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Pathological Studies on Fungi Associated with Diseased Safflower Seedlings and their Control

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Safflower diseased plants, showing typical symptoms of damping-off, root and stem rot, wilt and/or rust diseases, were collected from Behera and Giza governorates for isolation the associated microorganisms. Isolated fungi were carefully purified and identified as well as their frequencies were calculated. *Fusarium oxysporum*, *Pythium* sp., *Rhizoctonia solani*, *Sclerotinia sclerotiorum* were only isolated from Giza. Meanwhile, *Fusarium solani* and *Phytophthora* sp. were isolated only from Behera. *Macrophomina phaseolina* was widespread and isolated from the two governorates with high frequency. *Puccinia carthami*, the causal of safflower rust was encountered elsewhere. Pathogenicity tests were performed to throw light on the relative importance of the tested fungi to cause the aforementioned diseases. *F. oxysporum* caused damping-off and vascular wilt symptoms. *P. carthami* showed also damping-off and the seedling rust phase. The other fungi were able to colonize safflower roots and cause damping-off and root rot symptoms. The results showed that the amount of the disease was affected by the tested fungi and the sowing date(s).–In most cases, sowing at November 2nd recorded the intermediate amounts of infection and the best seed germination. One biocide, *viz.* Biocontrol; one resistance inducer, *viz.* Biomycin in addition to three fungicides, *viz.* Moncut, Vitavax-T and Rizolex-T were tested *in vivo* for their ability to control safflower damping-off and root rot caused by the tested fungi, *i.e. M. phaseolina, R. solani* and *F. solani.* The obtained data revealed that none of the evaluated formulations was able to prevent entirely infection with any of the tested fungi. The best control of *M. phaseolina* was given by seed treatment with Biomycin, Vitavax-T and Rizolex-T. *R. solani* was controlled by Biomycin and Rizolex-T, Meanwhile, Vitavax-T, Biomycin and Rizolex-T were the best treatments against *F. solani.*

Keywords: Biocontrol, Biomycin, Rizolex-T, safflower, seedling diseases, sowing dates, Vitavax-T.

Safflower (*Carthamus tinctorious* L.) is considered one of the multi-purpose oilseed crops due to the numerous uses of its flowers, flower petals and edible oil. In addition, safflower has a high adaptation to different abiotic stresses, especially resistance to drought. Therefore, the plants are suited to grow in arid and semi-arid areas and are capable to produce a high seed yield using the minimum water requirements (Sharaan *et al.*, 1991; Ghanem and Ash-Shormillesy, 2007 and Dordas and Sioulas, 2009).

In most areas where it is grown, safflower is liable to attack by several diseases at any growth stage (Klisiewicz, 1993). Fungi causing diseases of safflower seedlings, *i.e. Pythium* spp., *Phytophthora* spp., *Macrophomina phaseolina*, *Rhizoctonia solani*, *Fusarium* spp., *Sclerotinia sclerotiorum*, *Fusarium oxysporum* and *Verticillium dahliae* are reported to be the most pathogenic fungi causing damping-off, root and stem rot, charcoal rot and wilt diseases (Anonymous, 1956; Gattani, 1957; Evans and Kochman, 1969; Klisiewicz, 1980; Molero *et al.*, 1988; Majumdar *et al.*, 1989; Govindappa *et al.*, 2005 and Pahlavani *et al.*, 2007). In addition, *Puccinia carthami* is widespread in all areas of safflower production causing the foot and root phase of safflower rust (seedling rust) and also the foliage rust (Zimmer, 1963; Mortensen *et al.*, 1991 and Klisiewicz, 1993).

In Egypt, there has been very little work done on safflower diseases (Melchers, 1931; Ali *et al.*, 1972; Thoma, 1979 and Anonymous, 1988). Therefore, the present study was planned to throw some light on the diseases affecting safflower seedlings and their causal organisms. The work was also expanded to study the effect of sowing dates, some biocontrol agents and fungicides on the infection with some of the tested pathogenic fungi.

