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DELETERIOUS EFFECTS OF INSECTICIDES ON THE EFFICIENCY OF SEED-DRESSING FUNGICIDES USED FOR CONTROLLING DAMPING-OFF OF COTTON SEEDLINGS.

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ABSTRACT

The interaction between the seed-dressing fungicides Monceren, Vitavax 200, Rizolex T, and Beret MLX. and the insecticides Nuvacrone, Azodrin, and Kalthane S was evaluated under field conditions in Assiut and Mallawy, in 1998. As a general rule in Assiut, and in most cases in Mallawy, the tested fungicides were effective in increasing stand and yield when they were used in the absence of insecticides; however, they showed a decline, or even complete loss of efficiency when they were used followed by the application of insecticides. The present study demonstrates the potential detrimental effect of using certain insecticides on the efficiency of seed-dressing fungicides commonly used for controlling cotton seedling damping-off, and suggests the importance of studying the interactive effects among pesticides before they are recommended for commercial use.

INTRODUCTION

The occurrence of major losses of cotton seedlings from diseases and insect damage is not uncommon in all cotton-producing areas in Egypt. These losses vary over years and locations but characteristically result in poor stands. Stands may be replanted if severely damaged and, even if damage is not sever enough for replanting, it may make weed control and other cultural practices difficult for the remainder of the season. Replanting, poor stands and seedling development, and weed competition ultimately affect plant maturity, fiber quality and seedcotton yield (Kappelman, 1977). Thus, the use of fungicides and insecticides, during seedling stage, has become indispensable under Egyptian conditions for obtaining maximum seedcotton yield.

