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OCCURRENCE, PREVALENCE AND CONTROL OF WHEAT SEEDLING BLIGHT, COMMON ROOT ROT AND SPOT BLOTCH CAUSED BY *Cochliobolus sativus* IN EGYPT

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ABSTRACT

A widespread occurrence of seedling blight, common root rot, and spot blotch, caused by *Cochliobolus sativus* Drechs.ex Dastur, was recorded on wheat in Egypt from 1998 to 2002. The prevalence of these diseases was more evident in North Egypt (Delta region) than in Middle and South (Upper) Egypt. Fourteen synthetic fungicides and two natural products were selected for controlling *C. sativus*. All compounds significantly reduced seedling blight and root rot incidence and spot blotch severity (%). Consequently, improvement of seedling growth, grain yield and other agronomic traits were obtained with the application of these compounds. Benomyl, carbendazim, thiabendazole and mancozeb, were the most effective compounds, followed by bupirimate, neem-leaf extract, carboxin and oxycarboxin. The two natural products, extract of neem (*Azadirachta indica*) and luban (frankincense, *Boswellia sacra*) were superior to some fungicides tested. Therefore, the possibility of using them to control *C. sativus* as safe compounds for human and environment was discussed.

INTRODUCTION

Cochliobolus sativus (Ito & Kuribayashi) Drechs. ex Dastur (the conidial stage : *Bipolaris sorokiniana* (Sacc.) Shoem, syn.: *Helminthosporium sativum* (Pammel, King & Bakke), is a serious pathogen that causes seedling blight, root rot, foot rot, spot blotch, head, and kernel blight on wheat and other cereals, in many hot, humid areas of Asia, Africa and South America (Gilchrist & Pfeiffer, 1991and Villareal *et al.*, 1995). Yield losses due to these diseases vary widely on wheat from 38 to 87% according to the magnitude of reduction in root growth and plant vigor (Hill & Blunt, 1994).

In Egypt, *C. sativus* has been isolated since 1970, and increased tremendously during the last decade (Sabet, 1972 and Hammouda, 2003).

Chemical control of *C. sativus*, using five chemical fungicides as seed treatments and four as foliar spray, was applied to improve productivity. However, none of these fungicides completely eradicated the pathogen on wheat seeds. They were relatively effective against this pathogen and resulted in higher yield and increment of kernel weight (Hetzler *et al.*, 1991; Goulart, 1998; and Goulart & Reis, 1998).

Because of the possible detrimental effects of synthetic pesticides on human and environment, the use of natural compounds such as plant-derived products has become one of the promising means for controlling plant diseases (Prakash & Rao, 1997). The antifungal effects of a wide range of some cultivated plants and natural flora were demonstrated, as they inhibited sporulation and spore germination of *C. sativus*, *in vitro* (Turkusay & Onogur, 1998).

The objectives of the present study were to survey seedling blight, common root rot and spot blotch in wheat fields in Egypt and to evaluate the efficiency of chemical fungicides and natural products in controlling these diseases and improving agronomic traits.

MATERIALS AND METHODS

- Disease survey:

The field-selection method suggested by Schilder and Bergstron (1989) was adopted to conduct a general survey during 1998, 1999, 2000, 2001 and 2002 growing seasons, in cooperation with the extension service of Ministry of Agriculture. The main wheat-growing areas of Egypt were surveyed in January, February, March and April; to inspect plants and record the occurrence and prevalence of seedling blight, root rot and spot blotch. Egypt was considered as three distinct regions with different environmental conditions to facilitate the survey. These regions were: North Egypt (low temperature, more average rainfall and high humidity); Middle Egypt (moderate conditions) and South (Upper) Egypt (relatively high temperature, rare rainfall and very low humidity), (Anonymous, 1998).

More accurate survey was conducted through Wheat Disease Trap Nurseries (WDTN) distributed all over the wheat-growing areas of Egypt (Abdel-Hak *et al.*, 1979). Twenty-five wheat cultivars and lines, showing different levels of susceptibility to *C. sativus* were planted as 3.5-m. rows with 30 cm distance, during November 2001 and 2002, at 20 governorates (Table,1).

Table (1): Wheat cultivars and lines of Disease Trap Nurseries with their pedigree or C.I. No.*

No.	Cultivar & line	Pedigree or C.I. No.
1	Giza 155	(Regent 975-11 x Giza 139^2)/Mida Cadet x Hindi 62
2	Sakha 61	Inia-RL 4220 x 7c / Y 50
3	Sakha 69	Inia-RL 4220 x 7c / Y 50
4	Giza 160	Chenab 70 x Giza 156
5	Giza 162	Vcm. X Cno. 67 "S"-(7c) Kal-BB
6	Sakha 92	Napo 63 x Inia 66-Wren "S"
7	Gemmeiza 1	Maya 74 "S"-On x 1160-147/BB-Gall/Chat "S"
8	Sohag 1	Gdovz 469/3/Ja "S"//bi-130/Lds
9	Sohag 2	Cran "S" Pelicano x Cr "S"
10	Beni Sweef-1	Jo "S"/AA "S"//Fg "S"
11	Sohag 3	Mexi "S"/MGHA *51792//Durum 6
12	Sids 1	
13	Gemmeiza 3	Bb/7C*2/Y50E/Kal*s/SKh8/41Pev/WW15/3/Bj"S"//on *3/Bon.
14	Sids 8	
15	Sids 9	
16	Carina	C.I. 3756
17	Webster	C.I. 3780
18	Mediterranean	C.I. 3332
19	Hussa	C.I. 4843
20	Little Club	C.I. 4066
21	Reichersberg	
22	Exchange/6*TC	
23	Khapli	C.I. 4013
24	To*6/T. tauschi	
25	Pcliss	

C.I. No.; Cereal Investigation Number (USDA).

