SOIL RECOLONIZATION BY SAPROPHYTIC FUNGI AFTER SOLARIZATION AND SOIL AMENDMENTS

WAZEER ALI HASSAN AND ASMER AHMED YOUSIF
Dept. of Plant Protection, Faculty of Agriculture and Forestry, University of Duhok, Kurdistan Region-Iraq
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ABSTRACT

The effects of solarisation using clear, UV stabilized , 25 µm low density polyethylene mulching combined with soil amendment of chicken manures 12 th^{-1} , mixed fungicides of Metalaxyl 2 g- Benlate 1.5 g L^{-1} , Biocontrol agent of *Trichoderma harzianum* (T.h.) and NPK fertilizer 180 Kg h^{-1}, were ascertained during summer 2008 for counting the total population density of thermotolerant soil fungi *Aspergillus niger, A. terreus, Rhizopus* sp., *Penicillium* spp., and *Ttrichoderma harzianum* (T.h) colonized in solarized soil amendments after mulching removal and repeated at 60 days intervals until may 2009.

Population of these saprophytes was initially depressed to 8.19 and 4.29×10^3 cfu/gm soil after 45 and 60 of mulching removal compared to 13.64 $\times10^3$ in non-solarized soil, with the most greatly reduction after application mixed of Metalaxyl & Benlate., the highest population density of the above fungi 20.07 cfu$\times10^3$ was observed in non-mulching chicken manure (CM) plots. After 6 – 8 months a total counts of these fungi were significantly reinforced in the solarized amended soil even in plots treated with mixture of both fungicides. Detection of pine damping off disease in non-solarized control plots was 83.33% with severity of 60%. Solar heating alone reduced the disease occurrence to 45 - 53.33% and severity to 10.42 - 11.67%. However, (CM), (Met.& Ben.) fungicide, and biocontrol agent of T.h. after along solarization (60 days) controlled soilborne disease to a lesser extent than other treatments. The effectiveness of these applications combined with solarization after 60 days on the disease infection were 29.17, 20, 15, and 28.33% ,respectively.

Finally, in growth chamber, application of CM and T.h. increased the quantitative composition of cfu soil fungi to 7.34 and 5×10^3 in spite of inoculating with pathogenic propagules of *Fusarium proliferatum* , *Macrophomina phaseolina*, and *Rhizoctonia solani* and the share of these pathogens in the both soil amendments were 13.89 and 30.9% respectively.

Keywords: Solarization, Soil amendments, Soil borne fungi, Fungicides, Thermophilic fungi.

1. INTRODUCTION

Under hot climatic conditions, soil solarization can be an effective method for controlling abroad spectrum of fungi, nematodes, weeds and other plant pests on diverse agricultural system, including in field and greenhouse production and in container media (Brown et al., 1989 ; Ramirez – Villapudua and Munnecke, 1988). Soil solarization frequently results in improved plant growth and yield increase (Chen et al., 1991; Gamliel and katan, 1991) and these effects can be partially attributed to increased populations of beneficial fungi and bacteria in the rhizosphere and roots of plants grown in solarized soils (Gamliel and Katan, 1993).

Another useful approach is the combination of solarization with various organic amendments that have pesticidal activity. Some may facilitate a shift soil to a community of micro floral that are antagonistic to certain soil borne pests, others release biotoxic compounds during their degradation in soil. This latter process, especially when volatile compounds are released into the soil atmosphere by the decomposing amendments, is popularly known as biofumigation (Stapleton, 1998). The efficiency of soil solarization in combination with chicken manure 12.5 t ha^{-1} as methyl bromide alternatives against root knot nematodes was investigated in plastic houses (Sogut and Elekcioglu, 2007). Commercial chicken compost, ammonium phosphate fertilizer, and solarization, alone or combined, controlled *P. ultimum*, in lettuce, whereas *M. incognita* was effectively controlled by the combination of these treatments (Gamliel and Stapleton, 1993b). It has been well documented that survival of many such plant pathogens as *F. oxysporum* , *R.solani* and *Verticillium dahliae* strongly reduced under an aerobic soil conditions (lack of oxygen) the accumulation of toxics products resulting from anerobic decomposition process and biocontrol by anerobic microorganisms have been implicated as critical factors (Cook and Baker, 1983; Strandberg, 1987). However the usefulness of soil amendments for pathogen control may be limited by low concentrations of toxic volatile compounds or by insensitivity of resting structure of target organisms. The utility

and predictability of both methods may be maximized by combination with solarization (Gamliel and Stapleton, 1993a).