Materials and Methods

Isolation and identification of the associated fungi:

Samples of naturally infected safflower plants showing the typical symptoms of damping-off, root rot, stem rot and wilt diseases were collected from yield plots at the Experiment. Desert Station, Fac. of Agric., Cairo Univ. in Wadi El-Natroon, Behera governorate and from the Experiment. Station, Fac. of Agric., Cairo Univ. at Giza governorate, during 2007/2008 growing season. Diseased plants were uprooted, placed in plastic bags and kept in a cool container during transportation. The plant samples were kept in a refrigerator at 5°C for further studies.

Infected roots and stems were washed thoroughly in tap water and cut into small pieces (0.5-1.0 cm), then surface sterilized with 2% sodium hypochlorite solution for 1 minute. Pieces were then washed several times with sterilized water and dried between folds of sterilized filter paper. Pieces were transferred onto the surface of potato dextrose agar (PDA) in Petri-dishes and incubated at 28°C for 7 days. Observations were daily carried out and the emerged fungi were picked up and cultured on PDA slants. All the isolated fungi were purified using the single spore and/or the hyphal tip techniques described by Dhingra and Sinclair (1985). The purified fungi were identified according to their morphological features either to the generic or to the species level using the descriptions of Snyder and Hansen (1940); Booth and Waterston (1964); Gilman (1957); Booth (1971) and Barnett and Hunter (1972). Stock cultures were maintained on PDA slants under paraffin oil in a refrigerator at 5-10°C and subcultured onto fresh medium every 6-8 weeks.

Concerning safflower rust, it was widespread in all production areas causing the foot and root phase (seedling rust) and foliage phase (foliage rust). Rusted plants were collected from the inspected fields and kept for further studies.

For isolation the uredospores were transferred on safflower plants of the susceptible cultivar Giza-1 grown under greenhouse conditions. Methods for inoculation were the same as described by Mortensen *et al.* (1991). Plants (8 weeks old) were inoculated by spraying them until runoff with a suspension of fresh uredospores. Inoculated plants were incubated in a moist chamber for 24 hours, the transparent plastic cover was removed and the plants were allowed to grow. Leaves collected from adult plants bearing teleospores were used for soil and/or seed infestation.

Pathogenicity of the isolated fungi:

All the experiments were carried out in pots kept in the greenhouse or in the experimental plots (1x1 m) located in the open field at the greenhouse of the Plant Pathol. Dept., Fac. Agric., Cairo Univ.

The soil and pots used in the greenhouse tests as well as soil in the experimental plots were treated with formalin solution made up at the rate of 1 liter of concentrated solution (36-40% formaldehyde) to 50 liter of water. The soil was covered with plastic sheets for 7 days to retain the gas. The soil was not planted until the odor of formaldehyde had disappeared.

The inoculum used for soil infestation was grown in 500 ml milk bottles, each containing 75 gm washed dried barley, 100 gm washed dried coarse sand and 65 ml potato decoction (Attia, 1966). After sterilization, a disc (5 mm in diameter) was taken from the margin of 7-days-old culture of the desired fungus and was manipulated to the autoclaved medium in the bottle. The bottles were incubated at 25°C for two weeks. After the sufficient growth of the fungi was achieved, the inoculum of each fungus was mixed alone with the soil at the rate of 30 gm/kg soil one week before planting. In check experiments, equal amounts of the uninoculated substratum were added. Seeds of safflower cv. Giza-1 were used to evaluate the pathogenic potentialities of the isolated fungi. Planted pots and/or experimental plots were irrigated as necessary.

Pathogenic potentialities of the isolated fungi:

Some of the isolated fungi were selected according to their highest frequency to test their ability of each to infect safflower cv. Giza-1. Inoculum preparation and soil infestation were carried out as described before. Seeds of cv. Giza-1 were planted in the experimental plots, a randomize plot design was followed, having eight isolates (treatments) belonging to 7 fungal species (Table 3) and three replicates.

The plot area was 1x1 meter and consisted of 6 rows, each within 4 hills (25 cm apart) and one seed was planted/hill. There were 24 seeds per plot. Three other uninfested experimental plots were prepared to serve as control.

Emergence counts were taken after 3 and 5 weeks from planting and percentage of pre-and-post-emergence damping-off was calculated. The survived plants were also examined periodically and the number of the dead plants due to infection by root rot and wilt was recorded after 8 weeks from planting.

