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EVALUATION OF SUNFLOWER PRODUCTIVITY, ROOT-ROT AND DAMPING OFF CONTROL BY USING SOME AGRICULTURAL PRACTICES

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Two field experiments were carried out at 6 October farm, El-Nubaria Province, El-Behaira Governorate, Egypt during the two successive summer seasons (2010 and 2011) to investigate the effect of some agricultural practices; i.e. irrigation treatments and different soil amendments on growth, productivity, suppression of root-rot and damping-off of sunflower (*Helianthus annuus* L.) var. Giza-102. Prior to the field experiments a pathogenicity test was carried out and identified that the causal pathogen of sunflower root-rot and damping-off diseases were *Macrophomina phasolina, Sclerotium rolfisii,* and *Rhizoctonia solani*. Missing the third irrigation was more appreciated than missing the fifth irrigation treatment compared to the normal irrigation as the control treatment, which represents the highest observations regarding sunflower growth and productivity. Soil amendment treatments increased the sunflower resistance to soil borne diseases hence enhanced its growth and productivity. The most promising results obtained from rice straw + EM_1 + urea, Biochar + compost, Rice straw + EM_1 and EM-Bokash with no significant differences, compost, and animal manure, respectively, compared to the control treatment (without soil amendment). The interaction (normal irrigation, missing the 3rd irrigation then missing the 5th irrigation, respectively) × (rice straw + EM_1 + urea), was the best between all the other interaction treatments, under normal, moderate and severe drought conditions, respectively, and compared to normal irrigation × without treatment, as the control treatment.

Keywords: Sunflower, *Helianthus annuus*, irrigation treatments, soil amendments, growth, productivity, root-rot, dampimg-off, *Macrophomina phasolina, Sclerotium rolfisii, Rhizoctonia solani*

Egypt has for a long time experienced serious shortage in edible oil supplies, due to the limited cultivation areas and rapid increase of demands resulted from the steady population growth. This gap between supplies and demands in edible oils could be overcome through either horizontal expansion (introduce the oil crops into the crop pattern of the newly reclaimed lands) or vertical expansion (implementation of more efficient agricultural practices) as reported by Dawood, Mona et al. (2012). The newly reclaimed lands are mostly exposed to a combination of environmental stresses including many desertification factors; such as drought, salinity, fertility depletion and heat stress, hence incidence of various plant diseases.

Sun flower (*Helianthus annuus* L.) is an oil seed species that is characterized by high productivity with high quality oil under a wide range of environmental stresses during its growing season (Weiss, 2000). As reported by Anonymous (2015), sunflower seed planted area and production will remain unchanged in 2014/15 referring to USDA's official forecast compared with 2014/15 at 7,000 ha and 17,000 MT, respectively produced from two main varieties; Sakha 53 and Giza 102, while the consumption will remain at 88,000 MT. Yet, among abiotic and biotic environmental stresses that challenged the success of sunflower agriculture in Egypt; drought, land fertility depletion and plant diseases will persist as the most dangerous ones.

Drought is the main abiotic challenge to any crop particularly growing under desert conditions (Carmen et al., 2015). They added that severe water deficits during the early vegetation growth result in reduced plant height, but may increase root depth, where adequate water stress during the late vegetative period is required for proper bud development. The flowering period is the most sensitive phenological stage to water deficits, which cause considerable yield decrease since fewer flowers come to full development (Beyazgul et al., 2000 and Ali and Shui, 2009).

Soil-borne diseases are a major threat to sunflower production in Egypt and worldwide for the wide host range of the pathogens, which survive long time in the soil (Ibrahim, 2006; Mousa et al., 2006 and Abd El-Hai et al., 2009). Chemical control was massively applied, however, for the increasing public concern over the fungicide usage, alternative control methods are strongly desired for sustainable agriculture where organic amendments play an important role (Mehta et al., 2012).

The organic amendments; such as animal manure, green manure, composts and peats have been proposed, both for conventional and biological systems of agriculture, to improve soil structure, plant soil water relations and fertility (Bonilla et al., 2012 and Kausar et al., 2014), and decrease the incidence of disease caused by soil-borne pathogens (Bonanomi et al., 2010 and Mehta et al., 2012). It reduced the pathogen propagules density of *Rhizoctonia solani, Macrophomina phaseolina, Fusarium* spp., *Virticillium* spp., and *Pythium* spp. (Scheuerellss et al., 2005 and Mousa et al., 2006) and increased microbial activity (Kausar et al., 2014). Similarly, biochar, which is a carbon rich soil amendment that is produced as a by-product during the pyrolysis of the agriculture wastes to produce the thermal gas, can significantly improve the gravimetric moisture content of soil, increase soil pH significantly (Lehmann and Joseph, 2008; Elad et al., 2011; Salmani et al., 2014 and Bonanomi et al., 2015). Thus it increased plant fresh and dry weights, yield and its components of sunflower (Salmani et al., 2014). Also, biochar addition to soil alters microbial populations in the rhizosphere, albeit *via* mechanisms not yet understood, and may cause a shift towards beneficial microorganism populations that promote plant growth and resistance to biotic stresses. There are also some scant evidences for biochar-induced plant protection against soil borne-diseases, the induction of systemic resistance towards several plant pathogens in different crop systems (Elad et al., 2011; Lehmann et al., 2011 and Bonanomi et al., 2015).

The EM technology is an example of an appropriate technique applied into organic farming systems (Guest, 1995). EM-bokashi is a Japanese expiration that points to an effective organic fertilizer in nature farming crop production (Kyan et al., 1999 and Higa, 2000). This type of farming provides several benefits to the growers and it is an environmental friendly method of cultivation. Further, organic manures contain many plant nutrients (nitrogen, phosphorus, potassium and many other essential nutrients) and it also increases infiltration of water and enhances retention of nutrients, and promotes growth of beneficial organisms that help plants to resist soil borne diseases. Moreover, it helps in CO_2 restoration in soil and reduces CO_2 emissions into the atmosphere that produce global warming (Ross, 2008). The organic fertilization treatments such as; EM-bokashi, compost and animal dung stimulated plant resistance to soil-borne diseases, therefore enhanced significantly plant growth, yield and its attributes and chemical composition (Abdel-Ati and El-Hadidy, Abeer, 2013).

This work aimed to study the integration between irrigation treatments and soil amendments as an effective ecofriendly strategy to overcome the dramatic conditions of biotic and abiotic stresses that challenge sun flower growth and productivity under desert conditions to conserve the environment and produce an appreciated yield.

MATERIALS AND METHODS

1. Pot Experiment

Pathogenicity test of fungi associated with damping-off and root-rot of sunflower

During 2009 growing season, the field with recent history of severe damping off and root-rot was monitored at Nubaria area. Diseased sunflower plants were collected 15, 45 and 90 days after sowing. Isolation of the causal fungi was conducted on PDA and identification was carried out according to Gilman (1971), Booth (1977) and Barnett and Hunter (1987).

