Egypt. J. Agric. Res., 80 (1), 2002.

EFFECT OF SOME FUNGICIDES AND ALTERNATIVE COMPOUNDS ON ROOT AND POD ROTS IN PEANUT

EL-DEEB A.A., S.M. ABDEL-MOMEN AND AWAREF A. HANAFI

Plant Pathology Research Institute, Agricultural Research Centre Giza, Egypt

(Manuscript received 18 June 2001)

Abstract

Effect of three fungicides and three alternative compounds on the incidence of root and pod rots in peanut was evaluated and compared under greenhouse and field conditions. The fungicides were vita-vax-thiram, rizolex-T and topsin-M70, while the alternative compounds were plant-guard (a formula of *Trichoderma harzianum*), rhizo-N (a formula of *Bacillus subtilis*) and the synthetic saponin. Experiments were carried out in artificially infested soil in the greenhouse, whereas the field was left for natural infection. The synthetic saponin was not used in pod rot experiments.

All treatments reduced the percentage of root and pod rots in both the greenhouse and the field. Percent infection was less with fungicides than when the alternative compounds were used. Root rot was as low as 8.24% in greenhouse and 6.67% in field under fungicidal treatments compared to 14.94% and 11.33% with the alternative compounds, respectively

Pod rot was 7.73 in greenhouse and 5.97 % in field in response to fungicides, while it was 12.17 and 12.50 % with the alternative compounds, respectively. Also, all treatments increased pod yield compared to the non-treated control. The fungicidal treatments gave a higher yield than that obtained in the alternative compound treatments.

INTRODUCTION

Peanut (*Arachis hypogea* L.) is an important crop in Egypt. it is used as a source for dietary protein, oil and direct consumption as nuts. The cultivation of peanut in Egypt is concentrated in the newly reclaimed lands such as Ismaillia, Nubaria, and south Tahreer.

The production of peanut in Egypt is negatively affected by several factors. Some of these factors are the fungal diseases (Abdel-Ghany *et al.*, 1971). Unfortunately, all parts of a peanut plant are subjected to fungal infection(s). Roots are subject to infection by several soilborne fungi such as *Rhizoctoni solani*, *Sclerotium rolfsii*, and *Fusarium* spp. causing root rots (Abdel-Ghani *et al.*, 1973; Ibrahim *et al.*, 1977; Baird *et al.*, 1993 and Abdel-Momen and Starr, 1998).

Also, the stem may become infected with *Aspergillus niger* causing rot to the crown area (Elnagar, 1987) and with *S. rolfsii* causing stem blight (Mehan *et al.*, 1995). Moreover, pods of peanut are susceptible to some fungal pathogens such as *Aspergillus* spp., *R. solani, Fusarium* spp. and *Macrophomina phaseolina* causing pod rots (Han *et al.*, 1989 and Filonow and Russel, 1991); some of the aforementioned fungi can infect peanut seed causing pre- or post-emergence damping off diseases (Yahia *et al.*, 1979). Also, leaves of peanut are attacked by *Cercospora* spp. causing leaf spots (Culbreath and Brenneman, 1993).

The control of the aforementioned diseases is achieved mainly by fungicides. Several reports indicated the efficiency of fungicides in reducing peanut pod and root rots and consequently increasing the quantity and quality of pod yield (El-Deeb *et al.*, 1985; Barnes *et al.*, 1990 and Mahrous *et al.*, 1993). The hazardous effect of fungicides on humans and animals is a motivation for finding safer means to prevent or reduce fungal infections.

The objective of this study was to evaluate some fungicides compared with some alternative compounds on peanut root and pod rots as well as yield.

