Management of Charcoal Rot of Sesame by Seed Soaking in Medicinal Plant Extracts and Hot Water

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Macrophomina phaseolina causing charcoal rot was isolated from sesame seeds (cvs. Giza 32 and Shandawel-3) collected from different localities of Assiut, Sohage and EL-Minia Governorates. The fungus was found in the highest frequently in samples collected from Assiut Governorate followed by Sohag and finally EL Minia Governorate. The obtained isolates were different in their virulence on the tested sesame cvs. Also, they differed in their growth nature including colony color and sclerotial production. The color of colonies of the pathogen seem to be correlated with density of sclerotial formation. Aqueous extracts of Majorna, Wild chamomile, Geranium oil and Nees plants were highly toxic to tested isolates of *M. phaseolina*, *in vitro*. On the other hand the rest of the tested aqueous extracts had no effect. Under greenhouse conditions in 2005 and 2006 seasons, soaking seeds of sesame before sowing in aqueous extracts of Eucalyptus, Nerium, Ocimum and Rosemary plants decreased the disease incidence. Aqueous extracts of Eucalyptus and Ocimum were the most effective treatment. Dipping sesame seeds in hot water at 60°C for 5 minutes increased seed germination of Giza 32 and Shandawel-3 cvs. followed by 55°C, 50°C and 45°C, while 40°C treatment resulted the lowest seed germination rate. Dipping sesame seeds in hot water at different temperature before planting decreased seed, seedling and charcoal rots. Soaking seeds in hot water at 60°C increased greatly plant height and decreased seed, seedling rot and charcoal rot followed by 55°C and 50°C, under greenhouse condition.

Keywords : Charcoal rot, hot water treatment, *Macrophomina phaseolina*, plant extracts, Sesame

Charcoal rot caused by the fungus, *Macrophomina phaseolina* Tassi (Goid) is a very serious disease on sesame (*Sesame indicum* L.) crop in Egypt and is one of the most important factors which reduced yield and minimizing the competition of sesame in crop rotation (Abdou et al., 2001;

Seoud et al., 1984; Al-Ahmed and Saidawi, 1988; Zahra, 1990). The pathogen was found to be associated with sesame seeds in Brazil (Arriel et al., 1996), Egypt (Khalifa, 2003 and Saeed, 2001), India (Subrahmaniyan et al., 2001), Korea (Park and Yu, 1980), Sudan (Abuelgasim and Zeidan, 1985) and Thailand (Sanaomung and Sirithorn, 1996). The isolates obtained from different hosts like, sesame, peanut, sunflower, sorghum and different beans were occasionally varied in colour of colonies, type of mycelia growth, pigment production, number and size of sclerotial as well as pathogenicity and tolerance to fungicides (Devi and Singh, 1998; El-Wakil et al., 1985; Hoda and Grover, 1988; Mohammed et al., 2001 and Shamarao et al., 2001; Pereira et al., 1996; Simosa and Delgado, 1991). Management of the disease was conducted by treating seeds before planting by using plant extracts (Shalaby et al., 2001), fungicides (Abdou et al., 2001) and hot water (Nabila, 1999). Using biocontrol agent and planting resistant varieties were also suggested (Pereira et al., 1996; Gabr et al., 1998).

The present work was planned to study the morphological characters and pathogenicity of *M. phaseolina* isolates, causing charcoal rot disease of sesame. Effect of plant extracts, hot water seed treatment and bioagents was also evaluated for integrated control of the diseases.

Materials and Methods

Source of *M. phaseolina* isolates. Seed samples of Giza 32 and Shandawel 3 sesame cultivars were collected from different localities of EL-Minia, Assuit, and Sohag Governorates of Upper Egypt, during the season 2002. Surface sterilized sesame seeds were used for fungus isolation. Seeds were washed in tap water then dipped into 1% sodium hypochlorite solution for 3 minutes followed by complete washing in sterile distilled water for seed surface sterilization as reported by Gopinath and Shetty (1985). From each sample, hundred surface sterilized seeds were seeded in Petri-dishes (5 seeds/plate) containing potato-dextrose agar (PDA) medium amended with 40 µg/ml streptomycin sulfate to minimize bacterial contamination. Seeded plates were incubated at 28°C for 5-7 days. Pure

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cultures of the developed fungi were kept at 5°C on PDA slants until used. Identification of the isolated fungi was carried out by using the cultural characteristics and their microscopic features according to Domsch et al. (1980); Singh (1994) and confirmed by Assiut University Mycological Center (AUMC), Egypt. Capability of different isolates to produce sclerotia and color of mycelia colonies were determined after 10 days growth on PDA medium at 27°C as described by Khalifa (2003).