The experiment was carried out in artificiality infested sandy clay soil at the greenhouse of Plant Protection Department, Desert Research Center (DRC). Inocula of isolated fungi, i.e. *Macrophomina phasolina, Sclerotium rolfisii, Rhizoctonia solani* and *Fusarium solani* were prepared with 10 ml conidial suspension /kg soil ($1x10^4$ spore/ml) of *F. solani* or 5 g/kg soil of barley grain inoculum of other fungi and incorporated to soil. Seeds of sunflower var. Giza 102 were surface disinfested with 2% sodium hypochlorite, rinsed in sterile distilled water, and sown in 25-cm plastic pots filled with autoclaved clay and sand (1:1, v/v). Four replicates for each tested isolate were prepared; each was sown with five seeds of sunflower. Plants were watered as needed and treated according to the normal agricultural practices. Re-isolation was conducted to insure the association of the tested isolates with the developed disease. The incidence of pre and post emergence damping off, incidence of root-rot and survived plants were calculated at 15, 30 and 45 days after planting, respectively.

2. Field Experiments

Two field experiments were carried out at 6 October farm, El-Nubaria Province, the desert backyard of El-Behaira Governorate, Egypt, during the two successive summer seasons (2010 and 2011) to investigate the effect of some agricultural practices; i.e. some irrigation treatments and different soil amendments on growth, productivity, root-rot and damping-off of sunflower (*Helianthus annuus* L.) var. Giza-102.

Physical and chemical analysis of the experimental soil was determined and included the following characters: sand 91.20%, silt 3.70%, clay 5.10%, pH 7.80, organic matter 0.21%. $Ca\ Co_3$ 1.00%, E.C. 0.50 mmhos/cm^3. The available total N, P, K were 8.10, 3.20, 20.0 ppm, respectively at 0-60 cm depth as described by Chapman and Pratt (1978).

The experimental soil was ploughed twice, ridged and divided into plots 4 meters long and 3.60 meter apart including 6 ridges with 0.60 and 0.20 cm apart between rows and hills, respectively, and the total plot area was 14.4 m^2. During soil preparation, 150 kg calcium super phosphate/fed (15.5% P_2O_5) was added as a general application, while 45 kg N/fed as ammonium sulphate (20.6% N) was added in three equal doses at sowing, after thinning and pre-configured buds flowering, whereas 50 kg/fed potassium sulphate (48% K_2O) was added after plant thinning.

Seeds of sunflower var. Giza-102 were obtained from Agricultural Research Center, Giza, Egypt, were sown at 15 March in both seasons at seeding rates of 5 kg/fed (3-5 seeds per hill) and thinned at 15 days after sowing date.

Drip irrigation method was applied immediately after sowing, then once every week intervals, according to the agricultural practices in the region, while the irrigation treatments {normal irrigation (control), missing the third irrigation and missing the fifth irrigation} were applied after full emergency.

The soil amendment treatments were added into each plot in the rate of 20 m^3/fed and mixed with the soil before planting. It consisted of seven treatments as follows; without treatment (control), rice straw (after fermentation with EM_1 and water for two months), rice straw (after fermentation with EM_1 and water for two months plus urea) (in order to adjust the C/N ratio), biochar of rice straw (2% w/w) and compost (in order to adjust the C/N ratio), compost, animal manure and EM-bokashi. The used compost in the experiment was town refuse compost.

The experimental design that used in this experiment was split plot design in four replicates, where the irrigation treatments occupied the main plots, the soil amendment treatments were arranged in the sup ones.

3. Data Recorded

Damping-off and root-rot incidences were recorded at 15, 45 and 90 days after sowing date, and then expressed as percent disease incidence.

Population of the fungal pathogens in plant rhizosphere: Soil samples were collected from each plot at 0, 15, 45 and 90 days after sowing. Samples were taken from plant rhizosphere, 15 cm of the soil surface, where four soil extracts were prepared for each plot. Serial dilution of 10 g soil/ 90 ml of sterile distilled water were made to obtain 10^3 dilution and 0.1 ml of each dilution was spread plated on appropriate selective media (Nash and Synder, 1962; Ko and Hora, 1971; Cloud and Rupe, 1991 and Steadman et al., 1994) for enumeration of the most expected pathogenic fungi. Inoculated plates were incubated at 25ºC in darkness and developed colonies were enumerated five days after inoculation.

Microbial population in plant rhizosphere: Soil extracts were prepared and 10^3 dilutions were made as above mentioned. A 0.1 ml of each dilution was spread plated on each of Lingappa and Lockwood (1962) and Collins and Lyne (1985) media for the total counting of actinomycetes and bacteria, respectively. Plates were incubated at 30ºC in darkness for three days before counting bacterial colonies, and for five days before counting actinomycetes. At harvest, a random sample of ten plants were taken from each plot to determine the following; plant height (cm), head diameter (cm), head weight (g), seed weight/head (g), 100 seed weight "seed index" (g), biological yield (ton/fed), seed yield (ton/fed), straw yield (ton/fed) and the oil yield (ton/fed), which was estimated by ground dry mature seeds into very fine powder to determine oil percentage using Soxhlet apparatus and diethylether according to A.O.A.C. (1990), then the oil yield was estimated by multiplying seed oil percentage by seed yield (ton/fed).

4. Statistical Analysis

Pooled data were subjected to the combined statistical analysis after passing the homogeneity test using M-STAT C (Russell, 1991), while Duncan's multiple range test was used to verify the significant differences between treatments means as described by Duncan (1955).

RESULTS AND DISCUSSION

1. Pathogenicity Test of Isolated Fungi the Causal of Damping off and Root-rot

As shown in table (1), the fungi isolated and identified in the samples of the infested sunflower showed clear symptoms of root-rot, therefore pathogenicity of the recovered fungi revealed that *Macrophomina phasolinae*, *Sclerotium rolfsii* and *Rhizoctonia solani* were the most pathogenic to sunflower at the pre-emergence damping-off stage assessed 15 days after sowing. These fungi indicated 34.3, 32.5 and 27.5%, respectively, however, *Fusarium solani* showed lowest in pathogenicity (18.9%). At the post emergence damping-off stage, 30 days after sowing, *R. solani, S. rolfsii* and *M. phasolinae* fungi incited more disease being 29.3, 27.5 and 26.6%, respectively. Moreover, *F. solani* incited 17.8% damping-off. However, at 45 days after sowing, *R. solani, S. rolfsii, M. phaseolina* and *F. solani* showed 35.2, 34.6, 33.5 and 26.3%, respectively, as root-rot disease. These observations are in agreement with several reports in Egypt and other parts of the world (Bokor, 2007; Morsy and El-Korany, 2007 and Abd El-Hai et al., 2009).

