Minia J. of Agric. Res. & Develop.
Vol. (38), No. 1, pp. 129-142, 2018

FACULTY OF AGRICULTURE

MANAGEMENT OF SOYBEAN ROOT ROT DISEASES USING MICROWAVE THERMOTHERAPY, POTASSIUM SILICATE AND SODIUM BICARBONATE

Noha A. Mohamed[(1)], Haanaa M.M. Hassan[(2)], Mahmoud K.M. Arafa[(1)] and Anwar A. Galal[(2)]

[(1)]Plant Pathology Research Institute, ARC., Giza, Egypt
[(1)]Plant Pathology Dept., Fac Agric., Minia Univ., El-Minia Egypt

Received: 27May (2018)　　　　Accepted: 5June (2018)

ABSTRACT

Soybean root rot diseases were occurred wherever soybean cv. Giza 111 grown among different districts of Assiut and El-Minia Governorates, Egypt. Root rot incidence was varied with different districts and growing seasons. Disease incidence significantly higher in 2015 (10.71%) than 2014 (6.16%). Assiut district recorded the highest district (12.35%) followed by Dermowas (8.65%). Six fungal species belong to five genera, namely *Fusarium solani, F. oxysporum, Macrophomina phaseolina, Rhizoctonia solani, Alternaria* sp., and *Stemphylium* sp. were frequently isolated from root rotted soybean samples. The highest frequency (33.5%) was record by *F. solani* followed by *F. oxysporum* (20%), *R. solani* (18.0%), *M. phaseolina* (17.0%), *Alternaria* sp. (6.0%) and *Stemphylium* (5.5%). Only the tested isolates of *F. soalni, F. oxysporum, M. phaseolina* and *R. solani* were pathogenic.

Microwave electric field radiation (MER), K. silicate (PS) and Na. bicarbonate (SB), were significantly reduced soybean root rot when seeds were treated before planting. In addition, MER treated seeds for 6 sc exposure time and subsequently immersed in PS or SB solution, individually for 12 hr. before planting significantly reduced root rot severity more than single treatment. Since highest reduction was achieved when soybean seeds were MER treated followed by PS treatment, 45.97, 55.61, 60.00 and 62.09% reduction against infection with *F. solani, R. solani, M. phaseolina* and *F. oxysporum*, respectively.

Key words: Soybean, *Glycine max* (Lin) Merril, root rot fungi; microwave electric field radiation; potassium silicate and sodium bicarbonate.

INTRODUCTION

Soybean (*Glycine max* (Lin.) Merril), the "golden bean" is one of the foremost important oil seed crop known for its excellent protein (42.45%), oil (22%) and starch content (21%). It is a good source of vitamin B complex, thiamine and riboflavin. Soybean protein is rich in valuable amino acids like lysine (5%) in which, most of the cereals are deficient. Its oil is the largest component of the world's oils. In spite of phenomenal increase in area and soybean production, its productivity remains low because of lack of quality seeds (Venugopal Rao *et al*., 2015).

Root rot diseases of soybean cultivars are considered the most important diseases that affect plant stand causing great losses in the annual seed yield. Some of these diseases are caused by seed and/or soil borne pathogens such as *Rhizoctonia solani, F. oxysporum, F. solani, Macrophonia phaeolina* and *Fusarium* spp. (Safdar *et al*., 2013). In order to increase the productivity, the leguminous crops should be protected against root rot/wilt disease complex and other diseases as well. Integrated control programs of plant diseases are the most successful and economical means to control diseases, especially when all available pertinent information regarding the crops, its pathogens, the environmental conditions expected to prevail, locality, availability of materials and costs are considered in developing the control program (Paulitz and Baker, 1987 and Abou Zeid *et al*., 2003).

An approach to eradicate seed-borne pathogens is the use of microwave energy (Reddy *et al*., 1998 and Ibrahim *et al*., 2016). Although good control of seed infestation was obtained, the treatments significantly reduced seed germination (Motallebi, 2016). Nowadays, it was possible to obtain better germination of barley or soybean seed, while significantly reducing infection by careful control of absorbed microwave power and gamma radiation. Additionally potassium silicate and sodium bicarbonate had been inflicted to reduce several plant diseases (Turkkan, 2013 and Polanco *etal* 2014).

This work is aimed to evaluate the inorganic salts. K. silicate and Na. bicarbonate, and microwave electric field radiation, as seed treatment to control the soybean root rot under greenhouse conditions.

