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SUSCEPTIBILITY OF SOME FLAX CULTIVARS TO SEEDLING DAMPING-OFF

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ABSTRACT

The seedlins of growing flax cultivars and promising strains exhibited various reaction of seedling damping–off. *Fusarium* spp.;*Rhizoctoniasolani* ; *Pythium* spp.; *Macrophomina phaseolina* and *Sclerotium rolfsii* were isolated from affected seedlings and shown to be pathogenic to flax under specific controlled conditions. A wide range of resistance among and within varieties resulted from the difference among varieties to the same isolates and the different reaction of a single variety to many isolates. Isolates of *Rhizoctonia solani* and *Macrophomina phaseolina* were the primary agents in pre-emergence damping-off and were associated with sever necrosis of roots and/or hypocotyls. *Macrophomina* and *Fusarium* induced severe post-emergence, and induced severe root necrosis on surviving plants. All of the three pathogens considered important components of the flax seedling damping–off diseases.

INTRODUCTION

Common flax *″Linum ustitissimum* L.″ is one of the first crops domesticated by man. Egyptian began cultivating flax about 5000 B.C. (Ann.1). Seedling diseases of flax frequently reduce plant stands. These losses include pre- and post-emergence damping-off, seedling death and weakened plants because of fungi, which cause lesions and injuries to roots and hypocotyls. Several fungi, including *Aureobasidium lini*; *Fusarium* spp.; *Olpidium brassicae*; *Pythium* spp.;*Rhizoctonia solani* and *Thielaviopsis basicola*, may either singly or collectively cause the disease (Nyvall,1999). Michail *et al*., 1972 found that *Corticium solani*; *Fusarium oxysporum*; *F. solani*; *F. semitectum*; *Pythium middlelonii* and *Pythium* sp. are responsible for the damping-off disease in Egypt. Some fungi may cause more injury under cool soil temperatures, while other fungi grow better at higher soil temperatures (Nyvall, 1999). Losses are most severing in extremely cold, wet growing conditions (Oplinger *et al*.1989). *Rhizoctonia solani* Kühn appears to be a major pathogen in this disease complex (Erwin& Kennedy, 1957 and Fredriksen, 1965). Other work indicated that *Pythium* spp. is the most important fungi under wet soil conditions (Nyvall, 1999). The aims of this work to study the susceptibility of some flax cultivars and promising strains to seedling diseases and to identify the major pathogen causes this disease.

MATERIALS AND METHODS

Diseased seedlings were used in isolated and identified the root rot pathogens. This samples were collected from flax cultivars (Sakha 1,Sakha 2, Giza 7,Giza 8, Blenka) and five new promising strains (Strains1; 3; 5; 6 and 7).

Isolation and identification of fungi: Roots and basal stem pieces with lesions were washed thoroughly under running tap water, surface disinfested in 0.5% NaOCl for 30 sec, blotted dry between sterile filter papers, then plated onto PDA media. Plats were incubated in dark at 25±3°c and observed daily for the development of fungi. Young colonies transferred to PDA slant, amended with rose bengal, for identification and further studies. The resulting fungi identified to genus level according to Barnett&Hunter (1979).

Pathogenicity of some isolated fungi: The pathogenicity of nine fungal isolates representing one of *Macrophomina phaseolina*: four of *Rhizoctonia solani* and four of *Fusarium* spp., were tested on flax seedlings of the previous flax cultivars and strains, for their ability to cause pre- and post-emergence damping-off. Inocula of isolates increased in an autoclave (121ºc for 1.5hr, twice) cornmeal sand mixture (1:20, w/w) in flasks (200g / flask). The mixture infested with small disks of one-week old culture and incubated for three weeks. The flasks were shaken vigorously every 3-4 days, to facilitate uniform colonization of the mixture. The colonized mixture thoroughly mixed with the sterile soil at rat of 0.5% of the soil weight. The pots watered for ten days before planting to enhance fungal growth. The previous cultivars and strains sown at rate 25 seeds per pot. Control plants grown in uninfested sterile-soil. Pathogenicity assessed by the percent of pre- and post-emergence damping-off and disease severity. The surviving plants were extracted and rated for *Rizoctonia* and *Macrophomina* on hypocotyls based on a 1-5 scale (according to Nelson *et al*., 1996, where 1= no symptoms, 2= lesion(s) <3mm and/or≤25% girdling, 3= lesion(s) 3-6mm and/or >25 to 50% girdling, 4= lesion(s)>6mm and /or >50%girdling, and 5= 75%of leaves wilted or plant dead) and for *Fusarium* on roots based on 0-4 scale (0=no symptoms; 1=few necrotic lesions in roots; 2=abundant necrotic lesions in root; 3=extensive necrosis or several cankers in root and 4= dead seedling).This experiment was repeated once.