Effect of fungicides on incidence of cotton seedling disease

El-Safty *et al.* (1980) found that Quintozene was the most effective soil treatment against *R. solani* on cotton, Terrazole (etridiazole) had poor activity and was phytotoxic, a combined seed treatment with Quintozene + Terrazole was excellent in controlling seedling damping-off. Abd El-Rehim *et al.* (1982) found that in the field tests, cotton seeds treated with a suspension of Vitavax (carboxin) + Captan in acetone produced a better stand than those with Vitavax + Captan or acetone alone. Minton *et al.* (1982) mentioned that in greenhouse tests using soil artificially infested with *R. solani and Trichocladium* (= *Thielaviopsis*) *basicola,* treatments of cottonseed with Carboxin 34F + benomyl or technical carboxin + benomyl increased plant stands. In field tests using soil naturally infested with *R. solani, T. basicola, Fusarium* spp*., Pythium* spp., and *Meloidogyne incognita,* treatment of cottonseed with Captafol, technical Carboxin + Captafol, Thiram, Chloroneb, and Carboxin 34F increased the number of surviving seedlings. Lint yields were higher but not significantly for all fungicide treatments than for the control. Application of fungicides to mechanically damaged seed increased the performance of Acala SJ-2 more than that of Stoneville 213. Captafol, Thiram, carboxin 35F, and technical Carboxin + Captafol increased seedling survival. Captafol appeared to reduce the adverse effects (phytotoxicity) associated with the application of technical carboxin in acetone. Huppatz *et al.* (1983) studied the fungitoxicity of carboxin and several of its analogues, including Pyracarbolid, Fenfuran, Methfuroxam, and Furmetamid, as well as two experimental Pyrazole carboxanilides against *R. solani.* The activities of these compounds were compared both *in vitro* on mycelial growth and *in vivo* against damping-off disease in cotton seedlings grown under glasshouse conditions. Carboxin, Methfuroxam, and Furmetamid were the more active inhibitors in *vitro,* whereas Furmetamid, the Pyrazole derivatives, and Carboxin were the more effective compounds *in vivo.* Eisa *et al.* (I 987) screened 14 fungicides for control of *R. solani, S. rolfsii, P. ultimum,* and *M. phaseolina* on cotton under greenhouse conditions. All the fungicides controlled the pathogens but with varying degrees. The relative frequencies of fungi isolated from diseased seedlings differed according to the seed treatment. *M. phaseolina was* frequently isolated regardless of the seed treatment. Cano (1988) screened 5 fungicides, using the manufacture's recommended rates, against *R. solani and S. rolfsii* causing damping-off of cotton under greenhouse conditions using the seed-soaking method. Results showed that percentage damping-off caused by *R. solani* ranged from 85.3% to 97.7% despite treating the seed with fungicides. The percent control ranged only from 1.7% to 14.1%. Damping-off infection caused by *S. rolfsii* in plots treated with different fungicides at various concentrations ranged from 16.3% to 49.3%. Orthocide 50 WP at levels 0.5 g/l and below, Manzate 200 at 2.0 g/L and Cobox blue at 2.0 g/l were likewise effective against the pathogen with a percent control of 49.4% to 74.5%. DeVay *et al.* (1988) investigated, in field and greenhouse trials, the use of granular preparation seed treatments containing sterol-inhibiting fungicides for control of seedling disease of cotton. Seeds were treated with a combination of Apron 350F (metalaxyl) and chloroneb 30F or Baytan 30F (triadimenol) and added to soil infested with *R. solani, P. ultimum, and T. basicola.* These treatments effectively controlled *R. solani, P. ultimum* but not *T. basicola.* Preplant applications of Basamid (dazomet) gave effective control of all seed and seedling pathogens. Hillocks *et al.* (1988) tested Quintozene, Benodanil, Captan, Carboxin, Fenfuram, lprodione, Pencycuron, Procymidone, Thiophanate-methyl, Thiram, and Tolclofos-methyl against *R. solani* in the lab. and were then evaluated for the control of seedling disease in cotton In field plots. Both seed dressing and in-furrow applications gave some control with all fungicides tested, but in-furrow treatments were more effective, specially against post-emergence damping off. Best control was given by Tolclofos-methyl as a seed dressing and Pencycuron plus Captan in-furrow, reflecting results from the lab. test. Several other compounds were also as effective as Quintozene in controlling seedling loss. According to Panhwar *et al.* (1988), comparative *in vitro* tests indicated that Flusilazole and Penconazole gave effective control of *P. ultimum and R. solani at* 10 µg/ml. Houston black clay artificially infested with one or both pathogens was treated with Flusilazole or Penconazole. Both fungicides controlled pre- and post-emergence damping-off of cotton. Flusilazole was more active against *P. ultimum* than Penconazole, but the reverse was observed with *R. solani.* Alagarsamy and Jeyarajan (1989) tested 5 fungicides against growth of *R. solani* in culture. Of the tested fungicides, Tolclofos-methyl was the most inhibitory, followed by Carbendazim. In seed treatment trials with the same fungicides, Carbendazim gave the best germination followed by Toiclofos-methyl; post-emergence mortality was least with Carboxin. In a soil drenching experiment Carbendazim was superior to the other fungicides in improving germination and controlling post-emergence mortality. Yield of seed cotton was improved by Carbendazim and Toiclofos-methyl soil treatment. Ahmed and Ali (1990) evaluated Benlate (benomyl), Vitavax Thiram (Carboxin + thiram), Homai (Thiophanate-methyl + thiram), Ridomil (metalaxyl), Rizolex (Tolclofos-methyl) and Dithane-S-60 (mancozeb) for control of seed rot and damping-off of cotton caused by 2 isolates of *R. solani, P. ultimum* and *P. aphanidermatum* in Iraq. Benomyl, Tolclofos-methyl and Carboxin + Thiram at 0.2% controlled *R. solani* and Metaloxyl (0.1 %) and Carboxin + Thiram (0.2%) controlled *the Pythium* spp. The mixtures Benomyl + Metalaxyl, Tolclofos-methyl + Metaloxyl and Carboxin + Thiram reduced disease in seeds receiving a mixed inoculum of these pathogens. None of the seed treatments resulted in visible phytotoxicity. Aly *et al.* (1992) evaluated the efficiency of Monceren Euparen, Monceren Combi, Vitavax 200 FF, Provax FF, Quinolate Pro, Tecto TM, Bay M, Vincit P, and Rizolex T as seed treatments against *R. solani or, S. rolfsii* under greenhouse conditions. None of the fungicides used stimulated emergence. In terms of surviving seedlings, the fungicides showed variation in their effectiveness against damping-off caused by *R. solani.* Provax FF and Tecto TM were ineffective, while Bay M increased surviving seedlings to a level comparable to that of the uninoculated control. Vitavax 200 FF and Rizolex T were the only fungicides which gave significant control of pre-emergence damping-off caused by *S. rolfsii;* however, their effectiveness was lost beyond this stage. Eisa *et al.* (1992) evaluated the efficiency of Rizolex T, Basitac Plus 80, Provax FF, Rizolex Captan, Provax FF Plus, and Agricet as seed treatments against damping-off caused by *R. solani; S. rolfsii; P. ultimum, and M. phaseolina* under greenhouse and outdoor conditions. All tested fungicides, except Agricet, overcame the adverse effect of the fungi tested whether singly or in a mixture. The efficiency of the fungicides differed; however, according to the fungus. Efficiency of most of the fungicides were higher in outdoor tests. Lisker and Meiri (1992) found that under lab. conditions, seed treatment with Quintozene + Etridiazole, Quintozene + Captan, Tolclofos-methyl + Thiram, Carboxin + Captan, Pencycuron + Captan, Carboxin + Thiram, and Thiabendazole + Thiram increased the percentage seedling emergence and decreased disease severity of seedlings of two cotton cultivars. In several cases, a mixture of Thiabendazole plus hydroxyquinoline in glycolic acid and oxine-copper also decreased disease incidence. Caspan (ethoxy, mercuric chloride), the only fungicide currently in use for seed treatments, had no effect. Abdel-Aziz *et al.* (1996) indicated that in a greenhouse test, the application of Toclofos-methyl, Toclofos-methyl + Thiram, and Pencycuron + Dichlofluanid as seed treatments gave excellent control of cotton seedling disease in soil infested with *R. solani* (AG4), *S. rolfsii,* and *M. phaseolina* singly or in a mixture. Davis *et al.* (1997) conducted 25 field trials over a 3-year period included the following treatments: non-treated cotton seed; seed treated with myclobutanil for the control of *R. solani*-induced damping-off, seed treated with Metalaxyl for the control of *Pythium*-induced damping-off, and seed treated with a combination of the two fungicides. In general, the fungicide seed treatment active against *R. solani* increased stands of the cultivar Maxxa regardless of soil type and pathogen populations. Increased stands from the Metalaxyl treatment occurred in 1 of the 3 years of the study. Wang and Davis (1997) found that seed treatment with Carboxin-pentachloronitrobenzene for the control of *Rhizoctonia*-induced damping-off resulted in stand increase in 12 cotton cultivars in greenhouse tests and in 3 of 6 cultivars in field trials.

