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EFFECT OF PACLOBUTRAZOL ON GROWTH, YIELD AND ANATOMICAL STRUCTURE OF PEANUT PLANT INFECTED WITH POD ROT PATHOGENS

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ABSTRACT

The effects of paclobutrazol (PBZ) on growth, yield and anatomical structure of peanut plant infected with pod rot pathogens were investigated. Treatments with PBZ at 250 and 500 ppm decreased plant height but increased shoot dry weight, number of branches and pegs per plant, 100 pod weight (g) and 100 seed weight (g). Soil infested with either *Fusarium solani* or *Rhizoctonia solani* reduced all above mentioned parameters. *R. solani* was more virulent than *F. solani* on plant growth and yield. Treatment with PBZ at 250 and 500 ppm partially reduced the injurious effect of soil infested with either *F. solani* or *R. solani.* PBZ at high concentration (500 ppm) was more effective in this respect.

Anatomically, the most striking anatomical changes occurred in the infected stems and carpophore with *R. Solani* are complete destruction of the epidermis, severe plasmolysis in the cortex followed by hydrolysis or dissolution of cell components and degradation of the primary cell walls leading to cell separation and some area of cortex tissue. In addition, dissolution and degradation of cell components accompanied with breakdown and separation were found in some regions of pod shell and the cotyledons.

Key words*:* Anatomy, Paclobutrazol, *Arachis hypogaea* L*, F. solani, R. solani*

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is one of the most important crops grown successfully in sandy soil in Egypt. Most of peanut production is currently used for human consumption that sold as raw shelled pods or roasted seeds and used in confection industry.

The most damaging soil borne disease attack peanut crop in Egypt is pod rot caused by *Rhizoctonia solani* (Kühn) and/or *Fusarium solani* (Mart.). In Egypt, no commercial cultivar of peanut has a high level of resistance to pod rot disease (El-Wakil *et al*., 1984 and Saleh; 1997). Therefore, peanut crop requires intensive management because of the crop's vulnerability to yield losses caused by plant diseases. *R. solani* causes several disease symptoms such as seed decay, seedling damping-off; hypocotyl necrosis; peg rot; pod rot and limb rot. *F. solani* is commonly isolated from root tissues, seed and pod shells. It causes seedling stunt; tap root rot; peg lesions; pod blight; pod rot and slow wilting in adult stage of plant. (Abd EL-Al ,1973; Abu-Arrkub, 1973; Garcia and Mitchel 1975; Porter *et al.,* 1990; Saleh; 1997). Also, pod rot disease complex caused by *R. solani* and/or *F. solani* is associated with marked anatomical changes in all plant organs. These fungi may enter directly through the epidermis and/or stomata and its penetration

occurs mostly through enter-and entracellular (Lawrence *et al*., 1981; Brammal and Higgins, 1987; and EL-Samra *et al*., 1994).

In the world, growth regulators and chemicals play a major role in pest management strategies for peanut production due to limited availability of acceptable alternatives (Phipps *et al.,* 1997). Recently, attempts have been made to use growth regulator substances not only to increase yield but also to control or to minimize the damage and loss caused by plant pathogens (Breneman and Sumner, 1994; Fauzi and paulitz 1994). Previous studies reported by Fouda & Salama (1998) indicated that growth regulators modify peanut growth and increase its yield.

Recently, several triazole derivatives had been developed and used as plant growth regulators or fungicides that control fungal plant diseases (Fletcher *et al*., 1986, Fletcher and Hofstra, 1990 and Brenneman & Sumner, 1994)

Owing to the importance of peanut crop in Egypt, the present investigation aimed to study the possibility of improving peanut growth and yield through controlling two soil-borne fungal pathogens using paclobutrazol. From the anatomical point of view, it was necessary to investigate the modifications occurred in certain plant organs affected by fungal infection under investigation.