Statistical analysis: A complete randomized design used in this nvestigation. Duncan′s multiple range test was applied for comparing means. The software Irristat performed analysis.

RESULTS

Identification and frequency of pathogens: The necrosis of roots and hypocotyls tissues occurred in all tested cultivars and strains of flax. *Fusarium* spp.; *Rhizoctonia solani*; *Pythium* spp.; *Macrophomina phaseolina* and *Sclerotium rolfsii* were isolated from symptomatic seedling at testing trail. *Rhizoctonia* was the most frequent isolated fungi, *Fusarium* spp. succeed after them (Table 1). *Pythium* spp. was associated with all cultivars and strains except Giza 7 and strain 6. *Macrophomina phaseolina* had low frequent and isolated from three cultivars only (Sakha 1; Giza 7and Giza 8) and strains 3 and 5. *Sclerotium*. *rolfsii* isolated from strain 7 only. On the other hand, the cultivar blenka had the highest number of isolated fungi.

Table (1): Frequency of isolated fungi from infected seedling of flax.

Cultivars	*Fusarium*	*Rhizoctonia*	*Pythium*	*Macrophomina*	*Sclerotium*	**Mis	Total
Sakha 1	*30.43	39.13	8.7	0.0	0.0	21.74	23
Sakha 2	30.43	39.13	8.7	4.35	0.0	17.39	23
Giza 7	29.41	35.29	0.0	5.88	0.0	29.42	17
Giza 8	25.0	30.0	15.0	10.0	0.0	20.0	20
Blenka	23.26	39.54	18.6	0.0	0.0	18.60	43
Strain 1	47.06	41.18	5.88	0.0	0.0	5.88	34
Strain 3	47.82	17.39	8.7	8.7	0.0	17.39	23
Strain 5	45.83	16.67	8.33	8.33	0.0	20.84	24
Strain 6	25.0	65.0	0.0	0.0	0.0	10.0	20
Strain 7	42.31	42.31	11.53	0.0	3.85	0.0	26
Mean	34.65	36.56	8.54	3.73	0.35	16.12	

***Total isolates of cultivar.**

****Miscellaneous= Category includes several nonpathogenic fungi (species of *Alternaria*: *Epecoccum*; *Nigrospora*; etc.).**

Susceptibility of certain cultivars and strains of flax to artificial inoculation by the causal fungi: The ability of isolated fungi to cause root rot evaluated using five flax cultivars and five strains. One isolate of *Macrophomina phaseolina*; four isolates of *Rhizoctonia solani* and four isolates of *Fusarium* spp. used in this trails. All isolates were pathogenic to flax; it induced pre-emergence seedling death and restricted necrosis on roots and hypocotyls.