MATERIALS AND METHODS

1- Survey of soybean root rot diseases:

Pre-, post-emergence damping-off and surviving soybean plants,cv.Giza 111, were recorded 15, 30 and 90 days planting that grown at three different districts belong to Assiut Governorate namely (Manfalout, Abnob and Assiut) and El-Minia Governorate (Dermowas) were surveyed during

2014 and 2015 growing seasons. Three fields of each district were concerned and the diseased seedlings or plants showing typical symptoms of damping-off and root rot were surveyed in the exact location. Sampling sites were determined with a field map, five sampling sites were designated per field tested, one of each of the four corners plus one in the center of the field. Sampling sites were located at least 5 meter from the edge of the field (Ray and Mel-aughlin, 1942). At least 200 planted holes were examined per each sampling site. Only disease incidence (DI) was calculated as follow:

$$(DI) = \frac{\text{Number of root rotted plant}}{\text{No.of total plants}} \times 100$$

2- Frequency of fungi associated with soybean root rot plants:

Root rot samples, were collected from Dermowas, El-Minia Governorate and Manfalout, Abnob and Assiut districts, Assiut Governorate, during 2014 growing season. Infected roots of 15, 30, and 90 days old seedlings or plants were separated, washed thoroughly with running tap water and cut into small segments (2-5 cm) were taken from area infected and healthy tissues, surface sterilized by 2% sodium hypochlorite solution for 3 minutes, then washed several times with sterilized distiller water and placed onto Petri plates containing potato dextrose agar (PDA) medium supplemented with antibiotics penicillin 20 units/plate. The plates were incubated for 5 days at 25°C. Hyphal tip and single spore isolation techniques were carried out to obtain pure cultures of the developed fungi. The established fungal isolates were identified on the basis of culture morphology and microscopic characteristics according to Gilman (1957), Booth (1971) and Barnett and Hunter (1972). Inoculated tested tubes containing slants of PDA medium were incubated at 25°C for 7 days and kept at 5°C as stock cultures of the isolated fungi for further studies.

3- Pathogenicity tests:

The pathogenic properties of the isolated fungi were determined for soybean (*Glycine max* (L.) Merr. cv. Giza 111) seeds. Sterilized clay pots (30 cm in diameter) filled with sterilized loamy soil. Soil sterilized was carried out by drenching with commercial formalin solution (5%), treated soil was covered with polyethylene sheet for one week, and then aerated for two weeks. the fungal inocula were prepared by growing each fungus on autoclaved sand-barley medium in 250 ml. Erlenmeyer flasks (each contained 60 gm barley grains, 40 gm water-washed sand and covered with distilled water) then incubated for 2 weeks at 25°C. incouled barley grains and fungus free grains, were add separately to sterilized soil at rate 2.5% w/w then mixed well and distributed into pots . Seeds of soybean cv. Giza 111 were sterilized using 0.5% sodium hypochlorite solution (v/w) for 3 minutes, then washed several times with sterilized distilled water and then sown (5 seeds/pot), careful observation in the open field of Agricultural Research Station

Assiut, and examined for pre- and post-emergence damping-off for 15 and 30 days after sowing, respectively. While survivals(diseased and healthy plants), 90 days after planting. Re-isolation was carried out from some of the artificially diseased plant to fulfill Koch's postulations and the developed fungi were confirmed with original isolates. The most pathogens isolates of each genus were isolated to verify their identification by Plant Research Institute Agriculture Research Center, Giza, Egypt.

4- Disease assessment:

Soybean root rot was assessed as root rot severity by using arbitrary scale 0-5 where 0= No infection plant, 1= 20-25%; 2= 26-50%; 3= 51-75% and 5= >75% were completely dead plants. Damping-off seedlings were considered dead plants and graded at maximum disease grade. After that root rot severity % were recorded. (Liu *et al*., 1995).

Root rot disease severity % = [∑ (n× v) ×N] ×100.

Where: n = number of plant within each infection categories,V = numerical values of infection categories,N = total number of plant examined and 5 = constant, highest numerical value.