Wheat plants were examined as aforementioned. Disease occurrence was calculated as the number of infected fields over the total number of fields inspected (Cherif *et al.*, 1994). Disease prevalence was recorded according to James (1974), as the mean of incidence (% infection) for seedling blight and root rot, or severity of infection (leaf area affected) for spot blotch.

Isolation and identification of the pathogen: Small portions of diseased tissues (roots and leaves) of wheat plants were surface sterilized in 2% NaOCl for 5 min, washed in sterile distilled water, carefully dried in between two sterilized filter papers and placed in Petri dishes containing potato-dextrose agar (PDA) and stored in the dark at room temperature (20 – 23°C). Single germinated conidia were obtained from the emerged fungi by placing 1 ml of a spore suspension, diluted so conidia were abundant but separated from one another by at least four times their length, in Petri dishes containing water agar (WA). Single germinated spores were removed 16 hr later, along with a small piece of agar and multiplied on PDA at 23°C for 15 days (Hill & Blunt, 1994). Four pure isolates were tested and found equally virulent on wheat seedlings (cv. Giza 139) under similar conditions, then immediately sent to the CAB International Mycological Institute, Kew, Surrey, UK; for identification.

Evaluation of fungicides and natural products: Efficacy of 14 systemic and non-systemic fungicides, as well as two natural products, were evaluated as seed treatments in greenhouse under artificial inoculation. Suspensions of the tested materials were prepared, using the recommended doses of fungicides (The Pesticide Manual, 7th ed., Worthing and Walker (eds.), 1983), 0.5% luban (gum of frankincense, *Boswellia sacra*) and 0.05% a.i. leaf extract of neem (*Azadirachta indica*) (Neemosan, T.B. Chemicals and Pharma Ltd., India) (Table, 2).

Table (2): Common name, trade name, concentration and recommended doses of 14 fungicides, as well as two natural products used against *C. sativus*, the incitant of seedling blight, root rot and spot blotch of wheat.

No.	Common name	Trade name	Concentration	Dose
1	**Bupirimate**	Nimrod	25% E.C.*	0.30 g.a.i./l.
2	**Carboxin**	Vitavax	75% W.P.	0.40 g.a.i./l.
3	**Benomyl**	Benlate	50% W.P.	0.50 g.a.i./l.
4	**Mancozeb**	Dithane M-45	80% W.P.	0.30 g.a.i./l.
5	**Thiabendazole**	Tecto	40% W.P.	0.40 g.a.i./l.
6	**Buthiobate**	Qenmert	10% E.C.	0.35 g.a.i./l.
7	**Carbendazem**	Bavistin DF	50% W.P.	0.50 g.a.i./l.
8	**Penconazole**	Topas	10% E.C.	0.35 g.a.i./l.
9	**Fenarimol**	Rubigan	16% E.C.	0.15 g.a.i./l.
10	**Imazalil**	Fungaflor	20% E.C.	0.05 g.a.i./l.
11	**Ethirimol**	Milcurb Super	25% E.C.	0.20 g.a.i./l.
12	**Pyrazophos**	Afugan	30% E.C.	0.30 g.a.i./l.
13	**Hydroxy quinoline**	Fongoren	10% E.C.	0.15 g.a.i./l.
14	**Oxycarboxin**	Plantavax	75% W.P.	0.40 g.a.i./l.
15	**Neem-leaf extract**	Neemosan	80% E.C.	0.50 g.a.i./l.
16	**Luban**	Luban	0.5%	5.00 g/l.

*** a.i.: active ingredient. E.C.: emulsifiable concentrate. W.P.: wettable powder.**

Seeds of the susceptible wheat cultivar; Giza 139 were soaked in the suspensions of the tested compounds for 60 min before planting. The inoculum was prepared by comminuting fungal culture from 9-cm Petri plate with 200 ml of distilled water for 15 sec in a Warring Blender; 25 ml of the inoculum was poured over 15-cm diameter clay pots containing a soil mixture (1:1 v/v silt loam and sand) autoclaved at 120°C and psi pressure for 20 min. After applying the inoculum, 5-cm height of this soil was added on top of the inoculated soil. Twenty-five seeds of each treatment and untreated control were planted in each of five replicate inoculated pots (Lal *et al.*, 1980). Four weeks later, roots were rinsed for one hour under tap water, then plant height (from seed to tip of longest leaf) and total lengths of all leaves were recorded. Plants were air-dried for 30 min, then examined for root and crown tissue discoloration. Plants were placed in an oven at 70°C. dry shoot and root weights were recorded 24 hr later.