Pre-emergence damping-off: A significant differences among the tested flax cultivars and strains to the three fungal pathogens were observed (Table 2). *M*. *phaseolina* induced pre-emergence percent ranged from 10% for Giza 8 to 60% for Sakha 2. *Rhizoctonia solani* isolates exhibited much higher pre-emergence damping-off ranged from 47.4 to 88.6%. Isolate 1 induced 62.0% at strain 7 and it was lowest at blenka (18.0%). The highest percent for second isolate was 90.0% for strain 6 when Sakha1 and blenka had the same percent (50.0%). Giza 7 showed 80.0 and 100.0% for isolates 3 and 4, respectively (highest effect) when lowest effect recorded for blenka (38.0%) and strain 5 (60.0%) for isolates 3 and 4, respectively. *Fusarium* isolates had low infected percent ranged from 8.25 to 16.65%. The highest infected percent were for Sakha2 (48.0%); strain6 (50.0%); Sakha1 (40.0 and 18.0%) for isolats1; 2; 3 and 4, respectively, while strain 3 had the lowest percent for the four *Fusarium* isolates. Generally, *Rhizoctonia* isolate 4 was the highly pathogenic isolate, it had the highly significant pre-emergence percent 88.6%) compared with the rest isolates. *Fusarium* isolate 4 had the lowest percent (8.25%). Sakha2 was the highly susceptible cultivar; it had highly significant mean percent (44.8%) while blenka tend to be slightly resistant. Data in table (3) presents reaction of the sacond trail. Strain 3 had the highest reaction to *M*. *phaseolina* (90.0%) while strain 6 had the lowest reaction (43.4%). Sakha 2 ; Sakha 1 ; strain 1 and Sakha 2 showed the highest pre-emergence percent for *Rhizoctonia* isolates where it were 80.0 ; 90.0 ; 86.7 and 100.0 for isolates 1; 2 ; 3 and 4 ,respectively .

On the other hand, blenka exhibited the lowest reaction for three isolates 1; 3 and 4 (19.9; 29.9 and 50.0%, respectively), while strain 3 showed the lowest reaction for isolate 2 (40.0%). *Fusarium* isolates produced rather high reaction from the first trail. Strain 6 produced the highest reaction for isolate 1 and 2 by 80.0 and 93.3% , respectively when Giza 7 showed the highest reaction for isolate 3 and 4 by 96.7 and 70.0% , respectively .The lowest reaction was for Giza 7 (isolate 1) ; strain 7 (isolate 3 and 4) and Sakha 1 (isolate 4) by 13.4 ; 3.35 ; 16.7 ; and 6.65 % respectively. Generally, *Rhizoctonia* and *Macrophomena* produced high pre-emergence damping-off percent and *Rhizoctonia* .isolate 4 had the highest one (79.99 %). *Fusarium* isolates showed rather low percent but it is higher than the first trail. Sakha 1 and Sakha 2 exhibited the susceptible reaction by induced mean percent non-significant differ (65.0 and 64.94%) when strain 5 and blenka showed the lowest reaction (33.37 and37.66, respectively).

Post-emergence damping -off: Data in table 3 revealed that *M*. *phaseolina* was the highest fungus caused post-emergence damping-off. Sakha 1 and strain 1 was the highest reaction (36.0%) when Giza 8 not produced post-emergence effect (0.0%). There was non-significant difference observed between flax cultivars and strains to *Rhizoctonia solani* inoculation to cause post-emergence damping-off. At least two tested cultivars had 0.0% reaction for every isolate and reaction ranged from 2.2to 7.25%. *Fusarium* isolates produced rather highly reaction of post-emergence percent from *Rhizoctnia* isolates. Strain 6 had the highest reaction for isolate 1 and 2 (28.0 and 12.0%, respectively) when Giza 7 and strain 1 showed the same reaction for isolates 3 and 4 (30.0 and 10.0 %, respectively). Generally, strain 3 did'nt produce post-emergence damping-off for all isolates (0.0%). Over-again, the tested fungi and flax cultivars exhibited significant different at the first trail, *M. phaseolina* had the highest reaction (15.9 %) and *Rhizoctonia* isolate 4 had the lowest one (2.2 %). On the other hand, Sakha 1 produced the highest mean reaction (12.6 %) and strain 5 produced the lowest one (3.0 %). Similar results found in the second trail with minor difference in the rank. Strain 1 had the same reaction for *M*. *phaseolina* , while strain 5 do not produce post-emergence percent (0.0). In this trail *Rhizoctonia solani* isolates produced increasing reaction from the first one. Strain 3 had the highest reaction (56.7%) when Sakha 1 and Blenka do not produced post-emergence damping-off (0.0%) for isolate 1. Isolate 2 produced 20.0% infection in strain 3 but there is not infection percent in Sakha 1 and 5. Blenka had the highest reaction (23.35 %), while Sakha 2 had the lowest one for isolate three. *Rhizoctonia* Isolate four had the lowest reaction on the tested strains, Only one cultivar and two strains produced infection percent (Giza 7 ; strains 3 and 7 produced 6.7 , 6.7 and 3.35 %, respectively), When the rest cultivars and strains did not infected (0.0%). *Fusarium* isolates produced rather highly reaction from the first trail, strain 3 was susceptible to isolate 1 it had 33.35% infection when Sakha 2 had the lowest reaction (6.65 %). Sakha 2 produced 33.35% post-emergence for isolate two while strain 1 do not infected. Isolate 3 showed 43.35% infection for strain 6 when Sakha 2 and Giza 7 was not infected (0.0 %). Giza 8 had the highest percent (40.0%) and strain 5 had the