Pathogenicity tests. Pathogenicity of *M. phaseolina* isolates was tested on Giza 32 and Shandawel 3 sesame cultivars under greenhouse conditions. Seed disinfection was done by dipping seeds in 1% sodium hypochloride solution for 3 minutes and then rinsed in sterilized distilled water. Soil and pots (20 cm in diameter) sterilization were carried out by 5% formalin solution for 15 minutes and left to dry for two weeks. Soil was covered with polyethylene sheet for 7 days to retain the gas. The soil was not planted until all traces of formaldehyde disappeared (after 2 weeks). Inocula of the tested isolates were prepared by inoculation sterilized milk bottles 0.5 L. containing barley medium (75g Barley + 25g pure sand + 2g sucrose + 0.1g yeast extract + 100 ml water) with the tested isolate and incubated at 28°C for two weeks. Inoculum of each isolate was added to the potted soil at rate of 5% (w/w) and mixed thoroughly with the soil, (each pot contained 1.4 kg soil), then watered and left for one week to insure establishment and distribution of the inoculum in soil. Each pot was seeded with 5 seeds and 3 replicates were used for each particular treatment. Pots containing non infested soil were used as control treatment. percentages of pre- and post-emergence damping-off were determined after 15 and 30 days, respectively. At 90 days after sowing, infection of sesame plants by charcoal rot was estimated.

In vitro, effect of plant extracts on growth of *M. phaseolina*. Aqueous extracts of 25 medicinal plants (Table 1) were tested for their suppressive effect on the growth of the causal pathogen, *in vitro*. Plant samples were dried, powdered and extracted with sterile distilled water by autoclaving at 121°C for 15 min at concentration 10% (w/v) as described by Maoz and Neeman (1998), and then filtrated through whatman No.1 filter papers. The filtrate was used as a test extract. Each Flasks (250 ml) contained 100 ml of sterilized PDA medium were melted then cooled to about 5°C. Ten ml of each plant extract was separately added to 100 ml of PDA before pouring into Petri dishes (20 ml/dish). Petri-dishes were inoculated with equal discs (5mm in diameter) of *M. phaseolina* taken from 3 day-old cultures. Four replicates were used for each treatment. The control treatment was carried out by culturing the test fungi

Table 1. Mycelial colour and sclerotial formation of the different *M. phaseolina* isolates on PDA medium

Isolate No.	Mycelial colour	No. of Sclerotia/plate
1	Gray	80.0 c
2	Gray	46.3 f
3	Black	102.5 b
4	Gray	66.33 e
5	Black gray	87.8 c
6	Gray	2.3 h
7	Gray	5.5 h
8	Gray	2.5 h
9	Black gray	113.5 a
10	Gray	0.5 h
11	Gray	36.5 g
12	Black	111.0 a
13	Gray	45.3 f
14	Black gray	115.0 a
15	Gray	50.0 f
16	Black gray	87.8 c
17	Black	101.0 c

Means followed by the same letter are not significantly different using L.S.D at 5%

on PDA medium without addition of plant extracts. After 7 day-incubation at 28°C fungal growth was measured and percentage of reduction in mycelial growth was calculated.

Suppressive effect of some plant extracts on disease incidence. The experiment was carried out under greenhouse conditions in 2005 and 2006 growing seasons. Sterilized pots (20 cm in diameter) were filled with sterilized sand- clay soil and mixed with the inoculum of *M. phaseolina* isolate No. 10 (highly virulent) as described before at the rate of 5% of soil weight, then pots were irrigated. Sesame seeds were soaked in the tested plant extracts and left to dry for 24 hours before sowing. After seven days from soil infestation, each pot was sown with five treated seeds of Giza 32 or Shandawel 3 sesame cultivars, separately. Infested soil mixed with 5% uninoculated Barley medium was used as control. Four replicates were used for each treatment. Plants were irrigated when necessary and daily observed for infection. Percentage of Pre -and Post emergence damping -off was observed for disease development after 15 and 30 days after sowing sesame seeds respectively. Charcoal rot was recorded after 90 days from sowing date as mentioned previously.

