt diseases followed by Ronilan + Homai or Vitavax + thiram treatments. **Khalifa (1997)** reported also that, Rizolex T or Benlate (as seed treatment) + chloroyhecieb (as soil treatment) were superior for controlling root rot and wilt diseases and increased seed yield of sesame under field conditions. Similar findings were reported by **Shalaby (1997)** and **Gabr *et al.* (1998).**

The tested cultivars and strains of sesame reacted differently throughout different stages of disease development either in artificially or naturally infested soil. Based on percentage of seedling survivals in potted soil infested with the charcoal rot pathogen, the screened 30 sesame entries were evaluated as highly resistant (3), resistant (9), moderately resistant (6), moderately susceptible (4), susceptible (6) and highly susceptible (2). The resistance and susceptibility to charcoal rot infection might be chemical in nature as amounts of free phenols, total phenols, reducing and total sugars, in general were obviously higher in high resistant “HR” and resistant “R” than the susceptible “S” and high susceptible “HS” sesame entries. These metabolites might play important roles in plant defense. The present similarity between protein bands of the selected 15 sesame entries against charcoal rot disease (*M. phaseolina*) might be influenced by accumulation of specific proteins, which might be synthesized at higher level in the highly resistant entries. **Hlinkova and Sykora (1996)** recorded that the new protein contents dependence on host genotype and virulence genes of the pathogens. **Radwan (2000)** showed that, the mutagenized barley plants recorded great variation in the protein patterns. In this respect, new proteins were detected in the mutagenized resistant (R) and immune (I) plants (new genotypes) from the two tested cultivars in comparison with susceptible ones and the control (parent). She also found that, the changes of proteins either by increasing or decreasing depended on the host genotype and sensitivity to infection.

The tested sesame entries varied differently in their seed yield production. The close relation between resistance to charcoal rot and seed yield production was partially detected in the present study. The highest seed yield was produced by the most resistant sesame entries Mutation 48 and Taka 2. In fact, susceptibility and seed yield production are genetic characteristics which might be influence by different gene(s) in the tested sesame entries. **El-Deeb *et al.* (1998)** indicated that sesame cultivars Giza 25 and Giza 32 were highly susceptible to charcoal rot, whereas the genotype H81F15 was moderately susceptible and the mutation 48 was the least susceptible cultivar. Under field conditions, cv. mutation 48 was the most resistant and gave the highest seed yield when compared with the other tested cultivars. **Rajput *et al.* (1998)** screened 107 genotypes of sesame under field conditions against *M. phaseolina* and found that, 1 genotype shows immune reaction while resistant reaction was shown on 46 genotypes, 25 genotypes were moderately resistant and 5 genotypes showed moderately susceptible reaction.

Seed oil content of the tested sesame entries had significantly decreased due to charcoal rot infection. Reduction in seed oil content seems to be not correlated with varietal reaction depending on season and sesame entry. The lowest and highest reduction in this respect, was detected in the susceptible entry Tushka 2 (3.95%) and the high susceptible one strain 806 (11.28%), respectively. Again, seed oil content percentage is a genetic character which might be controlled by different genes. Several investigators recorded that the oil content of sesame seeds was decreased when sesame plants infected by root rot and/or wilt pathogens **(Khalifa, 1997** and **Shalaby *et al*., 1998). Ragab *et al.* (2002)** recorded that, Taka varieties were considered resistant under greenhouse conditions. Positive correlation was found between yield components (i.e., seed yield and oil content) and infection. Reduction in yield components of cvs. Taka was significantly lower than of that of Giza 32 cv.

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مقاومة مرض العفن الفحمي في السمسم الم
تحت ظروف الحقل باستخدام الأصناف المق

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أظهرت معاملة بذور السمسم قبل الزراعة بأى
3جم/كجم بذرة أفضل مقاومة للمرض فى الصوبة (باد
93.3% ، 83.3% ، نباتات مصابة بالعفن الفحمى 3.3% ، 6.7%
التربة التى استخدمت فيها المبيدات ريزولكس-
تأثير معنوي فى مقاومة المرض فى مرحلة البا
مرحلة النضج (نباتات ناضجة سليمة 46.7% ، 43.3% لكل
26.7% فى معاملة المقارنة. أما تحت ظروف الحقل فق
(بذرة ، تربة ، معاملة مزدوجة) تأثيرات معنوية
أن المعاملات المزدوجة (بذرة/تربة) التالية: ر
ريزولكس-ت/ريزولكس-ت ، بنليت/فيتافاكس-ت ، بن

أظهرت مدخلات (أصناف وسلالات) السمسم الم
المختلفة لتطور المرض تحت ظروف الصوبة - وفى ه
أنتجت <50% ؛ 50 إلى <60% ؛ 60 إلى <70% ؛ 70 إلى <80% ؛ 8
90.0% بادرات حية (في مرحلة البادرة) وأ نباتات س
تصنيفها كمدخلات عالية القابلية للإصابة ، ق
المقاومة ، مقاومة ، عالية المقاومة على التر
بين 3.3-40.0% في المدخلات عالية القابلية للإصاب
، سلالة 799 ، سلالة 11ب ، صنف جيزة-32 ، سلالة توشك
80.0-83.3% فى المدخلات المقاومة (سلالة 771 ، سلالة
(5/91) ، صنف طاقة 2). هذا وقد أظهرت المدخلات المقا
أوراقها (في مرحلة البادرة) من الفينولات الحر
التحليل الكهربائي للبروتينات في عدد 15 مدخل
بدرجات مختلفة طبقا لاستجاباتها المرضية.

أما تحت ظروف الحقل فقد كانت الأصناف أستير
طفرة-48 الأكثر مقاومة بينما كانت السلالة 806 و
وقد كانت الأصناف طاقة 2, طفرة-48 ، عدنان 1(5/91) ال
كانت السلالة 806 ، السلالة 11ب, السلالة 779 ، الص
أسيترو-م ، السلالة 773 ، الصنف طاقة 1 الأقل إنت
محصول البذرة للسلالة توشكا-2 القابل للإصاب
في المدخلات المقاومة شندويل-3 ، السلالة 787 ، أس
الفحمي على نسبة الزيت في جميع المدخلات المخ
طفرة-48 جيزة-32 في منطقة التحرير (محافظة البحي
سدس (محافظة المنيا) أقل معدل للنقص فى محتوى ب
(2.53-4.66%) بينما أظهرت السلالة 806 أعلى معدلات ال