Table (1). Pathogenicity of the isolated fungi in a pot experiment.

Isolated fungi	**Damping-off (%)**		**Root-rot (%)**
	Pre-emergence damping off	**Post- emergence damping off**	
Macrophomina phasolinae	34.3a	26.6a	33.5a
Rhizoctonia solani	27.5b	29.3a	35.2a
Sclerotium rolfsii	32.5a	27.5a	34.6a
Fusarium solani	18.9c	17.8b	26.3b
Control	0.0d	0.0c	0.0c

Means having similar letters at same column has no significant differences at $P \geq 0.05$.

1. Effect of Irrigation Treatments on;

1.1. Disease incidence

Results presented in table (2) indicate that the plants deprived of one of the irrigation treatments could magnify the negative consequences of infection with the both of damping off and root-rot diseases. Moreover, this deprive should not occurs during one of the plant sensitive phenological stages for drought stress (Bokor, 2007). Therefore, missing the fifth irrigation followed by missing the third irrigation and compared to the normal irrigation treatment; had the massive bad effect on damping off (%) and root-rot (%) either in pre-emergency or in post-emergency. Similar trends were obtained by Elad et al. (2011).

Table (2). Effect of different irrigation treatments on incidence of damping-off and root-rot of sunflower at Nubaria province (mean of 2010 and 2011 summer seasons).

Irrigation treatments	**Damping off %**		**Root-rot (%)**
	Pre	**Post**	
Normal	18.2c	12.7b	22.1c
Missing the third irrigation	22.5b	17.0a	25.9b
Missing the fourth irrigation	24.4a	16.7a	31.0a

Means having similar letters at same column has no significant differences at $P \geq 0.05$.

1.2. Fungal pathogens and rhizospheric microbial populations

Results that presented in table (3) indicate that missing the fifth irrigation decreased significantly each of *M. phasolina, S. rolfsii, R. solani* and microbial populations of sunflower rhizosphere at 0, 15, 45 and 90 days after sowing date, followed by missing the third irrigation treatment, compared to the control treatment. This may be because the soil temperature is getting higher during the period when the fifth irrigation is applied. This may increase the bad consequences of drought stress on the natural propagation of the natural micro-flora of the soil. Similar trend was obtained by Lazarouits (2001).

1.3. Sunflower growth and productivity

Results illustrated in table (4) indicate the effect of irrigation treatments; i.e. missing the 3rd or the 5th irrigation on growth and yield and its components of sunflower var. Giza 102 grown under Nubaria province and compared with the normal irrigation as the control treatments. It is clear that missing the 5rd irrigation followed by missing the 3rd irrigation decreased significantly all the studied characters; i.e. plant height (cm), head diameter (cm), head weight (g), seed weight/head (g), 100 seed weight "seed index" (g), biological yield (ton/fed), seed yield (ton/fed), straw yield (ton/fed) and the oil yield (ton/fed). This is in agreement with Mike and Navari-Izzo (1992), who reported that; in sunflower subjected to drought, water deficit conditions resulted in reduced growth of the plants and in increased membrane permeability. In comparison to the control, the unwatered seedlings showed lower chlorophyll and soluble protein amounts, as well as a reduction in total and polar lipid contents. Beyazgul et al. (2000) and Ali and Shui (2009) reported that severe water deficits during the early vegetation growth result in reduced plant height, but may increase root depth, while during the flowering period; which is the most sensitive phenolic stage to water deficits, causes a considerable yield decease since fewer flowers come to full development.

Table (3). Effect of different irrigation treatments on *M. phasolina, S. rolfsii, R. solani* and rhisospheric microbial populations of sunflower at 0, 15, 45 and 90 days after sowing (colonies x 10^3/g soil) in Nubaria province (mean of 2010 and 2011 summer seasons).

Studied characters	**Days after sowing date**	**Irrigation treatments**		
		Normal (control)	**Missing 3rd irr.**	**Missing 5th irr.**
M. phasolina	0	41.6Da	38.9Db	37.9Dc
	15	42.7Ca	41.0Cb	38.7Cc
	45	43.0Ba	41.3Bb	38.9Bc
	90	49.2Aa	47.7Ab	45.9Ac
S. rolfsii	0	45.4Da	43.4Db	41.2Dc
	15	44.9Ca	42.9Cb	41.0Cc
	45	41.6Ba	39.4Bb	37.6Bc
	90	41.0Aa	39.2Ab	37.0Ac
R. solani	0	46.0Da	44.4Db	41.9Dc
	15	45.9Ca	43.7Cb	41.7Cc
	45	46.5Ba	44.5Bb	42.1Bc
	90	46.9Aa	45.0Ab	42.7Ac
Total microbial populations	0	15.6Da	14Db	14.1Dc
	15	60.6Ca	50.3Cb	43.2Cc
	45	97.9Ba	77.3Bb	71.5Bc
	90	88.9Aa	45.0Ab	66.6Ac

Means having similar capital letters at same column and similar small letters at same raw under each studied character has no significant differences at $P \geq 0.05$.

As a general conclusion, sunflower can mitigate drought during the early vegetative growth, yet, it is very sensitive to water stress during the flowering period. So, when soil-borne diseases are present the bad consequences of water stress are magnified. Thus, a special care should be given to the moderate irrigation particularly during the sensitive phenolical stage to drought.

Table (4). Effect of different irrigation treatments on sunflower var. Giza 102 growth and yield and its components grown under Nubaria province conditions (combined analysis of 2010 and 2011 summer seasons).

Irrigation treatments	Studied characters								
	Plant height (cm)	**Head dia-meter (cm)**	**Head weight (g)**	**Seed weight /head (g)**	**100 Seed weight (g)**	**Bio-logical yield (ton/fed)**	**Seed yield (ton/fed)**	**Straw yield (ton/fed)**	**Oil yield (ton/fed)**
1) Control	115.5a	14.0a	78.6a	31.1a	5.85a	6.1a	1.2a	4.9a	0.139a
2) Miss 3rd irr.	100.2b	12.2b	68.2b	27.0b	5.08b	5.2b	1.0b	4.2b	0.121b
3) Miss 5th irr.	78.6c	9.6c	53.5c	21.1c	3.80c	4.1c	0.8c	3.3c	0.940c

- Control = normal irrigation- 2) Miss. 3rd irr.= missing the third irrigation- 3) Miss. 5th irr. = missing the fifth irrigation
- Means having similar letters at same column has no significant differences at $P \geq 0.05$.

