# *IN VITRO* EVALUATION OF SOME FUNGICIDES, COMMERCIAL BIOCONTROL FORMULATIONS AND NATURAL PLANT EXTRACTS ON PEANUT ROOT-ROT PATHOGENS

**EL-HABBAA G.M.[1], M.S. FELAIFEL[2], A.M. ZAHRA[2] AND R.E. ABDEL-GHANY[2]**

*1 Agric. Botany. Dept., Fac. Agric., Moshtohor, Benha Branch, Zagazig Univ.*

*2 Plant Pathology Institute, Agric. Res.Center., Giza, Egypt*

(Manuscript received Nov. 2001)

***Abstract***

Evaluation of different fungicides revealed that Maxim was the most effective as it prevented the *in vitro* growth of *F. solani, M. phaseolina, B. theobromae, S. rolfsii* and *R. solani*, at 1-5 ppm, followed by Benlate at (10-800 ppm), Vitavax-T (25-200 ppm) and Rizolex-T (200-800 ppm). Apron and Monceren had no or little effect and failed to produce a considerable reduction in growth of all tested fungi even at 800 ppm. Among the tested plant products, thyme extract was the most effective *in vitro* against all tested fungal pathogens, followed by Trilogy (neem oil) and Kenze oil (castor oil). Reduction in fungal linear growth was increased more or less by increasing the concentration of these plant products; however, Leek extract had no effect in this respect. As for antagonistic microbes, both Rizo N and Plantguard caused significant decrease in linear growth of the tested fungi. Rizo N was significantly better than Plantguard; however, both antagonistic microbes, may be considered weak in terms of their toxicity against the tested pathogens.

## INTRODUCTION

Peanut (*Arachis hypogea L.*) is one of the most important leguminous crops in Egypt as well as in many parts of the world. Several serious diseases such as pod rot, crown rot, root rot and others attack growing plants and fruits of peanut. Root rot caused by *Rhizoctonia solani, Sclerotium rolfsii, Fusarium solani, Fusarium oxysporum, Macrophomina phaseolina* and *Botryodiplodia theobromae* is one of the most serious diseases on peanut plants in Egypt (El-Deeb, 1977, Saleh, 1997 and Abdel-Ghany, 2001). Reduction in peanut yield due to root rots reached 25.1% as recorded by El-Deeb *et al.*, (1977).

Tolclofos–methyl at 4 ppm and benomyl at 8 ppm were more effective against *R. solani in vitro* than dichlofluanid, copper oxyquinolate + Carboxin or pencycuron (Osman *et al.*, 1990). Henriquez and Montealegre (1992) tested 11 fungicides *in vitro* against *S. rolfsii* and found that Vitavax-T, Basitac, Plantavax, Rizolex, Bayleton and Baytan were the most effective. Benlate was the most inhibitive fungicide *in vitro* against *Macrophomina phaseolina, Fusarium spp., Altenaria alternata* and *R. solani* followed by Rizolex-T (Tolclofos–methyl + thiram) and vitavax + captan (Saleh, 1997).

Plant extracts such as leaf oil of *Azadirachta indica* was the most effective followed by *Eucalyptus globulus* and *Ocimum canum* against *Sclerotium rolfsii* (Singh and Dwivedi 1990). Neem oil was the most effective of the volatile and nonvolatile fractions tested against *Sclerotium rolfsii* where sclerotial germination was only 8% compared to 71% in the untreated control. Wilson *et al.*, (1997) tested 49 essential oils and found that palamarosa (*Cynobopogon martin*), red thyme (*Thymus zygis*), cinnamon leaf (*Cinnamomum zeylanicum*) and clove buds (*Eugenia caryophllata*) showed the most antifungal activity against *B. cinerea.* These compounds increased the activity of chitinase and peroxidase associated with the induction of resistance. Furthermore, they stimulated the accumulation of phenolic compounds, as antifungal substances, in plant tissues.

Benhamou and Chet (1993) observed, using scanning electron microscopy investigations, that coiling of the antagonist (*Trichoderma harzianum*) around its host (*R. solani*) was an early event preceding hyphal damage. Saleh (1997) stated that *Bacillus subtilis* isolated from the rhizosphere of naturally infected plants was inhibitory to the *in vitro* growth of the tested fungi; *Fusarium campactum, Fusarium oxysporum, Macrophomina phaseolina, R. solani* and *Sclerotium rolfsii.* El-Garhy (2000) reported that all biocontrol agents *Trichoderma harzianum, Gliocladium virens, Paecilomyces farinosus, Bacillus subtilis and Streptomyces griseoviridis* significantly decreased the mycelial radial growth of *R. solani* and *Sclerotinia sclerotiorum* on PDA medium compared with the control.

