Egypt. J. Agric. Res., 76 (3), 1998.

STUDIES ON THE VIRULENCE OF ROOT ROT PATHOGENS ON SESAME PLANTS

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(Manuscript received 22 June 1997)

Abstract

Fusarium solani, *Rhizoctonia solani* and *Macrophomina phaseolina* causing root rot disease complex of sesame plants increased both root rot incidence and respiration rate of sesame plants. Growth parameters, stem height, leaf area and dry weight, and transpiration rate of sesame plants were decreased as a result of the infection with root rot pathogens. *F.solani*, *R.solani* and *M.phaseolina* had certain effects on root rot incidence, growth parameters, respiration rate and transpiration rate of sesame plants were more pronounced in the late stage of plant growth than those of early stage. Weight of 1000-seeds and total carbohydrate in sesame seed were not significantly affected by infection. The number of capsules/plant, total protein and oil contents of seeds were decreased. Root rot pathogens varied in their effect, where *M.phaseolina* was the highest effective fungus on root rot incidence, growth parameters, respiration rate, transpiration rate, seed yield and chemical components of sesame plants.

INTRODUCTION

Root rot caused by *F.solani* (Zahra *et al.*, 1994), as well as *R.solani* and *M.phaseolina* (El-Deeb *et al.*, 1987; El-Barougy, 1990; Ali *et al.* 1991; Ziedan 1993) is one of the most destructive diseases of sesame plants in Egypt.

Limited data are available concerning the effect of root pathogens on disease incidence, growth parameters, respiration and transpiration rate, yield and chemical components of sesame seeds. El-Barougy (1990) and Ali *et al.* (1991) stated that *M.phaseolina* was the most virulent fungus on sesame plants causing 69.2 and 46.6% infection on sesame cultivars, Giza 25 and Giza 32, respectively. Abd El-Gawad

(1977) found that sesame plant height was greatly reduced after inoculation with *R.solani* and *M.phaseolina*. Gupta and Gheema (1992) indicated that the number of microsclerotia of *M.phaseolina* associated with sesame seed was negatively correlated with the dry matter production and shoot length of seedlings .

The aim of this study was to obtain some informattion concerning the virulence of root rot pathogens including incidence, growth parameters, respiration and transpiration rates, yield and chemical components of sesame seeds.

MATERIALS AND METHODS

The present investigation was conducted during the growing seasons of 1995 and 1996 at Kassasin Agric. Res. Station, Ismailia Governorate.

Root rot pathogens were isolated from infected sesame plants on PDA medium according to Riker and Riker (1936), and subcultured using single hyphal tips or single spore technique. The resulting cultures were identified according to their morphological features (Barnett and Hunter, 1970 and Booth, 1977).

The experiment was designed in a complete randomized block layout with three replicates. Pots (30cm in diameter) were filled with autoclaved soil mixture (50% clay + 50% clean sand). The inocula were prepared by growing each of the isolated fungi in bottles (500 ml) containing sand barley medium (25 gm clean sand + 75 gm barley grains + 100 ml sterilized water) at 25°C for two weeks. The soil was infested with the isolated fungi singly at the rate of 4% (w/w). Pots were watered every other day for one week before planting and after that as needed. The same amount of autoclaved sand barley mixture was added to the pots to serve as a check treatment. Five healthy sesame seeds, cv. Giza 32, were surface sterilized with 0.01% sodium hypochlorite solution for two minutes and then washed several times with sterilized water and planted in each pot with a total of 80 seeds for each treatment. Seven days after planting the percentage of seed germination was calculated to estimate the pre-emergence damping-off. The post emergence damping-off and survivors were counted 15,30 and 45 days after planting by removing the root system carefully. The percentage of infection was calculated as mentioned by Lewis and Papavizas (1977). Growth parameters of sesame plants *i.e.*, stem height, leaf area and dry weight were recorded. Dry weight was determined according to the method described by The Association of Agricultural chemists (Anon., 1970). Respiration rate was estimated according to Salisburg and Ross (1969).Transpiration rate was estimated in the first two mature leaves (Stocker, 1956). These characters and chemical analysis were measured 15, 30 and 45 days after planting. In addition, yield components were recorded as 1000 - seed weight and number of cap-

sules/plant. Total carbohydrates were determined according to Bernfeld (1955) and Miller (1959). Total protein and oil were determined as described by The Association of Agricultural Chemists (Anon., 1970).