Effect of insecticides on incidence of cotton seedling disease

Phorate, used as cotton-seed treatment for insect and spider mite control, protected cotton seedlings from damping-off caused by *R. solani* (Erwin and Reynolds, 1958; Erwin *et al.,* 1959; Hacskaylo and Stewart, 1962). Increased in cotton stand in *R. solani*-infested soil occurred at 27-33°C,but not at 21-22°C. The ability of Phorate to reduce *R. solani* damping-off appeared to be related to its direct toxicity to the pathogen. Phorate or a breakdown product; however, increased cotton damping-off caused by *Pythium* spp. (Erwin *et al.,*1961) or damping-off caused by *F. moniliforme* at 27-33°C (Hacskaylo and Stewart, 1962). Since Phorate concentrations used in cotton did not affect *F. moniliforme* in potato dextrose agar, Hacskaylo and Stewart (1962) believed that the insecticide may have increased cotton damping-off by predisposing the host to this rather mild soil-borne pathogen. Treatment of cotton seeds with the systemic insecticide Thimet 44 D in the absence of a fungicide caused a statistically significant reduction in the stand of seedling plants in four of seven field tests conducted in several cotton-growing areas of California. Stands were improved when seeds were treated with a fungicide (Ceresan 200, Ceresan m, or Captan) prior to adding the thimet coating (Erwin *et al.,* 1959). In field trials, Aly *et al.* (1994) found that the insecticide Nuvacron significantly reduced the incidence of cotton seedling disease, while Hostathion increased seed cotton yield 23.53% over that in the control.

Effect of the interaction between fungicides and insecticides on incidence of cotton seedling disease

Several studies have shown that multiple seed treatments with fungicides and insecticides can significantly reduce cotton *(Gossypium hirsutum* L.) stands (Ranney, 1964; Ranney, 1970; Minton, 1972; Ranney, 1972; Ranney and Heartly, 1972; Kappelman, 1980). In these studies, systemic fungicides were not as toxic as systemic insecticides. Combining systemic fungicides with systemic insecticides reduced the deleterious effects of the latter on cotton survival (Ranney, 1970). Changing the application sequence has improved germination, seedling growth, and survival when fungicides and insecticides were used as multiple seed treatments (Ranney and Heartly, 1972). In field trials, Aly *et al.* (1994) indicated that the fungicides Monceren Combi, Rizolex T, and Vitavax 300 showed the highest levels of efficiency when they were used followed by the application of the insecticide Nuvacron. Under greenhouse conditions, Abdel Aziz *et al.* (1996) found that the combinations of the insecticide imidacloprid with the fungicides Toclofos-methyl, Tolclofos-methyl + Thiram, Pencycuron + Dichlofluanid, or Pencycuron + Captan were more effective in controlling cotton seedling disease than the fungicides alone.

