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EFFECT OF SOME ANTIOXIDANTS ON THE INCIDENCE OF DAMPING-OFF, ROOT ROT, WILT, YIELD AND YIELD ATTRIBUTES IN SESAME. *(Sesamum indicum. L)*

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ABSTRACT

Effect of four antioxidants namely Di-potassium hydrogen orthophosphate (K_2HPO_4), Aspirin (acetyle salicylic acid) ASA, Tartaric acid and Citric acid on damping- off, root rot, wilt and yield and it's attributes in sesame plants was investigated. Isolation trails from infected seedlings and plants showing symptoms of damping-off, root rot, charcoal rot and wilt diseases yielded six soilborne fungi which were identified as *Macrophomina phaseolina (Tassi) Goid, Fusarium oxysporum (Schlecht.) f. sp sesami Jacz, F. solani (Mart.)Sacc, Rhizoctonia solani (Kuhn), Sclerotium rolfssii (Sacc). and Phytophthora parasitica Dast.* The first two fungi were the most frequently isolated ones (35.3% and 22.4%), while *P. parasitica* was the least (6.4%). Linear growth values of *M. phaseolina and F. oxysporum f. sp sesami* were significantly reduced with specific rates of the tested antioxdants. All antioxidants showed less significant reduction in the growth of both fungi than control. The best reduction values of linear growth were obtained with Tartaric acid followed by Citric acid at 10 mM concentrations.

Moreover, effect of the used antioxidants on pre -and post-emergence damping-off, charcoal rot, wilt, yield and yield attributes under greenhouse and field conditions during two successive growing seasons 2004 and 2005 at Ismailia Agricultural Research Station was tested. Six treatments for application methods were tested against disease incidence, yield and yield attributes under field conditions. Tartaric acid at 10 mM concentration was superior in minimizing disease incidence followed by Citric acid 10 mM, while Aspirin at 5 mM showed the lowest effect on the disease incidence. Among other antioxidants, K_2HPO_4 was the most effective on yield and yield attributes. The best treatment, viz. treatment of sesame seeds with seed dressing in the antioxidants and spraying the plants after one and two months from sowing also (S_3) was superior in minimizing diseases incidence and gave the highest values for number of capsules/plant, seed yield/plant and 1000-seed weight as the result of the interactions.

Seed yield/fed was positive and highly correlated with the studied characters except oil percentage. Sesame seeds treated with any of the tested antioxidants increased peroxidase activity. The highest activity was obtained from plants grown from seeds previously treated with Tartaric acid followed by Citric acid at 10 mM concentration.

INTRODUCTION

Sesame *(Sesamum indicum. L.)* is one of the most essential oil crop in Egypt as well as in many parts of the world. It plays an important role as an industrial food crop in baking and other purposes because of its high nutritional value, especially protein content. The oil content in the seeds is ranging from 45 to 63 % and consequently has been called the queen of oil seed crops (Lyon, 1971).

Oil production could be increased by increasing the area of oil crops, and sustained a recommended number of plants/feddan through using some antifungal treatments to obtain higher seed yield and higher components. Abd –El Hakem and Abou Salama (1995) indicated that treatments of sesame seeds with fungicidal increased yield and its components in a highly significant manner.

Sesame wilt and root rots caused by *Fusarium oxysporum f. sp. sesami, F. solani, Rhizoctonia solani, Macrophomina phaseolina, Sclerotium rolfsii* and *Phytophthora parasitica* are of great economic importance in Egypt.

Macrophomina phaseolina and *F. oxysporum* were the most serious diseases of sesame in Egypt and other countries (Armstrong and Armstrong, 1950; Yu and Park, 1980; Zahara, 1990; Khalifa, 1997 and El-Deeb *et al.*, 1998). Controlling these diseases is mainly depending on fungicidal application, however fungicides are hazard to human health and the environment.

In addition, the percentage of infected plants was lower in treated seeds with fungicidal. Highly significant positive correlation was found between yield and most of its attributes. El- Deeb *et al.* (1985) studied varietal reaction in fungicidal effect to root rot and wilt diseases of sesame in field experiments using seeds dressings on four sesame cultivars of local origin. The results showed that yield was increased from 190.5 for control treatment to 263.5 for fenlate treatment, 450.0 for fenlate + daconil treatment and 400 kg/fed for fenlate + botran treatment with the percentage of 38.3%, 136.2% and 109.4%, respectively in 1980. Results of 1981 growing season showed the same trend. Galal and El- Nagar (1997) pointed out that antifungal disease treatments in sesame, tended to decrease the percentage of infected plants, but they increased plant height, number of branches/plant, lowered the height of 1st capsule and increased seed yield and yield components, as well as oil content. Chavan and Chopde (1981) revealed that increasing plant resistance showed a positive direct effect on plant height, number of capsules/plant and crop yield.

The application of fungicides is laborious and expensive process. Antioxidants of systemic resistance sensitize plant to respond rapidly after infection. These responses include phytoalexin accumulation (Kuc, 1982) and activation of peroxidase, phenol oxidase, chitinase and B-1,3 gluconase (Boller, 1985 and Metraux and Boller, 1986). plant resistance and yield components were increased by using antioxidants, i.e tartaric acid, citric acid, K_2HPO_4 and aspirin (ASA) than control in many crops (Reuveni *et al.*, 1995; Abd El-Kareem *et al.*, 2001 and Hanafi *et al*, 2001).