5-Effect of seed exposure to microwave electric field radiation (MER) on germination %:

Soybean seeds cv. Giza 111 were exposed to MER (Microwave model-M06T, single phase, 220V., 50 Hs., 1.3 Kw output at a frequency of 2450 MHz. fresh. Mad in Egypt) for 0.0 untreated served as control, 2.0, 4.0, 6.0, 8.0, and 10.0 seconds. At least 150 seeds were exposed in each exposure time. After that untreated and treated seeds were distributed individually in Petri-dishes (16 cm diameter) contained sterilized water filter papers (16 cm). Each treatment consisted of 3 replicates, 1 plate for replicate and 50 seeds/plate. Germination was calculated 7 days after incubation at 25°C seed was considered germinated when root reached 1.5 fold of seed **(Amber *et al.*, 2013)** .Seed germination was calculated as follows:

Germination % =

$$\frac{\text{No. of Germinated seeds}}{\text{Total no. of seeds}} \times 100$$

6- Effect of seed exposure to microwave electric radiation (MER), potassium silicate (PS) and sodium bicarbonate (SB) on root rot severity:

Exposure time that gave highest germination %, 6.0 seconds, were tested in this experiment. MER – treated seeds and set of non-MER once was 12 h emmersed in K-silicate (PS) or Na-bicarbonate (SB) individually then sowed in infested pots which prepared as described above. This experiment randomized complete block design that includes 24 treatments, each treatment contained 3 replicates (4 pots/replicate) and 5 seeds/pot were sowed. Disease assessment was recorded as above described.

Statistical analysis:

Data were analyzed statistically using analysis of variances, and means were compared according to the LSD test (**Gomez and Gomez, 1994**).

RESULTS

1- Survey of soybean root rot:

Wherever, soybean cv. Giza 111 grown showed root rot symptoms in different districts tested during two growing seasons (Table 1). Root rot incidence significantly varied by different districts and growing seasons. However, root rot incidence was significantly higher during 2015 growing season (10.71) then 2014 (6.16). Assiut district provided highest root rot incidence (14%) followed by Der Mowas (11.6%) during 2015 growing seasons. The lowest root rot incidence (3.3%) was recorded in Abnob followed by Manfalout (4.01%) during (2014) growing season. Along two growing seasons, the highest root rot incidence was occurred (12.35%) in Assiut district followed by Der Mowas (8.65%) while Abnob recorded least disease incidence (5.52%) followed by Manfalout district (6.65%).

Table (1): Soybean root rot incidence occurred in different districts in Assiut and El-Minia Governorates.

Districts	Infection (%) in 2014 season	Infection (%) in 2015 season	Means
Assiut	10.7	14.0	12.35
Manfalout	4.01	9.2	6.65
Abnob	3.30	8.04	5.52
Der Mowas	6.64	11.6	8.65
Means	6.16	10.71	

L.S.D. at 5% for districts (A): 1.42, Seasons (B) : 2.04 and A x B: 3.01

2- Frequency of fungi associated with root rotted soybean plants:

Among root rotted soybean plants cv. Giza 111, 5 fungal genera, e.g. *Alternaria, Fusarium, Macrophomina, Rhizoctonia* and *Stemphylium* were frequently isolated (Table 2). Two *Fusarium* species, *F. oxysporum* and *F. solani* recorded highest frequency (33.5% *F. solani* and 20% *F. oxysporum*) followed by *Macrophoina phaseolina* (18%) and *R. solani* (17%). *Stemphylium* sp. and *Alterniaria* sp. provided harvest frequency percentage 5.5 and 6.0%, respectively.

3- Pathogenicity tests:

Only 10 fungal isolates, one isolate *F. solani*, 2 isolates *F. oxysporum*, 2 isolates *M. phaseolina*, 2 isolates *Alternaria* sp., 2 isolates *Stemphylium sp.* And 1isolate *R. solani* were selected from frequency experiment and tested for pathogenicity.

Data presented in Table (3) revealed that isolates of *Alternaria* sp. or *Stemphylium* sp. failed to infect soybean plants. The highest percentage of root rot severity were obtained by *R. solani* R6 (92.0%) followed by isolate F1of *Fusarium oxysporium* (90.0%). Isolate F5 of *F. solani* caused 82.5% and isolate F4 *F. solani* caused 36.6%, then isolate M3 of *M. phaseolina* caused 62.0% and M2 of *M. phaseolina* caused 20.0%, respectively . However isolates R6, F1, F3 and, M3 were the most virulent they used for further studies.

Table (2): Frequency of fungi associated with root rotted soybean plants grown in Assiut and El-Minia Governorates.