The objectives of this study were to determine if insecticides, commonly used during seedling stage, have a differential effect on efficiency of seed-dressing fungicides commercially recommended for controlling damping-off of cotton seedlings and to evaluate the possible effects of such insecticides on incidence of cotton damping-off under field conditions.

MATERIALS AND METHODS

Experiments were conducted at Mallawy Agricultural Research Station and in the Farm of Faculty of Agriculture in Assiut in 1998. Each experiment was designed as a randomized complete block of five replicates, each replicate consisted of four 4 -meter rows in Mallawy or two 4-meter rows in Assiut. Each row included 20 hills, each containing 10 seeds. Seeds of cotton (*Gossypium barbadense* L.) cultivar Giza 83 in both locations were treated with fungicides at the recommended doses (Table 1). Fungicides were added to slightly moist seeds. The seeds were shaken thoroughly in plastic bags for 5 minutes and allowed to dry before being planted. Planting dates were 24, 31 March 1998 in Assiut and Mallawy, respectively. Insecticides (Table 1) were applied as post-emergence spray treatments 14 days after planting. Data were recorded 45 days from sowing in terms of percentage of post-emergence damping-off and survival. Seed cotton yield (cottonseed and lint before ginning) was picked on 15-30 October at each site and determined as g/plant and kg/plot.

Statistical analysis of data

Data were analyzed for each experiment separately. Analysis of variance (ANOVA) was used to determine the effects of treatments (fungicides and insecticides) and their interaction on percentage of post-emergence damping-off, survival, and yield. All variables were considered fixed in the analysis except replicates (blocks) which were considered random. The original data were transformed into arc sine angles or square roots before carrying out ANOVA to produce approximately constant variance. ANOVA was performed with the MSTAT-C Statistical Package (A Microcomputer Program for the

Design, Management, and Analysis of Agronomic Research Experiments, Michigan State Univ., USA).

Table 1: Insecticides and fungicides used in experiments during 1998 griowing season and their active ingredients.

Pesticides		Rate	Active ingredient [b]	Formulation [c]
Insecticides	Nuvacron[a]	200 ml/100 liters of water	40% Monocrotophos	WSC
	Azodrin	200 ml/100 liters of water	40% Monocronophos	WSC
	Kelthane S	250 ml/100 liter of water	18.5% Dicofol	EC
Fungicides	Monceren	3 g/lg seeds	25% Pencycuron	WP
	Rizolex T	3 g/kg seeds	20% Tolclofos-methyl+30% Thiram	WP
	Vitavax 200	4 g/kg seeds	20% Carboxin + 20% Thiram	FS
	Beret MLX 350	1.75 ml/kg seeds	20% Metalaxyl + 16% Fenpicloni	FS

[a] Trade name
[b] Common name
[c] WSC = Water soluble concentrate, EC = Emulsifiable concentrate, WP = Wettable powder and FS = Flowable suspension.

EXPERIMENTAL RESULTS

ANOVA of Assiut data (Table 2) showed that insecticides were the only significant source of variation in post-emergence damping-off. Insecticides were nonsignificant source of variation in survival, while fungicides and insecticides x fungicides interaction were very highly significant sources of variation. Fungicides were the first in importance as a source of variation in survival, while insecticides x fungicides interaction was the second in importance (Table 3). Insecticides were the most important sources of variation in post-emergence damping-off. A least significant difference (LSD) was used to compare between the individual fungicide means within insecticides (Table 4). These comparisons showed that fungicidal efficiency was differentially affected by the application of insecticides. All the tested fungicides were effective in increasing the percentage of surviving seedlings when they were used in the absence of insecticides, while they showed a sharp decline in efficiency, or even complete loss of efficiency when they were followed by the application of insecticides.

Table 2: Analysis of variance of the effect of insecticides and fungicides on the incidence of cotton seedling disease under field condition in Assiut in 1998

Source of variation [a]	d.f.	Post-emergence damping-off			Survival		
		M.S.	F-value	P > F	M.S.	F-value	P > F
Replications	4	1.513	2.4645	0.0521	6.318	0.7346	
Insecicides (S)	3	2.233	3.6371	0.0165	17.903	2.0817	0.1096
Fungicides (F)	4	0.526	0.8574		84.978	9.8806	0.0000
S x F	12	0.554	0.9030		26.424	3.0724	0.0014
Error	76	0.614			8.600		

[a] Replications are random, while insecticides and fungicides are fixed.

Table 3: Relative contribution of insecticides, fungicides, and their interaction to variation in post-emergence damping-off and survival of cotton seedlings under field conditions in Assiut in 1998.