Effect of hot water seed-dipping on seed germination, in vitro. Seeds of Giza 32 and Shandawel 3 sesame cultivars were soaked in water for five minutes before hot water treatments. Lots of 200 seeds were sealed in loose-fitting cheesecloth bags and soaked in hot water for 5 min. Hot water temperature was increased in increments of 5°C from

40 to 60°C. Then treated seeds were spread out for cooling and drying immediately (Agarwal and Sinclair, 1996). One hundred seeds from each replicate of the temperature treatment were distributed on filter paper in 10 cm Petri dishes (20 seeds/petri dish) representing a replicate and then covered with two additional filter papers, 2 ml of water was added to each dish. Four replicate were used for each test. After 10 day-incubation in the dark at 20°C, germination percentage was recorded (the emerged radicle was at least 3 times the length of the longest seed axis) by Strandberg and White (1989).

Effect of hot water seed treatments on disease incidence and plant growth under greenhouse conditions. Five seeds from each treatment were sown in (20 cm in diameter) pots containing sand-clay infested soil with *M. phaseolina* as mentioned previously in pathogenicity tests. Four replicates were used for each treatment. Uninfested pots were used as control. The experimental work was done in air condition insect-proof greenhouse. After 15, 30 and 90 days from sowing date, percentage of Pre-emergence damping-off, Post-emergence damping-off and charcoal-rot were recorded, respectively (Nabila, 1999). Also, length of plants in uninfested pots was measured after 90 days from planting date.

Statistical analysis. Data were analyzed statistically using analysis of variance and means were compared, using L.S.D.

test at 5% as described by Gomez and Gomez (1984).

Results

Seventeen *M. phaseolina* isolates were isolated from sesame seeds collected from different locations of Assuit, Sohag and El-Minia Governorates of upper Egypt. Isolation frequency of the fungus in seed samples was different by location. Assuit seed samples showed the highest isolation frequency of the fungus (64.70%) followed by Sohag samples (29.42%), then El-Minia samples (5.88%).

Variation in mycelial colour, production of sclerotia and pathogenicity of *M. phaseolina* isolates on sesame cultivars. Data obtained in Table 1 show that the examined seventeen isolates of *M. phaseolina* were different in their growth nature, mycelial color and sclerotial production on PDA medium. Since, the mycelial color of isolates No 1, 2, 4, 6, 7, 8, 10, 11, 13 and 15 was gray, however it was black for isolates No 3, 12 and 17 and dark gray for isolates No 5, 9, 14 and 16. Variation existed among the pathogen isolates in production of sclerotia was also pronounced. In general, the tested isolates of the pathogen could be classified based on production of sclerotia as following:

- A- Isolates produced few numbers of sclerotia: isolates No. 6, 7, 8 and 10.
- B- Isolates produced moderately numbers of sclerotia:

Table 2. Pathogenic capability percentage of *M. phaseolina* isolates on two sesame cultivars (Giza 32 and Shandawel-3)

