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EFFECT OF VERMICOMPOST TREATMENTS AND EM1 ON ONION WHITE ROT DISEASE

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ABSTRACT

Effects of vermicompost, Effective microorganisms (EM1) and the combination between vercompost and EM1 were applied to manage white rot of onion caused by *Sclerotium cepivorum* Berk. under greenhouse and field trials at Mallawy Agric. Res. St., Menia Governorate. The recommended fungicide Folicure 25% EC (tebuconazole 25%) was used as comparison.

All treatments under investigation either under greenhouse or field conditions reduced the percentage of infection by white rot of onion compared with untreated plants. The combination between vermicompost and EM1 under greenhouse or open field conditions was more effective in reducing the disease more than single treatments.

From other hand, all treatments under investigation increased the all assessment parameters i.e., onion bulb yield, plant height, no. of leaves/plant, bulb diameter, fresh and dry bulb weight compared with untreated plants. Vermicompost treatment at the rate of 5 ton/fed combined with EM1 treatment was the best treatment for increasing onion bulb yield more than control and Folicure treatment.

Key words: Effective microorganisms, EM1, *Sclerotium cepivorum,* vermicompost and white rot of onion.

1. INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important vegetable crops grown in Egypt, not only for local consumption but also for exportation. It is also used as medicinal plant in controlling human and plant diseases **(Vohora et al., 1974).** The first record for white rot disease in Egypt was in 1931 by Nattrass at Maghagha county, Minia governorate. Fungal disease control is achieved through the use of fungicides which is hazardous and toxic to both people and domestic animals and leads to environmental pollution. Many studies have been conducted to manage the disease biologically (**Abd El-Moityand Shatla, 1981 and Amin, 2003)**, chemically **(Kay and Stewart, 1994 and Khaled et al., 1997),** with solarization **(Porter and Merriman, 1983, Basallote-Ureba and Merlero-Vara, 1993),** as well as with soil amendments and agricultural practices **(Salama *et al*., 1988 and Amin and Fawaz 2015).** Red worm castings contain a high percentage of humus Vermicompost is the excreta of earthworm, which are capable of improving soil health and nutrient status. Vermiculture is a process by which all types of biode- gradable wastes such as farm wastes, kitchen wastes, market wastes, bio-wastes of agro based industries, live- stock wastes etc. are converted while passing through the worm-gut to nutrient rich vermicompost. Vermi worms are used here act as biological agents to consume those wastes and to deposit excreta in the process called vermicompost **(Adhikary, 2012).** The technology of effective microorganisms (EM) is a proven method for increasing

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crop yields in natural farming **(Higa, 1998).** EM solutions, which contain naturally occurring microorganisms, enhance the value of organic matter by accelerating its decomposition and releasing greater quantities of nutrients for crop utilization **(Higa and Wididana, 1991). Duan *et al*., 2005 and Awad and El-Ghamry, 2007**). Showed that effective microorganisms at 0.4% could promote potato growing and resistance to diseases, and therefore increasing the yield and enable better uptake of nutrients from the soil.
The present study aims to evaluate organic compound that is, Inicium, Vermicompost and Effective Microorganisms (EM1) as resistance inducers on onion plants against onion white rot diseases under greenhouse and field conditions. Also, its effect on growth parameters and yield parameters of onion Giza 6 cv. were studded in field.

2. MATERIALS AND METHODS

Sclerotium cepivorum

An isolate of *S. cepivorum* was isolated from infected onion plants collected from Menia Governorate. Identified based on the morphological characteristics as mentioned by **Mordue (1976)**. The isolate was used to inoculate sterilized barley seeds medium for 3 weeks at 20^{o} C (**Van der Meer *et al*., 1983)** and used as inoculum.

Effective Microorganisms (EM1) (EM)

EM1 was prepared and collected from Ministry of Agriculture, Egypt (Under license of EMRO, Japan).

Vermicompost

Vermicompost in this investigation was collected from (Central Laboratory for Agricultural Climate, ARC, Giza, Egypt). The system of vermicomposting was conducted as described by **(Abul-Soud *et al*., 2009).** Characteristics of used compost are shown in Table (1).

Table (1): Chemical analysis of used vermicompost.

Property	N	P	K	C	C/N ratio
Value (%)	1.71	0.79	1.51	11.7	6.84

Greenhouse experiments

Pot experiments were carried out in the greenhouse of Onion, Garlic and Oil Crops, Plant Path. Res. Inst., ARC during 2012/2013 season to evaluate onion white rot incidence under different treatments.