Concerning rust disease, soil was artificially infested with teleospores on safflower leaves collected from the field. The leaves were crushed and mixed with

air-dried steamed loam soil at a ratio of 1:227 (w/w). About 2 grams of the mixture were placed in each hill before planting. Emerged seedlings were counted and percentage of rusted seedlings was calculated after 28 days from planting. The total number of infected plants was counted and the percentage of infection was calculated, in addition, re-isolation from the infected plants was also carried out.

Effect of sowing date(s):

The experiments were performed during 2008/2009 growing season. The randomized complete block design was followed. Experimental plots, located in the open field at the greenhouse of the Plant Pathol. Dept., Fac. Agric., Cairo Univ., each of 1x1 m was used. The experimental plot compromised 6 rows; each within 4 hills and sown one seed/hill. Each treatment was replicated three times. In all cases, soil disinfestations, inoculum preparation and soil infestation were carried out as described before. Any tested sowing date consisted of two treatments, *i.e.* sowing in infested soil and non-infested soil. Seeds of safflower Giza-1 were sown in October 20th; November 2nd and December 2nd 2008. Great care being taken in leveling the land and infixing the drilling tines rigidity so that the depth of sowing was as accurate as possible. In all cases, the seeds were allowed to grow according to the common agricultural practices recommended for safflower production. Disease assessment was determined as mentioned before.

Effect of some formulations on the infection by the tested fungi:

Three of the highly pathogenic fungi, *viz. M. phaseolina, R. solani* and *F. solani* were used in this experiment, safflower seeds of cv. Giza-1 were divided into lots, and each was treated with each of the following:

Biomycin:

A broad-spectrum immunomodulator cum plant defense activator, with prophylactic, preventive and curative properties in controlling the disease. Safflower seeds cv. Giza-1 were soaked in the diluted solution for 12 hours before planting.

Biocontrol:

A biocide was kindly provided by Prof. Nabil I. Hegazi, Microbiol. Dept., Fac. Agric., Cairo Univ. biocontrol Cx5 is a mixture of 5 rhizospheric microorganisms (RMO). The seeds were soaked for 12 hours in the diluted solution before planting. Five ml of the diluted formulation were applied onto the planted seeds in each hill, ensuring even coverage of all surfaces of the seeds.

Moncut SC Fungicide:

Active constituent: 464 g/l Flutolanil. Prior to application Moncut was diluted with sufficient water, the seeds were soaked in this solution for 3 hours before planting. Five ml of the diluted formulation were applied onto the planted seeds in each hill, ensuring even coverage of all surfaces of the seeds.

Vitavax-T 200 WP:

Carboxin+Thiram, 75% (5,6-dihydro-2-methyl-1,4-oxathiin-3-carboxanilide + tetramethyl thiuron disulphide) was used as seed dressing at the rate of 1-3g/kg seed.

Rizolex-T WP:

Tolclofos-methyl+Thiram, 50% (0.2,6 dicloro-4 Methylephenyl o, o-dimethyl phosphorothioate thiurom disulphide) was used as seed dressing at the rate of 3g/kg.seed

In addition, untreated seeds were planted in the infested soil to serve as control. Moreover, another treatment, *viz.* untreated seeds sown in uninfested soil was also taken into consideration. The experiment was conducted during the growing season 2009/2010 (October 20th) using the Experimental plots (located in the open field at the greenhouse of the Plant Pathol. Dept., Fac. Agric., Cairo Univ. Soil disinfestation, inoculum preparation, and soil infestation were carried out as described before. After planting, seeds were allowed to grow and the plants received the recommended agricultural practices for safflower production. Disease assessments were determined as mentioned before.

Statistical analysis:

Most of the data were statistically evaluated according to Snedecor and Cochran (1967) and the LSD procedure (Fisher, 1948).

Results

Isolation and identification of causal fungi:

The isolated fungi (Tables 1 and 2) were purified and identified to the generic and/or the species level according to their morphological characteristics. Results (Table 1) indicate that *Macrophomina phaseolina* (Tassi) Goidanich was the most dominant among isolated from Giza governorate showing 25.88% frequency, followed by *Alternaria alternata*, *Rhizoctonia solani* Kuhn, *Sclerotinia sclerotiorum* (Lib.) DeBary, *Fusarium oxysporum* Schiecht. and *Pythium* sp.