The present work aimed at evaluating the effect of some fungicides, commercial antagonistic microbes and natural extracts on peanut root-rot pathogens under laboratory conditions.

## MATERIALS & METHODS

Five isolates i.e., *Rhizoctonia solani, Sclerotium rolfsii, Fusarium solani, Macrophomina phaseolina* and *Botryodiplodia theobromae* isolated from rotted roots of peanut plants and tested for their pathogenicity to peanuts as mentioned by Abd-El- Ghany (2001) were used in the following experiments.

### 1. Evaluation of some fungicides on growth of the pathogenic fungi :

This experiment was conducted for studying the effect of some fungicides as shown in Table (1), namely, Maxim, Topsin–M, Rizolex–T, Benlate, Vitavax-T, Monceren and Apron on the linear growth of the pathogenic fungi *Rhizoctonia solani, Sclerotium rolfsii, Fusarium solani, Macrophomina phaseolina* and *Botryodiplodia theobromae.* The fungicides were tested at different concentrations up to 800 ppm based on their active ingredient. PDA medium was poisoned with each fungicidal concentration immediately before solidification and poured into 9-cm plates. Plates were inoculated at the center by 5-mm discs taken from 7 day–old cultures of the above mentioned pathogenic fungi and incubated at 28°C. Four plates were used for each particular treatment as replicates. Linear growth of the tested fungus was measured when its mycelial growth completely covered the surface of the medium in the control treatment (un-poisoned medium) by calculating the average of two perpendicular diameters of fungal growth in mm.

### 2. Evaluation of some natural plant products on growth of the pathogenic fungi :

In this experiment, Triology (neem oil 90%) and kenze oil 2000 (castor oil 70%) as commercial plant products in addition to leaf extracts of leek (*Allium porrum*) and thyme (*Thymus vulgaris*) were used. The latter two leaf extracts were prepared as follows: A known weight (100 g) of fresh leaves of leek and thyme were washed under running tap water, air dried for one hour in the laboratory and homogenized in 100-ml sterile distilled water using electric blender. The homogenates were centrifuged at 3000 rpm for 15 min. and filtered through filter paper (Watman No. 1). The supernatants were sterilized using bacteria proof Seits filter and kept as stock solutions (100% conc.) in dark sterile bottle in a refrigerator.

The above mentioned plant products and leaf extracts were added to PDA medium before pouring the plates at different concentrations i.e. 0, 100, 250, 500, 750 and 1000 ppm (v/v). Four plates for each concentration were inoculated at the center with discs (5-mm) taken from 7 day-old culture of tested fungi. The plates were incubated at 28°C. Linear growth of the tested fungi was measured as mentioned before.

Table 1. List of tested fungicides, their active ingredients, recommended dose and formulators.

| Trade name & formulator | Common name & Active ingredient | Chemical formula | Dose (ml or g / Kg seed) |
|---|---|---|---|
| Maxim (Novartis) | Fluioxonil (35%) | 4-2.2-difluoro-1.3-benzodioxol-4-yl-1H-pyrrole-3-carbonitrite (IUPAC) | 3 ml |
| Topsin-M-70 (Nippon-soda-Japan | Thiophanate-methyl (70%) | Dimethyel (1.2 phenylene) bis (iminocarbono-thiole)bis carbonate | 3 g |
| Rizolex-T (Sumitomo Chem. Co., LTD) | Tolclofos-methyl+thiram -50% | 20%Rizolox-T:tolclofos-ethyluro 0-dimethyl)-0-2.6 dichloro-4-methyl-phenyl phosporo thiole 30% thiram (TMTD) : bis(dimethyl – thiocarbamayl disulphide. | 3 g |
| Benlate (Du-pont, France) | Benomyl (50%) | Methyl 1-(butyl carbamoyl)-2-benzimidazole carbamate. | 3 g |
| Vitavax-T (Uniroyal, England) | Carboxin (31.5%) + thiram (37.5%) | 5.6-dihydro-2-methyl-N-phenyl-1.4-oxathiin-3-carboxyamide-Bis(dimethyl thio-carbamayl)disulfide | 3 g |
| Monceren (Bayer) | Pencycuron -25% | 1-(4-chlorobenzyl)-1-cyclopenyl-l urea. | 3 g |
| Apron (Novartis) | Metalaxyl (35%) | N- (2,b-dimethyl phenyl) -N(methoxy acetyl)-D1-kg alanine methyl ester (CAS) | 3 g |