Fungi	District (Governorates)		Mean
	Assiut (Assiut)	Der Mowas (El-Minia)	
F. solani	42.0	25.0	33.5
F. oxysporium	16.0	24.0	20.0
M. phaseolina	17.0	19.0	18.0
R. solani	20.0	14.0	17.0
Alternaria sp.	2.0	10.0	6.0
Stemphylium sp.	3.0	8.0	5.5
Means	16.67	16.67	
Total	100	100	100

Table (3): root rot Severity (%) of soybean plants cv.Giza 111 grown in infected pots with root rotting fungal isolates.

Fungi and isolate No		location	Root rot severity
F. oxysporium	F1	Assiut	90.0
M. phaseolina	M2	DerMowas	31.5
	M3	Assiut	62.0
F. solani	F4	DerMowas	36.6
	F5	Assiut	82.5
R. solani	R6	Assiut	92.0
Alternaria sp.	A7	DerMowas	0.0
	A8	DerMowas	0.0
Stemphylium sp.	S9	Assiut	0.0
	S10	Assiut	0.0
Control			0.0

L.S.D at 5%: 6.44

4- Effect of seed exposure to microwave electric field radiation (MER) on germination %:

Data in Table (4) showed that the exposure of soybean seeds to microwave electric field radiation of 2 and 4 sc. did not significantly affect the percentage of seed germination. Exposure soybean seeds to 6 sc. incited a slight increase in the percentage of seed germination (86.66% germination). The germination percentage was significantly decreased in seeds which exposed for 8 sc. (13.33%) and 10 sc. (6.0%).

5- Effect of seed exposure to microwave electric field radiation (MER), potassium silicate (PS) and sodium bicarbonate (SB) on root rot severity:

Soybean root rot severity was reduced significantly when soybean plants grown from treated soybean seeds by 6 sc exposure time with microwave electric field radiation (MER) or emmersed in 200 ppm potassium silicate (PS) and sodium bicarbonate (SB) individually or combined MER + PS and MER + SB (Fig. 1). MER-treated seeds showed root rot severely lesser than PS- or SB-treated once individually. Root rot severity under *R. solani* infection was most affected than other fungi tested through MER or PS treatments. In addition, MER + PS treated seeds showed highest reduction in root rot severely followed by MER + SB treated once. As for, *F.oxysporum*, MER +PS gave the highest disease reduction to disease indcidence (62.09%), followed by *M. phaseolina* and *R.solani* was 60.00% and 55.61% respectively. However, *F.solani* was highly affected by MER+SB,the percent of disease reduction was 45.97%.

In general, the lowest percentage of root rot infection was 30.4, 26.4, and 34.8% caused by F. *oxysporum*, *M. phaseolina,* and *R. solani* respectively, when

Treat with MER+PS, while it was 32.2% for *F. solani*, on the MER+SB treatment in this respect

Table (4): Effect of seed exposure to microwave electric field radiation (MER) on germination %:

Exposure time (sec.)	Seed germination (%)
2	81.00
4	80.70
6	86.66
8	13.33
10	6.00
Untreated 0.0	80.00
LSD at 5%	4.46

.