Source Of Variation [a]	Relative contribution[a] to variation in: Post-emergence damping-off	Survival
Insecicides (S)	31.15	7.30
Fungicides (F)	9.79	46.18
S x F	30.93	43.08

[a] **Calculated as percentage of sum of squares of the explained (model) variation.**

Table 4: Effect of insecticides and fungicides on the incidence of cotton seedling disease under field condition in Assiut in 1998.

Insecticides	Fungicides: None		Monceren		Vitavax 200		Rizolex T		Beret MLX		Mean	
Post-emergence damping-off [a]												
None	1.99	(4.90)	1.85	(4.15)	2.19	(5.55)	1.66	(3.60)	1.18	(1.50)	1.78	(3.90)
Nuvacron	2.27	(5.85)	2.63	(7.10)	3.06	(9.80)	1.92	(3.95)	2.36	(6.00)	2.45	(6.50)
Azodrin	1.95	(4.15)	1.77	(3.80)	1.78	(3.75)	2.14	(4.45)	2.24	(5.45)	1.98	(4.30)
Kalthane S	2.08	(4.95)	2.68	(7.55)	2.32	(5.95)	2.22	(5.85)	2.05	(5.35)	2.27	(5.90)
Mean	2.07	(5.00)	2.23	(5.65)	2.33	(6.30)	1.99	(4.47)	1.96	(4.60)		
LSD (transformed data) for insecticides = 0.44 (P < 0.05)												
Survival [b]												
None	30.16	(25.35)	40.29	(41.90)	39.99	(41.40)	40.89	(42.90)	42.34	(45.40)	38.73	(39.40)
Nuvacron	36.96	(36.30)	39.92	(41.20)	38.42	(38.70)	40.39	(42.05)	40.99	(43.10)	39.34	(40.30)
Azodrin	36.71	(35.80)	40.29	(41.90)	42.24	(45.25)	41.89	(41.50)	38.44	(38.70)	39.91	(40.60)
Kalthane S	40.33	(58.55)	39.64	(40.75)	41.48	(43.90)	40.21	(41.75)	41.94	(44.90)	40.71	(46.00)
Mean	36.04	(39.00)	40.03	(41.40)	40.53	(42.30)	40.84	(42.00)	40.93	(43.00)		
LSD (transformed data) for fungicides x insecticides = 3.69 (P < 0.05) or 4.9 (P < 0.01)												

[a] **Percentage data were transformed into $\sqrt{X}$ before carrying out the analysis of variance. Percentage data are shown in parentheses.**

[b] **Percentage data were transformed into arc sine before carrying out the analysis of variance. Percentage data are shown in parentheses.**

Insecticides were highly significant sources of variation in seed cotton yield per plant, while they were nonsignificant sources of variation in seed cotton yield per plot (Table 5). Fungicides and insecticides x fungicides interaction were all very highly significant sources of variation in seed cotton yield per plant and seed cotton yield per plot. Fungicides were the most important sources of variation in seed cotton yield per plant and seed cotton yield per plot (Table 6).

Insecticides and insecticides x fungicides interaction were almost equally important as sources of variation **in** seed cotton yield per plant. All the tested fungicides were effective in increasing seed cotton yield per plant as well as seed cotton yield per plot when they were used in the absence of insecticides, while they showed a decline in efficiency, or even complete loss of efficiency, when they were followed by the application of insecticides (Table 7). For example, Monceren increased seed cotton yield per plant by 31.99% when it was used alone and by 20.11% when it was used followed by the application of Nuvacrone. When it was used followed by the application of Azodrin or Kalthane, no significant increase in seed cotton yield per plant was observed-that is, it lost efficiency in increasing seed cotton yield per plant. A noteworthy peculiarity in Table 7 was the increase in seed cotton yield per plot from 22.26%, when Monceren was used alone, to 43.17% when it was used followed by the application of Nuvacrone.

Table 5: Analysis of variance of the effect of insecticides and fungicides on the seedcotton yield under field condition in Assiut in 1998.

Source of variation [a]	d.f.	Seedcotton yield (g/plant) M.S.	F-value	P > F	Seedcotton yield (kg/plot) M.S.	F-value	P > F
Replications	4	85.865	1.7483	0.1482	0.729	4.4955	0.0026
Insecicides (S)	3	546.837	11.1344	0.0000	0.144	0.8891	
Fungicides (F)	4	645.615	13.1457	0.0000	1.526	9.4025	0.0000
S x F	12	127.262	2.5912	0.0061	0.432	2.6618	0.0049
Error	76	49.112			0.162		

[a] Replications are random, while insecticides and fungicides are fixed.