Table 1. Frequency occurrence (%) of fungi isolated from diseased safflower plants collected from the Experimental Farm of Fac. Agric. Cairo Univ., Giza governorate, 2007-2008 growing season

Isolated fungus	Number of isolates	Frequency (%)
Alternaria alternata	17	20.00
Aspergillus niger	5	5.88
A. flavus	3	3.53
Fusarium sp.	4	4.71
F. oxysporum Schiecht.	7	8.24
Macrophomina phaseolina (Tassi)	22	25.88
Pythium sp.	5	5.88
Rhizoctonia solani Kuhn	13	15.29
Sclerotinia sclerotiorum (Lib.) DeBary	9	10.59
Total	85	± 100

Table 2. Frequency occurrence (%) of fungi isolated from diseased safflower plants collected from Wadi El-Natroon Farm, Fac. Agric. Cairo Univ. at Behera governorate, 2007-2008 growing season

Isolated Fungus	Number of isolates	Frequency (%)
Alternaria sp.	25	31.25
Fusarium sp.	8	10.00
Fusarium solani (Mart.) Sacc.	17	21.25
Penicillium sp.	11	13.75
Phytophthora sp.	3	3.75
Macrophomina phaseolina (Tassi)	16	20.00
Total	80	± 100

Isolation from Wadi El-Natroon yielded 80 isolates, among them *Fusarium solani* (Mart.) Sacc. showed the highest frequency, being 21.25%, followed by *M. phaseolina* (20.0%). Fungi belonging to genera *Alternaria*, *Fusarium*, *Penicillium*, *Phytophthora* were also isolated.

In addition, *Puccinia carthami* Corda, the causal of safflower rust was widespread in both localities, *i.e.* Giza and Wadi El-Natroon, and it was identified according to Zimmer (1963). It also observed that, *Puccinia carthami* Corda, the causal of safflower rust was widespread elsewhere, *i.e.* Giza governorate and Wadi El-Natroon.

Pathogenicity tests:

Seven fungal isolates representing the soil-borne fungi and one rust isolate (Table, 3) obtained from diseased safflower plants were chosen to study their pathogenic potentialities using the susceptible safflower cv. Giza-1. Data presented in Table (3) indicate obviously variation in respect to the ability of the tested fungi to attack safflower. All the tested fungi were able to cause the damping-off disease (pre- and post-emergence damping-off). *F. solani* showed the highest number of infected seedlings (5.00) followed by *M. phaseolina* I (isolated from Wadi El-Natroon), *R. solani*, *M. phaseolina* II (from Giza), *Pythium* sp., *S. sclerotiorum*, whereas *F. oxysporum* and *P. carthami* showed the lowest percent of pre- and post-emergence together.

The plants were left to grow, after 8 weeks from planting, then the number of infected plants was determined. Plants grown in soil infested with *F. oxysporum* only (4.7) showed symptoms of Fusarium wilt (plants were collapsed, showed vascular discoloration).

Infection with rust (seedling phase) was increased showing the typical rust symptoms on 15 seedlings. All the other six fungi isolates caused the typical symptoms of root rot. *M. phaseolina* II and *M. phaseolina* I and *R. solani* showed the highest numbers of infected seedlings, followed by *F. solani* (5.33) and *S. sclerotiorum* (3.00). In general, the percentage of infected plants was the highest when soil was infested by each of alone; *M. phaseolina* II (83.29%); *P. carthami* (81.96%); *M. phaseolina* I (70.83), *F. oxysporum* (40.29%), *Pythium* sp. (40.29%) and *S. sclerotiorum* (36.13%). On the other hand, control treatment showed 6.95% infected plants.