MATERIALS AND METHODS

Experimental design

Field experiments were conducted in the research Farm of Plant Pathology Department at the Faculty of Agriculture, Mansoura University during two successive summer seasons of 1997 and 1998. The land was prepared by using additional amounts of sand then plowed to be loamy sand (1:1, v/v)in both growing seasons. The land had not been previously planted with peanut and there was no peanut cultivation in the region. The experiments were designed as randomized complete blocks replicated three times. Each plot included 5 rows of 60-cm width and 4 m length. Plots were separated from each other by fallow border area about 1-m. The plots were located in a different area of the same field each year to avoid problems caused by repeating planting in the same area. On 25 May of both 1997 and 1998 growing seasons, peanut seeds of Giza 5 cultivar were treated with 0.1% sodium hypochlorite for 3 min and washed in sterilized water, then sown in row ridges at 40-cm distances between hills. Each experiment included eight treatments consisting of two levels i.e, 250 and 500 ppm of Paclobutrazol (PBZ) combined with two treatments of infested soil with either *F. solani* or *R. solani.* Non combined treatments included each level of PBZ and each pathogen alone. Control treatment was non-sprayed plants with PBZ grown in non-infested soil. The cultural practices of peanut crop production were followed according to the Ministry of Agriculture instructions. Data were subjected to analysis of variance (ANOVA) using a Costat program (1990) in an IBM PC/AT computer and means were compared using Duncan's multiple range tests.

Inoculum preparation and soil infestation

Cultures of *Fusarium solani* (Mart.) and *Rhizoctonia solani* (Kuhn), were isolated originally from infected seeds and lower stem of peanut plants collected from fields at EL-Ismailia province, Egypt. Pure inoculum of each fungus was produced in 250-ml glass bottles contained autoclaved natural medium that composed of crushed peanut seeds and pod shells. The medium was inoculated with 9-mm-diameter mycelial disks of *F. solani* or *R. solani*. The bottles with inoculated medium of each fungus were incubated at 22±2°C for two weeks. Mixture of sterile sand and inoculum of each fungus (2:1, v/v) was used in soil infestation. Ten grams of sand and inoculum mixture were placed 5 cm deep of rhizosphere of each plant after 2 weeks of planting, The inoculum concentration was $2x10^4$ conidia for *F. solani* or mixture of 50 sclerotia (approx.) plus mycelium for *R. solani*. Uninfested control plants received 10 g of sterile sand only without inoculum.

Paclobutrazol treatments

The plants were sprayed till dripping after one month from sowing with Paclobutrazol, (2RS, 3RS) -1-(4 –chlorophenyl) – 4,4 – dimethyl – 2 -(1H-1, 2 , 4 – triazol -1-yl)-Penta n-3-ol] solution mixed with 5 drops of tween 20 per liter as spreading agent. Two levels, 250 and 500 ppm of the substance were used in addition to distilled water as a control

Evaluation of plant growth and yield

At the end of the growing season (about 150 days after planting), plants were dug up by hand. The following characters were determined for each treatment, plant height, shoot dry weight, number of branches, number of pegs, pod and seed number per plant, and weight of 100 pods and 100 seeds.

Assessment of disease incidence

At harvest plants of each plot were separated into healthy and diseased groups. Diseased plants were evaluated visually for disease incidence with either *F. solani or R. solani.* The percentage of disease incidence was recorded using the following formula:

Disease incidence % = (A – B) / A x 100

Where, A= Number of healthy plants produced from planting in soil free of pathogen. B= Number of healthy plants produced from planting in soil infested with pathogen.

Anatomical studies

Specimens were taken at harvest from the basal portion of stem at the first internode, carpophore, peg, pod shell and seed represented healthy and infected plants with *R. Solani*. The samples were fixed in FAA solution, dehydrated in alcohol series followed by xylene for clearing and embedded in paraffin wax (52-54 C m p). Cross sections at 12-15 μm thick were prepared using rotary microtome, stained in saffranin-light green combination, cleared in clove oil and mounted in Canada balsam (Gerlach, 1977) and examined microscopically