2. Effect of Soil Amendments Treatments on;

2.1. Disease incidence

Results illustrated in table (5) indicate that the most effective treatment for suppressing damping off and root-rot incidence was rice straw + EM_1+ urea, followed by biochar + compost, then rice straw + EM_1, and then EM-bokashi, while the compost, cow manure and control treatments exhibited the lowest effect, respectively. This agrees with what reported by Kausar et al. (2014), who told that rice straw as soil amendment suppress soil borne diseases as bioenhancer and bioprotectant. Application of urea to soil was effective in preventing carpogenic germination of sclerotia of *S. sclertiorum* that were not in direct contact with the soil, and they suggested that ammonia was the key toxic component for the suppression of this pathogen (Huang et al., 2002). In contrary with the EM-bokashi, the use of the chemical fertilization under this biotic stress conditions not only affect the virgin environment and human health negatively, but it increases the probability of infection and development of root-rot pathogens as a result of plant cell elongation, rapid cell mitosis, thinness of cell walls caused by the presence of nitrogen compounds in high concentration within short time period as happened when nitrogen fertilization is applied. These conditions might be perfect for the soil borne diseases to produce its mass injury (Higa 2000 and Abdel-Ati and El-Hadidy, Abeer, 2013).

Table (5). Effect of different soil amendments on incidence of damping-off and root-rot of sunflower at Nubaria province (combined analysis of 2010 and 2011 summer seasons).

Soil amendments	Damping-off (%)		Root-rot (%)
	Pre	Post	
Without treatment (control)	31.6	23.6	34.9
Rice straw + EM$_1$	18.7	12.9	23.6
Rice straw + EM$_1$+ urea	12.0	8.5	17.0
Biochar + compost	15.3	9.5	20.9
Compost	25.1	18.0	30.1
Animal manure	27.9	20.5	32.4
EM-bokashi	21.1	15.2	25.8

Means having similar letters at same column has no significant differences at $P \geq 0.05$.

2.2. Fungal pathogens and rhizospheric microbial populations

Data presented in table (6) indicate that all soil amendments except cow manure decreased populations of the associated fungal pathogens significantly, i.e. *M. phaseolina*, *S. rolfsii* and *R. solani*. The most effective treatment was rice straw + EM$_1$+ urea for all fungal pathogens, followed by the biochar + compost, then rice straw + EM$_1$, and EM-bokashi amendments. However, the cow manure did not exhibit any significant effect. Similarly as reported by Abdel-Ati and El-Hadidy, Abeer (2013) and Kausar et al. (2014). The decline in the inoculum potential of *M. phaseolina* by incorporation of organic amendments might be due to the release of toxicants (Mehta et al., 2012).

Results illustrated that all soil amendments, except cow manure increased the population beneficial microbial soil; the stimulated saprophytic microbial soil population depleted the nitrogen level or changes its form in the soil, resulting in impairing the infection process by the pathogen. (Mehta et al., 2012 and Larkin 2015).

2.3. Sunflower growth and productivity

Results shown in table (7) indicate that effect of applying the different soil amendments to the rhizosphere of sunflower var. Giza 102 grown under Nubaria province conditions and infested with root-rot and damping off diseases, during 2010 and 2011 summer seasons, increased significantly all the studied growth and yield parameters; i.e. plant height (cm), head diameter (cm), head weight (g), seed weight/head (g), 100 seed weight "seed index" (g), biological yield (ton/fed), seed yield (ton/fed), straw yield (ton/fed) and the oil yield (ton/fed), compared to the control treatment. The highest significant observations were obtained from rice straw + EM_1 + urea, biochar + compost, Rice straw + EM_1 and EM-bokashi with no significant differences, compost, and animal manure, respectively, compared to the control treatment (without soil amendment). This may be due to that soil amendments improve the soil properties by improving the soil structure, enhancing plant soil water relations and fertility (Bonanomi et al., 2010). Organic manures as well contain many plant nutrients (nitrogen, phosphorus, potassium and many other essential nutrients) and it also increases infiltration of water and enhances retention of nutrients, reduces wind and water erosion, thus promoting plant growth and productivity as reported by Higa (2000).

Table (6). Effect of different soil amendments treatments on *M. phasolina*, *S. rolfsii*, *R. solani* and microbial populations of sunflower at 0, 15, 45 and 90 days after sowing (colonies x10^3 /g soil) in Nubaria province (mean of 2010 and 2011 summer seasons).

Studied characters	**days After sowing date**	**Soil amendments treatments**						
		WT	**RS-EM_1**	**RS-EM1-U**	**B-C**	**Comp.**	**AM**	**EM-B**
M. phusolina	0	45.2Db	45.3Ab	45.7Aa	45.7Aa	45.5Aa	45.6Da	45.5Aa
	15	46.6Ca	43.7Bb	39.8Bc	43.8Bb	45.3Aa	47.5Ba	44.7Ba
	45	48.7Aa	38.2Dc	30.4Dd	36.4Dc	43.4Bb	48.0Aa	38.5Dc
	90	47.6Ba	40.8Cb	30.7Cc	38.1Cb	45.5Aa	46.9Ca	41.2Cb
S. rolfsii	0	43.3Cb	43.2Ab	42.6Ac	44.3Aa	43.0Ab	43.1Bb	43.7Ab
	15	45.4Ba	41.5Bd	39.5Bd	42.2Bc	43.6Ab	45.3Aa	43.1Bb
	45	47.6Aa	37.6Cd	29.1Df	34.5De	42.3Bc	43.2Bb	42.3Cc
	90	43.7Ca	36.1Dc	32.2Cd	35.4Cd	43.6Aa	39.3Cb	43.2Ba
R. solani	0	44.6Db	42.9Ad	45.2Aa	44.0Ab	43.8Bc	44.3Cb	43.8Dc
	15	45.4Ca	42.8Ad	43.0Bc	42.5Bd	43.7Bc	45.1Ba	44.0Cb
	45	46.9Bb	42.9Ac	38.9De	40.3Cd	46.6Ab	48.2Aa	46.8Bb
	90	47.2Ab	42.7Ad	41.2Cd	40.6Ce	46.7Ac	48.6Aa	47.3Ab
Total microbial populations	0	14.7Db	14.7Db	14.3Dc	14.3Dc	14.3Dc	15.0Da	14.7Db
	15	33.8Ce	54.1Cb	58.1Ca	57.9Ca	52.7Cc	48.5Cd	54.7Cb
	45	44.7Ae	88.2Ab	95.3Aa	95.0Aa	88.4Ab	77.3Ad	86.5Ac
	90	38.5Bbc	83.7Bb	86.8Ba	86.5Ba	79.9Bc	71.3Bd	84.1Bb

- **WT**= Without treatment (control), **RS- EM_1** = Rice straw + EM_1, **RS- EM1-U**= Rice Straw + EM1+ urea, **B-C**= Biochar + compost, **Comp.** =Compost, **AM**= Animal manure, **EM-B** = EM-bokashi.
- Means having similar Capital letters at same column and similar small letters at same raw under each studied character has no significant differences at $P \geq 0.05$.