Evaluation of the same fungicides and natural products against spot blotch caused by *C. sativus* was carried out on 70-day wheat plants (cv. Giza 139) planted in 25-cm clay pots. The tested compounds were sprayed on plants, two days after inoculation with spore suspension of *C. sativus* (10^4 spores/ml). Four replicates were used for each treatment. Inoculated plants pots were sprayed with water to serve as untreated control. Severity of infection was assessed when symptoms were full, developed (12 days after inoculation) according to James (1974) as showed in Fig. (1).

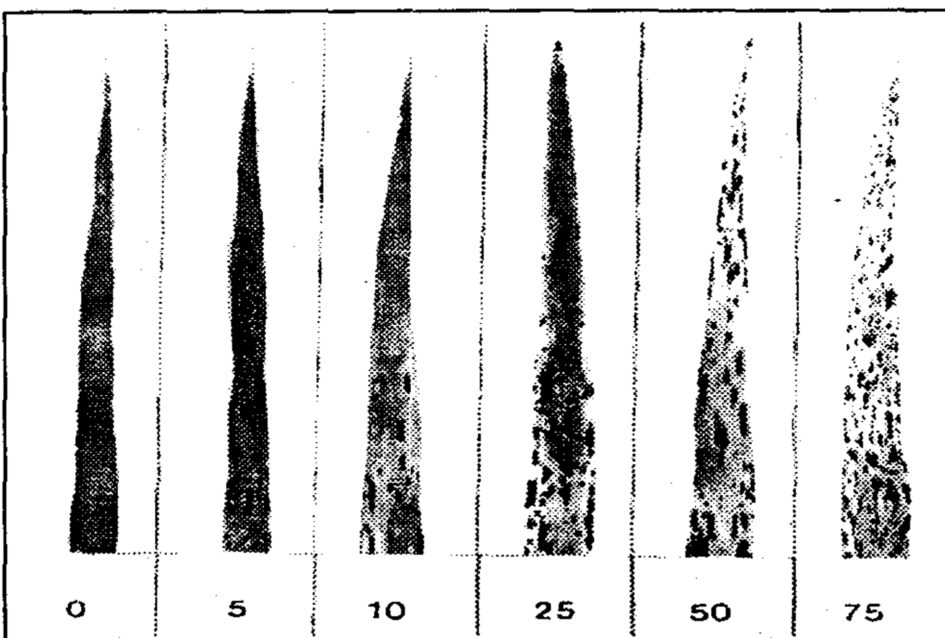

Fig. (1): Severity of wheat spot blotch infection caused by *Cochliobolus sativus.*

A randomized-complete-block-design (RCBD) field trials, with 2 x 2-m plot size and three replicates, were conducted at Zarzoura Research Station, Beheira governorate, during 1999-2000 and 2000-2001 growing seasons. Suspensions of the tested compounds were sprayed to run-off on 70-day wheat plants artificially inoculated with spore suspension of *C. sativus.* Severity of spot blotch infection was recorded two weeks later. Data of agronomic traits were recorded on time for both 50% flowering and physiologic maturity, plant height, spike length, above-ground biomass, grain yield, number of grains per spike, and 1000-grain weight.

RESULTS

A general survey conducted during 5 years from 1998 to 2002 revealed that *Cochliobolus sativus* Drechs.ex Dastur may attack all parts of the wheat plants, in all growth stages causing mainly three widespread diseases, *i.e.* seedling blight, common root rot and spot blotch. The percentages of infected fields were significantly more in North-Egypt than those in Middle- and Upper Egypt, except in 99\2000 season, since seedling blight and root rot incidence was 22, 25 and 38% in NE, ME, and 38 respectively (Table, 3).

Table (3): Occurrence of seedling blight, common root rot and spot blotch caused by *Cochliobolus sativus*; on wheat in North-Egypt (NE), Middle-Egypt (ME), and Upper-Egypt (UE); from 1997/98 to 2001/02 growing seasons.

No.	Growing season	* Disease incidence/Location							
		Seedling blight and root rot				Spot blotch			
		NE	ME	UE	Mean	NE	ME	UE	Mean
1.	1997/98	* 36	26	22	28	20	15	7	14
2.	1998/99	40	23	21	28	31	12	7	17
3.	1999/00	22	25	38	28	23	18	10	17
4.	2000/01	42	40	35	39	35	24	8	22
5.	2001/02	39	31	20	30	30	19	11	20
Mean		36	29	27	31	28	18	9	18

*** Percentage of infected fields over the total number of fields inspected.**

L.S.D. for	Region (R)	Season (S)	R x S
at (P = 0.01)	7.2	4.5	8.1
(P = 0.05)	3.1	2.9	5.6

The highest incidence of seedling blight and common root rot, expressed as the percentage of infection, was generally, recorded at 6 governorates of North Egypt; Kafr El-Sheikh, Beheira, Damietta, Daqahlia, Ismailia and Sharqia, where the mean incidence ranged from 15 to 25% (Table, 4). Similar trends were approximately obtained regarding the severity of spot blotch infection (25 – 45 except Damietta 97/98) as shown in (Table, 5). The above results were confirmed by those of Wheat Disease Trap Nurseries (WDTN) planted at 20 locations of Egypt (Table, 6). Moreover, the number of infected cultivars varied from year to year and from location to another.