RESULTS AND DISCUSSION

(A) Evaluation of growth and yield characters

Data presented in Table 1, indicate that treatment with PBZ at 250 and 500 ppm increased all growth characters expressed by shoot dry weight, number of branches and pegs per plant, but decreased significantly plant height. With regard to yield characters, Table (2) shows that treatment with PBZ also increased number of pods and seeds per plant, 100 pods weight (g) and 100 seeds weight (g). PBZ at high concentration (500 ppm) was the most effective treatment in this respect. On the other hand, soil infested with either *F. solani* or *R. solani* reduced all the above mentioned growth and yield parameters. *R. solani* was more virulent than *F. solani* on plant growth and yield of peanut plants grown in infested soil (Fig. 1). It is also clear that, treatments with PBZ, 250 and 500 ppm partially reduced the injurious effect of soil infested with either *F. solani* or *R. solani.* It was improved also both pod and seed yield. PBZ at high concentration (500 ppm) was more effective in this respect.

The retardant effect of PBZ on reducing plant height and increasing number of branches may be attributed to the reduction in internode length (Lecain *et al*., 1986). Also, it causes an inhibition or an interference with the biosynthesis of gibberllic acid by blocking the oxidation of kaurene to kaurenoic acid (Wang and Dunlap, 1994). In addition, PBZ tends to reduce the synthesis and action of auxin in plants through enhancing the activity of IAA oxidase and peroxidase as well as reducing the rate of transformation of treptophan into IAA (Imam *et al.,* 1995 and Wang *et al.,* 1998). The reduction in plant growth and yield due to infection occurred by either *F. solani* or *R. solani* may be attributed to killing and damage of the root system that reduced absorption surface and uptake of essential nutrients and water (Porter *et al.,* 1990), as well as, reduction in the supply of cytokinins and gibberellins translocated to shoots (Burrows and carr, 1969). In addition, infection with these fungi cause chlorosis of leaves (Saleh, 1997), leading to reduction in photosynthic capacity and net photosynthesis. Also, the results of this study demonstrated that these fungi reduced number of branches and pegs per plant (Table 1 and 2). The role of PBZ on reducing the pod and root rot disease and improving the yield may be attributed to the inhibition of ergestrol biosynthesis and blocking C-14 demethylation reaction in fungi (Fletcher *et al.,* 1986 and Fletcher & Hofstra, 1990). Also, PBZ as growth regulator stimulated plants to increase number of branches and pegs as indicated in Tables (1) and (2). In addition, other researchers reported that PBZ increased cytokinin content in plants (Izumi *et al.,* 1988). Cytokinins are known to delay chlorophyll destruction and senescence (Dalziel and Lawrence, 1984), as well as, accelerate the translocation of C-14 assimilated to storage parts (Mauk *et al.,* 1986).

Table 1: Effect of Paclobutrazol on peanut plant growth as influenced by *Fusarium solani* or *Rhizoctonia solani* infection during the two growing seasons 1997 and 1998.

Treatments	Plant height (cm.)		Shoot dry Weight (g)		Branches No./plant		Pegs No./ plant	
	1997	1998	1997	1998	1997	1998	1997	1998
Control	70 a[Y]	72 a	29.8 a	33.3 c	19.0 d	21 0 e	17 d	18 c
PBZ 250	42 b	45 b	28.5 a	39.4 b	26.3 b	33 0 b	24 b	30 a
PBZ 250 + *F. solani*	41 bc	39 bc	20.5 bc	26.3 e	25.0 c	28 0 cd	20 c	26 b
PBZ 250+*R. solani*	38 c	35 cd	19.6 bc	25.5 e	23.0 c	26 0 d	19 c	23 b
PBZ 500	32 d	29 d	30.6 a	41.7 a	30.0 a	36 0 a	28 a	32 a
PBZ 500 +*F. solani*	28 e	29 d	20.8 bc	28.3 d	29.7 ab	30.3 c	26 ab	25 b
PBZ 500 + *R. solani*	26 e	29 d	18.7 c	25.2 e	29.0 ab	29.3 c	25 ab	24 b
F. solani	71 a	70 a	21.4 b	22.5 f	14.0 e	19.0 e	15 d	15 c
R. solani	68 a	69 a	20.9 bc	20.8 f	12.7 e	20.0 e	14 d	16 d