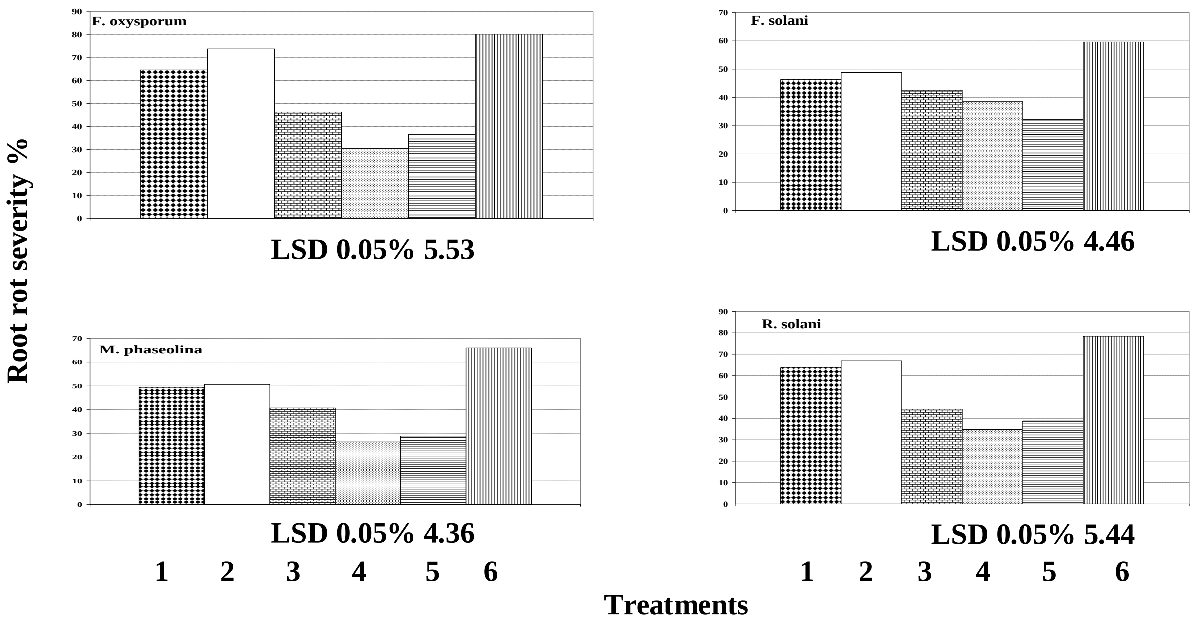

Fig. (1): Soybean root rot severity caused by *F. solani*, *F. oxysporum*, *R. solani*, and *M. phaseolina* as affected by (1) potassium silicate (PS), (2) sodium bicarbonate (SB), (3) microwave electron radiation (MER), (4) MER + PS, (5) MER + SB and (6) untreated soybean seeds (cv. Giza 111) before planting.

DISCUSSION

Soybean (*Glycine max* (L.) Merrill) the "golden bean" is prome to attack by different pathogens, including fungi, bacteria, nematoda and virus. Among all these pathogens the most destructive pathogen for this crop is fungus. It causes heavy yield losses of this crop a very year. The root rot and damping-off pathogenic fungi are major threat of this crop as these cause poor emergence, stunted seedlings, weak growth and reduced productivity of soybean plants (Zhang *et al*., 2010). Yield losses of soybean due to fungi root rot were estimated to over 7300 metric tons in Canada and 86600 metric tons in the United States in 1998 (Datnoff and Sinclair, 1988; Zhang *et al*. 2012 and Lakshmeesha *et al*. 2013).

The disease incidence reached between 3.30% - 10.7% in 2014 and 8.65% - 14.0% in 2015 seasons, showing gradual increase in different locations from year to year. The disease is very spread in all field cultivated with soybean. Root rot disease is distributed in Assiut and El-Minia Governorates. It seems warm weather might be favorable for infection and development of these diseases. This result agrees with those obtained by Arafa (1994) .

The fungi belonging to five genera, namely, *Rhizoctonia solani*, *Fusarium solani, F. oxysporum*, *Macrophomina phaseolina*, *Alternaria* sp., and *Stemphylium* sp. were isolated from naturally infected plants. *Fusarium solani* and *F. oxysporum* were the most common isolated fungi, followed by *R. solani* then *M. phaseolina*. The other isolated fungi (*Alternaria* sp. and *Stemphylium* sp.) occurred, however, in lower frequencies.

According to the available literatures, *F. solani, F. oxysporum, R. solani* and *M. phaseolina* were recorded on soybean plant in Egypt by Abd El-Kader (1983); Abdel-Lateef *et al*. (1984); Arafa (1994), ElBarougy *et al*. (2009) Samy *et al*. (2016), on the other hand, *Fusarium solani, F. oxysporum,* and *R. solani* were isolated from soybean in U.S.A. by Datnoff and Sinclair (1988), Rizvi (1996); David (2017), also, *M. phaseolina* and *F. spp*. were isolated from soybean in India by Lakshmeesha *et al*. (2013). *Fusarium oxysporum* and/or other fungi were the most frequently isolated fungi from soybean plants by Martens *et al*. (1984). In Canada, at 2012, *Fusarium oxysporum* was the most prevalent species, while, *F. sporatrichioide; F. solani* and *F. pone* were the least frequent species in the soybean rhizosphere by Zhang *et al*. (2012).

Pathogenicity of the identified fungi on soybean indicated that, *F. oxysporum, F. soalni, R. solani*, and *M. phaseolina* were the major root-rot aggressive fungi caused root rot. These results are somewhat similar to those reported by Zhang *et al*. (2012), also the present results are in agreement with those reported by Lakshmeesha *et al*. (2013). The fungus M. *phaseolina* causes a post-emergence damping-off of soybean seedlings were reported by Lakshmeesha *et al*. (2013), while Datnoff and Sinclair (1988), found that the fungi, i.e. *F. oxysporum*, and *R. solani* caused a root rot disease of soybean. In Pakistan, Inam, *et al*. (2012) studied the diversity of fungi occurring and damping soybean and sunflower are prome to attack by root infecting fungi like. These fungi were *F. oxysporum*, *F. solani, M. phaseolina,* and *R. solani*. These fungi were reported by Inam *et al*. (2003); Haas and Defogo (2005), also on soybean and by Rizvi (1996) and faba bean, Abou-Zeid *et al*. (2003).