Plastic pots (25-cm-diam.) filled with sterilized sand-clay soil (1:1 v/v) were infested with the prepared *S. cepivorum* inoculum at the rate of 2 % w/w, 7 days before transplanting. Four pots were used for each treatment and control (infested pots free treatment). Five seedlings of Giza 6 cv. (60-day-old) were transplanted in each pot at November and irrigated when needed.

Compost treatment

Compost was mixed with soil 7 days before transplanting at the rate of 1, 2, 3, 4, 5, and 6% w/w.

EM1 treatment

Onion transplants were dipped for 15 min. in EM1 suspension mixed with 1% arabic gum and left to dry for one hour before transplantation.

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The combination between vermicompost and EM1 treatment

vermicompost was mixed with soil 7 days before transplanting at the rate of 1, 2, 3, 4, 5, and 6% w/w., and onion transplants were dipped for 15 min. in EM1 suspension mixed with 1% arabic gum and left to dry for one hour before transplantation.

Folicure treatment

The recommended fungicide, Folicure 25% EC (tebuconazole 25%) was used in this investigation as a comparison with the test treatments. Transplants were dipped for 5 min. in the Folicure 25% (25 ml/L water) just before transplanting then the grown plants were sprayed at 6 and 12 weeks after transplantation (187.5 ml/100L water).

Field experiments

Field experiments were carried out during 2014/2015 and 2015/2016 seasons in naturally infested soil with *S. cepivorum* the cause of onion white rot at Mallawy Agric. Res. St., Menia Governorate (Physical and chemical properties for soil are shown in Table, 2). The efficiency of vermicompost and EM1 for controlling onion white rot as well as its effect on yield and growth parameters were estimated at the end of each seasons in the presence of fungicide Folicure as chick control. Sixty days old, onion transplants (Giza 6 cv.) were transplanted in November. Experiments were designed as complete randomized blocks. Four replicate plots were used for each treatment and control. The area for each plot was 10.5 m2 (3.0 X 3.5 m). All treatments received the same normal agricultural practice until harvest at April. The percentages of infection, onion bulb yield, plant height, no. of leaves/plant, bulb diameter, fresh and dry bulb weight were estimated at harvest.

Table (2): Physical and chemical properties of soil, Mallawy Agri. Res. Stat., Menia Gov.

Property	Value
Mechanical analysis	
Sand %	8.10
Silt %	53.50
Clay %	37.85
Texture grade	Silty clay loan
pH (soil paste)	8.13
E.C (dsm^{-1}) at 25^{o}C	1.75
Soluble cations ($meqL^{-1}$)	
CA^{++}	8.45
Mg^{++}	3.80
Na^{+}	4.55
K^{+}	0.30
Soluble anions ($meqL^{-1}$)	
CO^{-}	0.00
$HCO3^{-}$	3.85
CL^{-}	5.90
$SO4^{-}$	7.50
Organic matter %	21.35
Total N %	8.45
Total soluble N (mg/Kg^{-1})	175.00
Available P (mg/Kg^{-1})	1.14

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Compost treatment

Compost has been added to the soil during processing for agriculture at the rate of 1, 2, 3, 4, 5 and 6 ton/fed.

EM1 treatment

Onion transplants were dipped for 15 min. in EM1 suspension mixed with 1% arabic gum and left to dry for one hour before transplantation.

The combination between compost and EM1 treatment

Compost has been added to the soil during processing for agriculture at the rate of 1, 2, 3, 4, 5 and 6 ton/fed, and onion transplants were dipped for 15 min. in EM1 suspension mixed with 1% arabic gum and left to dry for one hour before transplantation.

Folicure treatment

The recommended fungicide, Folicure 25% EC (tebuconazole 25%) was used in this investigation as a comparison to the test treatments. Seedlings were dipped for 5 min. in the Folicure 25% (25 ml/L water) just before transplanting then grown plants were sprayed at 6 and 12 weeks after transplantation (187.5 ml/100L water).

Disease index and estimated parameters

At the end of each season under greenhouse and open field percentage of infection (treatment-control/control X100) were assessment, while onion bulb yield, plant height, no. of leaves/plant, bulb diameter, fresh and dry bulb weight were estimated at harvest of each season under open field conditions only.

Statistical analysis:

The data were statistically analyzed and significance among means was assessed by least significant difference (LSD) at 5% probability level using SAS ANOVA program V.9 (Anonymous, 2014).

