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EFFECT OF GROWTH REGULATORS IN CONTROLING OF PEANUT ROOT ROT DISEASES AND COMPARED TO FUNGICIDES TREATMENT

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ABSTRACT

Greenhouse and field experiments were conducted in 2003 and 2004 to study the effect of growth regulators, which included Indole Butyric acid (IBA), Cycocel (CCC) and Gibbrellic acid (GA_3) at 50, 100 and 200 ppm in reducing of peanut root rot and compared to fungicides treatment. All tested growth regulators clearly affected on the incidence of damping-off, wilt and root rot disease, under greenhouse and field conditions Indole Butyric acid (IBA) followed by Cycocel (CCC) at 200 ppm were the most effective treatments in reducing peanut infections with damping-off, wilt and root rot, while treatment with Gibbrellic acid (GA_3) at 200 ppm recorded the highest infection compared to other treatments. There were positive relationship between increasing the concentration of IBA and CCC and their effect on incidence of damping-off, wilt and peanut root rot, while with GA_3 this relationship was negatively. All tested fungicides and commercial biocides reduced percentage of damping – off, wilt and peanut root rot diseases and consequently increasing percentage of healthy survival plants, Vitavax-Thiram followed by Rhizolex-T recorded the highest effect in reducing damping-off wilt and root rot of peanut under greenhouse and field conditions.

This study clearly showed that there is no clear differences between the efficacy of growth regulators and fungicides effect in reducing peanut root rot diseases especially with the damage effect of fungicides on the environment.

INTRODUCTION

Damping – off, wilt and root rot diseases are among the most destructive diseases attacking peanut in Egypt (Yehia *et al.,* 1979). The damage of these diseases not only lies in affecting the yield, quantitatively infestation with causal pathogens year after year consequently, growing peanuts in these soil becomes unprofitable (Yehia *et al.,* 1979, Al-Ahmer *et al.,* 1989 and Hassan and Frederick, 1995). These diseases also affect plant stand in the field (Fancelli and kimati, 1986 and Sharma and Bhowmik, 1986) plant growth, seed yield and seed oil content (Zayed *et al.,* 1986, Sharma and Bhowmik, 1986 and 1987 and Hilal *et al.,* 1990).

The role of plant growth regulators in plant diseases is not clearly identified. There is increasing evidence that both the pathogen and the host have the capacity to synthesize various plant growth regulators (Singh *et al.,* 1997 and El-Masri *et al.,* 2002). On the other hand, many authors studied the effect of growth regulators on linear growth, sporulation and sclerotial formation of pathogens and they stated that, auxins such as IAA, IBA and NAA are a potential antifungal (Nakamura *et al.*, 1978, Tomita *et al.*, 1984, Michniewicz and Rozej, 1988 and Khalifa, 2003). Marei, (2000) reported that, all growth substances tested greatly reduced peanut pod rots caused by *M. phaseolina, Fusarium* spp., *S. rolfsii, R. solani, Aspergillus* spp. In all growth substances, apparently healthy pod was increased, parallel and proportional with increasing concentration. Spraying peanut with growth regulators (IAA, GA_3 and CCC) significantly reduced leaf spots; root and pod rot diseases compared to untreated control in both successive seasons (Khalil, 2002).

Several reports indicated the efficiency of fungicides in reducing peanut root rot and wilt (El-Deeb *et al.*, 1985, Barnes *et al.*, 1990 and Mahrous, *et al.*, 1993). Benlate markedly decreased disease incidence of peanut wilt and root rot when used as seed treatment (Saleh, 1997). El-Deeb and Ibrahim (1998) recorded that, using seed dressing fungicides significantly decreased pre- and post emergence damping–off and pod rot diseases. Rizolex–T and Vitavax–Thiram gave the highest percentage of healthy survival plants. Rizolex-T (50%) was the best fungicide in reducing peanut root rot and wilt in both seasons, under greenhouse and field experiments (El-Wakil and Ghonim, 2000). While El-Deeb *et al.*, (2002) showed that, peanut root rot was as low as 8.24% in greenhouse and 6.67% in field under fungicidal seed treatment (Rizolex–T, Vitavax– Thiram and Topsin–M 70) compared to 14.94% and 11.33% with the alternative compounds (Plantguard, Rizo–N and Saponin).

The aim of this research is an attempt to study the effect of growth regulators in reducing peanut root rot diseases and compared to treatment with fungicides.