The combined data of the two growing seasons were statistically analyzed according to Snedecor and Cochran (1972).

RESULTS AND DISCUSSION

1. Disease incidence :

Pre-emergence damping-off was not significantly different from the control treatment (Table 1).

Table 1. Effect of three fungal species on infection % of sesame plants.

Treatment	Pre-emergence damping-off % after 7 days from sowing	Post emergence root rot (day) after planting		
		15	30	45
Check	0.0	0.0	0.0	0.0
F.solani	0.0	2.0	9.0	17.0
R.solani	0.0	2.0	6.0	14.0
M.phaseolina	0.0	2.0	11.0	21.0
L.S.D. at 5% level	N.S	N.S	1.75	2.02

Data also indicated that all tested fungi induced root rot in sesame plants. Among these fungi, *M.phaseolina* was the most virulent fungus causing 11.0 and 21.0% infection, followed by *F.solani* causing 9.0 and 17.0% infection, while *R.solani* was the least effective fungus causing about 6.0 and 14.0% infection after 30 and 45 days from planting, respectively. These results are in agreement with those reported by El-Barougy (1990) and Ali et al. (1991). It is clear, therefore, that *M.phaseolina* was the most virulent fungus.

Growth parameters:

Data presented in Table 2 indicate that growth parameters *i.e.*, stem height, leaf area and dry weight of sesame plants were not significantly affected as a result of the infection with the three tested fungi after 15 days from planting, as compared with the check. Data also, indicated that the tested fungi decreased stem height, leaf

area and dry weight of sesame plants when datermined at 30 and 45 days from planting. These fungi varied in their effect, and again *M.phaseolina* was the highest effective fungus, followed by *F.solani*, while *R.solani* was the least effective fungus.

Table 2. Effect of the infection after 15,30 and 45 days from seeding by three fungal species on growth parameters of inoculated sesame plants.

Treatment	Stem height (cm)			Leaf area (cm)			Dry weight (g/plant)		
	Days from seeding								
	15	30	45	15	30	45	15	30	45
Check	0.0	21	33	18.4	35.5	42.2	0.48	1.30	1.89
F.solani	2.0	17	29	17.9	30.2	35.3	0.47	1.11	1.68
R.solani	2.0	19	31	18.1	31.2	38.5	0.48	1.18	1.79
M.phaseolina	2.0	14	26	17.8	21.9	31.1	0.47	0.86	1.59
L.S.D. at 5% level	N.S	2.35	3.30	N.S	4.91	2.85	N.S	0.09	0.08

Such results indicate that root rot infection by the tested fungi resulted in reduction in growth parameters of sesame plants. Similar results were reported Abd El-Gawad (1977), El-Barougy (1990) and Gupta and cheema (1992).

Such reduction in growth parameters may be attributed to the decay of root system (Steme et al., 1978) or changes in the physiological processes of the plants which adversely affect growth parameters.

Respiration rate:

It is clear from the data presented in Table 3 that the respiration rate in sesame leaves was not significantly affected as a result of the infection with all tested fungal species at 15 days after planting. At 30 and 45 day after planting, however, the respiration rate in leaves of infected plants was increased *M.phaseolina* infection was accompanied by the highest increase, followed by *R.solani*, while *F.solani* was the least stimulative.

Increased respiration was reperted in bean hypocotyls as a result of *R.solani* infection (Bateman and Daly, 1967). It might be suggested that respiratory rises may be contributing to the establishment of compatible responses by providing the invading pathogens with carbon sources. Usually, pathological increase in respiration produce very low yield of ATP because of the uncoupling reaction in the electron transport system, as Suggested by Daly and Sayre (1957).

Transpiration rate:

Data in Table 3 also show that transpiration rate of sesame leaves was decreased due to the infection with root rot pathogens at 30 and 45 days after planting. *M.phaseolina* was the most effective, followed by *F.solani* where *R.solani* was accompanied with the least reduction. Up to 15 days after planting, the tested fungi showed no significant effect on transpiration rate of sesame leaves as compared with the check.