Isolates No	Seed rot %			Seedling rot %			Charcoal rot %		
	Giza 32	Shandawel 3	Mean	Giza 32	Shandawel 3	Mean	Giza 32	Shandawel 3	Mean
1	13.34 j	46.70 h	30.02 c	26.67 l	6.67 n	16.67 b	6.67 o	20.00 o	13.33 b
2	53.33 h	46.70 h	50.01 b	33.33 l	0.00 n	16.66 b	6.67 o	20.00 o	13.33 b
3	33.34 i	33.34 i	33.34 c	33.33 l	0.00 n	16.66 b	13.33 o	13.33 o	13.33 b
4	53.34 h	6.70 j	30.00 c	6.67 n	20.00 m	13.33 b	20.00 o	20.00 o	20.00 a
5	46.70 h	26.70 i	36.70 c	0.00 n	20.00 m	10.00 b	13.33 o	20.00 o	16.66 a
6	46.70 h	33.34 i	40.02 b	13.33 m	20.00 m	16.66 b	20.00 o	20.00 o	20.00 a
7	53.34 h	26.70 i	40.02 b	13.33 m	40.00 k	26.66 a	6.67 o	6.67 o	6.67 c
8	46.70 h	0.00 j	23.35 d	13.33 m	13.33 m	13.33 b	13.33 o	20.00 o	16.66 a
9	46.70 h	33.34 i	40.02 b	20.00 m	0.00 n	10.00 b	6.67 o	20.00 o	13.33 b
10	60.00 h	60.00 h	60.00 a	6.67 n	6.67 n	6.67 c	20.00 o	20.00 o	20.00 a
11	46.70 h	40.00 i	43.35 b	20.00 m	20.00 m	20.00 a	13.33 o	13.33 o	13.33 b
12	46.70 h	46.70 h	46.70 b	0.00 n	0.00 n	0.00 c	20.00 o	13.33 o	16.66 a
13	40.00 i	6.70 j	23.35 d	6.67 n	20.00 m	13.33 b	20.00 o	20.00 o	20.00 a
14	33.34 i	53.34 h	43.34 b	0.00 n	0.00 n	0.00 c	6.67 o	13.33 o	10.00 b
15	33.34 i	46.70 h	40.02 b	6.67 n	6.67 n	6.67 c	20.00 o	6.67 o	13.33 b
16	33.34 i	46.70 h	40.02 b	20.00 m	6.67 n	13.33 b	20.00 o	6.67 o	13.33 b
17	46.70 h	26.70 i	36.70 e	0.00 n	20.00 m	10.00 b	13.33 o	13.33 o	13.33 b
Cont.	0.00 j	0.00 j	0.00 e	0.00 n	0.00 n	0.00c	0.00 o	0.00 o	0.00 d
Mean	40.75 f	32.24 f		12.22 g	11.11 g		13.34 o	14.81 o	

Means followed by the same letter are not significantly different using L.S.D at 5%

isolates No. 1, 2, 3, 4, 5, 11, 13, 15, 16 and 17.

C- Isolates produced high numbers of sclerotia: isolates No. 9, 12 and 14.

Data in Table 2 reveal that the tested seventeen isolates of *M. phaseolina* were able to infect sesame seeds and plants with different degrees of infection.

M. phaseolina isolate No. 10 gave the highest percentage of seed rot on the tested two sesame cultivars (Giza 32 and Shandawel 3), while isolates No. 2, 5, 6, 7, 11, 14, 15, 16 and 17 caused moderate seed infection. Isolates No. 1, 3, 4, 8 and 9, 12, 13 exhibited the much lower lowest percentage of seed infection. Data also, show that the isolates No. 1, 2, 3, 6, 7 and 11 caused the highest percentage of seedling rot on tested sesame cultivars, while isolates No. 4, 8, 13 and 16 caused moderate infection of seedling rot followed by the rest of the tested isolates. Results also, reveal that the fungus isolates No. 4, 5, 6, 8, 10, 12, and 13 caused the much high percentage of infection of charcoal rot in Giza 32 and Shandawel 3 cultivars, while isolates No. 1, 2, 3, 9, 11, 15, 16 and 17 were able to cause moderate infection. Isolates No. 7 and 14 caused the lowest percentage of charcoal rot. Data also indicate that susceptibility of the tested two sesame cultivars to seed, seedling rot and charcoal rot incited by *M. phaseolina* was not significantly different

Effect of aqueous medicinal plant extracts on mycelial growth of *M. phaseolina*, *in vitro*. Results presented in Table 3 indicate that aqueous plant extracts of *Origanum majoranum*, *Matricaria chamamilla*, *Pelargonium graveolens* and *Cinnamomum cassia* inhibited significantly mycelial growth of the tested pathogen on PDA medium. They caused 52.22, 40.73, 5.92 and 5.36% of reduction in fungal growth, respectively. However, the rest of the tested 25 aqueous plant extracts had no suppressive effect on mycelial growth of the pathogen. The highest reduction in growth of *M. phaseolina* was obtained by extract of *O. majoranum*.