MATERIAL AND METHODS

1. Isolation and purification of the causal organism (s):

Peanut plants showing symptoms of root rot disease were collected from different locations namely Beni-Suef, Giza, Ismailia and Nobaria. The infected roots were washed thoroughly with tap water, cut into small pieces (1 cm.) each surface disinfested with sodium hypochlorite 2 % for two min., re- washed several times with sterilized water, dried between folds of sterilized filter paper, and were placed onto potato dextrose agar plates (PDA) supplemented with streptomycin-sulfate (100 µg/ml). Petri dishes were incubated at 28°C for five days. The growing fungi were purified using the hyphal-tip and single spore techniques (Brown, 1924 and Hawker, 1960)

2. Identification of causal organism (s):

Identification of the isolated fungi was carried out based on taxonomic criteria for these fungi as described by Barentt and Hunter (1977) for the genera of imperfect fungi, Ellis (1976) for *Macrophomina phaseolina*, Booth (1977) for *Fusarium* spp. Maren and Johan (1988) for *Aspergillus* spp. and Sneh *et al.*, (1992) for *Rhizoctonia solani.*

3. Preparation of fungal inoculum:

Inocula of isolates of *F. solani*, *F. oxysporium*, *M. phaseolina*, *R. solani*, *Sclerotium rolfsii* were prepared using sorghum - coarse sand - water (2:1:2 v/v) medium. The ingredients were mixed, bottled and autoclaved for 2 hours at 1.5 air pressure. The sterilized medium was inoculated using agar discs, obtained from the periphery of 5-day-old colony of each of the isolated fungi. The inoculated media were incubated at 28°C for 15 days and were then used for soil infestation.

4. Soil Infestation:

Inoculum of each isolate of *F. solani, F. oxysporium, M. phaseolina, R. solani* and *S. rolfsii* was mixed thoroughly with the soil surface of each pot, at the rate of 2% w/w , and was covered with a thin layer of sterilized soil. The infested pots were irrigated and kept for 7 days before sowing.

5. Disease assessment

Disease assessment was recorded as percentage of damping-off (pre- and post emergence) after 15 days from planting using the following formula =

$$\textbf{\% damping - off} = \frac{\textbf{pre-emergence + post emergence}}{\textbf{No. of planted seeds}} \times 100$$

The wilted plants and root rot plants were recorded after 45 days and during the harvest time, healthy survival plants were recorded using the following formula:

% Healthy survival plants =

100 - (% damping-off + % wilted plants + % root rot plants)

6. Effect of growth regulators as inducer resistance:

These experiments were carried out to evaluate the efficiency of three growth regulators, *i.e.* Gibberellic acid 92% ["GA3", Berelex tablets, Imperical Industries Plc, plant protection division (ICI), England], Indole butyric acid 99% ["IBA" Aldrich chemical Company, England] and Cicocel 40% ["CCC" Aldrich chemical company, England] against peanut root rot and wilt under artificial inoculation in greenhouse conditions and natural infested field.

6.1. Greenhouse experiment:

Each growth regulators were used as soaking treatment, at three different concentrations 50, 100 and 200 ppm. Peanut seeds, cv. Giza 5, were soaked for 4 hours in each tested concentration of the above mentioned growth regulators. The wetted seeds were left in air cabinet for 24 hours before sowing. Treated seeds were sown in pots (50 cm diam) filled with soil previously infested with the pathogenic fungi. Ten seeds were sown per each pot and untreated seeds were soaked in sterilized water and were sown as control. Five replicates were used for each treatment. Disease incidences were determined as previously mentioned.

6.2. Field experiment:

Treated peanut seeds, with various growth regulators were sown in the field on the first week of May during seasons 2003 and

2004. The experiment was arranged in completely randomized block design with four replicates. Disease assessments were recorded as shown before.

7. Effect of some fungicides and chemicals biocides:

The effectiveness of some fungicides namely Benlate, Noblight, Rhizolex-T, Vitavax, (Table A) and two chemicals biocides (Plantaguard and Rhizo-N) were evaluated under artificial inoculation under greenhouse conditions and naturally infested soil in the field .