Table 6: Relative contribution of insecticides, fungicides, and their interaction to variation in seedcotton yield under field conditions in Assiut in 1998.

Source of variation	Relative contribution [a] to variation in Seedcotton yield (g/plant)	Seedcotton yield (kg/plot)
Insecicides (S)	26.92	2.96
Fungicides (F)	42.38	41.70
S x F	25.06	35.41

[a] Calculated as percentage of sum of squares of the explained (model) variation.

Table 7: Effect of insecticides and fungicides on seedcotton yield under field condition in Assiut in 1998.

Insecticides	Fungicides: None	Monceren	Vitavax 200	Rizolex T	Beret MLX	Mean
			Seedcotton yield (g/plant)			
None	64.40	85.00	86.20	82.80	87.00	81.08
Nuvacron	71.60	86.00	86.00	81.00	78.20	80.56
Azodrin	80.60	76.00	87.20	89.00	94.80	85.52
Kalthane S	66.80	71.20	77.40	76.20	79.20	74.16
Mean	70.85	79.55	84.20	82.25	84.80	
LSD for fungicides x insecticides = 8.83 (P < 0.05) or 11.71 P(P < 0.01)						
			Seedcotton yield (kg/plot)			
None	2.92	3.57	3.59	4.11	3.60	3.56
Nuvacron	3.15	4.51	3.80	3.77	3.39	3.73
Azodrin	3.20	3.72	3.62	3.74	3.63	3.58
Kalthane S	3.37	3.57	4.06	3.42	3.53	3.59
Mean	3.16	3.84	3.77	3.75	3.54	
LSD for fungicides x insecticides = 0.51 (P < 0.05) or 0.67 (P < 0.01)						

ANOVA of Mallawy data (Table 8) showed that insecticides were the only significance source of variation in post-emergence damping-off. Insecticides and fungicides were very highly significant sources of variation in survival. Fungicides accounted for 54.31 and 36.89% of the explained (model) variation in pre-emergence damping-off and survival, respectively (Table 9). Insecticides accounted for 20.10 and 30.24% of the explained (model) variation in post-emergence damping-off and survival, respectively. Since the interaction of insecticides x fungicides was significant for all the variables under consideration, it was concluded that the tested insecticides and fungicides acted independently of each other-that is, fungicidal efficiency was not affected by the application of insecticides. Post-emergence damping-off was significantly reduced only by Nuvacrone. All the insecticides significantly increased the percentage of surviving seedlings. Monceren and Beret were the only fungicides, which were effective in increasing the percentage of surviving seedlings (Table 10). Fungicides and insecticides x fungicides interactions were very highly significant sources of variation in seed cotton yield per plant (Table 11). Insecticides and fungicides were very highly significant sources of variation in seed cotton yield per plot. Fungicides were the first in importance as a source of variation in seed cotton yield per plant. Thus, they accounted for 70.79% of the explained (model) variation in seed cotton yield per plant (Table 12). Insecticides were almost as important as fungicides in determine the variation in seed cotton yield per plot.

Table 8: Analysis of variance of the effect of insecticides and fungicides on the incidence of cotton seedling disease under field condition in Mallawy in 1998.

Source of variation [a]	d.f.	Post-emergence damping-off			Survival		
		M.S.	F-value	P > F	M.S.	F-value	P > F
Replications	4	1.591	4.7548	0.0018	13.438	1.8684	0.1247
Insecicides (S)	3	1.108	3.3111	0.0245	51.015	7.0934	0.0003
Fungicides (F)	4	0.514	1.5375	0.1998	46.795	6.5066	0.0001
S x F	12	0.400	1.1939	0.3030	9.457	1.3149	0.2279
Error	76	0.335			7.192		

[a] Replications are random, while insecticides and fungicides are fixed.

Table 9: Relative contribution of insecticides, fungicides, and their interaction to variation in post-emergence damping-off and survival of cotton seedlings under field conditions in Malawy in 1998.

Source of variation	Relative contribution[a] to variation in	
	Post-emergence damping-off	Survival
Insecicides (S)	20.10	30.24
Fungicides (F)	12.44	36.89
S x F	28.98	22.36

[a] Calculated as percentage of sum of squares of the explained (model) variation.