Effect of medicinal plant extracts on development of charcoal rot disease in greenhouse. Data in Table 4 indicate that, treated sesame Giza 32 seeds with the tested plant extracts, in 2005 and 2006 seasons, reduced incidence of damping-off and charcoal rot in greenhouse. In 2005 season sesame Giza 32 cultivar treated with Eucalyptus and Nerium aqueous extracts before planting gave the highest reduction of seed rot. However, Eucalyptus and Rosmary extracts gave the highest reduction percentage of seedling rot compared with control treatment. On the other hand Ocimum extract did not affect incidence of both diseases. In 2006 season, the tested extracts reduced incidence of seed rot, while extracts from Ocimum, Eucalyptus and

Table 3. Effect of certain aqueous plant extracts on mycelial growth of *M. phaseolina*, *in vitro*

Plants extracts	Reduction of linear growth (%)
Majorana (<i>Origanum majoranum</i>)	52.22 a
Rosemary (<i>Rosemarinus officinalis</i>)	0.00 d
Basil (<i>Ocimum basilicum</i>)	0.00 d
Spear mint (<i>Mentha spicata</i>)	0.00 d
Wild chomanile (<i>Matricaria chomamilla</i>)	40.73 b
Caraway (<i>Carum carvi</i>)	0.00 d
Anise (<i>Pimpinella anisum</i>)	0.00 d
Fruetus cumini (<i>Cuminum cyminum</i>)	0.00 d
Fennel (<i>Foeniculum vulgare</i>)	0.00 d
Wild celery (<i>Apium graveolens</i>)	0.00 d
Coriander (<i>Coriandrum sativum</i>)	0.00 d
Geranium (<i>Pelargonium graveolens</i>)	5.92 c
Henna (<i>Lawsonia inermis</i>)	0.00 d
Halfa gar (<i>Cymbopogon proximus</i>)	0.00 d
Black cumin (<i>Nigella sativa</i>)	0.00 d
Nerium (<i>Nerium oleander</i>)	0.00 d
Liquorice (<i>Glycyrrhiza glabra</i>)	0.00 d
Fenugreek (<i>Trigonella foenum graecum</i>)	0.00 d
Tamarind (<i>Tamarindus maica</i>)	0.00 d
Nees (<i>Cinnamomum cassia</i>)	5.37 c
Roselle (<i>Hibiscus sabdariffa</i>)	0.00 d
Blue gum (<i>Eucalyptus globulus</i>)	0.00 d
Caster bean (<i>Ricinus communis</i>)	0.00 d
Dill (<i>Anethum graveolens</i>)	0.00 d
Parsley (<i>Petroselinum sativum</i>)	0.00 d
Distilled water control	0.00 d

Means followed by the same letter are not significantly different using L.S.D at 5%

Rosmary only reduced incidence of seedling rot. In case of charcoal rot, extracts of Eucalyptus and Ocimum reduced significantly incidence of the disease. However Nerium and Rosmary extracts had little effect on incidence of the disease. Data also indicate that, treated seeds of Shandawel 3 sesame cultivar with aqueous extracts of Nerium, Eucalyptus and Rosmary reduced incidence of seed rot in 2005 and 2006 seasons, while Eucalyptus and Rosmary extracts reduced incidence of seedling rot. Results also, revealed that the extracts of Ocimum, Eucalyptus and Rosmary significantly reduced charcoal rot infection.

Effect of hot water seed treatment on seed germination *in vitro* and plant growth of two sesame cultivars. Soaking sesame seeds of Giza 32 and Shandawel-3 cultivars in hot water (40-60°C) for 5 minutes increased percentage of seed germination (*in vitro*) as shown in Table 5. Soaking seeds of both sesame cultivars in hot water at 60°C caused

Table 4. Effect of seed treatments of Giza 32 and Shandawel-3 sesame cultivars with four medicinal plant extracts on incidence of seed rot, seedling rot and charcoal rot caused by *M. phaseolina* in 2005 and 2006 seasons