lowest one (0.0 %) for isolate 4. Generally, *Fusarium* isolate 1 was the pathogenic isolate it produced 21.04 % post-emergence while, *Rhizoctonia* isolate 4 had the lowest reaction it produced 1.68%. Giza 8 was the susceptible cultivar for post-emergence infection but strain 5 was resistant one.

Disease Severity: *Macrophomia* and *Rhizoctonia solani* induced restricted and extensive hypocotyls necrosis at the two trails. In a few cases, it induced roots necrosis. Data in table 4 revealed that *M. phaseolina* was virulent for Sakha 1;Sakha 2 and strain 1 when it exhibited weakly reaction against Giza 8 and strains 3 and 5 for the trails 1 and 2, respectively. *Rhizoctonia* isolates showed significantly different reaction ranged from highly virulent to weakly virulent. Generally, isolate four was the virulent one in the first trail while there is no significant different between the isolates in the other trail. Sakha 2 and strain 1 exhibited the highly reaction, 2.23 and 3.48, at the trail1 and 2, respectively when blenka had the lowest reaction in the two trails.

Table (4): Disease severity of flax cultivars and strains under inoculation onditions of *Macrophomina phaseolina* and *Rhizoctonia solani* at two trails.

Trials	Cultivars	*Macrophomin*	*Rhizoctonia*				control	Mean
			1	2	3	4		
1	Sakha1	3.6a	1.43bc	1.33fg	2.12c	2.33d	1.0a	1.99
	Sakha2	3.48a	1.5b	1.56ef	3.25a	2.6d	1.0a	2.23
	Giza 7	1.35fg	1.96a	1.6ef	1.5de	5.0a	1.0a	2.07
	Giza 8	1.03g	1.06cd	2.21bc	1.57de	3.0c	1.0a	1.65
	Blenka	1.44ef	1.05cd	1.45ef	1.22ef	1.5e	1.0a	1.28
	Strain1	2.92b	1.0d	2.5b	1.64d	3.67b	1.0a	2.12
	Strain3	1.18c	1.05cd	1.0g	1.0f	5.0a	1.0a	1.87
	Strain5	1.3fg	1.19bcd	1.75de	2.22c	5.0a	1.0a	2.08
	Strain6	1.72de	1.36bcd	2.0ed	2.0c	1.0f	1.0a	1.51
	Strain7	1.96cd	1.35bcd	3.5a	2.86b	1.4e	1.0a	2.01
	Mean	2.10	1.30	1.89	1.94	3.05	1.0	1.88
2	Sakha1	3.0d	5.0a	1.0f	3.67c	1.5e	1.0a	2.53
	Sakha2	3.12d	1.08f	2.5d	1.33g	5.0a	1.0a	2.46
	Giza 7	3.0d	2.46e	2.78c	4.27b	3.0c	1.0a	2.75
	Giza 8	3.44c	3.17d	4.57a	1.18g	2.0d	1.0a	2.56
	Blenka	1.73e	1.04h	1.29e	2.33e	1.22f	1.0a	1.44
	Strain1	5.0a	5.0a	1.29e	3.6c	5.0a	1.0a	3.48
	Strain3	3.67b	4.4b	2.47d	1.86f	3.67b	1.0a	2.85
	Strain5	1.0g	3.86c	2.67cd	3.67c	1.0g	1.0a	2.20
	Strain6	1.24f	1.8f	2.78c	3.0d	1.22f	1.0a	1.84
	Strain7	3.4c	1.35g	2.75b	4.67a	1.5e	1.0a	2.61
	Mean	2.86	2.99	2.51	2.96	2.51	1.0	2.47

Disease severity was assessed on a 1-5 scale(1= no symptom, 5= dead seedling) .
Values in a column followed by different letters are significantly defferent at the 5% level by DMRT.