Table (7). Effect of different soil amendment treatments on sunflower var. Giza 102 growth and yield and its components grown under Nubaria province conditions (combined analysis of 2010 and 2011 summer seasons).

Soil amendment treatments	**Studied characters**								
	Plant height (cm)	**Head dia-meter (cm)**	**Head weight (g)**	**Seed weight /head (g)**	**100 seed weight (g)**	**Bio-logical yield (ton/fed)**	**Seed yield (ton/fed)**	**Straw yield (ton/fed)**	**Oil yield (ton/fed)**
WT	59.6f	7.3f	40.6f	16.1f	3.02f	3.1f	0.6f	2.5f	0.078f
RS- EM_1	104.9c	12.8c	71.4c	28.2c	5.31c	5.4c	1.1c	4.3c	0.126c
RS- EM_1-U	122.5a	14.9a	83.4a	33.0a	6.21a	6.4a	1.3a	5.1a	0.147a
B-C	116.2b	14.1b	79.1b	31.3b	5.89b	5.4b	1.2b	4.2b	0.139b
Comp.	92.8d	11.3d	63.1d	24.9d	4.70d	4.8d	1.0d	3.8d	0.111d
AM	86.3e	10.5e	58.7e	23.2e	4.37e	4.5e	0.9e	3.6e	0.103e
EM-B	104.5c	7.3f	71.1c	28.1c	5.29c	4.5c	1.1c	3.4c	0.125c

- **WT**= Without treatment (control), **RS- EM_1** = Rice straw + EM_1, **RS- EM1-U**= Rice Straw + EM1 + urea, **B-C**= Biochar + compost, **Comp.** =Compost, **AM**= Animal manure, **EM-B** = EM-bokashi.
- Means having similar letters at same column has no significant differences at $P \geq 0.05$.

As a general deduction; soil amendments (organic manure) is a natural farming crop production system that has many values added to the crops, farmers and environment. It contains many plant nutrients; i.e. nitrogen, phosphorus, potassium and many other essential nutrients in low prices. It improves the soil properties by adjusting the pH, increases the water infiltration into the soil and enhances retention of nutrients, thus promotes growth of beneficial microorganisms that help plants to resist soil borne diseases; therefore enhance significantly plant growth, chemical composition and yield and its attributes. Moreover, it also helps in CO_2 restoration in soil and reduces of CO_2 emissions into the atmosphere causing the global warming.

3. Effect of the Interaction between Irrigation and Soil Amendments Treatments on;

3.1. Disease incidence

Data represented in table (8) indicate that the most effective treatment for suppressing disease incidence was the interaction between irrigation treatments {(the normal irrigation) followed by (missing the 3rd irrigation) then (missing the 5th irrigation), respectively} × the soil amendments treatments {(rice straw +EM1+ urea), (biochar-compost), (rice straw-EM1), (bokashi), (compost) and (cow manure), respectively}, compared with normal irrigation × without treatment as the control treatment.

Table (8). Effect of the interaction between different irrigation and soil amendment treatments on incidence of damping-off and root-rot of sunflower at Nubaria province (combined analysis of 2010 and 2011 summer seasons).

Soil amendment treatments	**Normal (control)**			**Missing 3rd irr.**			**Missing 5th irr.**		
	Damping off (%)		**Root-rot (%)**	**Damping off (%)**		**Root-rot (%)**	**Damping off (%)**		**Root-rot (%)**
	Pre	**Post**		**Pre**	**Post**		**Pre**	**Post**	
WT	28.6 Ac	19.8 Ac	29.3 Ac	30.7 Ab	24.5 Ab	35.0 Ab	35.6 Aa	26.5 Aa	40.3 Aa
RS- EM$_1$	14.8 Ec	10.8 Ec	20.9 Ec	20.4 Eb	14.3 Eb	22.6 Eb	20.9 Ea	13.5 Ea	27.2 Ea
RS- EM$_1$-U	9.6 Fc	6.3 Fc	11.7 Fc	12.7 Fb	9.6 Fb	17.7 Fb	13.7 Fa	9.5 Fa	21.5 Fa
B-C	11.7 Gc	7.8 Gc	17.8 Gc	17.8 Gb	11.2 Gb	19.5 Gb	16.5 Ga	9.6 Ga	25.3 Ga
Comp.	21.7 Cc	14.8 Cc	25.6 Cc	25.5 Cb	19.7 Cb	28.9 Cb	28.2 Ca	19.5 Ca	35.7 Ca
AM	24.6 Bb	16.4 Bb	27.4 Bb	27.7 Bb	22.9 Bb	32.3 Bb	31.4 Ba	22.3 Ba	37.5 Ba
EM-B	16.4 Dc	12.7 Dc	22.3 Dc	22.7 Db	16.8 Db	25.5 Db	24.3 Da	16.2 Da	29.5 Da

- **WT**= Without treatment (control), **RS- EM$_1$** = Rice straw + EM$_1$, **RS- EM1-U**= Rice Straw + EM1+ urea, **B-C**= Biochar + compost, **Comp.** =Compost, **AM**= Animal manure, **EM-B** = EM-bokashi.
- Means having similar Capital letters at same column and similar small letters at same raw under each studied character has no significant differences at $P \geq 0.05$.

Damping off was suppressed, by the interaction treatments of (rice straw +EM1+ urea) × {(the normal irrigation) followed by (missing the 3rd irrigation) then (missing the 5th irrigation)}, respectively, at both the pre and post emergence stages. Similarly root-rot, was highly suppressed by the same consequences; i.e. the interaction of (rice straw +EM1+ urea) × {(the normal irrigation) followed by (missing the 3rd irrigation) then (missing the 5th irrigation)}, respectively.

The mode of action for the interaction between irrigation treatments and soil amendmants treatments, specifically rice straw + EM1 + urea, in suppressing *M. phasolinae, S. rolfsii* and *R. solani* could be understood as follows; when soil amendments were added while enough soil water content was available; the beneficial microorganisms such as EM1 can promote the soil conditions enriching the soil biota after adjusting the C: N ratio and pH.

Thus, induce the release of ammonia and ammonia related compounds in the rhizosphere to suppress the carpogonia germination of sclerotia of *S. sclerotiorum* (Higa, 2000 and Huang et al., 2002). Meanwhile, application of urea to the soil was effective in preventing carpogenic germination of sclerotia of *S. sclertiorum* that were not in direct contact with the soil , as ammonia is a key toxic component for the suppression of this pathogen. Yet, chemical nitrogen fertilization shouldn't be applied in high concentration in a short time period particularly in an infested area, because it provides the preferable conditions for the soil borne diseases to produce its mass injury (Huang et al., 2002).