Plant Extracts	2005 Season						2006 season					
	Seed rot %		Seedling rot %		Charcoal rot %		Seed rot %		Seedling rot %		Charcoal rot %	
	Giza 32	Shan- dawel-3	Giza 32	Shan- dawel-3	Giza 32	Shan- dawel-3	Giza 32	Shan- dawel-3	Giza 32	Shan- dawel-3	Giza 32	Shan- dawel-3
Nerium	25 b	15 b	20 d	15 d	30 f	30 f	25 h	15 i	25 k	15 k	30 m	40 n
Ocimum	30 a	20 b	20 d	15 d	25 f	20 g	25 h	20 h	20 l	15 k	20 n	15 o
Eucalyptus	20 b	15 b	10 e	10 e	20 g	20 g	15 h	15 i	20 l	5 l	20 n	10 o
Rosmary	30 a	5 c	10 e	10 e	30 f	20 g	15 h	5 j	20 l	10 m	30 m	20 n
Control	40 a	30 a	25 d	30 d	35 f	35 f	35 h	30 k	30 k	30 k	35 m	35 n

Mean followed by the same letter are not significantly different using L.S.D at 5%

Table 5. Effect of hot water seed treatment on seed germination of two sesame cultivars, *in vitro*

Temperature (°C)	Germination (%)		
	Giza 32	Shandawel-3	Mean
60	95.00 g	93.33 g	94.16 a
55	86.66 h	83.33 h	85.00 a
50	81.66 i	80.00 i	80.33 b
45	80.00 l	73.33 j	76.66 b
40	65.00 k	65.00 k	65.00 c
Control (25°C)	20.00 l	18.33 l	19.16 d
Mean	71.38 e	68.88 f	

Means followed by the same letter in each column are not significantly different using L.S.D at 5%

the highest increase in seed germination percentage, followed by 50, 45°C and finally 40°C. Seed germination % of Giza 32 cv. was higher than that of Shandawel-3 cv.

Data presented in Table 6 indicate that, in general, the tested hot water treatments increased the growth of sesame plants of Giza 32 and Shandawel-3 cultivars in 2005 and 2006 seasons. The highest increase of Giza 32 cv. In plant

Table 6. Effect of treating sesame seeds with hot water on the plant growth of Giza 32 and Shandawel-3 cultivars

Temperature (°C)	Plant height (cm)			
	2005 season		2006 season	
	Giza 32	Shandawel-3	Giza 32	Shandawel-3
60	132 a	129 d	134 f	128 h
55	105 a	112 d	105 f	113 h
50	96 b	116 d	81 f	110 h
Control (25°C)	26 c	30 e	23 g	34 i

Means followed by the same letter in each column are not significantly different using L.S.D at 5%

growth was achieved by 60°C temperature followed by 55 and 50°C. However in case of Shandawel-3 cv., the effect of the tested temperature on the growth of plants was similar.

Data in Table 7 show that treating sesame seeds by hot water at 60°C before sowing for 5 minutes decreased the infection percentage with seed rot, seedling rot and charcoal rot diseases in Giza 32 and Shandawel 3 cultivars under greenhouse conditions in the two seasons 2005 and 2006.

Table 7. Effect of hot water-seed treatment on incidence of seed rot, seedling rot and charcoal rot diseases caused by *M. phaseolina* on Giza 32 and Shandawel-3 sesame cultivars in 2005 and 2006 seasons in greenhouse

Temperature (°C)	2005 season						2006 season					
	Seed rot %		Seedling rot (%)		Charcoal rot (%)		Seed rot (%)		Seedling rot (%)		Charcoal rot (%)	
	Giza 32	Shan- dawel-3	Giza 32	Shan- dawel-3	Giza 32	Shan- dawel-3	Giza 32	Shan- dawel-3	Giza 32	Shan- dawel-3	Giza 32	Shan- dawel-3
60	10 b	10 d	10 f	10 h	10 j	5 l	10 n	10 p	10 r	5 t	10	5 y
55	25 a	25 c	25 e	20 g	20 i	15 k	20 m	20 o	20 q	20 s	20	15 x
50	30 a	35 c	25 e	25 g	20 i	30 k	30 m	30 o	25 q	30 s	20	25 x
Control	35 a	35 c	35 e	35 g	30 i	30 k	35 m	35 o	35 q	35 s	30	30 x

Means followed by the same letter in each column are not significantly different using L.S.D at 5%

However, in general, treated seeds of the two tested sesame cultivars with hot water at 55°C decreased percentage of seedling rot and charcoal rot in 2005 and 2006.