In the present study, the effect of (MER), on seed germination. At lower exposure time 2 and 4 sc revealed insignificant of plant treated seed germination. Decrease in seed germination is observed in all seed samples with increase in exposure time from 8 sc to 10 sc in soybean seed as compared to control treatment, except at 6 second increased in soybean seed as compared to control treatment (Martinez *et al*., 2003; and Sojo *et al*., 2003). Reduced in seed germination of *Acacia farnesiana* with increase in exposure time from 5 to 25 sc as compared to control (Ibrahim *et al*., 2016). Also reduced seed germination were observed in soybean seed and these results confirmed the findings of Amber *et al*. (2013), who reported that ionizing radiation enhanced the germination in maize.

The effect of soybean seed MER exposure time for controlling root rot diseases, results indicate that exposure of seeds to MER for 6 Sc significantly reduced the percentage of root rot severity. similarly as reported elsewhere (Ibrahim *et al*., 2016) an additional effect of the microwave energy showed that germinating grains, growth rate of exposed maize seedling and absorbance efficiency significantly increased compared to the control (Khalafallah *et al*., 2009). It was to determine microwave conditions that inactive seed borne (*Fusarium graminum*) is wheat without significantly affecting seed quality (Reddy *et al.*, 1998).

Results obtained from using (MER) for soybean seeds and subsequently were soaked individually in the tested inorganic salts of, K-silicate or Na-bicarbonate; all tested inorganic salts were generally effective in controlling root rot diseases and increased number of treated plants as compared to untreated seeds. The microwave electric field radiation MER treated seeds and potassium silicate or sodium bicarbonate as seed treatments in descending order, caused the lowest percentages of root rot infection induced with four tested fungi (i.e. *F. solani, F. oxysporum, R. solani* and *M. phaseolina*). Potassium silicate gave a high effect for controlling soybean root rot due to that silicon is effective in controlling various pests and diseases caused by both fungi and bacteria in different plant species (**Ma, 2004)**.

REFERENCES

Abdel-Kader, M.A. 1983. Studies on certain diseases of soybeans. Ph.D. Thesis, Fac. Agric, Assiut Univ.

Abdel-Lateef, M.F.A.; El-Samadisy, A.M.; El-Din Badawi, M.F. and Beshir, M.A. 1984. *Macrophomina* root-rot of soybean and its control. Al-Azhar J. Agric., Res., 2: 175-186.

Abou-Zeid, N.M.; Arafa, M.K.M.; and Attia,S. 2003. Biolgocial control of pre- and post-emergence diseases on Bean, Lentil and Chickpea in Egypt. Egypt. J. Agric. Res., 4: 1491-1502.

Amber, N.; Saeed,M.; Abid,M. and Shalkat,S.S. 2013. Effect of UV-B and microwave radiation on seed germination and plant growth in corn and okra. Fuuast J. Biol., 3 (1): 55-62.

Arafa, M.K.M. 1994. Studies on some diseases of soybean. Ph.D. Thesis, Fac. Agric., El-Minia Univ.

Barnett, H.L. and Hunter, B.B. 1972. Illustrated genera of imperfect fungi –Burgess Pub. CC. Minneapolis, Minnesota, pp. 241.

Booth, C. 1971. The *Genus fusarium* 1-237 pp, Commonwealth mycological institute, Kew, Surrey, England.

David, R. and Jimenez, C. 2017. Soybean root rot caused by *Fusarium oxysporum* and *Fusarium graminearum:* interactions with biotic and abiotic factors. IOWA State Univ.

Datnoff, I.E. and Sinclair, J.B. 1988. The interaction of *Fusarium oxysproum* and *Rhitoctonia solani* in causing root rot of soybeans. Phytopathology, 78: 771-777.

El-Barougy, E; Awad, N.M.; Turky, A.Sh. and Hamed, H.A. 2009. Atagonistic of selected strains of Rhizocbacteria against *Macrophomina phaseolina* of soybean plants. American Eurasian J. Agric. & Environ. Sci. 5 (3): 337-347.