The main objectives of this research work are to detect the effect of antioxidant and its application on seed yield, yield components and its attributes and plant disease resistance on the incidence of damping-off, charcoal rot and wilt diseases. In addition, peroxidase activity was determinedin sesame under both greenhouse and field condatims.

MATERIALS AND METHODS

1- Isolation and identification of the causal pathogens :

Diseased plants were collected form localities of Ismailia Governorate, in 2002 and 2oo3 growing seasons. Diseased roots were washed with tap water, cut into small pieces and surface sterilized by dipping into 2% sodium hypocholoride solution for 2 minutes, then rinsed several times in sterile water, plated on strile Petri dishes on PDA medium then incubated at 25C° for 7 days. Emerging fungi were purified using the single spore and/or the hyphal tip techniques. Identification was based on the morphological characteristics of the isolated fungi according to the descriptions of Gilman, 1957; Booth, 1977 and Domsch *et al*, 1980.Stock of the fungal cultures were kept at 5- 8 C° on PDA slants test tubes for further use.

2- Pathogenicity test :

Pathogenicity experiments were carried out using Giza 32 sesame cultivar. Surface sterilized seeds were sown in sterilized pots 30 cm in diameter, containing sterilized soil previously infested with each of *F. oxysporum. f. sp. sesami, Rhizoctonia solani, Sclerotium rolfsii, Phytophthora parasitica, Macrophomina phaseolina and F. solani* under greenhouse conditions. Seeds were disinfected by dipping in 2% sodium hypocholoride solution for 2.5 minutes. Inoculum of each fungus was prepared by growing the fungus under investigation in PDA medium in Petri dishes for 7 days at 25 C°. Discs5 mm in diameter, were cut from the margins of each fungal colony and used to inoculate glass bottles containing autoclaved growing medium consists of 200 gm . barley kernels +150 ml H_2O. The bottles were incubated at 26 C° for 15 days and were shaken for several minutes daily for the first 7 days to ensure a uniform distribution of the fungal growth.

Soil, in pots was infested with the desired fungal ionoculum at the rate of 2%. (w/w). Soil infestation was carried out 7 days before sowing, then 5 seeds were sown/pot. Four replicate pots were used for each treatment. Pots containing noninfested soil were planted to serve as control. Percentages of pre-and post-emergence damping-off, root rot and wilt diseases were recorded 1 and 3 months after sowing, respectively.

3- Effect of antioxidants on growth of *Fusarium oxysporum. F. sp. sesame and Macrophomina phaseolina* in vitro :

The tested antioxidants were dissolved in water and added to potato dextrose medium to obtain the desired concentrations (5 and 10 mM) from citric acid, tartaric acid and aspirin (acetyl salicylic acid, ASA), while 25 and 50 mM concentrations were prepared from K_2HPO_4 to test their direct effect on each of *F. oxysporum* and *Macrophomina phaseolina.*

Mycelium disks (5 mm-disk) from the growing edge of 7 days old culture representing the desired fungus were transmitted on PDA medium, in the center of the petri dish and incubated at 25 C°. The linear growth of the tested fungi was measured after 7 days from incubation.

4-Effect of sesame seed treatment with antioxidants on the incidence of charcoal rot and wilt diseases under greenhouse conditions :

Antioxidants were tested for their effect on the incidence of charcoal rot and wilt diseases under greenhouse conditions.

Disinfected seeds of Giza 32 sesame cultivar were treated with antioxidants three hours before sowing by soaking the seeds in 5 and 10 mM concentrations of each of citric acid, tartaric acid and aspirin and 25 and 50 mM from K_2HPO_4 seperately. Seeds were sown in sterilized pots (30 cm diameter) containing infested soil with either *F-oxysporum F. sp sesami or. Macrophomina phaseolina.* Each pot was seeded with 5 seeds. Four replicate pots were used for each treatment. Pots containing untreated seeds with antioxidants were used as control.

Percentages of damping-off, charcoal rot and wilt were recorded 1 and 3 months after sowing, respectively.

Field experiments :

Two field experiments were carried out at Ismailia Agricultural Research Station during the two successive summer seasons of 2004 and 2005, to investigate the seed yield and its attributes as affected by some antioxidants, methods of application and the incidence of fungal diseases using the local sesame cultivar Giza 32.

The studied treatments were 24 which included each antioxidant (4), viz. $K_2H\ PO_4$ (50 mM), Aspirin (ASA), Citric acid and Tartaric acid (10 mM) for each. The incidence of damping-off, charcoal rot, wilt, seed yield and yield attributes of sesame (c.v. Giza 32) in naturally infested sandy soil. In addition 6 application methods of the antioxidant were planned as follow:

(S_1) Seed dressing treatment: Seeds were soaked in the previously prepared concentrations of the desired antioxidant for three hours of each antioxidant before sowing.

(S_2) Seed dressing treatrent + spraying the plants after one month from sowing.