3.2. Fungal pathogens and rhizospheric microbial populations

Data in tables (9, 10, 11 and 12) represent the effect of the interaction among irrigation treatments and soil amendment treatments on the three fungal pathogens and microbial populations of sunflower rhizosphere grown in Nubaria province, during 2010 and 2011 summer seasons (combined analysis). The observations indicated that, in 0, 15, 45 and 90 days after sowing dates, the interaction treatments between irrigation and soil amendments decreased significantly the populations of sunflower rhizoshpere associated fungal pathogens; i.e. *M. phaseolina*, *S. rolfsii* and *R. solani*, while rhisospheric microbial populations increased. The lowest populations of three pathogens was obtained by the interaction treatments of (rice straw + EM1+ urea) × {(missing the 5th irrigation) followed by (missing the 3rd irrigation) then (the normal irrigation). This agrees with Lumsden et al. (1982), Rukmani and Mariappan (1990), Bonanomi et al. (2007) and Sudha and Prabhu (2008). The highest microbial population was obtained by the interaction treatments of (rice straw +EM1+ urea) × {(the normal irrigation) followed by (missing the 3rd irrigation) then (missing the 5th irrigation), this agrees with Kausar et al. (2014) and Larkin (2015). This could be understood though what Higa (2000) told; that when the soil amendments was fermented with $EM_{1,}$ while incorporation into the soil particularly when enough soil moisture is available, it improves the soil conditions towards the dominancy of the beneficial microorganisms in the soil and vice versa for the pathogenic ones. The mode of action includes improving the soil physical and chemical properties and release of some bio-chemicals in the soil such as esters, organic acids, phenols and urea compounds. This increase the total count of the rhizosphere beneficial microorganisms and *vice versa*, the decay microorganisms, thus enhance the plant growth and productivity (Toyoto and Kimara, 1991).

Table (9). Effect of the interaction between different irrigation and soil amendments on *Macrophomina phasolinae* populations in sunflower rhizosphere grown at Nubaria province 0, 15, 45 and 90 days after sowing (colonies x10^3 /g soil) (combined analysis of 2010 and 2011 summer seasons).

Soil amendment treatments	**Normal (control)**				**Missing 3rd Irr.**				**Missing 5th Irr.**			
	Days after sowing				**Days after sowing**				**Days after sowing**			
	0	**15**	**45**	**90**	**0**	**15**	**45**	**90**	**0**	**15**	**45**	**90**
WT	47.5Aa	49.6Aa	52.4Aa	49.6Aa	45.5Ab	47.6Ab	50.4Aa	47.6Ab	42.5Ac	42.6Bbc	43.4Bc	45.6Ac
RS- EM$_1$	47.6Aa	46.0Ca	40.1Ca	42.5Da	45.6Ab	44.0Bb	38.4Cb	40.5Cb	42.6Ac	41.0Bc	36.1Cc	39.5Cb
RS- EM$_1$-U	47.7Aa	41.8Da	32.4Ea	32.7Fa	45.7Ab	39.8Db	30.4Db	30.7Eb	43.7Ac	37.8Cc	28.4Dc	28.7Dc
B-C	47.7Aa	45.8CDa	38.4Da	40.1Ea	45.7Ab	43.8BDb	36.4Cb	38.1Db	43.7Ac	41.8Bb	34.4Cc	36.1Cc
Comp.	47.5Aa	47.3Ba	45.4Ba	47.5Ca	45.5Ab	45.3Bb	43.4Bb	45.5Bb	43.5Ac	43.3Ac	41.4Bc	43.5Bc
AM	47.6Aa	49.5Aa	50.0Aa	48.9Ba	45.6Ab	47.5Ab	48.0Ab	46.9Ab	43.6Ac	45.5Ac	46.0Ac	44.9Ac
EM-B	47.5Aa	46.7Ca	40.5Ca	42.5Da	45.5Ab	44.7Bb	38.5Cb	42.5Ca	43.5Ac	42.7Ac	36.5Cc	38.5Cb

- **WT**= Without treatment (control), **RS- EM$_1$** = Rice straw + EM$_1$, **RS- EM1-U**= Rice Straw + EM1+ urea, **B-C**= Biochar + compost, **Comp.** =Compost, **AM**= Animal manure, **EM-B** = EM-bokashi.
- Means having similar Capital letters at same column and similar small letters at same raw under each studied character has no significant differences at $P \geq 0.05$.

Table (10). Effect of the interaction between different irrigation and soil amendments on *Sclerotium rolfsii* populations in sunflower rhizosphere grown at Nubaria province 0, 15, 45 and 90 days after sowing (colonies x10^3 /g soil) (combined analysis of 2010 and 2011 summer seasons).

Soil amendment treatments	**Normal (control)**				**Missing 3rd Irr.**				**Missing 5th Irr.**			
	Days after sowing				**Days after sowing**				**Days after sowing**			
	0	**15**	**45**	**90**	**0**	**15**	**45**	**90**	**0**	**15**	**45**	**90**
WT	45.6Aa	47.7Aa	49.6Aa	46.0Aa	43.6Ab	45.7Ab	47.6Ab	44.0Ab	40.6Ac	42.7Ac	45.6Ac	41.0Ac
RS- EM1	45.2Aa	42.8Ca	39.6Ca	38.1Ca	43.2Ab	40.8Bb	37.6Cb	36.1Bb	41.2Ac	40.8Cb	35.6Cb	34.1Dc
RS- EM1-U	44.6Aa	41.5Da	31.4Da	33.5Da	42.6Ab	39.5Cb	28.4Db	32.5Ca	40.6Ac	37.5Dc	27.4Db	30.5Db
B-C	46.3Aa	44.2BCa	36.5Ca	37.4Ca	44.3Ab	42.2Bb	34.5Cb	35.4Cb	42.3Ac	40.2Cc	32.5Cc	33.4Db
Comp.	45.0Aa	45.6Ba	44.3Ba	45.6Aa	43.0Ab	43.6Ab	42.3Bb	43.6Ab	41.0Ac	41.6Bc	40.3Bc	41.6Bc
AM	45.1Aa	47.3Aa	45.2Ba	41.3Ba	43.1Ab	45.3Ab	43.2Bb	39.3Bb	41.1Ac	43.3Ac	41.2Bc	37.3Cc
EM-B	45.7Aa	45.1Ba	44.3Ba	45.2Aa	43.7Ab	43.1Ab	42.3Bb	43.2Ab	41.7Ac	41.1Bc	40.3Bc	41.2Bc

- **WT**= Without Treatment (control), **RS- EM$_1$** = Rice straw + EM$_1$, **RS- EM1-U**= Rice Straw + EM1+ urea, **B-C**= Biochar + compost, **Comp.** =Compost, **AM**= Animal manure, **EM-B** = EM-bokashi.
- Means having similar Capital letters at same column and similar small letters at same raw under each studied character has no significant differences at $P \geq 0.05$.