MATERIALS AND METHODS

Root rot control experiments:

In greenhouse:

Three fungicides and three alternative compounds were used as seed treatment before being sown in soil artificially infested with the fungal propagules of the pathogens used in this study. The used fungicides were vitavax-thiram , topsin-M70 and rizolex-T, each at the rate of 3 g/ kg seed. The alternative compounds were plant-guard (a formula of *Trichoderma harzianum* at 5 cm^3/ kg seed, synthetic saponin at 3 gm/ kg seed or rhizo-N (a formula of *Bacillus subtilis*), where seeds were soaked for five minutes in fungicide solution (4 g /l). Pots, 30 cm-diam., were filled with a sandy loam soil and infested by 2% (w/w) of the fungal propagules of *S. rolfsii, M. phaseolina, R. solani, F. solani, F. oxysporum* or their mixture. The inocula of these fungi were prepared by growing each fungus on autoclaved sorghum and sand medium for 15 days at the appropriate temperatures. Five seeds of peanut cv. Giza-5 were sown in each pot. Each

treatment was replicated ten times and ten non-treated pots were used as control. Percentage of incidence of the rotted roots in each treatment was recorded 90 days after sowing. Moreover, isolation from each treatment was made to confirm the infection of roots with the fungi under study.

In the field:

The same treatments made in the greenhouse were carried out under the field conditions and left for natural infection at Abou-Hamad, Sharkia governorate and south Tahrir province during the seasons 1997 and 1998. Experimental plots, 7X3 m, were prepared and sown with peanut seeds cv.Giza-5. The seeds were treated with the same materials and doses empolyed in the greenhouse. Every treatment was replicated four times and non-treated peanut seed were used in four plots as a non-treated control.

At harvest, plants were uprooted and 100 root segments were taken randomly from each plot, surface sterilized and placed on Potato Dextrose Agar (PDA) medium to determine the percentage of infection by each fungus. Pod yield of each treatment was weighed and recorded as yield per feddan.

Pod rot experiments:

In greenhouse:

Pots, 40-cm-diam., were filled each with ten kg. soil infested with *S. rolfsii*, *M. phaseolina*, *R. solani*, *Aspergillus* spp., *Penicillium sp.* singly or in mixture at the rate of 2% (w/w). The fungicides and the alternative compounds, except saponin, were used in pod rot experiments, and five seeds were sown in each pot. Each treatment was replicated ten times and ten non-treated pots were used as control. Four months after sowing, plants were uprooted and pods were examined for infection by different fungi.

In the field:

The field soil was not infested with any of the test fungi, but was left to the natural infection both in Sharkia governorate and the South Tahrir province. The fungicides used for soil treatment were vitavax-thiram, rizolex-T and topsin-M70 at the rate of 3 kg./ feddan and the alternative compounds were plant-guard at 100 kg/ feddan, rhizo-N at 80 kg/ feddan. The specific amount of fungicide needed for each plot was mixed

with some sand and drenched in the soil near to the sown peanut seed. Also, the specific amount of the alternative compound for each plot was applied without mixing with sand. The experimental plots were 3X7 m and the experimental design was the completely randomized blocks. At harvest, 100 pods were taken randomly from each plot and each pod that showed symptoms of fungal infection (s) was considered a rotted pod. Percentages were calculated and pod yield from each plot was determined and calculated as ton per feddan.

Statistical analysis:

Data of different experiments were statistically analyzed using the Fisher LSD method to determine the significant differences among means of different treatments.

RESULTS

Root rots:

Data (Table 1) indicated that all treatments significantly reduced root rots caused by any of the tested fungi compared to the non-treated control. The fungicidal treatments were more effective than those of the alternative compounds in reducing root rots caused by most of the tested fungi. Vitavax-thiram and rizolex-T had similar efficiency in reducing root rots of peanut in the two seasons of the experiment. Although topsin-M70 had a better efficiency than any of the alternative compounds, it was less effective than either vitavax-thiram or rizolex-T in both seasons.

In the fungicidal treatments, the lowest observed percentage of root rots (8.24) was recorded with vitavax-thiram against *F. solani* in 1998, while the highest (17.05%) was found with topsin-M70 on the same fungus in 1997.

The plant-guard, saponin and rhizo-N, as alternative compounds to fungicides, were less effective. The percentage of root rots resulting with the use of alternative compounds ranged from 12.55 % with rhizo-N against *F. solani* in 1998 to 29.24 % with plant -guard against the mixture of pathogenic fungi in 1998. Also, it is noteworthy to mention that the used fungicides and alternative compounds were effective against the mixture of the investigated fungi.