(S_3) Seed dressing theatrent + spraying the plants after one and two months from sowing, respectively.

(S_4) Spraying the plants only after one month from sowing

(S_5) Spraying the plants only after one and two months after sowing.

and (S_6) control (without using antioxidants).

The experiment was planned in a split plot design with four replications. The methods of application were distributed randomly in the main plots and the 4 antioxidant treatments were assigned in the sub- plots. Seeds of sesame were sown on 3rd June and 13 rd May in the 2004 and 2005 growing seasons, respectively.The area of each sub- plot was 9 m^2 and consisted of six rows of 3m in length and 50 cm apart. Hill spacing was 15 cm . The preceding winter crop was wheat in the two preceding seasons. The normal agricultural practices for sesame production were applied at the proper time.

Disease assessment was calculated as percentages of damping-off, charcoal rot and/or wilt 30 and 90 days from sowing, respectively.

At harvest time, ten guarded and competitive plants in each season of study were taken randomly from the middle rows of each sub –plot in each replicate to measure the following plant characters:

A- Plant growth characters:

1- Plant height (cm). 2- Fruiting zone length (cm).

B- Yield and yield attributes:

1- Number of capsules / plant. 2- Seed yield / plant (gm).
3- Seed yield (kg / feddan). 4- 1000- seed weight (gm).

C- Seed quality:

1- Oil percentage: It was estimated according to the procedures of A. O. A. C. (1980).

2- Oil yield (kg/fed) : It was calculated by multiplying the seed yield (kg / fed) by its oil percentage.

Statistical analysis :

Data of both seasons were statistically analyzed for split plot design according to Snedecor and Cochran (1967). For comparison between means, Duncan's multiple range test was applied (Duncan, 1955). The proper statistical analysis of split plot design was used. A combined analysis was performed for the characters recorded in the two seasons. Means followed by different letters were differing significantly from each other.

Effect of antioxidant treatments of sesame seeds on peroxidase activity:

Root samples of healthy sesame plants treated with any of the aforementioned antioxidants were collected after 30 and 90 days from planting. Samples (5 gm each) were prepared for enzyme extraction by macerating samples in 0.1 M sodium phosphate Buffer (pH 7) in mortar. The homogenous tissues were squeezed through layers of cheese cloth and filtrates were centrifuged at 300 r. p. m for 20 minutes. Supernatant fractions were used for peroxidase assay. Peroxidase activity was assayed as described by Maxwell and Bateman (1967).

RESULTS AND DISCUSSION

1- Isolation and identification of causal pathogens :

Six fungi were isolated from roots of the diseased seedlings and plants. (Table 1). They were identified as *Fusarium oxysporum (Schlecht) f. sp. sesami Jacz, F. solani (Mart) Sacc., Macrophomina phaseolina (Tassi), Goid, Rhizoctonia solani (kuhn), Sclerotium rolfsii Sacc. And Phytophthora parasitica* Dast. *M. phaseolina* (35.3%) and *F. oxysporum f. sp. sesami* (22.4%)" were the most frequently isolated fungi. However, *occurrence of F. solani, R. solani, S. rolfsii and P. parasitica* recorded 15.6, 12.21., 8.1 and 6.41%, respectively. These results are in agreement with those obtained by Mirza *et al.* (1986); Khalifa (1997) and EL -Deeb *et al.* (1998).

Table 1 : Occurrence and frequency (%) of fungi isolated from diseased sesame seedlings and plants.

Fungi	Frequency, %	The symptoms on seedling and plants
1- Fusarium oxysporum (Schlecht.) f. sp sesami Jacz.	22.4	Root rot & wilt
2- F. solani (Mart.) sacc.	15.6	Root rot
3- Macrophomina phaseolina (Tassi) Gold.	35.3	Root rot& stem rot
4- Rhizoctonia solani (Kuhn).	12.2	Root rot& stem rot
5- Sclerotium rolfsii (Sacc).	8.1	Root rot& stem rot
6- Phytophthora parasitica Dast.	6.4	Root rot
	100	

2- Pathogenicity test :

Testing the pathogenic capabilities of the isolated fungi, data (Table, 2) indicate that all the tested isolates were pathogenic to sesame plants.

Macrophomina phaseolina caused the highest infection percentage and caused seedling blight at the seedling stage and, latter caused charcoal rot, followed by *Fusarium oxysporum. f. sp. sesami and F. solani* which caused seedling blight, root rot and wilt, while *Rhizoctonia solani* caused seedling blight, root rot and stem rot, *Sclerotium rolfsii* caused also seedling blight and root rot, while *Phytophthora parasitica* showed the lowest percentage of infection and caused seedling blight and root rot. These results are in agreement with those reported by Yu and Park (1980); Zahara (1990); Abd EL -Moneem (1996) and EL -Deeb *et al* (1998).

Table 2 : Effect of soil infestation with six soilborne fungi on sesame (Giza 32 cv.) infection with pre-and post-emergence damping-off, root rot and wilt diseases under greenhouse conditions.