[X] **Treatments include two conc. (250 and 500 ppm) of Paclobutrazol (PBZ), combined with *F.solani* (F) or *R.solani (*R).**

[Y] **Means followed by the same letter within each column are not significantly different (*P*= 0.05) according to Duncan's multiple range test.**

Table 2: Effect of Paclobutrazol on peanut yield as influenced by *Fusarium solani* or *Rhizctonia solani* infection during the two growing seasons 1997 and 1998.

Treatments	Pods No. / plant		Seeds No. / plant		100 pods weight (g)		100 seeds weight (g)	
	1997	1998	1997	1998	1997	1998	1997	1998
Control	18 c[Y]	22 d	37.0 e	34.0 c	192 f	212 e	78.8 e	81.2 d
PBZ 250	24 ab	30 b	43.0 bc	45.0 a	216 b	230 b	87.8 b	91.2 b
PBZ 250 + *F. solani*	23 ab	26 c	38.0 de	40.0 b	202 e	210 ef	84.3 c	89.3 b
PBZ 250+*R. solani*	22 b	26 c	41.0 cd	42.0 ab	208 d	208 f	80.5 de	85.1 c
PBZ 500	25 a	35 a	48.0 a	46.0 a	230 a	233 a	94.9 a	95.2 a
PBZ 500 +*F. solani*	24 ab	32 ab	45.7 ab	43.0 ab	214 bc	220 c	88.3 b	80.3 d
PBZ 500 + *R. solani*	22 b	33 ab	43.0 bc	45.0 a	212 c	216 d	82.3 cd	88.3 b
F. solani	18 c	18 e	30.0 f	29.3 d	119 g	161 g	59.4 f	53.5 e
R. solani	16 c	15 e	32.0 f	30.7 cd	116 g	154 h	46.4 g	55.8 e

[X] **Treatments include two conc. (250 and 500 ppm) of Paclobutrazol (PBZ), combined with *F.solani* (F) or *R.solani (*R).**

[Y] **Means followed by the same letter within each column are not significantly different (*P*= 0.05) according to Duncan's multiple range test.**

(B) Assessment of disease incidence

The typical disease symptoms appeared as necrotic lesions on pegs, carpophore, pod and seed were observed in plants grown in infested pots. Also, severe infection of pod decay, root rot, lower stem rot, wilt and subsequent plant death was started from early flower stage till maturity stage. Significant differences (p=0.05) were found among treatments of PBZ,

infested soil and their interaction for pod rot disease incidence in 1997 and 1998 (Fig. 1). In general, all peanut plants grown in infested soil with either *F. solani* or *R. solani* were infected and exhibited variable degrees of disease incidence. There was significant (p=0.05) reduction in disease incidence in field plots infested with each fungus and treated with paclobutrazol. Moreover, within treatments of interaction between BPZ and each pathogen, the highest reduction of the fungal infection and disease incidence was found in plants grown in the infested plots and received 500 ppm of BPZ followed by 250 ppm level.

In the present investigation, paclobutrazol inhibited growth and development of *R. solani* and *F. solani* at relatively low concentrations (250 – 500 ppm). The Fungicidal effect of paclobutrazol is due to an inhibition and blocking of ergestrol biosynthesis in fungi. Ergestrol is essential for maintenance of fungal membrane structure, and without it the physical stability of membranes, as well as, the activity of membrane bound enzymes can be affected adversely (Brenneman, 1991). Similar work had been reported on ergestrol biosynthesis inhibition by Hancock and Weete, (1985) they reported that low concentration (0.15ug/ml) inhibited growth of *Cercosporidium personatum* in peanut.