Discussion

Charcoal rot of sesame incited by the soil borne fungus *Macrophomina phaseolina* (Tassi) Goid, is a major disease on sesame plants in Upper Egypt causing heavy losses of both seedlings and mature plants (Abdou et al., 2001; Seoud et al., 1984; Zahra, 1990). Seventeen isolates of *M. phaseolina* were isolated from Giza 32 and Shandawel-3 sesame seeds collected from different locations of Assiut, Sohag and EL-Minia Governorates. Isolation frequency of *M. phaseolina* at the tested governorates was different. The highest frequency (67%) of the fungus was found in Assiut governorate. These results are in agreement with Wasnikar et al. (1988) and Mahdy et al. (2005), confirming the important role of seeds in transmission of the pathogen, *M. phaseolina*. The 17 isolates of *M. phaseolina* caused seed, seedling and charcoal rots of sesame on Giza 32 and Shandawel-3 cultivars. However, reaction of both cultivars to infection with the disease was similar. Such findings are in accordance with those reported by Kushi and Khare (1979); Abuelgasim and Zeidan (1985); Al-Ahmad and Saidawi (1988); Singh et al. (1989); Gupta (1995); Arriel et al. (1996); Abd-EL-Moneem et al. (1997); Shalaby et al. (1998); Saeed (2001); Mahdy et al., (2005). On PDA medium, *M. phaseolina* isolates were different in their mycelial colour (ranged from gray to black) and sclerotial production (ranged from 0.5 to 115.0 sclerotia per microscopic field). No correlation was found between pathogenic capability of the tested isolates and colony colour or number of sclerotia produced by the isolates. However, black gray isolates produced the highest number of sclerotia and the grayish ones produced the lowest number of sclerotia. Variation in pathogenicity, colour of mycelia and production of sclerotia of *M. phaseolina* isolates obtained from different hosts was previously reported by EL-Deeb et al., 1985; EL-Wakil et al., 1985; Hassanain, 1985; Raut and Ingle, 1989; Ibrahim, 1996.

Control of sesame charcoal rot was by using certain plant extracts, and hot water treatment *in vitro* and under greenhouse conditions. Effect of aqueous extracts of 25 medicinal plants on growth of *M. phaseolina* was tested *in vitro*. Extracts of *Majorna hortensis*, Wild chamomile, Geranium oil and Nees proved to be toxic to the growth of tested fungus, however other tested extracts had no effect. Such results agree partially with those reported by EL-Sayed et al. (1986); Asthana et al. (1989); Sobti et al. (1995); Gehlot and Bohra (1999); Shalaby et al. (2001). Under greenhouse conditions, in 2005 and 2006 seasons,

charcoal rot disease incidence was decreased by soaking seed sesame before sowing in aqueous extracts of Eucalyptus, Nerium, Ocimum and Rosmary plants. Aqueous extracts of Eucalyptus and Ocimum were the most effective in this respect. These results agree with those reported by EL-Sayed et al. (1986); Dwividi and Dubey (1986); Sobti et al. (1995); Gehlot and Bohra (1999); EL-Habbaa et al. (2002).

The results in the present study concluded that the best control of charcoal rot disease on sesame plants could be obtained by soaking sesame seeds in filtered extracts of Eucalyptus (healthy standing plants 80%-90%). Treating sesame seed by dipping in hot water at different temperature before planting in 2005 and 2006 seasons decreased seed, seedling and charcoal rots of Giza 32 and Shandawel-3 cultivars under greenhouse conditions. Agarwal and Sinclair (1996) mentioned that the hot water soak treatment (50°C for 20 min) proved better than fungicidal seed treatment for reducing seed borne *Alternaria porri* and *Stemphylium vesicarium* associated with onion seeds, although germination and emergence were reduced. Hot water treatment of sesame seeds at 60, 55 and 50°C decreased charcoal rot by 5%, 15%, and 25%, respectively, on Shandawel-3 cultivar compared with control. However, decreased charcoal rot on Giza 32 cv. by 10%, 15% and 20%, respectively, compared with control. Such results are in accordance with the findings of Leben 1983; Kyauk et al., 1995; Agarwal and Sinclair 1996; Carvalho et al., 2001. Results indicated also that soaking seeds of the tested sesame cvs. in temperature of 60°C increased greatly plant growth compared with other tested temperatures and control.

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