7.1. Greenhouse experiment:

Peanut cv. Giza 5 seeds treated as seed dressing with the fungicides Benlate 50 %, Rhizolex-T 50%, Vitavax-T 75% and Noblight 50% at the rate of 3g/kg seed (Table A) or the commercial biocides Plantguard (Trichoderma spp. 3×10^6 spore/ml) and Rhizo-N (*Bacillus subtillis* 3×10^6 c.f.u/ml) at the rate of 5 ml and 5g/kg seed, respectively. The desired amount of each fungicide or biocide was thoroughly mixed with peanut seeds in plastic bags with Arabic gum solution (1%) as sticker and shacked for 10 min. to insure uniform coverage of seed with the tested compounds. Treated seeds were then allowed to dry for 24 hours before sowing. Seeds treated with Arabic gum solution were used as control.

Table (A): Fungicides used their active ingredient, common name, chemical constitutions, method and rate of application.

Fungicides, (Manufacture), and Active ingredient	Common or trade name	Chemical composition	Method of application	Rate of application
Benlate, (Du Pont Co., France), 50% W.P.	Benomyl	Methyl-1-(butylcarbamoyl)-2-benzimidazole-carbanate	Seed dressing	3 g/kg seed
Rizolex-T, (Sumitaomo Chemical Co., LTD Osaka Japan), 50% W.P.	Tolclofos-methyl 20% + thiram 30%	1-o-(2,6-dichloro-4-methyl-phenyl-o, o-dimethyl-phosphorothioate + thiram (30%)-Bis-(dimethyl-thio-carbamoyl)-disulphide	Seed dressing and soil treatment	3 g/kg seed 2 kg/fed
Vitavax-T, (Uniroyal England), 75%	Carathin 37.5% and thiram 37.5%	5,6-dihydro-2-methyl-N-phenyl-1,4-oxathiin-3-carboxyamide-Bis-(dimethyl-thio-carbamoyl)-disulphide	Seed dressing and soil treatment	3 g/kg seed 2 kg/fed.
No-Blight, (Kafr El- Ziat Co., Egypt), 50% W.P.	Thiram	Bis-(dimethyl-thio-carbamoyl)-disulphide	Seed dressing	4 g/kg seed

Any of the treated and untreated peanut seeds were sown in pots containing soil infested with mixture of pathogenic fungi at the rate of 10 seeds/pot, five pots were used for each treatment. Disease assessments were carried out as previously mentioned.

7.2. Field experiment:

Treated peanut seeds, with several fungicides (Benlate 50 %, Rhizolex-T 50%, Vitavax-T 75% and Noblight 50% at the rate of 3g/kg seed) and commercial biocides (Plantguard and Rhizo-N at the rate of 5 ml and 5g/kg seed, respectively) were sown in the field on the first week of May during seasons 2003 and 2004. The experiment was arranged in completely randomized block design with four replicates. Disease assessments were recorded as shown before.

8. Statistical analysis:

The data were statistically analyzed by analysis of variance (ANOVA) using the statistical Analysis System (SAS Institute, inc, 1996). Means were separated by Duncan's Multiple Range Test at $P \leq 0.05$ levels.

RESULTS

1. Effect of growth regulators:

These experiments were carried out to evaluate the efficiency of three growth regulators, Indole Butyric acid (IBA), Cicocel (CCC) and Gibbrellic acid (GA_3) at three different concentrations against peanut damping-off, wilt and root rot under artificial soil infestaion in the greenhouse and in natural infested field.

1.1. Under greenhouse conditions:

Data presented in Table (1) showed that, there was a significant effect of all growth regulators at their tested concentrations in reducing percentage of all studied disease parameters and consequently increasing percentage of healthy survival plants. Indole Butyric acid (IBA) followed by Cycocel (CCC) at 200 ppm were the most effective treatments in reducing peanut infections with damping-off, wilt and root rot diseases. While treatment with Gibbrellic acid (GA_3) at 200 ppm recorded the highest damping-off, wilt and root rot infection of peanut compared to other treatments. In general IBA followed by CCC at 200 ppm gave the highest percentage of healthy survival plants.

Data showed the relationship between increasing the concentration of growth regulators and their effect on the incidence of the studied parameters of the disease. Data clearly indicated that, increasing concentration of IBA and CCC caused an increase in their reducing efficiency of damping-off, wilt and root rot incidence. On the other hand increasing the concentration of GA_3 up to 100 ppm led to increase the incidence of damping-off, wilt and root rot.

Table(1):Effect of growth regulators, as seed soaking treatment, on damping-off,wilt,and root rot of peanut cv.Giza 5 under greenhouse conditions in artificially infested soil [x)].