Fungi	Percentages of infection		
	Pre-emergence	Post-emergence	dead plants
Fusarium oxysporum (schlecht) f. sp sesami	15	18	19
F. solani (Mart) Sacc.	10	14	14
Macrophomina phaseolina (Tassi), Gold	14	22	20
Rhizoctonia solani (Kuhn).	9	10	11
Sclerotium rolfsii (Sacc).	6	8	9
Phytophthora parasitica (Dast).	5	6	7
Control (uninfected soil)	0	0	0
L. S. D at 5%.	1.1	1.3	1.4

3- Effect of antioxdants on mycelium growth of *F. oxysporum. f. sp sesami* and *M. phaseolina In vitro* :

The linear growth values of each of *F. oxysporum* and *M. phaseolina* were significantly reduced under the effect of specific rates of antioxidants (Table, 3). The highest reduction on the linear growth was obtained when tartaric acid at 10 mM concentration was used followed by citric acid (10

mM), K_2HPO_4 (50 mM) and aspirin (10 mM), while the lowest value of reduction was obtained when Aspirin at 5 mM concentration was used.

The inhibition of fungal growth recorded in the present work supports the results previously reported for using some antioxidants at different rates, i.e. Galal and Abdou (1996) on growth of *Fusarium. sp* in the presence of 10 mM. Citric acid and Sodium citrate and Hanafi *et al* (2001) who tested some antioxidants at different rates on growth of *Pyrenocheata terrestris, Botrytis allii* and *Fusarium oxysporum. f. sp cepa* in onion and reported that the best reduction of linear growth was obtained when each of tartaric acid and sodium benzoate was used at 10 mM concentration.

Table 3 : Effect of some antioxidant compounds on the linear growth of *F. oxysporum. f. sp sesami and Macrophomina phaseolina.*

Antioxidant compounds	Concentration of antioxidants (mM)	linear growth, (cm) of	
		F. oxysporum.fsp sesami	*Macrophomina phaseolina*
Citric acid	5	7.21	7.45
	10	6.14	6.90
Tartaric acid	5	6.84	7.02
	10	5.98	6.78
Asprin (ASA)	5	8.45	8.67
	10	8.02	8.14
$K_2 HPO_4$	25	8.35	8.54
	50	7.98	8.21
Control	0	9	9
L.S.D. 5% treatments (T)	-	0.29	0.31
L.S.D. 5% concentrations (c)	-	0.38	0.27
L. S. D 5% TXC	-	0.18	0.22

4-Effect of sesame seed treatment with antioxidant on the incidence of charcoal rot and wilt diseases under greenhouse conditions :

Results in Table (4) indicate that treated seeds with four antioxidants at concentrations of 5 and 10 mM of citric acid, tartaric acid and aspirin and 25 mM and 50 mM of $K_2H\ PO_4$ decreased the percentage of infection by any of the tested fungi under greenhouse conditions in comparison with the control.

Tartaric acid at 10 mM was the best treatment that reduced significantly the infection compared with the untreated control followed by citric acid and K_2HPO_4 treatments. On the other hand, aspirin (ASA) at 5 mM concentration was the least effective treatment.

Reduction of infection with these diseases was varied according to the efficacy of the antioxidant. This trend of antioxidants efficacy on controlling plant diseases was similar to some antioxidants toxicity to the tested fungi Galal and Abdou, (1996) and Hanafi *et al.*(2001).

Table 4 : Effect of treatment sesame seeds (Giza 32 cv.) with some antioxidants on the incidence of damping- off, charcoal rot and wilt diseases under greenhouse conditions.

Antioxidant compound (mM)	Concentration of antioxidants (mM	*Soil infestation treatments*			
		M. phaseolina		*F. oxysporum. f. sp.sesami*	
		Damping-off%	Charcoal rot%	Damping-off %	Wilt%
Citric acid	5	29	36	24	31
	10	24	34	20	28
Tartaric acid	5	23	33	18	27
	10	18	29	15	23
Asprin (ASA)	5	35	39	30	35
	10	31	37	25	31
$K_2 HPO_4$	25	32	39	26	30
	50	27	35	22	26
Control (untreated)	-	60	60	46	53
L. S. D. 5% treatments (T)	-	1.4	1.7	1.4	1.8
L. S. D. 5% concentrations (c)	-	1.1	1.5	1.3	1.7
L. S. D 5% TXC	-	1.2	1.4	1.1	1.5

Table 5 : Effect of treatment sesame seeds (Giza 32 cv.) with some antioxidants on peroxidase activity.

Antioxidant compounds (m M)	Peroxidase activity after sowing, in days	
	30	90
Tartaric acid (10 mM).	0.79	0.85
Citric acid (10 mM).	0.73	0.80
K2H PO4 (50 mM).	0.67	0.74
Asprin (ASA) (10 Mm).	0.63	0.68
Control. (untreated)	0.51	0.55
L. S. D. at 5%.	0.01	0.03

*** Enzymes activity per minute as optical density.**

2-Field experiments :

Results presented in Tables (6,7 and 8) show the effect of antioxidant application methods on growth characters and yield and disease incidence. The treatment (S_3) treated seeds with seed dressing by antioxidants and spraying plants after one and two months from sowing was the best treatment under field conditions during the two successive seasons (2004 and 2005). This treatment decreased the damping-off disease incidence (11.4 –12.9) and the percentage of dead plants (Charcoal rot and/or wilt) (16.5 –17.2) in seasons 2004 and 2005, respectively in comparison with the (S_1) seed dressing treatment only (19.8- 20.1), (25.8- 26.1), (S_2) seed dressing and spraying plants one month from sowing (15.7- 16.3), (20.7- 21.2); (S_4) spraying plants after 1 and 2 months after sowing without seed dressing (28.6- 29.2), (30.7- 31.9) and the (S_6) control treatment without antioxidants (45.2- 46.1), (46.2- 47.2), Also, the first treatment (S_3) gave the best growth characters and yield (S_3) .