In the field experiments, a trend similar to that of the greenhouse experiments was observed in both seasons. The lowest percentage of root rots, in the fungicidal treatments, was observed both in Sharkia (7.5 and 6.67) and South Tahrir (7.85 and 7.13) in 1997 and 1998, in rizolex-T and vitavax/thiram respectively (Table3). Among the alternative compounds, the lowest percentage of root rots (11.33) was observed with rhizo-N in Sharkia in 1998 while the highest (20.5) was with saponin in South-Tahrir in the same year (Table3).

Regarding the pod yield in the root rot control experiments, all treatments gave higher yield compared to the non-treated control. Vitavax-thiram and rizolex-T gave the highest pod yield (1.418 ton/ feddan) compared to the other treatments. Pod yield from alternative compounds was as low as 0.985 ton/feddan in the plant-guard treatment and as high as 1.213 ton/ feddan from the rhizo-N treatment, whereas it varied in the control between 0.735 tons and 0.815 tons/feddan.

Pod rots control experiments :

In greenhouse, all treatments applied decreased the percentage of pod rots compared to the non-treated control. Vitavax-thiram and rizolex-T were the most effective treatments in reducing pod rots, while the alternative compounds gave a lower but reasonable reduction in pod rots incidence. The lowest percentage of pod rots of 7.73 % was observed with vitavax-thiram treatment against *M. phaseolina* in 1997, while the highest (29.24) was observed when plant-guard was used against the mixture of all fungi in 1998 (Table 2).

In the field experiments, treatments were evaluated under the natural infection and most treatments had a trend similar to that observed in the greenhouse. The lowest percentage of pod rots (5.97) was observed with vetavax-thiram, while the highest (23.33) was observed with plant-guard in Sharkia in 1998 (Table 4).

Regarding the pod yield, all tested treatments gave significantly higher pod yield compared to the non-treated control. The highest yield (1.315 ton/ feddan) was obtained with rizolex-T or vitavax-thiram treatment, while the lowest yield (0.975 ton/ feddan) was obtained with the plant-guard treatment (Table 4). Yield for the control treatment ranged from 0.745 in South Tahreer to 0.821 ton/ feddan in Sharkia in

Table 1. Effect of three fungicides and three alternatives compounds on root rots of peanut in the greenhouse in 1997 and 1998

Treatment	Dose/ kg seed	*S.rolfsii* infection %		*M. phaseolina* infection %		*R.solani* infection %		*F.oxysporum* infection %		*F. solani* infection %		Mixture fungi infection %	
		1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Vitavax-thiram	3 gm	11.75	8.83	11.21	9.17	13.06	10.67	9.91	8.67	10.09	8.24	13.72	10.64
Plant-guard	5 cm^3	19.75	21.94	18.86	20.57	20.84	20.98	17.42	20.88	18.02	22.50	22.49	26.67
Saponin	3 gm	18.12	22.83	17.68	19.81	20.75	21.99	16.98	21.72	17.05	23.32	21.17	25.17
Topsin-M70	3 gm	14.83	13.98	12.54	12.91	15.48	14.65	11.27	12.90	17.05	12.31	14.83	14.92
Rizo-N	4 gm	19.56	14.94	18.93	14.17	20.13	15.17	18.32	14.57.	18.65	12.55	20.15	15.34
Rizolex-T	3 gm	11.50	9.21	10.41	9.13	12.15	10.73	9.43	8.94	9.86	8.73	12.65	10.67
Control	Non-treated	50.95	49.96	95.14	44.87	51.24	50.57	44.97	43.72	46.63	41.88	52.97	51.28
L.S.D. 5%		1.18	1.24	1.08	1.17	1.23	1.29	1.32	1.44	1.41	1.09	0.98	1.09