Growth regulators	Conc. (ppm.)	Disease incidence (%)			Survival (%)
		Damping-off	Wilt	Root rot	
CCC [y)]	50	20 cd [z)]	8 dc	18 b	54 e
	100	18 ed	6 d	10 ed	66 c
	200	16 e	6 d	8 e	70 b
GA_3	50	22 bc	10 c	18 b	50 f
	100	20 cd	8 dc	16 bc	56 e
	200	24 b	14 b	18 b	44 g
IBA	50	18 ed	8 dc	12 d	62 d
	100	14 e	6 d	10 ed	70 b
	200	10 f	4 d	8 e	78 a
Control		28 a	18 a	20 a	34 h

x) Soil in each pot was infested with a mixture of pathogenic fungi at the rate of 2% (w/w).

y) Growth regulators were used as seed soaking treatment for 4 hrs. before sowing.

z) Means in each column with the same letter are not significantly different according to Duncan's Multiple Range Test (P = 0.05).

1.2. Under field conditions:

Data presented in Tables (2) indicated that, all tested growth regulators clearly affected the incidence of damping-off, wilt and root rot diseases and there was a significant decrease in disease parameters compared to control during the two growing seasons (2003 and 2004) except, gibbrellic acid at 200 ppm while had no effect on the incidence of peanut root rot. Indole butyric acid at 200 ppm was the best treatment in reducing damping-off and wilt, while Cicocel at 200 ppm was the most effective treatment in reducing peanut root rot during the two growing seasons 2003 and 2004.Indol butyric acid followed by Cicocel at 200 ppm gave the highest percentage of healthy survival plants compared to other treatments in both seasons. In general, gibbrelic acid at the three different concentrations gave the lowest effect on the incidence of the three disease parameters and gave the lowest percentage of healthy survival plants compared to other growth regulators at the same concentration.

Data also indicated that there were positive relationship between increasing the concentration of IBA and CCC and their effect on incidence of damping-off, wilt and peanut root rot diseases. This relationship differed in the case of GA_3 when its concentration was increased up to 100 ppm, where the incidence of the diseases parameters increased.

Regarding the effect of growth regulators at different concentrations on the total pod yield, data indicated that, all tested growth regulators showed significant increase in total pod yield compared to control during the two growing seasons. Indole butyric acid at 200 ppm gave the highest total peanut pod yield compared to the other treatments in both seasons (Tables 2).

Table (2): Effect of growth regulators, as seed soaking treatment, on damping-off, wilt, and root rot of peanut cv. Giza 5 under field conditions during season 2003 x).

Growth regulators[x)]	Conc. (ppm.)	Disease incidence (%)			Survival (%)	Pod yield (kg/fed.)
		Damping-off	Wilt	Root rot		
Season 2003						
CCC	50	15.11 bc [z)]	6.78 bcd	8.00 cd	70.11 ef	1194.7 cd
	100	12.71 cd	4.91 def	5.95 cde	76.43 cd	1200.0 c
	200	10.41 de	3.50 fg	4.08 e	82.01 ab	1187.7 d
GA_3	50	18.61 a	8.28 bc	9.00 bc	64.11 gh	1134.0 e
	100	13.41 cd	6.19 cde	12.17 ab	68.23 fg	1184.7 d
	200	17.21 ab	8.62 b	13.77 a	60.40 h	1205.3 c
IBA	50	13.91 c	5.11 def	7.47 cd	73.51 de	1196.0 cd
	100	9.13 ef	4.41 efg	7.06 cde	79.40 bc	1278.0 b
	200	6.51 f	2.11 g	5.65 de	85.73 a	1371.3 a
Control		20.41 a	12.43 a	13.56 ab	53.60 i	1021.3 g
Season 2004						
CCC	50	17.21 bc	8.17 b	11.31 bc	63.31 fe	1178.3 de
	100	15.31 cd	6.57 bcd	7.41 de	70.71 d	1195.4 c
	200	13.20 de	3.41 fe	3.78 f	79.61 b	1161.2 e
GA_3	50	20.01 ab	8.11 b	11.55 bc	60.33 fg	1122.3 gh
	100	16.31 c	6.01 bcd	12.65 ab	64.83 e	1142.5 f
	200	18.00 bc	7.91 bc	14.78 a	59.31 g	1191.5 c
IBA	50	15.11 cd	5.33 cde	9.73 cd	69.83 d	1182.2 cd
	100	11.11 ef	5.31 de	8.28 de	75.30 c	1218.1 b
	200	8.31 f	2.40 f	6.38 e	82.91 a	1268.5 a
Control		22.70 a	12.71 a	13.68 ab	50.91 h	990.7 h

x) Four replicates were used for each treatment; the area of field plot was 10.5 m2.
y) Growth regulators were used as seed soaking treatment for 4 hr. before sowing.
z) Means in each column with the same letter are not significantly different according to Duncan's Multiple Range Test (P = 0.05).