All the tested fungicides were effective in increasing seed cotton yield per plant when they were used in the absence of insecticides, while they showed a decline in efficiency, or even complete loss of efficiency when their use was followed by the application of insecticides (Table 13). However, the effect of

Azodrin or Kalthane on the efficiency of Rizolex as well as the effect of Kalthane on the efficiency of Beret was notable exceptions. The efficiency of Rizolex in increasing seed cotton yield per plant was increased from 32.43%, when it was used alone, to 37.05 and 52.36% when **it** was used followed by the application of Azodrin and Kalthane, respectively. Similarly, the efficiency of Beret was increased from 25.23%, when **it** was used alone, to 37.74% when it was used followed by the application of Kalthane. All fungicides and insecticides were effective in increasing seed cotton yield per plot; however, fungicides and insecticides acted independently of each other.

Table 10: Effect of insecticides and fungicides on the incidence of cotton seedling disease under field condition in Mallawy in 1998.

Insecticides	Fungicides										Mean	
	None		Monceren		Vitavax 200		Rizolex T		Beret MLX			
	Post-emergence damping-off [a]											
None	2.74	(7.60)	2.50	(6.35)	3.03	(10.60)	2.70	(7.60)	3.09	(10.80)	2.81	(8.60)
Nuvacron	1.94	(4.15)	2.84	(7.15)	2.63	(7.05)	1.90	(3.95)	2.69	(7.50)	2.36	(6.00)
Azodrin	2.96	(8.90)	2.33	(5.80)	2.31	(5.95)	2.33	(5.70)	2.78	(8.10)	2.54	(6.90)
Kalthane S	2.90	(8.90)	2.85	(8.35)	2.90	(8.60)	2.58	(7.07)	2.69	(7.35)	2.77	(8.05)
Mean	2.63	(7.39)	2.60	(6.91)	2.72	(8.05)	2.38	(6.08)	2.79	(8.14)		
LSD (transformed data) for insecticides = 0.33 (P < 0.05)												
	Survival [b]											
None	27.17	(20.93)	34.00	(31.32)	31.07	(26.70)	29.82	(28.16)	32.77	(29.40)	31.00	(27.30)
Nuvacron	35.07	(33.12)	34.24	(31.72)	32.87	(29.55)	34.00	(31.32)	35.80	(34.30)	34.40	(32.00)
Azodrin	31.74	(27.80)	32.64	(29.15)	32.71	(29.37)	32.95	(29.60)	36.43	(35.35)	33.30	(30.25)
Kalthane S	30.65	(26.10)	34.04	(31.50)	31.85	(34.37)	33.28	(30.21)	35.43	(33.70)	33.05	(31.78)
Mean	31.16	(27.00)	33.73	(30.90)	32.12	(30.00)	32.27	(29.80)	35.36	(33.19)		
LSD (transformed data) for insecticides = 1.51 (P < 0.05) or 2.00 (P < 0.01)												
LSD (transformed data) for fungicides = 1.69 (P < 0.05) or 2.24 (P < 0.01)												

[a] Percentage data were transformed into $\sqrt{X}$ before carrying out the analysis of variance. Percentage data are shown in parentheses.

[b] Percentage data were transformed into arc sine before carrying out the analysis of variance. Percentage data are shown in parentheses.

Table 11: Analysis of variance of the effect of insecticides and fungicides on the seedcotton yield under field condition in Mallawy in 1998.

Source of variation [a]	d.f.	Seedcotton yield (g/plant)			Seedcotton yield (kg/plot)		
		M.S.	F-value	P > F	M.S.	F-value	P > F
Replications	4	64.685	3.8357	0.0068	0.088	1.2437	0.2997
Insecicides (S)	3	24.277	1.4396	0.2379	3.093	43.7251	0.0000
Fungicides (F)	4	656.060	38.9031	0.0000	2.444	34.5486	0.0000
S x F	12	62.593	3.7117	0.0020	0.130	1.8436	0.0558
Error	76	16.864			0.071		

[a] Replications are random, while insecticides and fungicides are fixed.

Table 12: Relative contribution of insecticides, fungicides, and their interaction to variation in seedcotton yield under field conditions in Mallawy in 1998.

Source of variation	Relative contribution [a] to variation in: Seedcotton yield (g/plant)	Seedcotton yield (kg/plot)
Insecicides (S)	1.96	44.25
Fungicides (F)	70.79	46.62
S x F	20.26	7.46

[a] **Calculated as percentage of sum of squares of the explained (model) variation.**

Table 13: Effect of insecticides and fungicides on seedcotton yield under field condition in Malawy in 1998