Table 6 : Effect of application methods and antioxidant treatments on the percentage of infection with damping –off, 30 days after sowing and dead plants (charcoal rot and wilt) and plant height in sesame during 2004 , 2005 seasons and their combined under field conditions.

Characters / Treatments.	Percentage of infection: damping –off %			Dead plants (charcoal rot and wilt%)			Plant height (cm)		
	2004	2005	Comb	2004	2005	Comb	2004	2005	Comb
A-Application method treatments:									
S_1= Seed dressing.	19.8	20.1	20.0	25.8	26.1	26.0	160.50	172.94	166.72
S_2= Seed dressing +Spraying plants after one month.	15.7	16.3	16.0	20.7	21.2	21.0	162.50	157.56	169.03
S_3= Seed dressing +Spraying plants after 1 & 2 months.	11.4	12.9	12.2	16.5	17.2	16.9	164.81	177.63	171.22
S_4= Spraying plants after one month.	34.6	35.4	35.0	36.8	37.2	37.0	155.81	160.63	158.22
S_5 = Spraying plants after 1 & 2 months.	28.6	29.2	28.9	30.7	31.9	31.3	157.25	163.13	160.19
S_6= Control (without).	45.2	46.1	45.7	46.2	47.2	46.7	144.75	151.94	148.35
F- test	**	**	**	**	**	**	*	**	**
L . S. D 5%.	1.7	1. 9	1.8	2.1	2.3	2.2	11.24	10.87	7.49
B- Antioxidants treatments :									
1-Di- Potassium hydrogen orthophosphate. (K_2HPO_4)	21.3	22.3	22.2	32.6	33.8	33.2	160.33	169.54	164.94
2-Aspirin (Acetyl salicylic acid) ASA.	23.4	24.2	23.8	34.1	35.2	34.7	157.00	164.83	160.92
3-Tartaric acid	14.1	15.7	14.9	22.2	16.9	19.6	156.21	168.29	162.25
4- Citric acid.	19.8	21.2	20.5	28.1	23.1	25.6	156.88	165.21	161.05
F – test	**	**	**	**	**	**	*	N .S	*
L . S . D 5 %.	1.9	2.1	2.0	2.3	2.4	2.4	2.45	-	3.25
Interactions	N . S	N . S	N . S	N . S	N . S	N .S	N .S	N .S	N .S

Table 7 : Effect of application methods and antioxidant treatments on fruiting zone length (cm), number of capsules/plant and seed yield/plant (gm) in sesame during 2004 , 2005 seasons and their combined.

Characters / Treatments.	Fruiting zone length (cm)			Number of capsules/plant			Seed yield/plant (gm)		
	2004	2005	Comb	2004	2005	Comb	2004	2005	Comb
A-Application method treatments:									
S_1= Seed dressing.	76.56	91.06	83.81	36.88	41.50	39.19	5.41	6.19	5.80
S_2= Seed dressing +Spraying plants after one month.	79.50	95.19	87.35	40.75	43.00	41.88	5.66	6.31	5.99
S_3= Seed dressing +Spraying plants after 1 & 2 months.	83.13	98.75	90.94	43.56	45.44	44.50	5.85	6.53	6.19
S_4= Spraying plants after one month.	69.75	76.69	73.22	34.94	40.25	37.59	5.34	6.18	5.76
S_5 = Spraying plants after 1 & 2 months.	72.00	80.94	76.47	37.44	42.19	39.82	5.55	6.26	5.91
S_6= Control (without).	56.06	51.31	53.69	33.88	35.94	35.66	4.89	5.32	5.11
F- test	N . S	**	**	*	**	**	**	*	**
L . S. D 5%.	-	17.65	15.25	6.14	3.011	4.25	0.32	0.33	0.35
B- Antioxidants treatments :									
1-Di- Potassium hydrogen orthophosphate. (K_2HPO_4)	75.54	90.75	83.15	41.25	44.38	42.82	5.72	6.32	6.02
2-Aspirin (Acetyl salicylic acid) ASA.	72.38	79.42	75.90	34.42	39.29	36.86	5.45	6.12	5.79
3-Tartaric acid	70.63	83.33	76.98	37.88	41.79	39.84	5.45	6.13	5.79
4- Citric acid.	72.79	75.79	74.29	37.75	40.08	38.92	5.19	5.96	5.58
F – test	N .S	**	*	**	*	*	**	*	**
L . S . D 5%.	-	13.16	15.08	5.55	5.01	5.30	0.221	0.344	0.289
Interactions :	N .S	N . S	N . S	*	N . S	*	**	*	**

Table 8 : Effect of application methods and antioxidant treatments on 1000-seed weight (gm), seed yield (kg/fed) oil% and oil yield (kg/fed) in sesame during 2004 , 2005 seasons and their combined.