The ultimate aim of the present study is to compute population of saprophytic fungi in solarized and combined soil amendments after mulching removal and throughout the later period as well as the ability to re-build in the soil inoculated with soil borne pathogens.

2. Materials and Methods

Filed Experiments

Experiments were conducted in Malta nursery (Duhok) during the hottest summer months (July and August), rainy winter seasons of 2007- 2008. The experimental site was earlier planted by susceptible vegetables of solanaceous and cruciferous and was under cultivation for the previous several years and divide into two separate fields.

Combined application of solarization and soil amendments.

Solarization treatments of about 8 weeks duration were applied during summer months from 5 July to 5 September as described elsewhere (Loannou and Poullis, 1990).The field cultivated, levelled and irrigated to depth 40-50cm prior to solarization in the last June 2008, when the soil moisture reached an appropriate level to cultivate the land ploughed deeply (30-40cm), clods broken and the surface was levelled. Plots were 2m×2m separated by a 1m buffer zone in randomized split plot design with three replications. Five plots covered with a clear ,UV stabilized, 25µm, low density polyethylene mulch for 60 days, other five plots mulched for 45days and the remaining five plots were left non mulched to test main plot effects (solarization) versus non treated against soil borne pathogens .

Fresh chicken manures at 12.5 t ha^{-1} , fungicides of Metalaxyl 2g plus 1.5g Benlate L^{-1} , Fungal biocontrol agent *Trichoderma harzianum* (20K1), compound fertilizer (NPK, 12.4%N, 7.3% NH_3, 5.1% No_3, 11.4% P_2o_4, 17.7% K_2o,2.7 %Mg_2o, 8% S) at a rate equivalent to 180kg N h^{-1} and no treatment (control)were used in sub-plot treatments.

Chicken manure and mineral fertilizer added to plots before solarization and uniformly distributed on the soil surface and incorporated into the top 15-20cm layer of soil using a rake.

Drip irrigation pipes placed into plots with 25cm pores intervals after application each of the manures and fertilizers and then clear polyethylene mulch covered the soil surface. Following mulch removal, *T. harzianum* (1×10^7 cfu g^{-1} soil) applied twice with one month interval. *T. harzianum* was multiplied on potato dextrose broth in nine 250ml flasks incubated at 28 ± 2°C for 10 days. Contents of nine (T. h.) flasks blended for 30 sec. the liquid suspension was then mixed in 3kg soil. This soil is divided equally into nine lots and uniformly mixed to a depth of 30 cm in plots of the treatment before planting. Maximum soil temperature at 5, 15 and 30cm depth were monitored daily between 2:30 and 3:30 P.M. (Lodha and Solanki, 1992) using mechanical soil thermometers. Seeds of *Pinus brutia* were grown in 15cm diameter pots filled with the test soil in field experiment, which were seeded directly and thinned after emergence to five plants per pot. Plants grew in the greenhouse (22-28°C) for 75 days without fertilization. Mortality due to pathogen pre and post emergence damping off of seedling were recorded, disease severity were also computed depending upon density of root growth. Seedlings were uprooting, and growth response was calculated as increased of wet and dry weight. Shoot and root length of seedling over untreated control. Experiment was carried out in a randomized split plot design with three replicates for each treatment. Data were analyzed and the mean of studied characters were compared with each other according to Duncan multiple test.

2.2. Recolonization of saprophytic fungi in the solarized soil amendments

Fungal population in solarized and non mulched soils were counted by soil dilution method. Three 5-g soil sub-samples at 15 cm depth of each replicate for the treatments of experiment, added individually to 45ml of sterile water agar (0.1%) supplemented with $MgSO_4.7H_2o$ (0.1%), shaken for 15 min on a reciprocal shaker, and then serially diluted to 10^3 with the same solution. Samples of 0.2ml were spread on five Petri dishes that containing PDA medium, and incubated in the dark at 28 and 40 °C for the determination of thermotolerant fungi. Colonies counted after 4-10 days. Results are expressed as colony forming units (cfu) per gram of soil.