Gilman, J.C. 1957. A manual of soil fungi. 191-400 pp. 2nd Ed. The Iowa State College Press, Ames, Iowa, U.S.A.

Gomez, K.A. and Gomez, A.A. 1994. Statistical Procedures in Agricultural Research, New York, Chichester, etc.; Willy, 2nd ed., Paperback, pp. 1-680.

Haas, D. and Defago, G. 2005. Biological control of soil-borne pathogens by *Fluorescen pseudomonads*. Nature Reviews Microbiology.

Ibrahim, H.; Hanan G.E.F. and Nader A.E.S. 2016. Effect of microwave on seed germination and plant growth in *Acacia* sp. Alexandria Sci., Exchange J., 37 (3): 440-449.

Inam-Ul Haq, M.; Javed, N.; Ahmed, R. and Rehman, A. 2003. Evaluation of different strains of *Pseudomonas fluorescens* for the biocontrol of *Fusarium* wilt of chickpea. Pakistan Journal of Plant Pathology, 2 (1): 65-74.

Inam-Ul-Haq, M.; Mehmood, S.; Rehman, H.M.;Au, Z.; and Tahir, M.I. 2012. Incidence of root rot diseases of soybean in multan Pakistan and its management by the use of plant growth promoting rhizobacteria. Pak. J. Bot., 44 (6): 2077-2080.

Khalafallah, A.A.; Samira, M.M. 2009. Response of maize seed seedlings to Microwaves at 945 MHZ. Romanian J. Biophys. 19: 49-62.

Lakshmeesha, T.R.; Sateesh, M.K.; Vedashree, S. and Mohammad, Sh.S. 2013. Anti-fungal activity of some medicinal plants on soybean seed-borne *Macrophomina phaseolina*. Journal of Applied Pharmaceutical Science, 3 (2): 81-84.

Liu, I.; Kloepper, J.W and Tuzum,S. 1995 .Induction of systemic resistance in cucumber against *fusarium wilt* by plant growth promoting rhizobacteria .phytopathology.85:695-698.

Ma, J.F. 2004. Role of silicon in enhancing the resistance of plant to biotic and abiotic stresses. Soil Sci. Plant Ntr, 50 (1): 11-18.

Martinez, E.; Carbonell, M.V.; Florez,M. 2003. Stimulation of germination and growth by exposure to magnetic fields. Res. and Sci., 324: 24-28.

Motallebi,A. 2016. Effect of microwave radiation on seed viability, survival of *Aspergillus niger* van Tieghem and oil quality of oil seeds crop canola, soybean and sunflower. Acta Agric. Slovenica, 107 (1): 73-80.

Mrtens, J.W.; Seaman, W.L.; and Atkinson, T.G. 1984. Diseases of field crops in Canada. Candian Phytopathological Soc., Harrow, Ontario, 160 pp.

Paulitz, T.C. and Baker, R. 1987. Biological control of Pythium damping-off of cucumber with Pythium: population dynamics and disease suppression (2); Phytopathology, 11 (2): 335-340.

Polanco,L.R;Rodrigues,F.;Nascimento,K.J.T;Cruz,M.F.A ;Curvelo,C.R.S.; DaMatta,F.M. and Vale,F.R. 2013. Photosynthetic gas exchange and antioxidative system in common bean plants infected by *Colletotrichum lindemuthianum* and supplied with silicon. *Tropical Plant Pathology*.39(1):035-042.

Ray, W.W. and McLaughlin, H.H. 1942. Isolation and infection tets with seed and soil borne cotton pathogens. Phytophatology, 32: 233-238.

Reddy, M.W.B.; Roghavan, G.S.V.; Kushavan, A.C. and Paulitz, T.C. 1998. Effect of microwave treatment on quality of wheat seed infected with *Fusarium graminearum*. J. Agric., Engng, Res., 11: 113-117.

Rizvi, S.S.A. and yang, X.B. 1996. Fungi associated with soybean seedling disease in Iowa. Plant Disease, 80: 57-60.

Safdar, A.A.; Riaz,S.; Ahmad;C.A.;Subhani;M.N and Chattha;M.B. 2013. Mycoflora associated with stored seeds of soybean. Mycopathologia 11 (4): 24-33.

Soja, G.; Kunsch, B.; Gerzabek, M.; Reichenauer, T.; Soja, A.M.; Rippar, G. and Bolhar-

Nordenkampf, H.R. 2003. Growth and yield of winter (*Triticum aestivum*) and corn (*Zea mays*) to near high voltage transmission line. Bioelectromagnetics, 24: 91-102.