Table (4): Incidence of seedling blight and common root rot, *Cochliobolus sativus*, in wheat growing areas at 18 governorates of Egypt from 1997/98 to 2001/02 growing seasons.

Location	Growing season/Disease incidence														
	1997/98			1998/99			1999/02			2000/01			2001/02		
	* LS	** HS	Mean	LS	HS	Mean	LS	HS	Mean	LS	HS	Mean	LS	HS	Mean
North Egypt:															
1. Matruh	5.0	10.0	**7.5**	4.0	20.0	**12.0**	5.0	15.0	**10.0**	8.0	20.0	**14.0**	0.5	30.0	**17.5**
2. Alexandria	8.0	20.0	**14.0**	5.0	25.0	**15.0**	6.0	18.0	**12.0**	8.0	30.0	**19.0**	5.0	30.0	**17.5**
3. Kafr El-Sheikh	10.0	20.0	**15.0**	10.0	25.0	**17.0**	10.0	30.0	**20.0**	10.0	50.0	**30.0**	8.0	40.0	**24.0**
4. Beheira	10.0	20.0	**15.0**	10.0	20.0	**15.0**	10.0	30.0	**20.0**	10.0	30.0	**20.0**	8.0	40.0	**24.0**
5. Damietta	5.0	25.0	**15.0**	4.0	24.0	**14.0**	4.0	20.0	**12.0**	5.0	30.0	**17.5**	10.0	50.0	**30.0**
6. North Sinai	5.0	25.0	**15.0**	5.0	15.0	**10.0**	-	-	-	5.0	15.0	**10.0**	-	-	-
7. Daqahlia	10.0	25.0	**17.5**	10.0	30.0	**20.0**	5.0	35.0	**20.0**	7.0	35.0	**21.0**	8.0	40.0	**24.0**
8. Gharbia	5.0	15.0	**10.0**	4.0	20.0	**12.0**	5.0	15.0	**10.0**	5.0	15.0	**10.0**	5.0	35.0	**20.0**
9. Sharqia	10.0	30.0	**20.0**	8.0	30.0	**19.0**	7.0	35.0	**21.0**	7.0	35.0	**21.0**	10.0	40.0	**25.0**
10. Minufiya	5.0	15.0	**10.0**	5.0	15.0	**10.0**	5.0	15.0	**10.0**	5.0	15.0	**10.0**	5.0	30.0	**17.0**
11. Qaleubiya	5.0	15.0	**10.0**	5.0	15.0	**10.0**	5.0	15.0	**10.0**	5.0	15.0	**10.0**	5.0	25.0	**15.0**
12. Ismailia	8.0	20.0	**14.0**	6.0	30.0	**18.0**	7.0	30.0	**18.5**	7.0	40.0	**23.5**	10.0	35.0	**22.5**
Mean	**7.2**	**20.0**	**13.5**	**6.4**	**22.5**	**14.0**	**6.3**	**23.6**	**14.8**	**6.8**	**27.5**	**17.2**	**6.8**	**35.9**	**21.5**
Middle Egypt:															
1. Giza	5.0	13.0	**9.0**	6.0	20.0	13.0	5.0	15.0	**10.0**	4.0	20.0	**12.0**	6.0	30.0	**18.0**
2. Beni Sweef	5.0	10.0	**7.5**	5.0	15.0	10.0	3.0	15.0	**9.0**	4.0	15.0	**9.5**	4.0	25.0	**15.0**
3. Fayoum	7.0	14.0	**10.5**	6.0	20.0	13.0	5.0	15.0	**10.0**	4.0	20.0	**12.0**	6.0	30.0	**18.0**
4. Minia	6.0	10.0	**8.0**	5.0	10.0	7.5	4.0	15.0	**9.5**	3.0	15.0	**9.0**	3.0	7.0	**5.0**
Mean	**5.8**	**11.8**	**9.0**	**5.5**	**16.3**	10.9	**4.3**	**15.0**	**9.6**	**3.8**	**17.5**	**10.5**	**4.75**	**23.0**	**14.0**
Upper Egypt:															
1. Assiut	6.0	10.0	**8.0**	4.0	10.0	7.0	6.0	10.0	**8.0**	3.0	15.0	**9.0**	2.0	4.0	**3.0**
2. Sohag	6.0	10.0	**8.0**	4.0	10.0	7.0	4.0	8.0	**6.0**	3.0	10.0	**6.5**	1.0	4.0	**2.5**
Mean	**6.0**	**10.0**	**8.0**	**4.0**	**10.0**	7.0	**5.0**	**9.0**	7.0	**3.0**	**12.0**	7.8	**1.5**	**4.0**	**2.8**

* (LS): The lowest incidence; ** (HS): The highest incidence.