Disease severity for *Fusarium* isolates evaluated at the infected root. There were significant differences in disease severity among isolates of *Fusarium* of flax cultivars (Table 5). For the two experiments, isolates 3 and 4 produced the highest disease severity while it is equal of their reaction with isolate three at the second experiment. The first isolate had the lowest reaction at the first experiment and isolate two for the second experiment. Strain seven exhibited the highly reaction for the two experiments.

Table (5): Disease severity of flax cultivars and strains under inculation condetions of *Fusarium* spp.at two tralis.

Trials	Cultivars	*Fusarium*				control	Mean
		1	2	3	4		
1	Sakha1	0.0 c	1.51 b	1.50 a	1.0 b	0.0 a	0.80
	Sakha2	0.0 c	0.0 c	1.43 a	1.0 b	0.0 a	0.49
	Giza 7	0.0 c	0.0 c	1.2 bc	1.0 b	0.0 a	0.44
	Giza 8	0.0 c	2.0 a	0.0 d	2.0 a	0.0 a	0.80
	Blenka	0.0 c	2.0 a	0.0 d	2.0 a	0.0 a	0.80
	Strain1	2.0 a	0.0 c	1.0 c	0.0 c	0.0 a	0.60
	Strain3	1.5 b	0.0 c	1.36 ab	1.0 b	0.0 a	0.77
	Strain5	0.0 c	2.0 a	1.0 c	1.0 b	0.0 a	0.80
	Strain6	2.0 a	2.0 a	1.57 a	1.0 b	0.0 a	1.31
	Strain7	0.0 c	0.0 c	1.0 c	1.0 b	0.0 a	0.40
	Mean	0.55	0.95	1.0	1.1	0.0	0.72
2	Sakha1	2.0 a	2.18 a	0.00 d	1.79 a	0.0 a	1.19
	Sakha2	1.0 b	0.00 f	3.00 a	1.80 a	0.0 a	1.16
	Giza 7	2.0 a	0.50 de	0.00 d	1.00 b	0.0 a	0.70
	Giza 8	0.0 c	1.00 bc	0.00 d	0.20 c	0.0 a	0.24
	Blenka	0.0 c	1.25 b	0.32 cd	0.39 c	0.0 a	0.39
	Strain1	1.0 b	0.11 ef	1.89 b	0.29 c	0.0 a	0.65
	Strain3	2.4 a	0.77 cd	1.59 b	1.18 b	0.0 a	1.18
	Strain5	0.0 c	0.30 ef	0.67 c	1.93 a	0.0 a	0.58
	Strain6	0.0 c	0.00 f	1.67 b	1.90 a	0.0 a	0.71
	Strain7	1.2 b	0.12 ef	3.07 a	1.64 a	0.0 a	1.20
	Mean	0.95	0.62	1.22	1.21	0.0	0.80

Disease severity was assessed on a 1-5 scale (1= no symptom, 5= dead seedling).
Values in a column followed by different letters are significantly defferent at the 5% level by DMRT.

DISCUSSION

The seedling disease complex known as seedling blight, scorch, and root rot is common in the areas producing flax of the world. The importance of the seedling disease complex could increase if crop practices, weather conditions, or increases of inoculum of the pathogens involved favor the development of the disease in the complex. Diseased plants have lesions on their roots immediately blow the ground line. These lesions enlarge to kill seedling and weaken older plants. *Fusarium* spp., *Rhizoctonia solani* ,