Table 3. Effect of the three fungal species on respiration and transpiration rates of inoculated sesame plants after 15,30 and days from seeding.

Treatment	Respiration rate (µl O2 consumed h/g) Days from seeding			Transpiration rate (mg/h/plant)		
	15	30	45	15	30	45
Check	1.13	15.0	33	0.89	0.55	0.63
F.solani	1.13	33.6	29	0.39	0.25	0.39
R.solani	1.12	36.0	31	0.39	0.40	0.48
M.phaseolina	1.12	40.8	26	0.39	0.21	0.35
L.S.D. at 5% level	N.S	16.81	3.30	N.S.	0.12	0.16

This effect may be due to reduced water absorption as a result of root decay (Sterne et al. 1978), hence low water potential caused stomata to close, consequently transpiration was decreased. Duniway (1971) attibuted reduced transpiration rate to the low water potential in the leaf leading to stamatal closure.

Yield and its chemical components

Results in Table 4 indicate that weight of 1000-seeds and percentage of total carohydrates in seeds of sesame plants were not significantly affected due to root infechion. The tested fungi, on the other hand, reduced number of capsules/plant, *M.phaseolina* was the most effective pathogen followed by *R.solani*, while *F.solani* was the least effective one.

Data also indicate that total protein and oil contents in sesame seeds were decreased as a result of infection with the tested fungi. *M.phaseolina* was most effective fungus, followed by *F.solani*, and *R.solani* was the least effective in this respect.

These findings indicate that root rot pathogens of sesame plants had a negative correlation with the determined yield components of sesame plants. Such depressive effect may be due to the harmful effect of root rot pathogens on growth parameters of sesame plants as previously shown in our results and/or such modification in the physiological processes which may be induced in sesame plants.

Table 4. Effect of three fungal species on yield components of inoculated sesame plant after 45 days from seeding.

Treatment	1000-seeds weight (g)	Number of capsules/ plant	Total carbo-hydrate (g/100g)	Total protein (g/100g)	Oil (g/100 g)
Check	3.69	33.80	3.05	43.60	50.88
F.solani	3.65	26.60	3.03	41.50	47.50
R.solani	3.65	22.50	3.03	42.80	50.30
M.phaseolina	3.65	21.40	3.03	41.03	45.10
L.S.D. at 5% level	N.S	2.12	N.S	0.89	1.63

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دراسات على تأثير شدة الإصابة بمسببات مرض عفن الجذور على نباتات السمسم

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أجريت هذه الدراسة بغرض معرفة قدرة فطريات الفيوزاريوم سولانى و الريزوكتونيا سولانى والماكروفومينا فاسولينا على احداث مرض عفن جذور السمسم وتأثير الاصابة على خصائص نمو نبات السمسم ومعدلات التنفس والنتح والمحصول والمكونات الكيماوية للبذور. أوضحت النتائج أن وجود هذه الفطريات أدت إلى زيادة شدة الإصابة بمرض عفن الجذور ومعدل التنفس فى نباتات السمسم. وتبين من النتائج وجود نقص فى كل من خصائص نمو نبات السمسم (إرتفاع النبات- مساحة الورقة – الوزن الجاف) ومعدل النتح نتيجة الإصابة بمسببات مرض عفن جذور السمسم. وقد كان التاثير على شدة الإصابة ومعدل التنفس ومعدل النتح وخصائص نمو نبات السمسم أكثر وضوحاً فى المراحل المتأخرة من نمو النبات عنه فى المرحلة الأولى من النمو. وقد أوضحت النتائج عدم حدوث تغير معنوى فى كل من وزن الألف بذرة ومحتوى بذور نبات السمسم من البروتين الكلى والزيت نتيجة الاصابة وأظهرت النتائج وجود إختلاف واضح فى درجة تأثير مسببات مرض عفن جذور السمسم فيما بينها على احداث المرض وخصائص نمو النبات ومعدل التنفس ومعدل النتح والمحصول والمكونات الكيماوية للمحصول حيث وجد أن فطر الماكروفومينا فاسولينا كان اكثر هذه المسببات تأثيراً على الصفات تحت الدراسة.