2. Effect of seed treatment with some different fungicides and biocides against damping-off, wilt and root rot:

Four fungicides and two commercial biocides were used as seed treatment before sowing in artificially infested soil with pathogenic fungi under greenhouse conditions and in natural infested soil under field conditions during the two growing seasons 2003 and 2004.

2.1. Under greenhouse conditions:

Data presented in Table (4) indicated that, Vitavax had high significant effect in reducing damping-off, wilt and root rot diseases of peanut compared to the other treatments. Moreover it recorded the highest percentage of healthy survival plants. On the contrary Rhizo-N and Benlate recorded the highest percentage of infections regarding damping-off, wilt and root rot diseases, also they gave the lowest percentage of healthy survival plants compared to the other treatments.

Concerning the effect of treating peanut seeds with different fungicides and commercial biocides on percentage of damping-off, wilt and root rot of peanut plants grown under greenhouse and field conditions, there was a clear effect of all tested fungicides and commercial biocides in reducing percentage of all parameters of disease incidence and consequently increasing percentage of healthy survival plants. This is in agreement with Hassan and Federick, (1995) who stated that, peanut seed generally requires treatment with fungicides to assure an adequate plant stand in the field. Results also showed that, the most effective fungicide was Vitavax-Thiram followed by Rhizolex-T. Similar findings were obtained by El-Deeb and Ibrahim (1998), El-Wakil and Ghonim, (2000), Abdel-Ghany, (2001) and El-Deeb *et al.*, (2002).

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تأثير منظمات النمو على مكافحة أمراض أعفان الجذور في الفول السوداني ومقارنتها بالمعاملة بالمبيدات.

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أجريت هذة الدراسة تحت ظروف العدوي الصناعية بالصوبة والعدوي الطبيعية بالحقل خلال موسمي ٢٠٠٣ و ٢٠٠٤ لتقدير مدي تأثير منظمات النمو حمض الأندول بيوتيريك و السيكوسيل و حمض الجبريلليك عند تركيز ٥٠و١٠٠و٢٠٠ جزء في المليون علي أمراض أعفان جذور الفول السوداني ومقارنة تأثيرها بتأثير المعاملة بالمبيدات. هذا وقد أعطت كل منظمات النمو المختبرة قدرة علي خفض الإصابة بموت البادرات و أعفان الجذور والذبول في الفول السوداني وزيادة نسبة النباتات السليمة سواء في تجارب الصوبة أو الحقل، وكان حمض الأندول بيوتيريك و السيكوسيل عند تركيز ٢٠٠ جزء في المليون هم الأكثر تأثيرا في خفض نسبة الإصابة بموت البادرات و أعفان الجذور والذبول في الفول السوداني بينما حمض الجبريلليك عند تركيز ٢٠٠ جزء في المليون كان الأقل تأثيرا في خفض نسبة الإصابة.وقد أوضحت الدراسة أن هناك علاقة إيجابية بين زيادة تركيز كلا من حمض الأندول بيوتيريك و السيكوسيل وزيادة تأثيرهم في خفض نسبة الإصابة بموت البادرات و أعفان الجذور والذبول في الفول السوداني بينما كانت هذه العلاقة سلبية عند زيادة تركيز حمض الجبريلليك. أظهرت كل المبيدات الكيماوية والحيوية المختبرة قدرة علي خفض الإصابة بموت البادرات و أعفان الجذور والذبول في الفول السوداني وزيادة نسبة من النباتات السليمة، وقد سجل كلا من الفيتافكس- ثيرام و ريزولكس- ت أقل نسبة إصابة بموت البادرات و أعفان الجذور والذبول في الفول السوداني سواء في تحارب الصوبة أو الحقل.

وقد أظهرت الدراسة أنه ليس هناك فرق واضح بين تأثير كلا من منظمات النمو والمبيدات علي خفض الإصابة بأمراض أعفان الجذور في الفول السوداني خاصة في ظل وجود الأثر الضار للمبيدات علي البيئة.