L.S.D. for:	Location (L)	Season (S)	L x S
at (P = 0.01)	6.8	3.3	8.3
(P = 0.05)	4.4	1.9	5.8

Table (5): Severity of infection with spot blotch (%); *Cochliobolus sativus*, in wheat growing areas at 18 governorates of Egypt from 1997/98 to 2001/02 growing seasons.

Location	Growing season/Disease incidence														
	1997/98			1998/99			1999/02			2000/01			2001/02		
	*LS	** HS	Mean	LS	HS	Mean	LS	HS	Mean	LS	HS	Mean	LS	HS	Mean
North Egypt:															
1. Matruh	5.0	25.0	15.0	-	-	-	5.0	25.0	15.0	4.0	40.0	22.0	5.0	25.0	15.0
2. Alexandria	5.0	25.0	15.0	Tr ***	40.0	20.0	1.0	45.0	23.0	Tr	30.0	15.0	5.0	30.0	17.5
3. Kafr El-Sheikh	5.0	45.0	25.0	5.0	45.0	25.0	10.0	50.0	30.0	10.0	80.0	45.0	10.0	60.0	35.0
4. Beheira	5.0	45.0	25.0	5.0	45..0	25.0	10.0	50.0	30.0	10.0	80.0	45.0	10.0	80.0	45.0
5. Damietta	10.0	30.0	20.0	-	-	-	5.0	45.0	25.0	10.0	60.0	35.0	10.0	70.0	40.0
6. North Sinai	5.0	25.0	15.0	Tr	30.0	15.0	-	-	-	5.0	35.0	20.0	-	-	-
7. Daqahlia	10.0	40.0	25.0	5.0	45.0	25.0	2.0	50.0	26.0	10.0	70.0	40.0	10.0	80.0	45.0
8. Gharbia	5.0	20.0	12.5	5.0	25.0	15.0	2.0	30.0	16.0	4.0	40.0	22.0	5.0	60.0	32.5
9. Sharqia	10.0	50.0	30.0	5.0	60.0	32.5	10.0	60.0	35.0	10.0	70.0	40.0	10.0	80.0	45.0
10. Minufiya	5.0	25.0	15.0	5.0	45.0	25.0	4.0	30.0	17.0	8.0	40.0	24.0	5.0	45.0	25.0
11. Qaleubiya	5.0	25.0	15.0	4.0	458.0	24.5	5.0	30.0	17.35	6.0	40.0	23.0	5.0	45.0	25.0
12. Ismailia	10.0	40.0	25.0	10.0	70.0	40.0	10.0	60.0	35.0	10.0	60.0	35.0	10.0	70.0	40.0
Mean	6.7	32.9	19.7	4.4	45.0	24.7	5.8	43.2	24.5	7.3	53.8	30.5	7.7	58.6	33.2
Middle Egypt:															
1. Giza	7.0	2.5	16.0	5.0	25.0	15.0	5.0	25.0	15.0	8.0	30.0	19.0	8.0	40.0	24.0
2. Beni Sweef	3.0	15.0	9.0	Tr	20.0	10.0	2.0	20.0	11.0	Tr	30.0	15.0	5.0	25.0	15.0
3. Fayoum	5.0	23.0	14.0	5.0	25.0	15.0	3.0	25.0	14.0	6.0	30.0	18.0	8.0	30.0	19.0
4. Minia	2.0	20.0	11.0	Tr	10.0	5.0	-	-	-	2.0	25.0	13.5	4.0	20.0	12.0
Mean	4.3	20.8	12.5	2.5	20.0	11.2	3.3	23.3	13.3	4.0	28.8	16.4	6.3	28.8	17.5
Upper Egypt:															
1. Assiut	Tr	10.0	5.0	Tr	5.0	2.5	2.0	10.0	6.0	5.0	9.0	7.0	4.0	10.0	7.0
2. Sohag	5.0	10.0	7.5	4.0	8.0	6.0	2.0	8.0	5.0	5.0	5.0	5.0	5.0	10.0	7.5
Mean	2.5	10.0	6.3	2.0	6.5	4.3	2.0	9.0	5.5	5.0	7.0	6.0	4.5	10.0	7.3

* (LS): The lowest incidence; ** (HS): The highest incidence. *** (Tr): Trace, less than 1.0%.

L.S.D. for:	Location (L)	Season (S)	L x S
at (P = 0.01)	9.5	4.4	10.8
(P = 0.05)	6.3	2.5	7.7

Table (6): Prevalence of seedling blight, root rot and spot blotch occurred on 25 varieties cultivated in Wheat Disease Trap Nurseries (WDTN) at 20 locations of Egypt during 2001 and 2002.