Table (11). Effect of the interaction between different irrigation and soil amendments on *Rhizoctonia solani* populations in sunflower rhizosphere grown at Nubaria province 0, 15, 45 and 90 days after sowing (colonies x10^{3} /g soil) (combined analysis of 2010 and 2011 summer seasons).

Soil amendment treatments	Normal (control)				Missing 3rd Irr.				Missing 5th Irr.			
	Days after sowing				Days after sowing				Days after sowing			
	0	15	45	90	0	15	45	90	0	15	45	90
WT	46.6Ab	48.7Aa	51.6Aa	50.5Aa	44.6Ac	44.7Ac	45.6Ab	46.5Ab	42.6Ac	42.7Ac	43.6Ac	44.5Ac
RS- EM1	45.6Aa	45.1Ba	43.2Bb	43.0Bb	42.6Ab	42.1Bb	43.2Bb	43.0Bb	40.6Ab	41.1Ab	42.2Bb	42.0Cb
RS- EM1-U	46.5Aa	44.3Bb	40.2Bc	42.5Bb	46.5Aa	44.3Bb	40.2Bc	42.5Bb	42.5Ab	40.3Ac	36.2Cd	38.5Cd
B-C	46.0Aa	44.5Ba	42.3Bb	42.6Bb	44.0Aa	42.5Bb	40.3Bb	40.6Bb	42.0Ab	40.5Ab	38.3Cc	38.6Cc
Comp.	45.8Aa	45.4Ba	48.6Aa	48.0Aa	43.8Ab	43.4Bb	46.6Aa	47.0Aa	41.8Ab	42.4Ab	44.6Bb	45.0Ba
AM	46.3Aa	47.1Aa	50.2Aa	50.6Aa	44.3Ab	45.1Ab	48.2Aa	48.6Aa	42.3bA	43.1Ab	46.2Aa	46.6Aa
EM-B	45.8Aa	46.0Ba	49.5Aa	51.0Aa	43.8Ab	44.0Bb	47.5Aa	47.0Aa	41.8Ab	42.0Ab	43.5Bb	44.0Bb

- **WT**= Without treatment (control), **RS- EM$_1$** = Rice straw + EM$_1$, **RS- EM1-U**= Rice Straw + EM1+ urea, **B-C**= Biochar + compost, **Comp.** =Compost, **AM**= Animal manure, **EM-B** = EM-bokashi.
- Means having similar Capital letters at same column and similar small letters at same raw under each studied character has no significant differences at $P \geq 0.05$.

Table (12). Effect of the interaction between different irrigation and soil amendments on total microbial populations of sunflower rhizosphere grown at Nubaria province and infested with damping-off and root-rot (combined analysis of 2010 and 2011 summer seasons).

Soil amendment treatments	Normal (control)				Missing 3rd Irr.				Missing 5th Irr.			
	Days after sowing				Days after sowing				Days after sowing			
	0	15	45	90	0	15	45	90	0	15	30	90
WT	15Ae	43.4Cb	56.4Ca	51.2Ca	14Ae	31.4Cc	41.4Cb	35.7Cc	15Ae	26.1Cd	36.4Cc	28.7Cd
RS- EM1	15Ae	60.5Bc	97.6Ba	94.2Aa	15Ae	54.5Ac	86.5Ab	81.3Ab	14Ae	47.2Ad	80.4Ab	75.7Ab
RS- EM1-U	16Ad	66.5Ac	115.2Aa	97.5Aa	14Ad	57.7Ac	88.6Ab	84.5Ab	13Ad	50.1Ac	82.1Ab	78.4Ab
B-C	16Ae	67.5Ac	117.5Aa	102.3Aa	13Ae	56.5Ad	86.4Ab	82.3Ab	14Ae	49.6Ad	81.2Ab	74.9Ac
Comp.	16Ad	63.4Bc	114.8Aa	98.6Aa	13Ad	51.6Bc	78.6Bb	72.4Bb	14Ad	43.2Bc	71.9Bb	68.7Bb
AM	15Ad	57.4Bc	87.6Ba	81.5Ba	15Ad	47.8Bc	74.6Ba	68.9Bb	15Ad	40.2Bc	69.8Bb	63.6Bb
EM-B	16Ad	65.7Ac	96.4Ba	95.5Aa	14Ad	52.6Bc	84.7Ab	80.2Ab	14Ad	45.7Ac	78.5Ab	76.5Ab

- **WT**= Without Treatment (control), **RS- EM$_1$** = Rice straw + EM$_1$, **RS- EM1-U**= Rice Straw + EM1+ urea, **B-C**= Biochar + compost, **Comp.** = Compost, **AM**= Animal manure, **EM-B** = EM-bokashi.
- Means having similar Capital letters at same column and similar small letters at same raw under each studied character has no significant differences at $P \geq 0.05$.

3.2. Sunflower growth and productivity

Data presented in table (13) indicate that all the interactions amongst the different irrigation and different soil amendment treatments increased significantly all the studied characters; i.e. plant height (cm), head diameter (cm), head weight (g), seed weight/head (g), 100 seed weight "seed index" (g), biological yield (ton/fed), seed yield (ton/fed), straw yield (ton/fed) and the oil yield (ton/fed) of sunflower grown at Nubaria province and infested with root-rot and damping off diseases, during 2010 and 2011 summer seasons and compared to the control treatment (Normal irrigation × without treatment). The highest observations were obtained from the interaction {normal irrigation × (rice straw- EM_1- urea)}, while under the moderate water stress conditions, when missing the 3rd irrigation (vegetative phenolic stage). The highest observations were obtained from the interaction {missing the 3rd irrigation × (rice straw- EM_1- urea)}. Yet, under the severe drought conditions, when missing the 5th irrigation (flowering phenolic stage) the highest observations were obtained from the interaction {missing the 5th irrigation × (rice straw- EM_1- urea)}. This can be understood in the light of what reported by Guest (1995), Higa (2000) and Carmen et al. (2015), who told that organic farming as an environmental friendly method of cultivation provides several benefits to the farmers, especially under water stress conditions, because it contains many plant nutrients (nitrogen, phosphorus, potassium and many other essential nutrients). It also increases infiltration of water and enhances retention of nutrients, reduces wind and water erosion and promotes growth of beneficial organisms that help plants to resist soil borne diseases. Moreover, it helps in CO_2 restoration in soil and reduces of CO_2 emissions into the atmosphere that produce global worming (Ross, 2008). The organic fertilization treatments such as: EM-bokashi, biochar, compost and animal dung stimulated plant resistance to soil-borne diseases, therefore enhanced significantly plant growth, yield and its attributes and chemical composition (Abdel-Ati and El-Hadidy, Abeer, 2013 and Salmani et al., 2014).