Characters / Treatments.	1000-seed weight (gm)			seed yield kg/fed			oil%			oil yield (kg/fed)		
	2004	2005	Comb	2004	2005	Comb	2004	2005	Comb	2004	2005	Comb
A-Application method treatments:												
S_1= Seed dressing.	3.95	3.90	3.93	255.10	267.58	261.63	58.20	58.20	58.20	255.10	287.58	281.34
S_2= Seed dressing +Spraying plants after one month.	4.08	3.98	4.03	273.17	282.09	277.63	58.28	58.30	58.29	273.17	282.09	277.63
S3= Seed dressing +Spraying plants after 1&2 months.	4.15	4.18	4.17	283.03	292.98	288.01	58.40	58.45	58.43	263.03	292.98	288.01
S_4= Spraying plants after one month.	4.03	3.98	4.01	254.23	281.25	257.74	58.25	58.28	58.27	254.23	261.25	257.74
S_5 = Spraying plants after 1 & 2 months.	4.13	4.08	4.11	268.15	279.98	274.07	58.30	58.35	58.33	268.15	279.98	274.07
S_6= Control (without).	3.86	3.81	3.84	232.84	240.30	236.57	58.28	58.31	58.29	232.84	240.30	236.57
F- test	**	**	**	**	N. S	**	N. S	N. S	N. S	**	N. S	**
L . S. D 5%.	0.13	0.12	0.08	20.21	-	21.13	-	-	-	20.21	-	21.13
B- Antioxidants treatments :												
1-Di- Potassium hydrogen orthophosphate. (K_2HPO_4)	4.12	4.04	4.08	467.14	472.88	070.00	58.53	58.50	58.52	273.79	274.34	274.07
2-Aspirin (Acetyl salicylic acid) ASA.	3.99	0.98	3.96	404.00	463.31	430.09	58.21	58.24	58.23	250.92	269.53	260.23
3-Tartaric acid	4.07	3.99	4.03	447.00	462.40	454.70	58.21	58.27	58.24	260.24	269.24	264.74
4- Citric acid.	4.94	3.99	3.97	445.89	457.42	451.51	58.18	58.25	58.22	259.39	289.68	264.54
F – test	*	N.S	**	*	N.S	N.S	N.S	N. S	N.S	*	N.S	N.S
L . S . D 5%.	0.11	-	0.08	32.251	-	-	-	-	-	19.79	-	-
Interactions :	*	N.S	**	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

1-Effect of application antioxidant methods on yield and its attributes :

Data presented in Tables (6,7 and 8) indicate that plant height, fruiting zone length, number of capsules/plant, seed yield/plant, 1000-seed weight, seed yield (kg/fed), oil yield (kg/fed) and percentage of infection (% damping-off and charcoal rot and wilt) were significantly affected by the antioxidant application methods, except, seed oil content, which was insignificantly affected. The obtained data clearly indicate that (S_3), viz seed dressing + spraying plants after one and after two months produced a tallest plants with the highest values of fruiting zone length, number of capsules/plant, seed yield/plant, 1000-seed weight, seed yield/fed and oil yield/fed. It was also the best treatment for decreasing the damping – off disease incidence and charcoal rot and wilt, This was also true during the two growing seasons and combined data, followed by (S_2) viz seed dressing + spraying plants after one month from sowing. (S_1) viz seed dressing, (S_5) viz spraying plants after one and two months from sowing, (S_4) viz spraying plants after one month for plant height, fruiting zone length, seed yield/plant, 100-seed weight and seed and oil yield/fed, wherease control (untreated) was gave the lowest values for all plant growth characters and yield and its attributes.

The obtained data clearly indicate that seed treatment and/or plant treatment with antioxidants, may lead to the fact that antioxidants protect plants from fungal attack and consequently produce healthy and sound plants with more vegetative growth. The data reveale, also, that the increase in vegetative growth under the effect of antioxidant treatments was accompanied by a higher yield characterized by good components, except, oil content in comparison with the untreated control. EL-Deeb *et al* (1985) and Abd EL-Hakem and Abou-Salama (1995) reported that seed fungicidal treatments reduced infection of plants and consequently produced high seed yield.

2- Effect of antioxidant treatments on yield and its attributes:

Data in Tables (6,7 and 8) indicate that plant height, fruiting zone length, number of capsules/plant, seed yield/plant, 1000-seed weight and percentage of infection (%damping- off and % charcoal rot and wilt) were significantly affected by various antioxidant treatments, wherease seed yield (kg/fed), oil% and oil yield (kg/fed) were insignificantly affected.

Data clearly, also, show that di-potassium hydrogen orthophoshate (K_2HPO_4) treatment surpassed other substances followed by tartaric acid, citric acid in their effect on plant height, fruiting zone length, number of capsules/plant, seed yield/plant and 1000-seed weight. Moreover, tartaric acid surpassed other substances in decreasing the percentage of infection with damping- off, root rot and wilt diseases.