Table 3. Pathogenicity test of some fungi isolated from diseased safflower plants using the cv. Giza-1, February, 2008

Tested fungus	Number of infected plants due to *						Infected plants (%)
	Pre- ** emergence	Post- ** emergence	Root rot ***	Wilt ***	Rust ****	No. of Infected plants	
Fusarium oxysporum	2.7	2.00	0.00	4.70	0.33	9.67	40.29
F. solani	5.0	6.67	5.33	0.00	0.00	17.00	70.83
Macrophomina phaseolina I	4.0	6.33	9.00	0.00	0.00	19.33	80.55
M. phaseolina II	3.33	5.33	11.33	0.00	0.00	19.99	83.29
Pythium sp.	3.33	4.33	2.00	0.00	0.00	9.67	40.29
Puccinia carthami	4.00	0.67	0.00	0.00	15.00	19.67	81.96
Rhizoctonia solani	3.67	6.67	8.00	0.00	0.00	18.33	76.38
Sclerotinia sclerotiorum	3.00	2.67	3.00	0.00	0.00	8.67	36.13
Control	1.00	0.00	0.00	0.00	0.67	1.67	6.95

* Each figure representing the average of 3 replicates. Each replicate is a plot (1x1m), consisted of six rows, within 4 hills per each and one seed was planted/hill.
** Five weeks after planting.
*** Eight weeks after planting.
**** Four weeks after planting.

Effect of sowing date on the incidence of seedling diseases:

Data presented in Table (4) show clearly that the amount of the disease was affected by the tested fungi and the sowing date. Early sowing in soil infested with each of *F. oxysporum*, *F. solani*, *M. phaseolina* I, *M. phaseolina* II and *R. solani* caused higher infection than late sowing. Meanwhile, early sowing in soil infested with *Pythium* sp., *P. carthami* and *S. sclerotiorum* resulted in the lowest infection compared to the late sowing (2nd December).

The obtained data (Table 4) show that sowing at November 2nd recorded the intermediate amounts of infection and the best seed germination.

Evaluation of some formulations in vivo:

One biocide, *viz.* Biocontrol (Cx5 RMO) and one resistance inducer, *viz.* Biomycin in addition to three fungicides, *viz.* Moncut, Vitavax-T and Rizolex-T were tested in order to evaluate their ability to prevent or minimize the incidence of damping-off and root rot caused by the highly pathogenic fungi, *i.e. M. phaseolina, R. solani* and *F. solani.*

Table 4. Effect of sowing dates on the infection of safflower (cv. Giza-1) by the tested fungi during the growing season 2008-2009

Tested fungus	Sowing date *					
	20/10/2008		2/11/2008		2/12/2008	
	No. of infected plants **	Infection (%)	No. of infected plants	Infection (%)	No. of infected plants	Infection (%)
Fusarium oxysporum	7.33	30.54	4.67	19.46	2.67	11.13
F. solani	8.33	34.70	5.67	23.63	3.33	13.88
Macrophomina phaseolina I	8.67	36.13	4.33	18.04	3.67	15.29
M. phaseolina II	10.00	41.67	6.33	26.38	7.33	30.54
Pythium sp.	2.67	11.13	3.00	12.50	3.33	13.88
Puccinia carthami	3.33	13.88	10.33	43.04	17.00	70.83
Rhizoctonia solani	6.67	27.79	5.33	22.21	5.00	20.83
Sclerotinia sclerotiorum	1.67	6.96	3.67	15.29	7.00	29.17
Control	0.33	1.88	0.00	0.00	0.33	1.38
L.S.D. at 5% for	93	1.65	0.97	1.84	0.89	2.18

* Each sowing date consisted of 3 replicates (experimental plots, 1x1m), each with 6 rows, each within 4 hills, and 1 seed was planted/hill.

** Each figure representing the average of 3 replicates.

Data recorded after 60 days of sowing

Data presented in Table (5) reveal that none of the evaluated formulations was able to prevent entirely the infection with any of the tested fungi. However, percentages of diseased plants were obviously lower when seeds were treated with any of the tested formulations compared to the untreated control seeds. The best control of *M. phaseolina* was given by seed treatment with Biomycin, Vitavax-T and Rizolex-T. *R. solani* was controlled best by Vitavax-T and Rizolex-T. Meanwhile, Vitavax-T, Biomycin and Rizolex-T were the best treatments against *F. solani*.