**3. Evaluation of commercial antagonistic microbes on the pathogenic fungi :**

In this experiment, the commercial antagonistic microbes Plantguard (one ml contains about $30x10^6$ spore of *Trichoderma* spp) and Rizo-N (one gram contains about $30 \times 10^6$ cfu of *Bacillus subtilis*) were used to test their effect on linear growth

of the pathogenic fungi under study. 100 µl of plantgaurd or 100 µg of Rizo-N were spotted (for the first) or streaked (for the second) at two opposite sides on the surface of PDA medium and at equal distances from the peripheral of the plates. The treated as well as un-treated plates were inoculated simultaneously at their centers (between the two spots or streaks of the tested antagonistic microbe) each with a 5 mm disc of each pathogenic fungus. Four plates were used as replicates for each particular treatment and all plates were incubated at 25°C for about 5-7 days until plates of the control treatment (without antagonistic microbe) were covered by the mycelial growth of the tested fungus.

### Statistical analysis:

All afore-mentioned experiments carried out under laboratory, greenhouse or field conditions were performed in a complete randomized block design. All data were analysed according to Snedecor and Cochran (1989).

## RESULTS

### 1. Evaluation of some fungicides on growth of the pathogenic fungi :

This experiment was conducted to study the effect of different concentrations of some fungicides on the linear growth of *R. solani, S. rolfsii, F. solani, M. phaseolina* and *B. theobromae.*

Data in Tables (2-a, -b, -c, -d and -e) show that, Maxim and Benlate followed by Vitavax-T and Rizolex-T were the most suppressive fungicides to linear growth of all tested fungi. Adding Maxim at 1, 1, 1, 5, 5 ppm to the medium resulted in complete inhibition of linear growth of *F. solani, M. phaseolina, B. theobromae, S. rolfsii* and *R. solani*, respectively. However, at 1.0 ppm of Maxim, the linear growth of *R. solani* was significantly lower than that of *S. rolfsii.*

Benlate suppressed the linear growth of *M. phaseolina* at 10 ppm, *F. solani* and *B. theobromae* at 25 ppm and *R. solani* at 100 ppm. *M. phaseolina* seems to be more sensitive to Benlate than *F. solani.* At 10 ppm of Benlate, the latter two fungi showed 13 and 20 mm linear growth although growth of both was completely inhibited at 5 ppm. On the other hand, growth of *S. rolfsii* was un-affected by Benlate. At 800 ppm,

growth of *S. rlfsii* was comparable to that produced in control (un-treated) medium.

Vitavax-T was more toxic to the growth of *S. rolfsii* than to *B. theobromae,* where growth of both fungi was completely checked at 25 and 200 ppm respectively. Meanwhile, growth of *R. solani, F. solani* and *M. phaseolina* was stopped at 100 ppm. In this regard, *M. phaseolina* seems to be more tolerant to Vitavax-T than *R. solani* and *F. solani* where the linear growth at 50 ppm was 20, 13 and 13 mm, respectively.

Rizolex-T prevented linear growth of *R. solani, M. phaseolina* and *B. theobromae* at 200 ppm and *F. solani* at 400 ppm. Similar linear growth (11 mm) was reported on media treated with 100 ppm in case of the first three fungi. On the other hand, *S. rolfsii* seems to be resistant or more tolerant to this fungicide as it was still growning even on medium amended with 800 ppm showing 13 mm growth.

The data showed that, Apron was an ineffective fungicide against i*n vitro* growth of *S. rolfsii* and *R. solani,* while growths of *F. solani, M. phaseolina* and *B. theobromae* were slightly affected even at the highest tested concentration of 800 ppm.

The above results indicated that the tested fungicides differed greatly in their toxicity against in vitro growth of pathogens under test. Maxim fungicide was the most toxic as it stopped *in vitro* growth at 1-5 ppm, followed by Benlate (10-800 ppm), Vitavax-T (25-200 ppm) and Rizolex-T (200-800 ppm). Apron and Monceren fungicides had no or little effect and failed to result in a considerable reduction in growth of all tested fungi even at the highest concentration.