Location	Prevalence of disease							
	Spot blotch				Seedling blight and root rot			
	2001		2002		2001		2002	
	* N.I.V.	** H.S.	N.I.V.	H.S.	N.I.V.	***H.I.	N.I.V.	H.I.
North Egypt:								
1. Matruh	12a[¤]	40b	11b	50ab	9b	20b	24a	10b
2. Alexandria	15a	40b	8bc	30b	19a	50a	24a	10b
3. Kafr El-Sheikh	11a	40b	12b	40b	11b	40a	24a	15ab
4. Beheira	12a	70a	8b	40b	12b	40a	24a	20a
5. Damietta	10a	50b	14b	40b	9b	15c	24a	20a
6. North Sinai	7b	50b	11b	40b	10b	30b	24a	10b
7. Daqahlia	10a	20c	23a	70a	10b	40a	12b	5c
8. Gharbia	10a	41b	5c	20bc	11b	25b	18a	16ab
9. Sharqia	10a	70a	22a	70a	13b	20b	11b	20a
10. Minufiya	3c	20c	8bc	40b	9b	30b	21a	20a
11. Qaleubiya	10a	40b	8bc	40b	8bc	30b	20a	17ab
12. Ismailia	5c	30c	13b	40b	12b	50a	15b	30a
13. Suez	10a	30c	9bc	30bc	6c	10c	11b	20a
14. South Sinai	9b	42b	9bc	20bc	5c	10c	19a	16a
Mean	**9.6**	**41.6**	**12.1**	**40.7**	**9.6**	**28.6**	**19.4**	**16.4**
Middle Egypt:								
1. Giza	5c	20c	8bc	10c	5c	20b	5c	20a
2. Beni Sweef	8b	16d	6c	10c	0d	0d	3c	5c
3. Fayoum	3c	10d	4c	10c	4c	10c	7bc	15ab
4. Minia	2c	20c	4c	10c	0d	0d	2c	4c
Mean	**4.5**	**16.0**	**5.5**	**10.0**	**2.3**	**7.5**	**4.5**	**11.0**
Upper Egypt:								
1. Assiut	2c	15d	3c	12	1d	5	1c	2
2. Sohag	2c	10d	2c	10	1d	5	3c	2
Mean	**2.0**	**12.0**	**2.5**	**11.0**	**1.0**	**5.0**	**2.0**	**2.0**

* N.I.V.: Number of infected varieties.
** H.S.: The highest severity.
*** H.I.: The highest incidence.

[¤] **Values within the columns followed by different letters are significantly different (P < 0.05) according to Duncan's multiple range test.**

Identification of *Cochliobolus sativus* (Ito & Kuribayashi) Drechs. ex Dastur was confirmed by CAB International Mycological Institute and kept under Herb. IMI numbers 309782, 309785, 309786 and 309788.

Data obtained from the greenhouse experiments indicated that the tested 14 fungicides, neem-leaf extract and luban (gum of frankincense) significantly reduced incidence of seedling blight, root rot since it ranged from 6.5 to 32.0% comparing to 92.4% for control (Table, 7) and severity of spot blotch diseases (Table, 8); when seeds of the susceptible wheat cultivar; Giza 139 were treated with these compounds and grown in soil infested with *C. sativus*. Benomyl, carbendazem, mancozeb and thiabendazole; were ranked on the top of the compounds tested, followed by bupirimate, neem-leaf extract, carboxin and oxycarboxin (Table, 7). Benomyl and neem-leaf extract gave the best results for controlling spot blotch. Other four fungicides were, also, highly effective in reducing severity of spot blotch by more than 86%, *i.e.* thiabendazole, mancozeb, bupirimate, and carboxin (Table, 8).

Seedling height (cm), leaf length (cm), shoot and root dry weight (mg) of seedlings of wheat cultivar; Giza 139, in general, increased when their seeds were treated with the tested fungicides and the two natural compounds. The highest seedling height and leaf length was obtained by benomyl (16.9 and 33.3 cm), carbendazem (6.5 and 32.9 cm) and neem-leaf extract (16.3 and 30.4 cm) treatments, respectively. Regarding to shoot and root dry weight, mancozeb was superior to the other compounds, followed by benomyl, carbendazem and neem-leaf extract (Table, 7).

Table (7): Effect of different fungicides and natural products on the incidence of seedling blight and root rot caused by *Cochliobolus sativus*, and some agronomic traits of wheat seedlings (cv. Giza 139).

Fungicides and natural products		Incidence of seedling blight and root rot (%)	Seedling height (cm)	Leaf length (cm)	Shoot weight (mg)	Root weight (mg)
Control		* 92.4 (73.9)	12.3	21.8	14.0	12.1
Bupirimate		12.5 (20.7)	14.3	29.0	28.1	27.0
Carboxin		15.0 (22.8)	14.2	28.9	28.0	27.0
Benomyl		6.5 (13.6)	16.9	33.3	31.2	29.1
Mancozeb		9.4 (17.9)	15.1	30.1	36.0	29.8
Thiabendazole		10.1 (18.5)	15.9	29.8	28.9	27.9
Buthiobate		32.0 (34.5)	14.0	26.0	22.4	21.3
Carbendazem		7.6 (16.0)	16.5	32.9	30.1	28.7
Penconazole		31.0 (33.8)	14.2	26.9	21.2	19.0
Fenarimol		27.0 (31.2)	14.9	24.8	23.1	22.9
Imazalil		35.9 (36.8)	14.1	26.4	31.3	19.4
Ethirimol		24.2 (29.5)	15.0	25.0	24.5	21.3
Pyrazophos		30.8 (33.7)	15.0	25.2	20.1	21.4
Hydroxy quinoline		25.0 (30.0)	15.1	25.1	24.3	21.0
Oxycarboxin		15.2 (23.0)	14.9	27.8	27.0	25.3
Neem leaf extract		12.9 (21.1)	16.3	30.4	29.0	28.0
Luban gum		25.2 (30.1)	15.1	24.9	24.0	20.9
L.S.D. at	1%	(8.5)	3.6	7.3	8.4	11.5
	5%	(6.3)	2.7	5.4	6.4	8.4

* Figures in parentheses are angular transmitted values.