3. RESULTS

The data presented in Table (3) and (4) about percentage of infection show that, all treatments under investigation either under greenhouse or field conditions reduced the percentage of infection by white rot of onion compared with untreated plants (79.17 % in greenhouse and 63.54 and 65.00 in open field in 2014/15 and 2015/16 seasons for control respectively). In addition, the combination between vermicompost and EM1 under greenhouse or open field conditions was better than single treatments.

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Table (3): Effect of vermicompost, EM1 and fungicide Folicure (25%) on white rot infection of onion plants cv. Giza 6 under greenhouse conditions during growing seasons 2014/2015.

Treatment	% infection	% Efficacy
Vermicompost 1.0 ton/fed	70.84	10.52
Vermicompost 1.0 ton/fed + EM1	58.34	26.31
Vermicompost 2.0 ton/fed	62.50	21.05
Vermicompost 2.0 ton/fed + EM1	50.00	36.84
Vermicompost 3.0 ton/fed	54.17	31.58
Vermicompost 3.0 ton/fed + EM1	41.67	47.37
Vermicompost 4.0 ton/fed	41.67	47.37
Vermicompost 4.0 ton/fed + EM1	37.50	52.63
Vermicompost 5.0 ton/fed	29.17	63.16
Vermicompost 5.0 ton/fed + EM1	20.84	73.68
Vermicompost 6.0 ton/fed	37.50	52.63
Vermicompost 6.0 ton/fed + EM1	37.50	52.63
EM1	41.67	47.37
Folicur	12.50	84.21
Control	79.17	-
LSD	1.20	-

Whenever vermicompost concentrations until 5 ton/fed as a single or combined treatment with EM1 decreased percentage of infection inversely with the vermicompost concentrations, while the concentration at the rate of 6 ton vermicompost/fed increased the percentage of infection from previous concentrations either in greenhouse or open field.

Table (4): Effect of vermicompost, EM1 and fungicide Folicure (25%) on white rot infection of onion plants cv. Giza 6 under naturally infested soil with *S. cepivorum* located at Mallawi Agric. Res. Sta., Menia Governorate, during growing seasons 2014/2015 and 2015/2016.

Treatment	2014/15		2015/16	
	% infection	% Efficacy	% infection	% Efficacy
Vermicompost 1.0 ton/fed	61.98	2.46	61.46	5.45
Vermicompost 1.0 ton/fed + EM1	58.33	8.20	58.33	10.26
Vermicompost 2.0 ton/fed	61.46	3.28	61.46	5.45
Vermicompost 2.0 ton/fed + EM1	57.29	9.84	58.29	10.32
Vermicompost 3.0 ton/fed	51.04	19.67	52.08	19.87
Vermicompost 3.0 ton/fed + EM1	48.43	23.78	48.96	24.68
Vermicompost 4.0 ton/fed	45.83	27.87	45.83	29.49
Vermicompost 4.0 ton/fed + EM1	41.25	35.08	39.17	39.74
Vermicompost 5.0 ton/fed	20.83	67.22	22.48	65.42

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Vermicompost 5.0 ton/fed + EM1	19.79	68.85	21.88	66.34
Vermicompost 6.0 ton/fed	41.08	35.35	41.33	36.41
Vermicompost 6.0 ton/fed + EM1	40.71	35.93	41.08	36.80
EM1	26.04	59.02	27.92	57.05
Folicur	7.29	88.53	9.38	85.58
Control	63.54	-	65.00	-
LSD	1.73	-	2.04	-

Generally, the best treatment under investigation for controlling white rot of onion under greenhouse or open field was vermicompost at the rate of 5 ton/fed combined with EM1, which gave 20.84 % under greenhouse and 19.79 % and 21.88 % under open field conditions in 2014/15 and 2015/16 seasons respectively. It is very important to state that here that the Folicure treatment as a check control was better than any treatment under test either in greenhouse or in open field for decreasing the percentage of infection.

The data present in Table (5) show that all treatment under test increased bulb yield compared to non-treated plants. The most effective treatment in increasing bulb yield was vermicompost at the rate of 5 ton/fed combined with EM1 that gave 14.74 kg/plot and 15.00 kg/plot in 2014/15 and 2015/16 seasons respectively. There is a Proportional increase of onion bulb yield with vermicompost concentration. It is very important to state that, all vermicompost treatments at the rate of 4, 5 and 6 ton/fed either separate or combined with EM1 were better than Folicure treatment in which of increasing bulb yields.