**2. Evaluation of some natural plant products on growth of the pathogenic fungi :**

In this experiment, four natural plant products i.e. extracts of thyme and leek leaves, in addition to the commercial plant products Trilogy (neem oil-90%) and Kenze-2000 (castor oil-70%) were tested, at concentrations 0, 100, 250, 500, 750, and 1000 ppm for their potentialities against linear growth of the tested peanut root-rot fungi. The obtained results (Table 3) indicated that, thyme extract was the most effective against growth of all tested fungal pathogens, followed by Trilogy (neem) and Kenze (castor oil) which was not effective against *B. theobrome*, whereas leek extract showed no effect against all fungi at all tested concentrations.

Table 2-a. Effect of different fungicides at different concentrations on linear growth (mm) of *S. rolfsii.*

| Fungicides | Concentratins (ppm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0.5 | 1 | 5 | 10 | 25 | 50 | 100 | 200 | 400 | 800 | Mean |
| Maxim | 90 | 58 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15.5 |
| Topsin M-70 | 90 | 80 | 71 | 57 | 49 | 39 | 33 | 20 | 13 | 0 | 0 | 41.1 |
| Rizolex-T | 90 | 90 | 82 | 73 | 69 | 63 | 52 | 45 | 33 | 25 | 13 | 57.7 |
| Monceren | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 82 | 71 | 62 | 85.0 |
| Benlate | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90.0 |
| Vitavax-T | 90 | 62 | 41 | 18 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 20.0 |
| Apron | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90.0 |
| Mean | 90.0 | 80.0 | 69.4 | 59.7 | 56.7 | 53.1 | 50.7 | 47.9 | 44.0 | 39.4 | 36.4 | 57.0 |

| L.S.D. at 5% for | Concentration (C) | Fungicides (F) | C x F |
|---|---|---|---|
| | 1.08 | 0.86 | 2.86 |

Table 2-b. Effect of different fungicides at different concentrations on linear growth (mm) of *R. solani.*

| Fungicides | Concentratins (ppm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0.5 | 1 | 5 | 10 | 25 | 50 | 100 | 200 | 400 | 800 | Mean |
| Maxim | 90 | 45 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13.5 |
| Topsin M-70 | 90 | 77 | 65 | 53 | 47 | 24 | 13 | 0 | 0 | 0 | 0 | 33.6 |
| Rizolex-T | 90 | 71 | 58 | 43 | 28 | 24 | 16 | 11 | 0 | 0 | 0 | 31.0 |
| Monceren | 90 | 90 | 84 | 75 | 60 | 45 | 45 | 33 | 29 | 22 | 13 | 53.3 |
| Benlate | 90 | 64 | 56 | 43 | 30 | 20 | 12 | 0 | 0 | 0 | 0 | 28.6 |
| Vitavax-T | 90 | 85 | 65 | 36 | 34 | 31 | 13 | 0 | 0 | 0 | 0 | 32.2 |
| Apron | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90.0 |
| Mean | 90.0 | 74.6 | 61.6 | 48.6 | 41.3 | 33.4 | 27.0 | 19.1 | 17.0 | 16.0 | 14.7 | 40.3 |

| L.S.D. at 5% for | Concentration (C) | Fungicides (F) | C x F |
|---|---|---|---|
| | 1.43 | 1.14 | 3.79 |

Table 2-c. Effect of different fungicides at different concentrations on linear growth (mm) of *F. solani*.

| Fungicides | Concentratins (ppm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0.5 | 1 | 5 | 10 | 25 | 50 | 100 | 200 | 400 | 800 | Mean |
| Maxim | 90 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11.6 |
| Topsin M-70 | 90 | 90 | 71 | 58 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 31.7 |
| Rizolex-T | 90 | 90 | 80 | 68 | 61 | 43 | 37 | 25 | 15 | 0 | 0 | 46.3 |
| Monceren | 90 | 90 | 90 | 78 | 75 | 68 | 61 | 55 | 45 | 43 | 39 | 66.7 |
| Benlate | 90 | 90 | 70 | 43 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 28.5 |
| Vitavax-T | 90 | 90 | 52 | 45 | 38 | 33 | 13 | 0 | 0 | 0 | 0 | 32.8 |
| Apron | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 82 | 71 | 64 | 59 | 82.4 |
| Mean | 90.0 | 82.6 | 64.7 | 54.6 | 46.3 | 33.4 | 28.7 | 23.1 | 18.7 | 15.3 | 14.0 | 42.9 |

| L.S.D. at 5% for | Concentration (C) | Fungicides (F) | C x F |
|---|---|---|---|
| | 1.52 | 1.21 | 4.01 |