Abd EL- Kareem *et al* (2001) reported remarkable increase in both plant height and number of leaves/plant with using the tested concentrations of K_2HPO_4. Also, Hanafi *et al* (2001) reported that tartaric acid 10 mM was the most effective against pink rot disease and increased yield of onion bulbs compared with the control.

3- Effect of the interactions :

Data of the combined analysis presented in Table (9) show that the interaction between application methods of anti-oxidant and antioxidant

treatments exerted a significant influence on the number of capsules/plant, seed yield/plant and 1000-seed weight.

In general, the highest values were obtained for the number of capsules/plant from the (S3) treatment, viz seed dressing +spraying plants after one and two months from sowing and di-potassium hydrogen orthophosphate (K_2HPO_4)treatment, being 48.38, while the lowest value, being was obtained from (S6) treatment, viz control with aspirin, being 32. 381.

Concerning seed yield/plant, the heighest value, being 6.350 was recoded from the (S3)treatment, and potassium di-hydrogen orthophosphate treatment, while the lowest value, being 5.150 was recorded for the (S6)=control with aspirin.

Furthermore, 1000-seed weight showed the heighest value, being 4.300 when the (S3) treatment, viz seed dressing +sprying plants after one and two months from sowing comined with di-potassium hydrogen orthophosphate treatment was used, while the lowest value, being 3.811 was recorded for the (S6) treatment, viz control with tartaric acid treatment.

Table 9 : Number of capsules/plant, seed yield /plant (gm) and 1000-seed weight (gm) of sesame as affected by the interaction between application method and antioxidant treatments (combined data).

Antioxidant treatments	Application method (M)					
	S1	S2	S3	S4	S5	S6
	N. of capsules/plant.					
1- K2HPO4.	42.38	44.38	48.38	40.75	41.13	39.88
2- Aspiriin (ASA).	35.75	40.88	42.88	34.10	39.13	32.38
3- Tartaric acid.	39.75	41.25	43.75	38.88	40.25	35.13
4- Citric acid .	38.88	41.00	43.00	36.63	38.75	35.25
L.S.D. 5%.	4.85					
	Seed yield/plant (gm).					
1- - K2HPO4..	5.975	6.085	6.350	5.838	6.013	5.777
2 Aspiriin (ASA).	5.725	5.963	6.163	5.763	5.938	5.150
3- Tartaric acid.	5.838	5.950	5.150	5.750	5.875	5.163
4- Citric acid .	5.675	5.963	6.050	5.688	5.788	4.350
L.S.D. 5%.	0.309					
	1000-seed weight (gm)					
1- K2HPO4.	3.95	4.10	4.30	4.05	4.20	3.875
2- Aspiriin (ASA).	3.850	3.950	4.150	3.950	4.050	3.820
3- Tartaric acid.	4.000	4.050	4.150	4.050	4.110	3.811
4- Citric acid .	3.900	4.000	4.050	3.950	4.070	3.825
L.S.D.5%.	0.104					

S1= Seed dressing
S4 = Spraying plants after one month without seed dressing
S2 = Seed dressing+ Spraying plants after one month
S5 = Spraying plants after one &two months without seed dressing
S3 = Seed dressing +Spraying plants after one& two months
S6 =Control (without).

4-Yield analysis:

Correlation studies

The results of simple correlation coefficients between seed yield/fed and its attributing characters are presented in Table (10). Seed yield/fed was positively and highly correlated with plant height, fruiting zone length, number of capsules/plant, seed yield/plant, 1000-seed weight and oil yield/fed; but seed yield/fed showed insignificant relations with oil %.

Also, plant height gave positive and highly significant correlation only with fruiting zone length and seed yield/plant.

At the same time, close associations were found btween fruiting zone length and each of number of capsules/plant, seed yield/plant, 1000-seed weight and oil yield/fed.

In addition number of capsules/plant exerted positive and highly significant interrelationships only with seed yield/plant and 1000-seed weight. Similar correlations were reported by Chavan and Chopde (1981) who found positive correlation between seed yield/plant and plant height and number of capsules/plant.

Furthermore, seed yield/plant showed positive and highly significant correlation with 1000-seed weight and oil yield/fed.

Likewise, 1000-seed weight was positive and showed highly significant correlation with oil % and oil yield/fed. Similar results were reported by Abd El-Hakem and Abou- Salama (1995).

Table 10 : Simple correlation coefficients between seed yield (kg/fed.) and other characters of sesame (combined data).

Character	1	2	3	4	5	6	7
y- seed yield/ fed.	0.8700**	0.8768**	0.9171**	0.9604**	0.8387**	0.3557	0.9883**
1- Plant height (cm)		0.9520**	0.1344	0.9008**	-0.0412	0.2237	-0.0089
2- Fruiting Zone length(cm)			0.8411**	0.9409**	0.6565**	0.1931	0.8617**
3- Number of capsules/ plant				0.8688**	0.7362**	0.4048	0.3432
4- Seed yield /plant (cm)					0.8260**	0.2706	0.9591**
5- 1000-seed weight (cm)						0.5563**	0.8528**
6- Oil percentage %							0.3540
7- Oil yield /fed (kg).							