Table (5): Effect of vermicompost, EM1 and fungicide Folicure (25%) on bulbs yield of onion under naturally infested soil with *S. cepivorum* at Mallawi Agric. Res. Sta., Menia Governorate, during growing seasons 2014/2015 and 2015/2016.

Treatment	2014/15		2015/16	
	Yield (kg/plot)	Increasing (%)	Yield (kg/plot)	Increasing (%)
Vermicompost 1.0 ton/fed	6.85	29.71	7.06	31.40
Vermicompost 1.0 ton/fed + EM1	9.60	81.73	9.94	84.88
Vermicompost 2.0 ton/fed	6.61	25.10	6.88	27.91
Vermicompost 2.0 ton/fed + EM1	9.31	76.25	9.63	79.07
Vermicompost 3.0 ton/fed	9.98	88.99	10.31	91.86
Vermicompost 3.0 ton/fed + EM1	11.41	116.13	11.81	119.77
Vermicompost 4.0 ton/fed	11.36	115.09	11.75	118.60
Vermicompost 4.0 ton/fed + EM1	12.54	137.41	12.75	137.21
Vermicompost 5.0 ton/fed	13.37	153.26	13.63	153.49
Vermicompost 5.0 ton/fed + EM1	14.74	179.09	15.00	179.07
Vermicompost 6.0 ton/fed	12.42	135.18	12.63	134.88
Vermicompost 6.0 ton/fed + EM1	14.22	169.20	14.44	168.60
EM1	12.39	134.65	12.63	134.88
Folicur	10.07	90.71	10.25	90.70
Control	5.28	-	5.38	-
LSD	0.58	-	0.58	-

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In respecting of plant height and no. of leaves/plant, all treatments under investigation as shown in Table (6) increased the mentioned parameters significantly more than untreated plants and Folicure treatments. Generally, the combination between vermicompost and EM1 was most effective more than single treatments. From other hand, there is a positive correlation between vermicompost concentration and increasing of tested parameters. The best treatment in increasing mentioned parameters was vermicompost at the rate of 6 ton/fed combined with EM1 which gave in case of plant height 64.66 and 64.43 cm while it gave 10.39 and 11.06 leaves/plant in the two successive seasons.

Table (6): Effect of vermicompost, EM1 and fungicide Folicure (25%) on plant height and no. of leaves/plant of onion at harvest under naturally infested soil with *S. cepivorum* at Mallawi Agric. Res. Sta., Menia Governorate, during growing seasons 2014/2015 and 2015/2016.

Treatment	Plant height (cm)		No. of leaves/plant	
	2014/15	2015/16	2014/15	2015/16
Vermicompost 1.0 ton/fed	53.17	53.72	8.56	9.00
Vermicompost 1.0 ton/fed + EM1	53.74	54.74	8.60	8.75
Vermicompost 2.0 ton/fed	54.77	55.76	8.60	9.13
Vermicompost 2.0 ton/fed + EM1	55.87	56.35	8.58	9.13
Vermicompost 3.0 ton/fed	56.31	56.95	8.28	8.94
Vermicompost 3.0 ton/fed + EM1	58.38	59.38	8.64	9.06
Vermicompost 4.0 ton/fed	58.55	59.15	8.80	9.31
Vermicompost 4.0 ton/fed + EM1	58.36	59.20	9.31	9.88
Vermicompost 5.0 ton/fed	59.00	60.25	9.58	10.21
Vermicompost 5.0 ton/fed + EM1	61.10	61.45	9.96	9.95
Vermicompost 6.0 ton/fed	61.03	61.03	9.58	10.14
Vermicompost 6.0 ton/fed + EM1	64.66	64.43	10.39	11.06
EM1	57.41	58.25	9.28	9.39
Folicur	52.85	53.33	8.65	9.04
Control	51.16	52.13	7.76	8.45
LSD	1.17	1.88	0.45	0.80

From other hand, the data present in Table (7) show that all treatments increased bulb diameter, onion fresh and dry weight compared with non-treated plants. In the two seasons, vermicompost at the rate of 6 ton/fed combined with EM1 treatment gave the highest increasing of bulb diameter and onion fresh weight, while vermicompost at the rate of 4 ton/fed combined with EM1 treatment gave the highest increasing of onion dray weight compared with untreated plants and Folicure treatment.