Table 2-d. Effect of different fungicides at different concentrations on linear growth (mm) of *M. phaseolina*.

| Fungicides | Concentratins (ppm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0.5 | 1 | 5 | 10 | 25 | 50 | 100 | 200 | 400 | 800 | Mean |
| Maxim | 90 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.3 |
| Topsin M-70 | 90 | 65 | 24 | 16 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 18.7 |
| Rizolex-T | 90 | 90 | 90 | 35 | 21 | 19 | 15 | 11 | 0 | 0 | 0 | 33.7 |
| Monceren | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90.0 |
| Benlate | 90 | 20 | 13 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11.6 |
| Vitavax-T | 90 | 90 | 90 | 90 | 78 | 56 | 21 | 0 | 0 | 0 | 0 | 46.8 |
| Apron | 90 | 90 | 90 | 90 | 90 | 82 | 81 | 78 | 73 | 72 | 65 | 81.9 |
| Mean | 90.0 | 66.9 | 56.7 | 46.6 | 41.4 | 35.3 | 29.6 | 25.6 | 23.3 | 23.1 | 22.1 | 41.9 |

| L.S.D. at 5% for | Concentration (C) | Fungicides (F) | C x F |
|---|---|---|---|
| | 1.02 | 0.82 | 2.71 |

Table 2-e. Effect of different fungicides at different concentrations on linear growth (mm) of *B. theobromae*.

| Fungicides | Concentratins (ppm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0.5 | 1 | 5 | 10 | 25 | 50 | 100 | 200 | 400 | 800 | Mean |
| Maxim | 90 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9.4 |
| Topsin M-70 | 90 | 90 | 29 | 22 | 13 | 12 | 0 | 0 | 0 | 0 | 0 | 23.3 |
| Rizolex-T | 90 | 90 | 71 | 24 | 21 | 17 | 13 | 11 | 0 | 0 | 0 | 30.6 |
| Monceren | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90.0 |
| Benlate | 90 | 27 | 24 | 19 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 15.7 |
| Vitavax-T | 90 | 90 | 90 | 90 | 75 | 55 | 20 | 13 | 0 | 0 | 0 | 47.6 |
| Apron | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 83 | 82 | 53 | 85.3 |
| Mean | 90.0 | 70.0 | 56.3 | 47.9 | 43.2 | 37.7 | 30.4 | 29.1 | 24.7 | 24.6 | 20.4 | 43.1 |

| L.S.D. at 5% for | Concentration (C) | Fungicides (F) | C x F |
|---|---|---|---|
| | 0.81 | 0.65 | 2.15 |

Table 3. Effect of different natural plant products at different concentrations on linear growth (mm) of the pathogenic fungi.

| Fungi | Product | Concentrations (p.p.m.) | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|
| | | 0 | 100 | 250 | 500 | 750 | 1000 | |
| *S. rolfsii* | Kenze 2000 | 90 | 90 | 90 | 90 | 83 | 76 | 86.5 |
| | Trilogy | 90 | 90 | 80 | 74 | 70 | 63 | 77.8 |
| | Leek extract | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | Thyme extract | 90 | 55 | 48 | 38 | 32 | 23 | 47.7 |
| Mean | | 90 | 81.3 | 77 | 73 | 68.8 | 63 | 75.5 |
| *R. solani* | Kenze 2000 | 90 | 90 | 90 | 90 | 78 | 72 | 85 |
| | Trilogy | 90 | 71 | 64 | 52 | 44 | 39 | 60 |
| | Leek extract | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | Thyme extract | 90 | 44 | 35 | 28 | 21 | 15 | 38.8 |
| Mean | | 90 | 73.8 | 69.8 | 65 | 58.3 | 54 | 68.5 |
| *F. solani* | Kenze 2000 | 90 | 90 | 82 | 78 | 69 | 60 | 78.2 |
| | Trilogy | 90 | 64 | 55 | 46 | 36 | 30 | 53.5 |
| | Leek extract | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | Thyme extract | 90 | 41 | 37 | 30 | 24 | 20 | 40.3 |
| Mean | | 90 | 71.3 | 66 | 61 | 54.8 | 50 | 65.5 |
| *M. phaseolina* | Kenze 2000 | 90 | 90 | 87 | 81 | 76 | 68 | 82 |
| | Trilogy | 90 | 85 | 71 | 65 | 48 | 38 | 66.2 |
| | Leek extract | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | Thyme extract | 90 | 71 | 64 | 46 | 32 | 24 | 54.5 |
| Mean | | 90 | 84 | 78 | 70.5 | 61.5 | 55 | 73.2 |
| *B. theobromae* | Kenze 2000 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | Trilogy | 90 | 75 | 61 | 46 | 41 | 33 | 57.7 |
| | Leek extract | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | Thyme extract | 90 | 63 | 50 | 35 | 23 | 11 | 45.3 |
| Mean | | 90 | 79.5 | 72.8 | 65.3 | 61 | 56 | 70.8 |