Also, PBZ increased activity of antioxidant enzymes that protect cell organelles from oxidative damage (Sankhla *et al.,* 1992) and increased Ca^{++} content in cell walls to be more resistant against fungal invasion (Bateman, 1964)

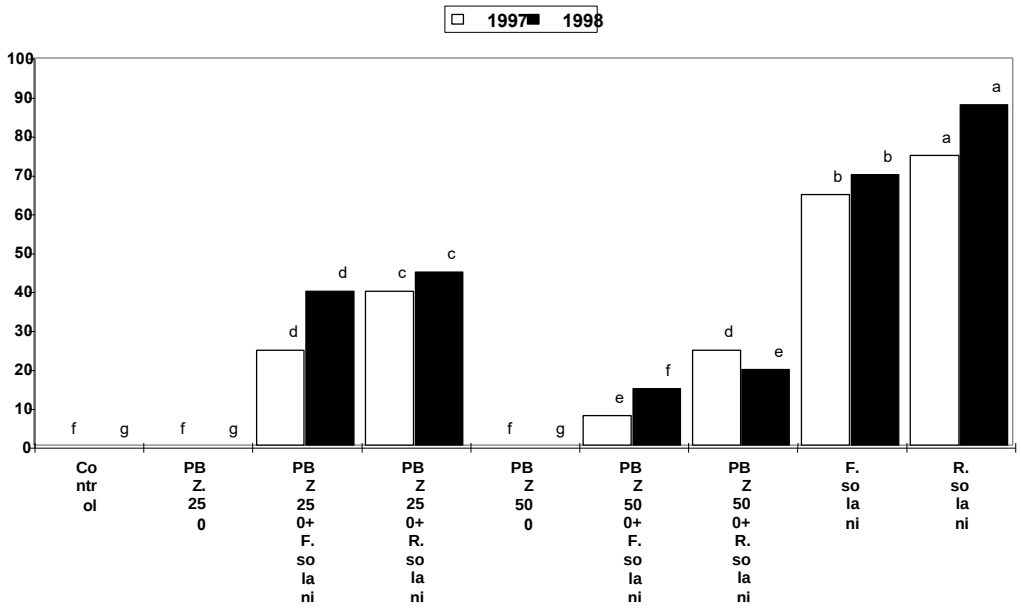

Fig. 1: Disease incidence of peanut pod rot disease as influenced by paclobutrazol applications at two concentrations; 250 and 500 ppm in field plots infested with either *F. solani* or *R. solani* during 1997and 1998 growing seasons.

(C) Anatomical structure

1 - stem structure

The structure of stem from normal peanut plants showed well-formed structures of wide cortex tissue, wide inter-vascular cambial region, vascular bundles are arranged in a complete cylinder and two types of large and small collateral bundles. (Fig.2-A). Clear differences of stem structures were found among stem sections obtained from normal healthy plants (control); healthy plants treated with PBZ and infected plants with *R. solani.* (Fig. 2, from A to-D). It has been observed that the stems of plant treated with PBZ have thicker epidermis, wider cortex and pith tissues compared with control ones (Fig. 2-B). On the other side, the anatomical structures observed in the cross section of infected stem taken from the basal portion of infected plants showed remarkable differences occurred mainly in epidermis, cortex and pith compared with control (Fig. 2-C). The most striking differences can be summarized as follow; (1) complete destruction of epidermis that exhibited dark brown epidermal surface. (2) The two distinguished zones; hypodermal and inner zone of cortex loss their cell integrity. The cells of hypodermal zone were completely collapsed up to death of their protoplasts and the inner zone cells were severely plasmolysed and their cell walls were observed wrinkled. (3) Along with the above modifications, there were limited phloem fiber groups and complete destruction of the central portion of pith tissue was also observed. In severely infected stem, the fungal infection took place in cortex tissue and extended deeper with time, causing degradation and dissolution of cell components. Moreover, separation in some area of cortex tissue; partial destruction of vascular tissue and accumulation of intercellular material in the cells were observed in cortex tissue (Fig. 2-D). In addition, complete dissolution of all cortex layers and disorganized vascular bundles with the formation of tylosis in the xylem vessel elements leading to closure of these vessels were clearly observed (Fig. 2-E). In this context, Bruckner and Hanna (1990) stated that parenchyma tissues were rapidly degraded by microorganisms than epidermis and lignified vascular tissues.