Pythium spp. , *Macrophomina phaseolina* and *Sclerotium relfsii* were isolated from affected tissues and shown to be pathogenic to flax under specific controlled conditions . Seedling and stem blight may be due to *Alternaria finicula* which its seed borne (Ann 3). Symptoms observed on seedlings affected by the disease complex were similar to those reported by the other researchers. (Nyvall, 1999; Berkeley, 1944; Muskett&Cohoun,1949; Schuster&Anderson, 1947; Dickson, 1956 and Anderson,1977). The ability of isolated fungi "*Macrophomina phseolina* ; *Rhizoctonia solani* and *Fusarium* spp." to cause root rot was evaluated using five cultivars and five promising strains of flax . All isolates were pathogenic to flax, and it included pre and post-emergence of seedling and restricted necrosis on roots and hypocotyls of emerged seedlings. Results with pathogenicity test indicated that *R.solani* was the most important pathogen in flax seedling damping-off, as reported by other researchers (Erwin&kennedy, 1957and Fredriksen, 1965).*Rhizoctonia* isolate 4 was highly virulent to flax cultivars and strains. Tsiang, 1947 found variability in resistance among varieties and hybrids of flax but concluded that the virulence of *R*. *solani* is general on flax and that there is little promise of selecting for resistance. The pathogenicity test indicated that *Rhizoctonia* and *Macrophomina* were the major pathogens of pre-emergence damping-off, when *Fusarium* was less pathogenic. Sakha 2 was the susceptible cultivar and blenka was the resistant significantly. Results indicated that *Macrophomina* was the major pathogen of post-emergence damping-off, when *Rhizoctonia* was the minor one, and strain 5 was the most resistant. *Macrophomina phaseolina* and *Rhizoctonia solani* induced restricted and extensive hypocotyls necrosis, and at a few cases, it induced root necrosis. *Rhizoctonia solani* especially isolate four was the virulence isolate, it exhibited the highly disease severity reaction. Strain 7 had the highly disease severity. The results indicate that the difference among varieties to the same isolates and the different reaction of a single variety to many isolates indicator of a wide range of resistance among and within varieties.

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القدرة المرضية لبعض المسببات المرضية لسقوط البادرات في الكتان و حساسية بعض الأصناف للإصابة بها

فتحية سليمان الشراكى

مركز البحوث الزراعية-معهد بحوث أمراض النباتات

أبدت بعض أصناف و سلالات الكتان رد فعل مختلف بالنسبة للإصابة بمرض سقوط البادرات في الكتان و ذلك عندما زرعت في تربة سبق زراعتها بالكتان وقد تم تعريف بعض المسببات المرضية لهذا المرض و هي أنواع من فطر الفيوزاريوم و فطر الريزوكتونيا سولانى و أنواع من الفطر بيثيوم و الفطر ماكروفومينا فاصيولينا و الفطر اسكليروشيم رولفزيابو التي تم عزلها من البادرات التي تحمل أعراض الإصابة . و أشارت نتائج اختبار القدرة المرضية لبعض عزلات من فطريات الريزوكتونيا و الماكروفومينا و الفيوزاريوم مدى واسع من الإصابة بين و داخل الأصناف حيث اختلفت الإصابة بين الأصناف داخل العزلة الواحدة و كذلك في أصابتها بالعزلات المختلفة . كانت عزلات الريزوكتونيا و الماكروفومينا اكثر العزلات قدرة على إحداث سقوط ما قبل الإنبات و كذلك حدوث شدة مرضية على الجذور و الأجزاء الأرضية للنبات في حين كانت الماكروفومينا و الفيوزاريوم اكثر قدرة على إحداث سقوط ما بعد الإنبات و إحداث شدة مرضية اكثر على الجذور. و تشير نتائج البحث إلى أن للفطريات الثلاثة دورا هاما في إحداث سقوط البادرات في الكتان.

Table (2): Pre-emergence reaction of flax cultivars and strains to atrificial infestation by some isolated root rot pathogens under greenhouse conditions at two saccesse trails.