| L.S.D. at 5% for | Concentration (C) | Natural extracts (E) | ( C x E ) |
|---|---|---|---|
| *S. rolfsii* | 1.58 | 1.29 | 3.15 |
| *R. solani* | 1.91 | 1.56 | 3.82 |
| *F. solani* | 2.20 | 1.79 | 4.40 |
| *M. phaseolina* | 2.20 | 1.79 | 4.39 |
| *B. theobromae* | 6.02 | 4.92 | 12,04 |

Thyme extract at 1000 ppm exhibited its highest toxicity against linear growth of *B. theobromae* (11 mm), followed in order by *R. solani* (15 mm), *F. solani* (20 mm), *S. rolfsii* (23 mm) and *M. phaseolina* (24 mm). Trilogy (neem oil 90%), at the same concentration (1000 ppm), was less toxic to linear growth of *F. solani* (30 mm), *B. theobromae* (33 mm), *M. phaseoline* (38 mm) and *R. solani* (39 mm) and less toxic against *S. rolfsii* (63 mm). Castor oil (Kenze 2000) used at 1000 ppm had no effect on growth of *B. theobromae* (90 mm) but caused slight reduction in growth of *F. solani* (60 mm) and *M. phaseolina* (68 mm), *R. solani* (72 mm) and *S. rolfsii* (76 mm) compared with growth on un-treated control PDA-medium (90 mm).

**3. Evaluation of commercial antagonistic microbes on the pathogenic fungi :**

Plantgaurd and Rizo-N as antagonistic microbes preparations were evaluated against *S. rolfsii*, *R. solani*, *F. solani*, *M. phaseolina* and *B. theobromae* under laboratory conditions.

The obtained results (Table 4) indicated that both Rizo N and Plantguard caused significant decrease in linear growth of the tested fungi. Rizo N was significantly better than Plantguard. However, both antagonistic microbes formulations, may be considered weak in terms of their toxicity against growth of the tested pathogens.

Table 4. Effect of Rizo-N and Plantguard bioagents on linear growth of some pathogenic fungi.

| | Linear growth (in mm) of the tested fungi | | | | | |
|---|---|---|---|---|---|---|
| Antagonistic microbes | *R. solani* | *S. rolfsii* | *F. solani* | *M. phaseolina* | *B. theobromae* | Mean |
| Control | 90 | 90 | 90 | 90 | 90 | 90.0 |
| Rizo N | 65.3 | 75.8 | 63.0 | 67.5 | 63.0 | 66.9 |
| Plantguard | 70.8 | 82.0 | 74.5 | 75.8 | 71.8 | 75.0 |
| Mean | 75.4 | 82.6 | 75.8 | 77.8 | 74.9 | |

| L.S.D. at 5% for | Antagonistic microbe (B) | Fungi (F) | B x F |
|---|---|---|---|
| | 2.58 | 3.34 | N.S. |

## DISCUSSION

The toxicity of the used fungicides against growth of the tested fungi i.e. *F. solani, M. phaseolina, B. theobromae, S. rolfsii* and *R. solani* was variable. The concentration (in ppm) at which the in vitro growth was completely stopped were dependent on the tested fungus. These concentrations were 1-5 ppm for Maxim; 10-100 ppm for Benlate; 25-200 ppm for Vitavax-T and 200-400 ppm of Rizolex-T. It was found that, *S. rolfsii* was not affected by Benlate even at 800 ppm, and was still able to grow at the same concentrations of Rizolex-T. On the other hand, Apron and Monceren fungicides had no or little effect and failed to produce a considerable reduction in growth of all tested fungi even at the highest concentration. Similar results were found by Anwar *et al.*, (1991) who reported that, benomyl was 100 % effective even at 20 ppm against *Fusarium solani*; Henriquez and Montealegre (1992) who reported that Vitavax-T, Basitac, Plantavax, Rizolex, Bayleton and Baytan were the most effective for controlling *S. rolfsii*; Saleh (1997) reporting that Benlate inhibited the growth of *R. solani, Macrophomina phaseolina* and *Fusarium* spp. at 3–5 ppm.