Table 5. Effect of seed treatment with some formulations on the infection of safflower cv. Giza-1 by the tested fungi, during 2009-2010 growing season

Seed treatments	Tested fungus											
	M. phaseolina				*R. solani*				*F. solani*			
	Pre-emergence	Post-emergence	Root rot	Infection (%)	Pre-emergence	Post-emergence	Root rot	Infection (%)	Pre-emergence	Post-emergence	Root rot	Infection (%)
Biomycin	1.33	0.67	1.00	12.50	2.67	1.00	1.33	20.83	2.00	1.67	1.33	20.83
Biocontrol	2.33	1.33	2.33	25.00	2.33	2.00	1.67	25.00	4.33	1.67	2.00	33.33
Moncut	3.00	2.00	2.00	29.17	1.67	2.67	2.67	29.17	1.67	2.00	2.33	25.00
Vitavax-T	1.33	0.67	1.00	12.50	1.00	2.00	0.00	12.50	1.67	0.67	0.67	12.50
Rizolex-T	1.67	0.67	0.67	12.50	2.33	0.33	0.33	12.50	2.33	1.67	1.00	20.83
control	6.00	2.67	2.33	45.83	4.00	1.67	2.33	33.33	4.00	2.67	3.33	41.67
LSD (5%)	0.93	0.30	0.28	2.1	0.34	0.24	0.27	1.81	0.32	0.29	0.52	2.3

Emergence in uninfested soil= 22

Infection (%) = infected versus inoculated.

Each figure representing the average of 3 replicated plots (1x1 m), each within 6 rows, 4 hills/row, one seed/hill.

Discussion

Safflower plants (*Carthamus tinctorious* L.) are liable to attack with several diseases, among which seedling diseases are widespread and serious in most area where this crop is grown (Zimmer, 1963; Klisiewicz, 1980 and 1993). In Egypt, little attention has been given to the control of safflower soil-borne diseases, *viz.* damping-off, root and stem rots, wilt as well as foot and root phase of safflower rust (seedling rust). Therefore, the present investigation was planned to throw some light on fungi causing diseases of safflower seedlings. During the present investigation, diseased plants were collected from the inspected fields located at Behera and Giza governorates for further studies. Isolation trials yielded 85 fungal isolates from samples collected from Giza and 80 isolates from Behera governorate. *Fusarium oxysporum*, *Pythium* sp., *Rhizoctonia solani* and *Sclerotinia sclerotiorum* were isolated from Giza, but not from Behera. Meanwhile, *Fusarium solani* and *Phytophthora* sp., were isolated from Behera, but not from Giza. *Macrophomina phaseolina* was widespread and isolated from the two governorates with high frequency. *Puccinia carthami*, the causal of safflower rust, was encountered elsewhere. This variation in the occurrence and frequency of the isolated fungi may be due to the prevailing environmental conditions in the two governorates.

In addition, the soil of the Experimental Desert Station, Fac. Agric. Cairo Univ. in Wadi El-Natroon, Behera governorate is considered sandy, saline and poor in nutrients (NPK), as well as, organic matter. Also, irrigation water is saline and poor in nutrients. (Abu-Hagaza *et al.*, 2009). Therefore, the mechanical and chemical

properties of Wadi El-Natroon soil, together with irrigation water are considered as factors affecting the occurrence and frequency of the isolated fungi.

Pathogenicity test revealed that all the tested fungi were able to cause damping-off disease, but in different degrees. *F. oxysporum* caused damping-off and the typical symptoms of Fusarium wilt, *Puccinia carthami* showed also damping-off and seedling rust symptoms. The other fungi were able to colonize safflower roots and caused damping-off and root and/or stem rots diseases. The obtained results confirm those obtained by many investigators (Evans and Kochman, 1969; Klisiewicz, 1980 & 1993 and Majumdar *et al.*, 1989).

In irrigation countries at least, where there is complete control of water supply, some agricultural practices, such as sowing date can be devised as possible ways of controlling root rots. Moreover, these ways are the cheapest and simplest in relation to increasing seed yield and its quality. Data reported herein indicated that the amount of the disease was affected by the tested fungi and the sowing date(s). In most cases, sowing safflower seeds at November 2nd recorded the intermediate amounts of infection and the best seed germination. Ibrahim and Abdel-Rehim (1965) found that the incidence of faba bean root rots was higher in late plantings (December) than in earlier ones (October). On the other hand, Abd-Allah (1969) claimed that infection of faba bean with rots was decreased by delaying the date of sowing, the best date of sowing was at November 15th and December 1st. These contradictory results may be due to the tested cultivar, soil conditions and the environmental factors prevailing during that time.