2- Carpophore structure

Figure (3A), shows that cross section of carpophore from normal peanut plant which is characterized by well formed structures of vascular bundles separately arranged in the vascular cylinder and two types (large and small) collateral bundles. Sections taken from PBZ treated plants had wider cortex and pith tissues as well as larger bundles compared with healthy or infected plants with *R. solani* (Fig. 3-B). Sections made from infected carpophore clearly showed marked differences appeared in the form of complete plasmolysis of cortex tissue and degradation of cell components in the epidermis, cortex and pith tissues leading to separation in some areas of cortex tissue. In addition, examined sections showed hydrolysis of cell components and degradation of the primary cell walls of cortex and pith tissues leading to development of lysigenous cavities (Fig. 3-C). Moreover, hyphae of fungal growth were present in the inter- and intracellular pith tissue (Fig. 3-D).

Fig. 2: Cross sections of peanut stem (Obj. 4X. Oc. 15X) A: Healthy stem, B: Treated with PBZ at 500 ppm, C: Infected stem with *R. Solani* showing complete destruction of epidermis and outer zone of cortex. D and E: severely infected stems showing complete dissolution of all cortex and disorganization of vascular bundles.
E= epidermis; CO= cortex; Phf= phloem fibers; X= xylem; VB= vascular bundle; and Pi= pith.

Fig. 3: Cross sections of peanut carpophore (Obj. 4X. Oc. 15X) A: Healthy carpophore, B: carpophore of plants treated with PBZ at 500 ppm, C: Infected carpophore with *R. Solani* showing degradation of cell components in the epidermis, cortex and pith tissues. D: cross section in the pith tissue showing penetration of fungal hyphae (Obj. 10X. Oc. 15X)
E= epidermis; CO= cortex; phf= Phloem fibers; X= xylem; VB= vascular bundle; Pi= pith; LC= lysigenous cavities and My= mycelium

3- Pod shell (pericarp)

The structure of pericarp was observed in the sections from normal or healthy pod shell as described by Halliburton *et al.* (1975). The exocarp consists of sclerified epidermal and sub-epidermal cell layers; mesocarp and endocarp that include several layers of sclerenchyma cells with an exception that the inner layer of endocarp is parenchymatic (Fig. 4-A). The vascular bundles are located in mesocarp/endocarp inter-face in association with extension sclerenchymatous layers (Fig. 4-B). Examination of section taken from infected pod shell showed complete destruction and death of the exocarp cell layers. Also, partial destruction and development of lysigenous cavities were observed in the parenchyma (Fig. 4-B and 4-C). Dissolution and degradation of cell components were clearly distinguished in severely infected pod shell along with breakdown and separation in some regions of pod shell including the vascular bundles (Fig. 4-D).

4- Seed structure

In Fig. (5-A), the peanut seed is non-endospermous, covered by a thin testa. The epidermal layer of the cotyledon is followed by few aleurone layers. The ground tissue of the cotyledon is formed of parenchyma that contains protein and oil globules (Sundaraj and Thulasidas, 1993). Examination of infected seed sections show complete degradation of testa followed by destruction and dissolution of cell wall and cell components leading to separation of some areas of cotyledons (Fig. 5.B).

The anatomical changes in different plant organs due to fungal infection are associated with changes in parenchymatous cell walls, involving swelling, desintigatration, loss of the fibrillar wall, hydrolysis or dissolution of cell components and eventually maceration of the tissues. Such changes may be attributed to an increase in ethylene production in plants by many kinds of stresses (Kimmerer and Kozlowski, 1982). Ethylene promoted the activity of exo-and endo cellular hydrolytic enzymes i.e., pectinethylestarse, polyglacturonase and cellulase (Huberman and Goren, 1979). An increase in cellulolytic and pectolytic enzymes produced by *R. solani* and *Fusarium* was reported previously by (Baker *et al.,* 1980; Brammall and Higgins, 1987; Kassem *et al.,* 1992 and EL-Samra *et al.,* 1994).