Turkkan,M. 2014. Antifungal Effect of Various Salts Against *Fusarium oxysporum* f.sp.*cepae*, the Causal Agent of Fusarium Basal Rot of Onion. Journal of Agricultural Sciences 19:178-187.

Venugopal Rao, T.; Rajeswari, B.; Keshavulu, K. and Sanderp V, V. 2015. Studies on seed-borne fungi of soybean. SSRG International Journal of Agric. and Environmental Sci. (SSRG. IJAES), 2: 16-24.

Zhang, J. X.; Xue, A.G.; Zhang, H.J.; Nagasawa, A. E. and Tambong, T.T. 2010. Response of soybean cultivars to root-rot caused by *Fusarium* species. Can. J. Plant, Sci., 90: 767-776.

Zhang, J.X.; Xue, A.G.; Cober, E.R.; Morrison, M.J.; Zhang, H.J.; Zhang, S.T and Gregarich, E. 2012. Prevalence, pathogenicity and cultivar resistance of *Fusarium* and *Rhizoctonia* species causing soybean root-r ot. Can. J. Plant, Sci., 13: 221-236.

مكافحة امراض عفن جذور فول الصويا بمعاملة البذور بالإشعاع الإليكتروني للميكرويف وسيليكات البوتاسيوم وبيكربونات الصوديوم

نهي أنس محمد[1]، هناء محمد المرسي[2]، محمود كمال محمود عرفه[1]، أنور عبدالعزيز جلال[2]

1- مركز البحوث الزراعية – معهد بحوث أمراض النبات – الجيزة – مصر.

2- كلية الزراعة – قسم أمراض النبات –جامعة المنيا – مصر.

سجلت زراعات فول الصويا بجميع المراكز المختبرة بمحافظتي أسيوط والمنيا نسب متفاوتة لأعفان الجذور حيث اختلفت باختلاف المناطق و المواسم المختبرة. وكانت متوسط نسبة الاصابة في موسم 2015 (10.71%) مقارنة بموسم 2014 (6.16%). حيث سجلت اعلي نسبة إصابة بمركز أسيوط (14%) يليه مركز ديرمواس (11.6%) في موسم 2015 وسجلت أقل نسبة إصابة بمركز أبنوب (أسيوط) (8.04 %) ثم مركز منفلوط (9.2%). تكرارت 6 أنواع تابعة لخمس أجناس فطرية وهي:

Fusarium solani, F. oxysporum, Macrophomina phaseolina, Rhizoctonia solani, Alternaria sp., *Stemphylium* sp. بنسب متفاوتة حيث سجل الفطر *F. solani* تكرار (33.5%) يليها الفطر *F. oxysporum* (20%) والفطر *Rhizoctonia solani* (18%) والفطر *Macrophomina phaseolina* (17%) بينما الفطرين *Stemphylium, Alternate* سجلا أقل نسب تكرار (6.0% و 5.5%) علي التوالي.

– أظهر اختبار القدرة المرضية ان العزلات التابعة الفطريات *R. solani* ،*F. solani* , *F.oxysporum* , *M. phaseolina* . فقط ذات قدرة مرضية، بينما *Stemphylium,* *Alternate* ليس لهما قدرة مرضية.

- ادي معاملة بذور فول الصويا بالإشعاع الالكتروني باستخدام الميكروويف لمدد مختلفة اختلاف في نسبة الانبات حيث ادي التعرض لمدة 2 و 4 ثوان إلي عدم تغيير معنوي في نسبة الإنبات مقارنة (بالمقارنة) بينما عند تعرض البذور لمدة 6 ثوان أدي إلي تحسين نسب الإنبات حيث زادت من 80% (المقارنة) إلي 86% وبزيادة فترات التعرض أكثر من ذلك أدت إلي خفض معنوي في نسب الإنبات.
- بمعاملة البذور بالإشعاع الاليكتروني ميكروويف لمدة 6 ثوان أو بغمر البذور في محلولي سيليكات البوتاسيوم أو بيكربونات الصوديوم كلا علي حده أدي إلي خفض معنوي في شدة الإصابة بعفن الجذور.
- أمكن الحصول علي أقل نسبة في شدة الإصابة بعفن الجذور عند معاملة البذور بالإشعاع الاليكتروني بالميكروويف ثم غمر البذور في محلول سيليكات البوتاسيوم قبل زراعتها في أصص معدية صناعياً بالفطريات الأربعة علي حده.