Results of the mean grain yield and agronomic traits of wheat plants, infected by *C. sativus* and treated with the 14 tested fungicides and the two natural products, are summarized in Table (8). Time for giving 50% flowering and physiologic maturity was significantly longer in benomyl, mancozeb, thiabendazole and carbendazem treatments than that in the untreated control. In neem-leaf extract, bupirimate, carboxin, buthiobate and oxycarboxin treatments, Table (8): Mean grain yield and other agronomic traits of wheat plants (cv. Giza 139) treated with different fungicides and natural products.

Fungicides and natural products		Severity of spot blotch infection (%)	Days to give 50% flowering	Physio-logic maturity (days)	Plant height (cm)	Above ground biomass (ton/ha)	Spike length (cm)	Grain yield (kg/ha)	No. of grains per spike	1000-grain weight (g)
Bupirimate		*10.0 (18.4)	81.0	116.0	87.1	8.6	8.4	3522	21.0	26.3
Carboxin		10.5 (18.9)	81.0	116.0	87.5	8.7	8.4	3543	21.2	26.2
Benomyl		4.8 (12.7)	82.0	117.5	89.9	9.7	10.2	3922	25.8	30.3
Mancozeb		9.1 (17.6)	82.0	114.5	87.8	9.1	8.8	3652	23.9	29.3
Thiabendazole		8.9 (17.4)	82.0	114.5	87.6	9.2	8.9	3661	24.0	29.4
Buthiobate		31.2 (34.0)	80.4	114.0	86.0	7.2	8.1	3442	18.9	25.8
Carbendazem		7.3 (15.7)	82.0	117.0	89.0	9.0	9.6	3791	24.5	29.1
Penconazole		32.9 (33.2)	79.5	112.0	85.4	6.7	7.8	3011	20.5	25.1
Fenarimol		25.0 (30.0)	80.0	112.0	86.9	7.1	8.3	3325	19.6	24.9
Imazalil		33.5 (35.4)	79.4	110.5	84.9	6.5	7.9	2937	18.9	24.7
Ethirimol		22.0 (28.0)	80.0	112.0	85.1	7.6	8.2	3301	19.4	24.9
Pyrazophos		25.2 (30.1)	80.0	112.0	85.5	7.5	8.3	3362	19.5	24.8
Hydroxy		23.4 (28.9)	80.0	112.0	85.3	7.6	8.2	3351	19.4	24.8
Oxycarboxin		17.5 (24.7)	80.4	114.0	87.1	8.6	8.7	3426	19.7	26.2
Neem (0.5%)		8.1 (16.5)	81.5	117.0	88.0	9.3	8.6	3681	25.1	27.4
Luban (0.5%)		24.1 (29.4)	80.0	112.0	86.1	7.5	8.7	3359	19.5	24.7
Control		80.0 (63.4)	78.0	105.0	83.0	5.9	7.5	2124	16.5	20.0
L.S.D. at	1 %	(4.1)	4.8	12.1	5.4	3.6	3.8	1234.6	3.0	5.8
	5 %	(3.1)	3.6	9.0	4.1	2.7	2.8	984.3	2.3	4.3

* Figures in parentheses are angular transmitted values.

a significant increase in time required for physiologic maturity, but not for 50% flowering, was obtained. Eight treatments gave significant increment in plant height and aboveground biomass traits, *i.e.*; benomyl, carbendazem, neem-leaf extract, mancozeb, thiabendazole, carboxin, bupirimate and oxycarboxin; whereas spike-length increment was nonsignificant in all treatments. Grain yield was significantly increased as a result of using the 16 compounds to control wheat spot blotch, *C. sativus*, compared with the untreated control treatment. Similar results were obtained in other two traits; number of grains per spike and 1000-grain weight. Benomyl gave the highest increment in these traits, followed by carbendazem (in grain yield), neem-leaf extract (in number of grains per spike), and by thiabendazole and mancozeb, respectively (in 1000-grain weight).