Table (13). Effect of the interaction between different irrigation and soil amendment treatments on sunflower var. Giza 102 growth and yield and its components grown under Nubaria province conditions (combined analysis of 2010 and 2011 summer seasons).

Irrigation treatments	Soil amendment treatments	Studied Characters								
		Plant height (cm)	Head dia-meter (cm)	Head weight (g)	Seed weight /head (g)	100 Seed weight (g)	Bio-logical yield (ton/fed)	Seed yield (ton/fed)	Straw yield (ton/fed)	Oil yield (ton/fed)
Normal (control)	**WT**	87.1j	10.6j	59.2j	23.4j	4.4j	4.5j	0.9j	3.6j	0.104j
	RS- EM$_1$	126.9c	15.4c	86.4c	34.1c	6.4c	6.6c	1.4c	5.2c	0.152c
	RS- EM$_1$-U	147.6a	18.0a	100.4a	39.7a	7.5a	7.7a	1.6a	6.1a	0.177a
	B-C	140.2b	17.0b	95.4b	37.7b	7.1b	7.3b	1.5b	5.8b	0.168b
	Comp.	100.3h	12.2h	68.3h	26.9h	5.1h	5.2h	1.1h	4.4h	0.120h
	AM	93.0i	11.3i	63.3i	25.0i	4.7i	4.8i	1.0i	3.8i	0. 112i
	EM-B	113.7ef	13.8ef	77.3ef	30.6ef	5.8ef	5.9ef	1.2ef	4.7ef	0.136ef
Missing 3rd irr.	**WT**	53.1n	6.5n	36.2n	14.3n	2.7n	2.8n	0.6n	2.2n	0.064n
	RS- EM$_1$	106.3g	12.9g	72.3g	28.6g	5.3g	5.5g	1.1g	4.4g	0.128g
	RS- EM$_1$-U	118.1d	14.3d	80.4d	31.8d	5.9d	6.1d	1.3d	4.8de	0.142d
	B-C	115.7de	14.1de	78.8de	31.1de	5.9de	6.0de	1.2de	4.8de	0.139de
	Comp.	101.6h	12.4h	69.1h	27.3h	5.1h	5.3h	1.1h	4.2h	0.122h
	AM	94.5i	11.5i	64.3i	25.4i	4.8i	4.9i	1.1i	3.8i	0.113i
	EM-B	112.2f	13.7f	76.4f	30.2f	5.7f	5.8f	1.2f	4.6f	0.135f
Missing 5th irr.	**WT**	38.7o	4.7o	26.3o	10.4o	1.9o	2.0o	0.4o	1.6o	0.046o
	RS- EM$_1$	81.5k	9.9k	55.5k	21.9k	4.1k	4.2k	0.9k	3.3k	0.098k
	RS- EM$_1$-U	101.9h	12.4h	69.3h	24.4h	5.2h	5.3h	1.1h	4.2h	0.122h
	B-C	92.7i	11.3i	63.1i	24.9i	4.7i	4.8i	0.9i	3.9i	0.111i
	Comp.	76.4l	9.3l	51.9l	2.06l	3.9l	3.9l	0.8l	3.1l	0.092l
	AM	71.3m	8.7m	48.5m	19.2m	3.6m	3.7m	0.7m	3.0m	0.083m
	EM-B	87.6j	10.7j	59.6j	23.6j	4.4j	4.5j	0.9j	3.6j	0.105j

- **WT**= Without treatment (control), **RS- EM$_1$** = Rice straw + EM$_1$, **RS- EM1-U**= Rice Straw + EM1+ urea, **B-C**= Biochar + compost, **Comp.** =Compost, **AM**= Animal manure, **EM-B** = EM-bokashi.
- Means having similar letters at same column has no significant differences at $P \geq 0.05$.

CONCLUSION

Biotic and abiotic stresses are the main challenges that face the universal agricultural production, yet, soil borne diseases and drought, respectively, will remain the most serious ones, particularly when integrated together to challenge the plant growth and productivity. Likewise this study; drought and soil borne diseases were integrated together to challenge the sunflower growth and productivity under the desert conditions of Nubaria province, Egypt. Under these conditions, ensuring the moderate irrigation water supply to the infested plants with root-rot and damping-off will remain the first key issue to mitigate the disease infection consequences. If the water scarcity is the dominant condition, then soil amendments will deliver the second issue to mitigate diseases bad consequences within several effective modes of actions. However, when drought and soil borne diseases are untied to challenge the plant together, the integration between irrigation and soil amendments will be the most effective ecofriendly strategy to overcome these dramatic conditions to conserve the environment and produce an appreciated yield.

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تقييم إنتاجية عباد الشمس ومقاومة عفن الجذور وموت البادرات بإستخدام بعض الممارسات الزراعية

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أقيمت تجربتان حقليتان في مزرعة ٦ أكتوبر النموذجية بالنوبارية بمحافظة البحيرة خلال الموسمين الصيفيين المتتابعين (٢٠١٠ و٢٠١١)، وذلك لدراسة تأثير بعض العمليات الزراعية مثل معاملات ري وإضافات التربة المختلفة على نمو وإنتاجية وتثبيط كلًا من أمراض موت البادرات وعفن الجذور لمحصول عباد الشمس صنف جيزه ١٠٢. قبل تجربة الحقل أجري إختبار القدرة المرضية للفطريات المعزولة من نباتات ظهرت عليها أعراض أعفان الجذور، وقد أظهرت تلك الفطريات أعلى قدرة مرضية
Rhizoctonia solani, *Sclerotium rolfisii*, *Macrophomina phasolina*

أظهرت النتائج أن غياب الرية الثالثة كان أفضل من غياب الرية الخامسة بالمقارنة بمعاملة الري الموصى بها والتي أعطت أعلى النتائج لنمو وإنتاجية عباد الشمس. أظهرت معاملات إضافات التربة زيادة في مقاومة نبات عباد الشمس للأمراض الكامنة بالتربة بجانب زيادة النمو والمحصول. حيث تم التوصل إلي أفضل النتائج من المعاملات التالية على الترتيب: قش الأرز EM1 + يوريا، بيوتشار + كمبوست، قش أرز+ EM1، EM بوكاشى، بينما لم يوجد إختلافات معنوية بين المعاملات الكمبوست والسماد البلدي، وذلك بالمقارنه بمعاملة المقارنة (الغير معامل بإضافات التربه). أوضحت نتائج التفاعل بين معاملات الري (العادي – غياب الرية الثالثة – غياب الرية الخامسة) مع معاملة إضافة التربة (قش الأرز + EM1 + يوريا) أفضلية عن معاملات التفاعل الأخرى تحت ظروف الري العادي و الجفاف والمتوسط والشديد وبالمقارنة بمعاملة المقارنة (الري العادي × خالي من إضافات التربة).