Toxicity of the natural plant products i.e. leaf extracts of thyme and leek, Trilogy (neem oil-90%) and Kenze-2000 (castor oil-70%) against *in vitro* growth of the tested peanut root-rot fungi was also variable. Thyme extract seems to be the most toxic followed by neem and castor oil; however, Leek extract had no effect in this respect. *B. theobromae* was the most affected by Thyme extract followed in order by *R. solani, F. solani, S. rolfsii* and *M. phaseolina*, meanwhile neem oil was more effective against *F. solani* followed by *B. theobromae, M. phaseolina* and *R. solani* and seems to be less toxic against *S. rolfsii*. Kenze 2000, however, had no effect on the growth of *B. theobrome* and shows little toxicity against *F. solani* and *M. phaseolina, R. solani* and *S. rolfsii*. Toxicity of these natural plant products against fungi might be attributed to their negative effect on enzymatic activities and other vital processes of these pathogens. Several investigators obtained similar results on other plant products like Singh and Dwivedi, (1990) and Abd-El-Baky, (1999) who found volatile plant substances can cause linear growth inhibition in *F. oxysporum f. sp. vasinfectum* and *R. solani,* except in the case of coriander (for *F.oxysporum f. sp. vasinfectum*) and leek (*Allium porrum*) for both fungi where, no inhibition was observed. They added that the essential oils of blue gum, castor-bean (*Ricinus communis*) and coriander resulted in variable linear growth inhibition

in case *of Fusarium oxysporum f. sp. vasinfectum* and *R. solani.* Favaron *et al.*, (1993) found that extracts of onion and leek contained factors that inhibited, to various extents, polygalacturonases produced *in vitro* by several fungi including *F. moniliforme, Sclerotium cepivorum* and *M. phaseolina.*

The antagonistic microbes Plantguard (*Trichoderma harzianum*) and Rizo-N (*Bacillus subtilis*) exhibited little decrease in growth of the tested fungi. Rizo N was significantly better than Plantguard. Several mechanisms were suggested to explain the effect of these antagonistic microbes including antagonistic action, hyperparasitism and antibiotic production (Brask, 1991 and Benhamou and Chet 1993). El-Awadi (1993) revealed that *Trichoderma viride* inhibited *in vitro* growth of *F. oxysporum f. sp. cicri* and *R. solani.* Saleh (1997) stated that *Bacillus subtillis* was inhibitory to the fungi *F. campactum, F. oxysporum, M. phaseolina, R. solani* and *S. rolfsii* in vitro.

## REFERENCES

1. Abd-El-Baky, A.A. 1999. Studies on some medicinal plants as a source of antifungal substances in North Africa. Cairo Univ., Institute of African Research and Studies, Dept of Natural Resources.

2. Abdel-Ghany, R.E. 2001. Pathological studies on root-rot disease of peanut (*Arachis hypogea* L.) in Eygpt. M. Sc. Thesis, Fac. Agric., Moshtohor, Bot. Dept. Zagazig Univ. Benha-Branch, Eygpt.

3. Anwar, N., S.I. Ahmed and A. Askari. 1991. Laboratory evaluation of six systemic fungicides for control of root-rot in *Doboisia leichhardtiif* Mull. Pakistan J. Sci. Industr. Res., 34: (10), 402-403. (c.f. Rev. Pl. Path., 73 (3): 2583.

4. Benhamou, N. and I. Chet. 1993. Hyphal interaction between *Trichoderma harzianum* and *Rhizoctonia solani*, Ultra-structure and gold cytochemistry of the myco-parasitic process. Phytopathology, 83 (10): 1062-1071.

5. Brask, P. 1991. Antibiotics from *Gliocladium* and *Trichoderma* and their influence on biological control of plant pathogens. Frederiksberg, Denmark, Institute for Plantebiologi, 122 pp. (c.f. Rev. Pl. Path., 72 (12): 6460.

6. El-Awadi, F.A. 1993. Sources and mechanism of resistance to root-rot and wilt disease complex in chickpea at sandy soil. Horticultura Sciencia, 1: 19-25.

7. El-Deeb, A.A.A. 1977. Studies on root-rot disease of peanut in A.R.E. and its control. M.Sc. Thesis, Fac. of Agric., Zagazig Univ., Egypt, 107 pp.