DISCUSSION

Cochliobolus sativus (Ito & Kuribayashi) Drechs. ex Dastur attacks all the parts of most wheat plants in all the stages of growth causing several diseases, *i.e.* seedling blight, common root rot, and leaf spot blotch under favorable environmental conditions in Egypt and other non-traditional warm wheat-producing countries (Gilchrist & Pfeiffer, 1991 and Hammouda, 2003). However, the prevalence of these diseases was more in North-Egypt and Delta region (except the western coastal governorates) than that in Middle- and South-Egypt (Upper-Egypt). The mean percentages of infected fields were 36,29, and 27% for seedling blight and root rot, and 28, 18, and 9 for spot blotch in NE, ME, And UE, respectively. The 5-year survey conducted from 1997/98 to 2002/03 seasons in the Egyptian commercial fields exhibited that the highest % infection of wheat seedling blight and root rot recorded was 50% and the highest severity of spot blotch infection was 80%. Variation of infected cultivars in (WDTN) indicated to the presence of new pathogen entities diversed from year to year and from location to another. The highest % infection of seedling blight and root rot was 50% in WDTN while severity of spot blotch infection reached 70%. The wheat diseases studied in the present course apparently reduced root system, and growth vigor of seedlings and adult plants and consequently minimized both quantity and quality of the producing grains (Hill & Blunt, 1994 and Villareal *et al.*, 1995). Therefore, evaluating a wide range of antifungal compounds and testing the effective methods of application for controlling *C. sativus* is very urgent to reduce the losses due to this fungus, which led to the considerable increase in crop yield and high improvement in grain quality. In this respect, seed dressing and foliar spray of 14 fungicides and two natural products were used in Egypt during the present course of study, as well as other eight fungicides previously evaluated in other countries (Goulart, 1998 and Goulart & Reis, 1998). Although the tested fungicides did not achieve a complete eradication of the pathogen on wheat seeds, emphasizing the findings of Gault & Reis (1998), they significantly reduced the incidence and severity of seedling blight, root rot and spot blotch diseases on wheat plants. Out of the 14 fungicides tested, eight were superior to the others. The highest effectiveness was obtained by benomyl, carbendazem, thiabendazole and mancozeb, respectively. The tested fungicides were, generally, found to increase root growth and vigor of both seedling and adult plants. Also, crop yield and other agronomic traits were, significantly, more than those of the untreated control. Tebuconazole, propiconazole, tridimenol and mancozeb; gave similar effectiveness in other countries (Goulart, 1998).

In spite of the importance and high efficacy of most synthetic pesticides, conclusive evidences have been obtained regarding the detrimental effects of such compounds on human and environment. Use of botanical pesticides (plant-derived compounds) was found to provide a save means with convenient effectiveness for pest management. Moreover, the risk of developing resistant or tolerant pathogen strains to these natural compounds used in natural forms was not proved (Prakash & Rao, 1997). Extracts of different cultivated plants and natural flora were frequently reported to be fungitoxic to *C. sativus* (Turkusay & Onogur, 1998). During the present study, two plant-derived products, i.e. neem-leaf extract and luban (gum of frankincense) were superior to some fungicides tested, for controlling *C. sativus*, improving root growth; vigor of seedlings and adult plants of wheat, as well as increasing grain yield and other agronomic traits. Accordingly, these botanical compounds may offer promising alternatives, avoiding both the detrimental effects and the risk of developing resistant pathogen strains that possibly obtained by several synthetic pesticides.

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تكشف وانتشار ومقاومة أمراض ندوة البادرات وعفن الجذور الشائع والتلطخ البقعى فى القمح والتى يسببها فطر كوكليوبولس ساتيفوس فى مصر

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أجرى هذا البحث بهدف دراسة تكشف وانتشار ثم مقاومة أمراض ندوة بادرات القمح وعفن الجذور الشائع والتلطخ البقعى التى يسببها فطر كوكليوبولس ساتيفوس وقد اتضح من نتائج البحث انتشار تلك الأمراض على نطاق واسع فى مصر خلال الفترة من ١٩٩٨ إلى ٢٠٠٢ م . وكانت هذه الأمراض أوسع انتشارا في شمال مصر (إقليم الدلتا) عنها فى مصر الوسطى والجنوبية (مصر العليا).

أيضا تم إختبار ١٤ مبيدا فطريا مخلقا بالإضافة إلى مركبين طبيعيين لمقاومة تلك الأمراض حيث اتضح من نتائج البحث أنها جميعا قد أدت إلى إنخفاض معنوى فى معدلات الإصابة بأمراض ندوة البادرات وعفن الجذور والتلطخ البقعى مما أدى بالتالى إلى تحسين نمو البادرات ومحصول الحبوب وتحسين عددا آخرا من الصفات النباتية.

وقد كانت مبيدات البينوميل والكاربندازيم والثيابندازول والمانكوزيب أكثر المركبات المختبرة فاعلية يليها البيوبيريمات ثم المركب الطبيعة مستخلص أوراق النيم فالكاربوكسين يليها الأوكسيكاربوكسين. وجد أيضا أن مستخلص أوراق النيم والمركب الطبيعى الثانى معلق اللبان قد أظهرا تفوقا على بعض المبيدات المخلقة فى إنخفاض معدل الإصابة بتلك الأمراض ، مما دعا إلى مناقشة إمكانية استخدامهما لمقاومة الفطر كوكليوبولس ساتيفوس باعتبارهما من المواد الآمنة تماما للانسان والبيئة.