It seems from the results of the present study that none of the evaluated formulations was able to prevent entirely the infection with any of the tested fungi, *viz. M. phaseolina, R. solani* and *F. solani*. However, percentages of diseased plants were lower when seeds were treated with any of the tested formulations compared to the untreated control seeds. Vitavax-T and Rizolex-T always gave the best control against the tested fungi, followed by Biomycin, Biocontrol and Moncut. Application of Biomycin (resistance inducer) and Biocontrol (bioagent) proved good control against damping-off and root rot diseases in comparison with control untreated. Further integrated program, with other control measures must be taken into consideration to avoid, as possible, the great damage caused by soil-borne diseases of safflower.

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دراسات مرضية على الفطريات المصاحبة لبادرات القرطم المصابه وطرق مقاومتها

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تم جمع عينات من نباتات القرطم المصابة بأعفان الجذور والسوق والذبول والصدأ من محطة التجارب الصحراوية لكلية الزراعة جامعة القاهرة بوادي النطرون محافظة البحيرة، وكذلك من محطة تجارب كلية الزراعة بالجيزة بغرض عزل وتعريف الفطريات المسببة لهذه الأمراض. وقد أمكن الحصول على ٨٥ عزلة من الفطريات من العينات التي جمعت من محافظة الجيزة، وكذلك ٨٠ عزلة من الفطريات من النباتات التي جمعت من محافظة البحيرة، وقد تم تنقيتها وتعريفها، حيث وجد أنها تتبع الفطريات *Fusarium oxysporum*, *Sclerotinia sclerotiorum*, *Pythium* sp., *Rhizoctonia solani*, من محافظة الجيزة وليس من محافظة البحيرة. بينما عزلت الفطريات *Fusarium solani*, *Phytophthora* sp. من محافظة البحيرة وليس من الجيزة. وكان الفطر *Macrophomina phaseolina* واسع الانتشار وتم عزله من المحافظتين بأعداد كبيرة. وكذلك كان الفطر *Puccinia carthami* منتشراً بشدة على النباتات في كلا المحافظتين.

أثبتت تجارب اختبار القدرة المرضية أن جميع الفطريات المختبرة كانت قادرة على إحداث مراض سقوط البادرات وإن تفاوتت النسب من فطر لآخر، وعلاوة على ذلك فإن الفطر *F. oxysporum* سبب بوضوح أعراض الذبول الوعائي، أما الفطر *P. carthami* فقد سبب أيضاً وبنسب عالية صدأ بادرات القرطم. وكانت الفطريات المختبرة الأخرى قادرة على استعمار وغزو الجذور مسببة امراض سقوط البادرات وعفن الجذور.

اختبر تأثير مواعيد الزراعة على إصابة بادرات القرطم بالفطريات المختبرة، واتضح من التجارب أن نسبة حدوث المرض قد تأثرت بموعد الزراعة والفطر المختبر. وفي معظم الحالات، وجد أن زراعة التقاوي في أوائل نوفمبر سجلت أحسن إنبات لتقاوي القرطم، وكانت ملائمة من حيث النسب المئوية للإصابة بالفطريات المختبرة.

اختبر تأثير بعض المستحضرات، بيوميسين (محفز للمقاومة)، بيوكنترول (مركب حيوي) وثلاث مبيدات فطرية هي مون كب، فيتافاكس- ثيرام وريزولكس- تى على حدوث الاصابة بكل من الفطريات *F. solani* ، *R. solani* ، *M. phaseolina* و دلت النتائج على أن أي من هذه المستحضرات لم يكن قادراً على منع حدوث الاصابة تماماً. وكانت المستحضرات بيوميسين، وفيتافاكس- ثيرام وريزولكس- تى أكثر كفاءة في مقاومة الاصابة بالفطر *M. phaseolina*. وقد أمكن مقاومة الإصابة بالفطر *R. solani* باستخدام البيوميسين والريزولكس-تى. وكانت أحسن المستحضرات في مقاومة الإصابة بالفطر *F. solani* الفيتافاكس- ثيرام والبيوميسين والريزولكس-تى.