Cultivars & Strains	Macrophomina *Phaseolina*	*Rhizoctonia solani (isolats)*				*Fusarium spp. (Isolats)*				Control	Mean
		I	II	III	IV	I	II	III	IV		
Trail 1											
Sakha 1	44.0 ab	58.0 ab	50.0 c	74.0 a	94.0 a	16.0 b	18.0 b	40.0 a	18.0 a	0.0 a	41.2 ab
Sakha 2	60.0 a	60.0 ab	80.0 abc	76.0 a	86.0 ab	48.0 b	6.0 b	18.0 ab	10.0 a	4.0 a	44.8 a
Giza 7	32.0 ab	52.0 ab	78.0 abc	80.0 a	100.0 a	6.0 b	8.0 b	8.0 ab	14.0 a	4.0 a	38.2 abc
Giza 8	10.0 c	50.0 abc	56.0 bc	72.0 a	96.0 a	12.0 b	16.0 b	10.0 ab	2.0 a	0.0 a	32.4 bcd
Blenka	42.0 ab	18.0 c	50.0 c	38.0 b	82.0 ab	6.0 b	8.0 b	8.0 ab	0.0 a	2.0 a	25.4 d
Strain 1	22.0 bc	46.0 abc	84.0 ab	72.0 a	92.0 ab	16.0 b	22.0 ab	6.0 b	10.0 a	4.0 a	37.4 abc
Strain 3	38.0 abc	28.0 bc	86.0 ab	74.0 a	92.0 ab	4.0 b	0.0 b	4.0 b	0.0 a	0.0 a	32.6 bcd
Strain 5	18.8 bc	40.0 abc	51.3 c	50.0 ab	60.0 b	20.0 ab	32.5 ab	12.5 ab	12.5 a	6.0 a	30.4 cd
Strain 6	16.0 bc	60.0 ab	90.0 a	64.0 ab	94.0 a	26.0 ab	50.0 a	8.0 ab	6.0 a	2.0 a	41.6 ab
Strain 7	26.0 bc	62.0 a	86.0 ab	58.0 ab	90.0 ab	12.0 b	6.0 b	6.0 b	10.0 a	4.0 a	36.0 abc
Mean	30.88	47.4	71.13	65.8	88.6	16.6	16.65	12.05	8.25	2.6	35.60
Trail 2											
Sakha 1	80.0 a	76.7 a	90.0 a	83.4 a	93.4 a	66.7 ab	53.3 abc	96.7 a	6.65 b	3.35 a	65.0 a
Sakha 2	56.0 a	80.0 a	80.0 ab	83.4 a	100.0 a	43.4 abc	60.0 ab	73.4 ab	66.7 a	6.65 a	64.94 a
Giza 7	46.7 a	36.7 abc	73.3 ab	60.0 ab	80.0 a	13.4 c	33.4 bcd	96.7 a	70.0 a	6.65 a	51.66 b
Giza 8	53.3 a	60.0 abc	83.3 ab	63.4 ab	96.7 a	60.0 abc	40.0 bcd	60.0 abc	26.7 ab	3.35 a	54.66 b
Blenka	63.4 a	19.9 c	76.7 ab	29.9 b	50.0 a	43.4 abc	43.4 bcd	30.0 bc	13.3 b	6.65 a	37.66 d
Strain 1	63.4 a	70.0 ab	73.4 ab	86.7 a	100.0 a	36.7 abc	20.0 bcd	40.0 bc	23.3 ab	10.0 a	52.33 b
Strain 3	90.0 a	26.7 bc	40.0 b	73.4 ab	90.0 a	20.0 bc	10.0 cd	30.0 bc	16.7 b	10.0 a	40.67 cd
Strain 5	45.0 a	36.7 abc	50.0 ab	50.0 ab	56.7 a	21.7 bc	8.35 cd	46.7 bc	10.0 b	8.75 a	33.37 d
Strain 6	43.4 a	63.4 abc	73.4 ab	60.0 ab	70.0 a	80.0 a	93.3 a	26.7 bc	23.4 ab	6.65 a	54.00 b
Strain 7	83.4 a	20.0 c	73.4 ab	80.0 a	63.3 a	33.3 abc	3.35 d	16.7 c	36.7 ab	3.35 a	41.33 c
Mean	62.44	48.99	71.33	67.00	79.99	41.84	36.5	51.66	29.33	6.54	49.56

Values in column followed by different letters are significantly different at the 5% level by DMRT.

Table (3): Post-emergence reaction of flax cultivars and strains to atrificial infestation by some isolated root rot Pathogens under greenhouse conditions at two saccesse traials.