The positive effect of PBZ on reduction of pod and root rot disease may be due to its effect on inhibition of both ethylene biosynthesis (Grossmann, 1990) and ergestrol biosynthesis (Fletcher and Hofstra, 1987). Also, they added that triazole increased epicuticular =wax which acts as protective waxy layer on the surface of the plant organs and decrease the size of stomatal openings. Singh *et al.,* 1980 noted that the outer thick cuticle of plant organs seem to be the barriers to inward movement of fungal mycelium. Moreover, paclobutrazol increased Ca^{++} content in treated plants (Wang *et al.,* 1985). Such increase leads to enhance cell wall resistant to invasion (Bateman, 1964) and inhibits the activity of polyglacturonase (PG) enzyme (Corden, 1965). Also, Cleand *et al.,* 1990, added that Ca^{++} increase the rigidity of plant cell walls by complixing with wall matrix polysaccharides.

Therefore, it could be concluded that paclobutrazol application is recommended for improving growth and yield as well as to control or reduce the pod rot disease of peanut plants.

Fig. 4: Cross sections of peanut pod shell (Obj. 4X. Oc. 15X) A: Healthy pod shell, B, C and D: infected pod shell with *R. Solani* showing partial destruction in exo and mesocarp tissues. D: Severly infected pod shell showing dissolution and degradation of cell components and breakdown.
Ex= exocarp; ME= mesocarp; En= endocarp; and VB= vascular bundle

Fig. 5: Cross sections of peanut seed (Obj. 4X. Oc. 15X) A: Healthy seed, B: Infected seed with *R. Solani* showing destruction and dissolution of cell components and separation of some area of cotyledons.
AL= aleurone layers; T= testa; and COT= cotyledone

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تأثير الباكلوبترازول على النمو ، المحصول والتركيب التشريحى لنباتات الفول السودانى المصابة بمرض عفن القرون

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تم دراسة تأثير **الباكلوبترازول** على النمو، المحصول والتركيب التشريحى لنباتات الفول السودانى المصابة بمرض عفن القرون. وأوضحت النتائج أن المعاملة **بالباكلوبترازول** بتركيزات ٢٥٠ ، ٥٠٠ جزء فى المليون أدت إلى نقص طول النبات بينما أدت إلى زيادة كلا من الوزن الجاف للمجموع الخضرى، عدد الأفرع والإبر لكل نبات وكذلك زيادة وزن المائة قرن والمائة بذرة بالجرام. كما أدت عدوى التربة بفطريات الفيوزاريوم سولانى و الرايزوكتونيا سولانى إلى نقص كل صفات النمو والمحصول السابقة. وكانت عدوى التربة بفطر الرايزوكتونيا سولانى أشد ضررا على النمو والمحصول مقارنة بالعدوى بفطر الفيوزاريوم سولانى. أدت المعاملة **بالباكلوبترازول** بتركيزات ٢٥٠ و ٥٠٠ جزء فى المليون إلى تقليل الأثر الضار على النبات نتيجة لعدوى التربة بفطريات الفيوزاريوم سولانى و الرايزوكتونيا سولانى وكان التركيز الأعلى (٥٠٠) جزء فى المليون أكثر تأثيرا فى هذا المجال.

ومن الناحية التشريحية أدت الإصابة بفطر الريزوكتونيا إلى حدوث تغييرات تشريحية فى أعضاء النبات المختلفة وكانت أهم التغييرات التشريحية فى السيقان والحوامل الكربلية هى حدوث تحطم كامل لنسيج البشرة مع بلزمة شديدة فى نسيج القشرة متبوعة بالتحلل المائى أو ذوبان محتويات الخلايا وتحطم الجدر الابتدائية للخلايا مؤدية إلى إنفصال بعض المساحات فى نسيج القشرة. بالأضافة إلى ذوبان وتحطم محتويات الخلايا وحدوث تحطم وإنفصال فى بعض مناطق القشرة فى القرن وفلقات جنين البذرة.