Table 2. Effect of three fungicides and two alternative compounds on pod rots of peanut in the greenhouse in 1997 and 1998

treatment	Dose/ feddan	*S.rolfsii* infection %		*M.phaseolina* infection %		*R.solani* infection %		*F.moniliforme* infection %		*Aspergillius sp.* infection %		*Penicillium sp .* infection %		Mixture Fungi infection %	
		1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Vitavax-Thiram	3 kg	11.72	8.17	7.73	0.7.97	13.96	12.67	11.34	10.24	12.33	11.83	9.84	9.33	14.44	13.19
Plant-guard	100 kg	18.32	25.96	16.24	23.23	20.65	26.76	21.02	22.92	19.78	21.78	18.66	19.67	23.68	29.24
Topsin-M70	3 kg	14.65	14.72	11.32	12.13	15.56	19.76	13.42	15.34	14.96	14.31	13.84	13.98	17.28	18.18
Rizo-N	80 kg	16.17	15.07	13.41	12.17	18.03	17.67	15.33	12.88	16.79	14.67	14.37	14.03	16.41	15.63
Rizolex-T	3 kg	11.67	8.21	8.24	7.91	13.84	12.88	11.65	10.23	12.24	11.64	9.83	9.41	14.21	13.88
Control	non treated	51.24	50.33	42.24	41.68	52.76	51.83	44.73	42.97	43.97	40.77	41.06	37.16	52.57	52.19
L.S.D.5%		1.26	1.32	2.01	1.43	1.38	2.01	2.04	1.98	1.01	2.21	2.21	2.01	2.14	2.22

Table 3. Effect of three fungicides and three alternative compounds on root rots and yield of peanut in the field in 1997 and 1998.

Treatment	Dose/ kg seeds	Abu-Hamad Sharkia				Eltahadi South Tahrir			
		infiction % by root rots		yield ton/ feddan		infiction % by root rots		yield ton/ feddan	
		1997	1998	1997	1998	1997	1998	1997	1998
Vitavax-thiram	3gm	7.74	6.67	1.325	1.410	8.10	7.13	1.215	1.319
Plant guard	5 cm^3	17.21	17.98	1.008	1.109	18.32	12.14	0 .981	1.009
Saponin	3 gm	15.21	18.81	1.035	1.960	18.24	20.50	0 .994	1.001
Topsin-M70	3 gm	12.43	10.55	1.125	1.217	12.63	11.07	1.100	1.183
Rizo-N	4 gm	18.75	11.33	1.010	1.213	17.73	12.23	0 .985	1.164
Rizolex-T	3 gm	7.50	6.68	1.394	1.418	7.85	7.63	1.273	1.314
Control	non treated	40.81	39.67	0.815	0.811	41.22	40.89	0.735	0.765
L.S.D. 5%		2.24	2.34	0.048	0.041	1.69	2.05	0.039	0.036

Table 4. Effect of three fungicides and two alternative compounds on pod rots and yield of peanut in the field in 1997 and 1998.

Treatment	Dose/ feddan	Abu-Hamad Sharkia				Eltahadi South Tahrir			
		infiction % by pod rots		yield ton/ feddan		infiction % by pod rots		yield ton/ feddan	
		1997	1998	1997	1998	1997	1998	1997	1998
Vitavax-thiram	3 kg	8.57	5.97	1.295	1.315	9.24	8.96	1.195	1.300
Plant guard	100 kg	16.82	23.33	1.002	1.030	16.96	22.67	0.966	0.975
Topsin-M70	3 kg	12.95	12.02	1.122	1.206	13.11	12.17	1.100	1.145
Rizo-N	80 kg	12.67	12.67	1.310	1.198	12.50	12.52	1.120	1.103
Rizolex-T	3 kg	8.50	8.85	1.315	1.312	9.33	9.94	1.210	1.299
Control	non treated	41.85	42.33	0.819	0.821	42.85	41.77	0.745	0.765
L.S.D. 5%		1.86	1.97	0.035	0.038	2.10	2.09	0.037	0.041

1997 and 1998, respectively.

DISCUSSION

The application of the fungicides gave the best results, in the present study, in controlling root or pod rots of peanut under greenhouse or field conditions compared to the non-treated control or the alternative biological formulations tested. This finding confirms the previous reports on the effectiveness of fungicides as a control measure for peanut diseases. Also, the superior effect of the fungicides than that of other alternative compounds is in agreement with what was reported in other cases on other crops (Omar *et al.*, 1999 and Abdel-Momen *et al.*, 2000).