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Table (7): Effect of vermicompost, EM1 and fungicide Folicure (25%) on bulb diameter, fresh and dry weight of onion at harvest under naturally infested soil with *S. cepivorum* at Mallawi Agric. Res. Sta., Menia Governorate, during growing seasons 2014/2015 and 2015/2016.

Treatment	Bulb diameter (cm)		Onion fresh weight (gm)		Onion dry weigh (gm)	
	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
Vermicompost 1.0 ton/fed	4.47	4.78	78.10	80.58	36.73	37.13
Vermicompost 1.0 ton/fed + EM1	4.48	4.54	81.65	82.84	38.66	39.90
Vermicompost 2.0 ton/fed	4.73	4.74	81.23	82.70	34.98	36.01
Vermicompost 2.0 ton/fed + EM1	4.76	5.03	84.91	86.29	41.28	42.06
Vermicompost 3.0 ton/fed	4.88	4.89	78.88	85.98	36.76	37.46
Vermicompost 3.0 ton/fed + EM1	5.25	5.58	88.00	94.13	44.51	45.13
Vermicompost 4.0 ton/fed	5.16	5.58	80.88	87.88	39.53	40.69
Vermicompost 4.0 ton/fed + EM1	5.53	5.64	90.89	93.41	45.36	45.10
Vermicompost 5.0 ton/fed	5.48	5.78	87.55	88.55	38.56	38.58
Vermicompost 5.0 ton/fed + EM1	5.73	5.79	96.30	97.55	44.75	44.38
Vermicompost 6.0 ton/fed	5.74	5.68	94.90	96.73	43.71	42.94
Vermicompost 6.0 ton/fed + EM1	6.05	6.19	102.75	104.50	40.23	41.83
EM1	5.04	5.44	77.26	78.14	36.29	37.18
Folicur	4.78	4.80	63.85	66.85	30.78	31.89
Control	3.51	3.74	70.01	72.26	31.54	32.53
LSD	0.27	0.23	3.79	1.87	1.163	1.23

Generally, it is very important to state that, the combined between vermicompost at the rate of 5 ton/fed and EM1 was the best treatment for reducing the percentage of infection and increased all tested vegetable parameters i.e., bulb yield, plant height, no. of leaves/plant, bulb diameter, fresh and dry weight compared to non-treated plants and Folicure treatment.

4. DISCUSSION

The results in this study stated that the use of all tested material under investigation (vermicompost, EM1 and the combination between vermicompost and EM1) significantly decreased the percentages of infection by onion white rot either in greenhouse or open field and increased all tested parameters, *i.e.*, bulb yield, plant height, no. of leaves/plant, bulb diameter, fresh and dry onion weight compared with non-treated plants. These results are in a harmony with many studies that found the use of vermicompost in crops inhibited soil borne diseases in field trials with pepper, tomatoes, strawberries and grapes (**Edwards and Arancon 2004 and Ayres 2007**). Vermicompost can suppress a wide range of fungal diseases, (**Orlikowski 1999)** it was observed that the addition of vermicompost extracts to three ornamental plant species significantly reduced sporulation of the pathogen Phytophthora cryptogea. The addition of vermicompost to tomato seeds significantly reduced infection caused by Fusarium lycopersici [**Szczech 1999]** and Phytophthora nicotianae [**Szczech and Smolinska 2001].** Vermicompost application significantly reduced infection by Pythium on cucumber, Rhizoctonia on radishes in the greenhouse, by Verticillium on strawberries and by Phomposis and Sphaerotheca fulginae on grapes in the field [**Noble and Coventry 2005]and Trillas *et al.* 2006].**

The high levels of agronomic beneficial microbial population in vermicompost protects plants by outcompeting plant pathogens for available food resources [**Nielson, (1965**)]. Vermicompost contains some antibiotics and actinomycetes that help in increasing the "power of biological resistance" among the crop plants against pest and diseases. Spray of chemical pesticides was significantly reduced by over 75% where earthworms and vermicompost were used in agriculture [**Suhane 2007** and **Singh 1992]**. The bacterial population of a cast is much greater than the bacterial population of either ingested soil or the worm's gut. Microbial activity of beneficial microorganisms in worm castings is ten to twenty times higher than that of in the soil and other organic matter [**Edwards 1995].** Among beneficial soil microbes stimulated by earthworms are nitrogen-fixing, phosphate solubilizing bacteria, actinomycetes, mycorrhizal fungi. Total count of bacteria ranges from 10^2-10^6/gm of vermicompost [**Suhane 2007]. Edward et al. 2006 Noble and Coventry 2005 Trillas, *et al.*2006**] found that the ability of pathogen suppression disappeared when the vermicompost was sterilized, convincingly indicating that the biological mechanism of disease suppression involved was microbial antagonism.