8. EL-Garhy, A.M.M. 2000. Pathological Studies on fungal rot diseases of lentil. Ph. D. Thesis. Fac., of Agric., AL-Azhar Univ, (2000).

9. Favaron, F., C. Castiglioni and P.D. Lenna. 1993. Inhibition of some rot fungi polygalacturonase by *Allium cepa* L. and *Allium porrum* L. extracts. Journal of Phytopath; 139 (3): 201-206.

10. Henriquez, S.J. and A.J. Montealegre. 1992. Chemical control of *Sclerotium rolfsii* Sacc. Agric. Tecnica (Santiago), 52 (1):79-84. (c.f. Rev. Pl. Path., 73 (11): 5413).

11. Osman, A.R., H.Y. Aly, N.A. El-Safty and Fatma M. Ghallab. 1990. Performance of selected fungicides against root and crown rot of strawberry caused by *Rhizoctonia solani* f.sp. *fragariae* as affected by the application of recommended fertilizer and nematocide. Ann. Agric. Sci., Moshtohor, 28 (4): 2201-2218.

12. Saleh, O.I. 1997. Wilt, root rot and seed diseases of groundnut in El-Minia Governorate, Egypt. Egypt. J. Phytopathol., 25 (1-2): 1-18.

13. Snedecor, G.W. and W.G. Cochran. 1989. Statistical Methods. 8th ed. The Iowa State Univ. Press, Ames, USA.

14. Singh, R.K. and R.S. Dwivedi. 1990. Fungicidal properties of neem and blue gum against *Sclerotium rolfsii* Sacc., a foot rot pathogen of barley. Acta Botanica, 18 (2): 260-262.

15. Wilson, C.L., J.M. Solar, A. Ghaouth and M.E. Wisniewski. 1997. Rapid evaluation of plant extracts and essential oils for antifungal activity against *Botrytis cinerea*. Plant Dis., 81: 204-210.

# التقييم المعملى لبعض المبيدات الفطرية وعوامل التضاد الحيوى التجارية والمستخلصات الطبيعية ضد المسببات المرضية لأعفان جذور الفول السودانى

**جهاد محمد الهباء [١] ، محمد صلاح فليفل [٢] ،**
**أبو القاسم محمد زهرة [٢] ، راضى السيد عبد الغنى [٢]**

١ قسم *النبات الزراعى - كلية الزراعة بمشتهر*
٢ معهد *أمراض النبات - مركز البحوث الزراعية*

أظهر التقييم المعملى لعدد من المبيدات الفطرية قدرة مبيد الماكسيم على إيقاف نمو فطريات الفيوزاريوم سولانى ، ماكروفومينا فاصولينا ، ، بوتريودبلوديا ثيوبرومى ، سكلروشيوم رولفسياى و الريزوكتونيا سولانى بتركيز يتراوح بين ١، ٥ جزء فى المليون حسب الفطر وتبعه فى ذلك مبيد البنليت بتركيزات تتراوح بين ١٠ إلى ٨٠٠ جزء فى المليون ثم مبيد الفيتافاكس عند ٢٥-٢٠٠ جزء فى المليون فمبيد الرايزولكس-ت بتركيزات ٢٠٠-٨٠٠ جزء فى المليون. كما ظهر أيضا أن مبيدات الأبرون والمونسرين ليس لها تأثير أو ذات تأثير ضعيف وفشلت فى عمل واضح فى نمو الفطريات المختبرة حتى عند ٨٠٠ جزء فى المليون. وقد أظهر إختبار بعض المستخلصات النباتية الطبيعية أن مستخلص الزعتر هو الأكثر كفاءة ضد جميع المسببات المرضية المختبرة تبعه فى ذلك زيت النيم وزيت الخروع ، وقد تزايد الإختزال فى النمو الفطرى بزيادة تركيز تلك المنتجات النباتية ، كما ظهر أيضا أن مستخلص الكرات ليس له أى تأثير يذكر. وأظهر إختبار عوامل التضاد الحيوى أن كلا من مركب ريزو-ن والبلانتاجارد قد خفضا معنويا من نمو جميع الفطريات المختبرة وكان الريزو-ن أفضل من البلانتاجارد فى ذلك الشأن ، ومع ذلك فإن كلا المنتجين يمكن إعتبارهما ذو تأثير ضعيف ضد مسببات أعفان الجذور فى الفول السودانى عند مقارنتهما بتأثير بعض المبيدات والمستخلصات النباتية المختبرة.