Effect of antioxidant treatments of sesame on peroxidase activity :

Peroxidase activity was higher in antioxidants treated plants than in the antioxidant free plants and the enzyme activity was increased in the treated plants by increasing plant age from 30 to 90 days after sowing (Table, 5). Treatment with tartaric acid 10 mM gave the highest activity (0.79 and 0.85), followed by Citric acid 10 mM treatment (o.73 and 0.80), K_2HPO_4 50mM treatment (.067 and 0.77) and Asprin (ASA) 10 mM treatment (0.63 and 0.68) as compared with control without antioxidants (0.51 and 0.55), respectively.

The increase of peroxides was a good indication of the usefulness of the used inducers as it played a role in disease reduction in several cases (Reuveni *et al.*, 1992; Abd EL-Moneem, 1996 and Mohamed, 2002).

In conclusion, application of the antioxidants can be used as safety measure to manage some soilborne diseases and to increase sesame yield. This may be due to the reduction of the disease incidence, in addition to the improvement of plant growth parameters, induced by using such antioxidants. These results can be taken for into consideration the possibility of using the antioxidants, at different rates and application methods. commercially for controlling the important fungal diseases of many economic crops, under different environmental conditions.

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تأثير بعض مضادات الأكسدة على الإصابة بأمراض موت البادرات وأعفان الجذور والذبول والمحصول ومكوناته فى السمسم

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أجرى هذا البحث فى محطة البحوث الزراعية بالإسماعيلية التابعة لمركز البحوث الزراعية خلال موسمي ٢٠٠٤، ٢٠٠٥ لدراسة تأثير أربعة مركبات مضادات أكسدة مختلفة هى فوسفات البوتاسيوم ثنائية القاعدية والأسبرين وحمض الطرطريك وحمض الستريك بتركيزين لكل منهم على المحصول ومكوناته وكذلك لدراسة تأثيرها على موت البادرات وأعفان الجذور والذبول والعفن الفحمى فى السمسم.

١- أمكن عزل ستة من فطريات التربة من بادرات ونباتات السمسم المصابة بأمراض أعفان الجذور والذبول والعفن الفحمى وعرفت أنها ماكروفومنيا فاسيولينا ، فيوزاريوم أكسيسبورم ، فيوزاريوم سولانى، رايزوكتونيا سولانى ، سكليروشيم رولفزياى وفيتوفثورا باراستيكا. وكان فطر ماكروفومينا فاسيولينا وفيوزاريوم اكسيسبورم أكثرها تكرارا فى العزل وكان نسبتها (٣٥,٣%، ٢٢,٤%) على التوالى، بينما كان فطر فيتوفثورا باراسيتكا أقلهم تكرارا (٦,٤%). تم تقييم قدرة هذه المركبات على تثبيط النمو الميسليومى فى المعمل على فطرى ماكروفومنيا فاسيولينا وفيوزاريوم اكسيسبورم.

٢- أحدثت كل المركبات المضادة للأكسدة انخفاضا فى نمو الفطريات المختبرة عند تركيز ٥ مولر من حمض الطرطريك وحمض الستريك والأسبرين و ٢٥ ملى مولر من فوسفات البوتاسيوم وكانت أكثر فعالية عند تركيز ١٠ ملى مولر من حمض الطرطريك ثم حمض الستريك.

٣- تم استخدام مضادات الأكسدة فى تجارب الصوبة والحقل فى محطة البحوث الزراعية بالإسماعيلية خلال موسمى ٢٠٠٤، ٢٠٠٥ وذلك لاختبار تأثيرها على موت البادرات وأعفان الجذور والذبول والعفن الفحمى ، واستخدمت ستة طرق مختلفة لإضافة مضادات الأكسدة فى الحقل لدراسة تأثيرها على المحصول ومكوناته وحدوث الإصابة بالأمراض وكان حمض الطرطريك بتركيز ١٠ ملى مولر أكثر فعالية فى خفض الإصابة بالأمراض، يليه حمض الستريك بينما كان الأسبرين بتركيز ٥ ملى أقل تأثيراً فى خفض الإصابة بالأمراض. ومن ناحية أخرى كانت معاملة فوسفات البوتاسيوم ذات تأثير كبير على زيادة المحصول ومكوناته كما أعطت معاملة بذور السمسم بالنقع فى مضادات الأكسدة ثم الرش بعد شهر وبعد شهرين من الزراعة أفضل نتائج فى خفض الإصابة بالأمراض وزيادة قيم الصفات المحصوليه.

٤- كما أعطت المعاملة السابقة أعلى تداخل الفعل فى قيم وصفات عدد الكبسولات / نبات ، محصول البذور / نبات ووزن الـ١٠٠٠ بذرة.

٥- كان هناك ارتباط موجب ومعنوي جداً بين محصول البذور / فدان وجميع الصفات تحت الدراسة فيما عدا صفة محتوى البذرة من الزيت.

٦- أدت المعاملة بمضادات الأكسدة المختبرة إلى زيادة نشاط إنزيم البيروكسيديز فى جذور النباتات وكان حمض الطرطريك تركيز ١٠ مل أكثر المركبات تأثيراً على زيادة نشاط إنزيم البيروكسيديز يليه المعاملة بحامض الستريك.