Despite the high efficacy and faster action of the fungicidal treatments, their harmful effect on humans and animals present constrains for their absolute use. Due to these constrains, the effect of some alternative compounds was explored. The best effective alternatives were rhizo-N and saponin. The role of rhizo-N in reducing pod and root rots of peanut can be attributed to its antifungal effect of *Trichoderma hanzianum* that was reported by several investigators on different crops (Hilal and Baiuomy, 2000). On the other hand, the efficacy of saponin in reducing root rots of peanut may be due to its harmful effect on the permeability of the fungal cell wall. Such a harmful effect may be attributed to the combination of saponin with the membrane sterols causing pores in the fungal cell wall and hence the loss of membrane integrity (Hostettmann and Marston, 1995 and Osbum, 1996). The antifungal effect of the investigated alternative compounds on both root and pod rots fungi gives an indication of the wide spectrum of the effect of these alternatives. However, the variation among them as to their effect on different pathogens needs further investigations. The increase of pod yield of different treatments when compared to the non-treated control can logically be attributed to the reduction in disease incidence and consequently the better plant vigour.

The increase in yield may be considered as a determinant for the most effective treatment; however, the quality and marketability of this yield should also be considered. In the present investigation, some alternatives to fungicides gave promising results with respect to the reduction of root and/ or pod rots and the increase of peanut

pod yield. To optimize the effect of the promising alternatives, some modifications of their applications such as the dose and time of application should be considered. Finally, such promising results are a step forward toward preventing or minimizing the use of the harmful fungicides to human health as well as the environment.

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تأثير بعض المبيدات الفطرية و المركبات البديلة على اعفان جذور و ثمار الفول السودانى

عبد الرحمن عبد اللطيف الديب ، صلاح محمد عبد المؤمن ، عوارف عبد المنعم حنفى

معهد بحوث أمراض النباتات – مركز البحوث الزراعية – الجيزة – مصر

قيم تأثير ثلاثة مبيدات فطرية و ثلاثة مركبات بديلة فى مكافحة أعفان جذور و ثمار الفول السودانيو كذلك تم مقارنة تأثيرات المعاملات المختلفة فيما بينها تحت ظروف الصوبة و الحقل ,و كانت المبيدات الثلاثة المستخدمة هى:فيتافاكس/ثيرام، ريزولكس-*T* وتوبسن- *M70* فى حين كانت المواد البديلة الثلاثة هى: بلانت جارد (تركيبة من الفطر تريكوديرما هارزيانم) و الريزو- *N* (تركيبة من البكتيريا باسلسى ستلس) بالأضافة الى مادة السابونين التى تم اختبارها فى حالة أعفان جذور الفول السودانى فقط.

و قد جرى التقيم تحت ظروف العدوى الصناعية فى الصوبة و تحت ظروف العدوى الطبيعية فى الحقل . و قد أظهرت النتائج أن جميع المعاملات قد قللت (بشكل معنوى) نسبة الاصابة بأعفان الجذور و الثمار مقارنة بالغير معامل سواء فى الصوبة أو فى الحقل. و قد قلت نسبة الاصابة بأعفان الجذور أو الثمار بدرجة أكبر عند استخدام المبيدات الفطرية عنها عند استخدام المركبات البديلة.

و كانت أقل نسبة للاصابة بأعفان الجذور عند استخدام المبيدات الفطرية هى ٢٤ . ٨٪ فى الصوبة و ٦٧ . ٦٪ فى الحقل. و عند استخدام المركبات البديلة كانت أقل نسبة أعفان جذور هي ٩٢ . ١٤٪ فى الصوبة و ٣٣ . ١١٪ فى الحقل و بالنسبة لأعفان القرون فقد كانت أقل نسبة اصابة عند استخدام المبيدات الفطرية هى ١٧ . ١٢٪ فى الصوبة و ٩٧ . ٥٪ فى الحقل مقارنة ب١٧ . ١٢٪ فى الصوبة و ٥ . ١٢٪ فى الحقل عند استخدام المركبات البديلة (ريزو – *N* وبلانت جارد) .

و قد زاد الناتج من قرون الفول السودانى زيادة معنوية مقارنة بالغير معامل سواء باستخدام المبيدات أو المركبات البديلة ,و بصفة عامة كانت الزيادة فى ناتج القرون أعلا عند استخدام المبيدات الفطرية مقارنة بتلك الزيادة عند استخدام المركبات البديلة.