Humic acid in humus are benefit to plants in many ways, enables plant to extract nutrients from soil, help to dissolve unresolved minerals to make organic matter ready for plants to use, stimulates root growth, helps plant to overcome stress, provides binding sites for the plant nutrients, such as calcium, iron, potassium, sulfur and phosphorus. These nutrients are stored in the humic acid in a form readily available to plants, and released when the plants require them. Humus increased water permeability, water retention capacity, increased nitrogen content and reduce soil salinity **(Canellas *et al.* 2002 Li, K. and Li, P.Z. (2010) , Ayres 2007).** Many studies speculated that the growth responses of plants from vermicompost appeared more like "hormone induced activity" associated with the high levels of nutrients, humic acids and humates in vermicompost [**Atiyeh *et al.* 2000 Edwards and Burrows 1988]**. Vermicompost contained growth promoting hormone "auxins", "cytokinins" and flowering hormone "gibberellins" secreted by earth-worms [**Suhane, 2007 Tomati *et al.* 1987 Tomati, *et al.* 1995].** It consistently improved seed germination, enhanced seedling growth and development, and increase plant productivity significantly **[Karmegam *et al.* 1999 Atiyeh, *et al.* 2000 Zaller, 2007 Arancon, *et al.* 2008 Lazcano, *et al.* 2010a**]. Vermicompost also increased vegetative growth, stimulating shoot and root development **[Edward *et al.* 2004]** increased leaf area and root branching **[Lazcano *et al.* 2009]** and also has been shown to stimulate plant flowering, increasing the number and biomass of the flowers produced **[Arancon *et al.* 2008 Atiyeh *et al.* 2002)]** as well as increasing fruit yield **[Arancon *et al.* 2004)] Arancon *et al.* 2004) Atiyeh *et al.* 2000) Singh *et al.* 2008)]**. Vermicompost may also increase the nutritional quality of some vegetable crops such as tomatoes [**Gutiérrez-Miceli *et al.* 2007**] Chinese cabbage [**Wang *et al.* 2010**] spinach **[Peyvast *et al.* 2008**] strawberries and lettuce **[Singh *et al.* 2008].**Integrated application of vermicompost, chemical fertilizer and biofertilizers (Azospirillum & phosphobacteria) increased rice yield by 15.9% over chemical fertilizer used alone. [**Jeyabal and Kuppuswamy (2001].**

Effective microorganisms (EM) is a proven method for increasing crop yields in natural farming (Higa, 1998). EM solutions, which contain naturally occurring microorganisms, enhance the value of organic matter by accelerating its decomposition and releasing greater quantities of nutrients for crop utilization (Higa and Wididana, 1991). Duan et al., 2005 and Awad and El-Ghamry, 2007) showed that effective microorganisms at 0.4% could promote potato growing and resistance to diseases, and therefore increasing the yield and enable better uptake of nutrients from the soil. Humic substances (HS) and EM treatment with compost showed positive effects compared with the recommended N fertilization. Thus, these treatments of HS and/or EM can replace entirely or partially N mineral fertilizer, which reduce production costs and conserve the environment from chemical pollution hazards on human and animal health (Abbas et al., 2014). Okorski et al. (2008) found that foliar application of EM reduced the incidence of pea diseases and increased the rate of photosynthesis in pea. While, soil application of EM, seed dressing and chemical control decreased the rate of photosynthesis in pea and molar transpiration values in pea. Abdel-Monaim et al. (2014) found that all organic compounds viz. Inicium, Bio-Health, Alga Grow-4, Humic acid, EM1 reduced significantly area under disease progress curve caused by F. solani and F. oxysporum under artificial infection in greenhouse and natural infection in field in both pepper cultivars (Long Red Cayenne and California Wonder).

The role of the tested organic compounds in reducing root rot/wilt diseases severity and stimulating plant growth may be due to enhanced natural resistance against plant diseases and pests, stimulated plant growth through increased cell division, as well as optimized uptake of nutrients, water and stimulated the soil microorganisms (Chakroune, 2008; El-Morsi et al., 2009; Okorski et al., 2010; Abdel-Monaim et al., 2011).

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