Cultivars & Strains	*Macrophomina phaseolina*	*Rhizoctonia solani(isolats)*				*Fusarium spp. (isolats)*				Control	Mean
		I	II	III	IV	I	II	III	IV		
Trail 1											
Sakha 1	36.0 a	4.0 a	38.0 a	8.0 a	4.0 a	6.0 ab	10.0 a	18.0 ab	0.0 a	2.0 a	12.6 a
Sakha 2	10.0 bc	4.0 a	2.0 b	8.0 a	6.0 a	12.0 ab	2.0 a	6.0 b	8.0 a	2.0 a	6.0 ab
Giza 7	10.0 bc	8.0 a	4.0 b	4.0 a	0.0 a	0.0 a	16.0 a	30.0 a	4.0 a	0.0 a	7.6 ab
Giza 8	00.0 c	2.0 a	10.0 b	0.0 a	2.0 a	6.0 ab	2.0 a	22.0 ab	8.0 a	2.0 a	5.4 ab
Blenka	06.0 bc	4.0 a	10.0 b	0.0 a	2.0 a	6.0 ab	8.0 a	0.0 b	0.0 a	0.0 a	3.6 b
Strain 1	36.0 a	4.0 a	4.0 b	4.0 a	4.0 a	0.0 b	0.0 a	2.0 b	10.0 a	3.0 a	6.7 ab
Strain 3	26.0 ab	0.0 a	2.0 b	2.0 a	2.0 a	0.0 b	0.0 a	0.0 b	0.0 a	0.0 a	3.2 b
Strain 5	05.0 bc	0.0 a	2.5 b	1.3 a	0.0 a	5.0 ab	2.5 a	7.5 ab	5.0 a	0.0 a	3.0 b
Strain 6	12.0 bc	0.0 a	0.0 b	6.0 a	0.0 a	28.0 a	12.0 a	6.0 b	0.0 a	1.3 a	6.4 ab
Strain 7	18.0 abc	0.0 a	0.0 b	16.0 a	2.2 a	24.0 a	10.0 a	2.0 b	10.0 a	0.0 a	8.3 ab
Mean	15.9	2.6	7.25	4.93	2.2	8.7	6.25	9.35	4.5	1.3	6.28
Trail 2											
Sakha 1	6.65 ab	23.35 b	0.0 a	6.65 a	0.0 a	23.3 a	6.7 ab	3.35 b	39.95 a	3.0 a	11.3 abc
Sakha 2	29.95 ab	0.0 b	6.65 a	0.0 a	0.0 a	6.65 a	33.35 a	0.0 b	16.65 ab	0.0 a	9.33 bc
Giza 7	23.35 ab	13.3 b	6.7 a	16.65 a	6.7 a	26.65 a	10.0 ab	0.0 b	10.0 ab	3.35 a	11.7 abc
Giza 8	16.65 ab	19.95 b	10.0 a	6.65 a	0.0 a	36.65 a	20.0 ab	40.0 a	40.0 a	3.35 a	19.33 a
Blenka	6.65 ab	0.0 b	0.0 a	23.35 a	0.0 a	10.0 a	3.35 ab	16.65 ab	26.7 ab	3.35 a	9.01 bc
Strain 1	36.65 a	30.0 ab	0.0 a	6.7 a	0.0 a	13.35 a	0.0 b	23.3 ab	20.0 ab	4.0 a	13.3 abc
Strain 3	6.7 ab	56.65 a	20.0 a	3.35 a	6.7 a	33.35 a	10.0 ab	13.35 ab	3.35 b	0.0 a	15.75 ab
Strain 5	0.0 b	16.65 b	0.0 a	6.7 a	0.0 a	16.65 a	13.35 ab	3.35 b	0.0 b	0.0 a	5.67 c
Strain 6	3.35 b	6.65 b	3.35 a	13.3 a	0.0 a	20.0 a	6.7 ab	43.35 a	23.3 ab	3.3 a	12.3 abc
Strain 7	10.0 ab	6.65 b	16.65 a	10.0 a	3.35 a	23.35 a	16.65 ab	23.35 ab	16.65 ab	4.0 a	13.1 abc
Mean	14.0	17.32	6.34	9.34	1.68	21.04	12.01	16.67	19.66	2.74	12.07

Values in column followed by different letters are significantly different at the 5% level by DMRT.