Insecticides	Fungicides: None	Monceren	Vitavax 200	Rizolex T	Beret MLX	Mean
	Seedcotton yield (g/plant)					
None	44.40	62.20	59.40	58.80	55.60	56.08
Nuvacron	49.60	51.60	54.60	58.00	54.60	53.70
Azodrin	44.80	59.60	55.80	61.40	51.80	54.70
Kalthane S	40.40	54.80	53.40	64.60	58.40	54.70
Mean	42.30	57.05	55.80	60.70	55.10	
LSD for insecticides = 5.17 (P < 0.05) or 6.86 (P < 0.01)						
	Seedcotton yield (kg/plot)					
None	3.03	3.79	3.89	3.62	3.64	3.60
Nuvacron	3.81	4.31	4.43	4.52	4.40	4.30
Azodrin	3.84	4.53	4.68	4.45	4.38	4.40
Kalthane S	3.29	4.53	4.17	4.57	4.31	4.20
Mean	3.50	4.30	4.30	4.30	4.20	
LSD for insecticides = 0.15 (P < 0.05) or 0.20 (P < 0.01)						
LSD for fungicides = 0.17 (P < 0.05) or 0.22 (P < 0.01)						

DISCUSSION

Insecticides may find their way into cultivated soils either through the accumulated plant debris that had been sprayed or through direct plant and soil applications. Considerable evidence has accumulated indicating that many of these insecticides exert an influence on soil fungi and affect the relationship between a host crop and its indigenous soil pathogens (Papavizas and Lewis, 1979).

In the present study, as a general rule in Assiut, and in most cases in Mallawy, the tested fungicides were effective in increasing stand and yield of cotton when they were used in the absence of insecticides; however, they showed a decline in efficiency, or even complete loss of efficiency when they were used followed by the application of insecticides. It seems reasonable to assume that the increase in susceptibility of cotton to pathogens is a possible mode of action by which insecticides exert their detrimental effects on efficiency of fungicides. This interpretation agrees with the findings of other workers. For example, Richardson (1957, 1959) observed in the laboratory and greenhouse that the insecticide Heptachlor somewhat increased barley seedling blight caused by *Cochliobolus sativus.* The insecticides Isodrin and

Lindane also increased tomato wilt caused by *F. oxysporum* f.sp. *lycopersici.* Since the pathogen in culture was not affected by any of these materials. Richardson postulated that the pesticides may alter the metabolism of the host, thereby decreasing resistance. Phorate, used as a cotton-seed treatment for insect and spider mite control, increased cotton damping-off caused by *Pythium* spp. (Erwin *et al.,* 1961) or damping-off caused by *F. moniliforme* at 27-33°C (Hacskaylo and Stewart, 1962).

Since Phorate concentrations used in cotton did not affect *F. moniliforme* in potato-dextrose agar, Hacskaylo and Stewart (1962) believed that the insecticide may have increased cotton damping-off by predisposing the host to this rather mild soil-borne pathogen. In conclusion, the present study demonstrates the potential detrimental effect of using certain insecticides on the efficiency of seed-dressing fungicides commonly used for controlling cotton seedling damping-off, and suggests the importance of studying the interactive effects among pesticides before they are recommended for disease control.

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التأثيرات الضارة للمبيدات الحشرية على كفاءة المطهرات الفطرية الكاسية للبذرة المستخدمة لمقاومة مرض موت بادرات القطن

على دياب على علام[1] ، على عبد الهادى على [2] ، عزت محمد حسين [2] ، عبد المنعم محمود أمين[1] ،عبد الرحيم محمد أحمد السمواتى [2]

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درس التفاعل بين المطهرات الفطرية الكاسية للبذرة مونسرين وفيتافاكس 200 وريزولكس تى وبيريت إم إل إكس والمبيدات الحشرية نوفاكرون وآزودرين وكالتين إس ، وذلك تحت ظروف الحقل ، فى كل من أسيوط وملوى ، فى موسم 1998. كقاعدة عامة فى أسيوط وفى أغلب الحالات فى ملوى ـ أدى إستعمال المبيدات الفطرية بدون المبيدات الحشرية إلى حدوث زيادة معنوية فى الإنبات والمحصول ، فى حين إنعدمت كفاءة المبيدات الفطرية فى إحداث زيادة معنوية فى الإنبات والمحصول ، أو حدث تدهور واضح للكفاءة عندما أعقب إستعمال المبيدات الفطرية الرش بالمبيدات الحشرية. تدل نتائج هذه الدراسة على أن إستعمال بعض المبيدات الحشرية قد يكون له تأثيرات ضارة على فعالية المطهرات الفطرية الكاسية للبذرة الشائع إستخدامها لمقاومة مرض موت بادرات القطن ، كما تدل نتائج الدراسة على أنه من الأهمية بمكان دراسة التفاعلات التى قد تحدث بين مبيدات الآفات وذلك قبل التوصية بإستعمالها على نطاق تجارى.