Assessments of recolonization of saprophytic fungi of the pine soils were accomplished by repeating this isolation method at 60 day intervals until May 2009 for continuous diversity and duration of the soil recolonization by saprophytic fungi.

2.3. Occurrence of different soil borne pathogens and antagonists in autoclaved soil.

Robinia pseudoacacia were selected as indicator plant test since its fast growing tree species and grown as green shelters in Duhok nurseries, seeds cultivated in pots containing 750g autoclaved sandy loam soil at rate of 15 seed per pot. Isolates of pathogenic fungi propagated were used for soil infestation at the rate of 10ml spore suspension of *F.proliferatum* 13.6×10^4 spore ml^{-1}, *M. phaseolina* 4×10^5 sclerotia ml^{-1} for each pot, in addition to blending mycelial growth 5 days old culture of *R. solani* (9cm Petri plate/500ml distilled water).These pathogens were isolated from forest seedling of the most common growing species in Duhok and Erbil (pine, poplar and short thorn locust). Virulent pathogenic isolates of these fungi were separately multiplied in bulk on 5% corn meal and sand media for 15 days at30 $\pm2^0$C (Israel et al., 2005). The produced sclerotia of *M. phaseolina* and *R. solani,* and conidia of *F.proliferatum,* were passed through a 300 mesh (35μm) sieve. The infested material (left on the sieve) were first examined separately under dissecting microscope to ensure that it contained only propagules of mentioned fungi, and then mixed with several kilo grams of field soil to prepare infested soil which was left for 10 days in bright sunlight (37-40°C) for further stabilization before use. Mixed saprobes (50ml spore suspension) for *Aspergillus niger, A. terreus, Penicillium* spp.,*Rhizopus* sp., and *T. harzianum* added to the same substrates of the following treatments:

1 – Chicken manures 8.4g mixed with the soil before autoclaving. to avoid the effect of produced antagonistic compounds found naturally in this substrate.

2 – Fungicides of metalyxl 2.5g plus benlate $1.5gl^{-1}$.at rate of 50ml pot^{-1}.

3 – *T .harzianum* 24.2×10^4spore ml^{-1}.

4 – NPK fertilizer (12.4% N, 7.3% NH_3, 5.1%No_3, 11.4% P_2O_4, 17.7% K $_2O$, 2.7% Mg_2O, 8% S) 5g/750g soil.

5 – Control (non treated).

Treatments (2–5) were applied after soil autoclaving; pots were incubated in growth chamber for 7 days at 28°C, 70%R.H., and 12 hrs light daily.

Frequency of pathogens infection on the roots was computed. *T.harzianum* and total average of *A. niger, A. terreus, Penicillium* spp.,*Rhizopus* sp., were counted using serial dilution as cfu$\times10^3$ per gram of soil.

3. RESULTS

Nursery predominate cropping system, favour climate and agro-ecological conditions raise the rapid developments and growth of various soilborne pathogens. Soil solarization, (Met.&Ben.) Fungicides, biocontrol agent of T.h. combined with solarization for the period of 45 and 60 days were reduced pre-emergence damping-off and its severity significantly. Detection of disease in non-solarized control plots was 83.33% with severity of 60%. Solar heating alone reduced the disease occurrence to (45-53.33)% and severity to (10.42-11.67)%. However, (CM), (Met.& Ben.) fungicide, and biocontrol agent of T.h. after along solarization (60 days) controlled soilborne disease to a lesser extent than other treatments (Table 1), the effectiveness of these applications combined with solarization after 60 days on the disease infection were (29.17, 20, 15, and 28.33)% respectively compared with (73.34, 62.6, 58.33, and 76.67)% for the same treatments in control non-solarized soil. The Increase in the foliage growth, and shoot biomass of the seedlings following solar heating soil might be related to increased amounts of available nitrogen or by reduction in pathogen population.

Thermophilic / thermotolerant fungi when incubated at 40°C were still reduced in the heating soil after mulching removal. This reduction reached 52 and 61% after both solarization periods. Two to four months after the end of mulching, significantly higher reduction of microbial population 45.9 – 61.6% and 50.7 – 70.5% respectively, were detected in mulched soil.(Table 2).

In solarized soil, the total population density of soil fungi *Aspergillus niger*, *A. terreus*, *Penicillium* spp., *Rhizopus* sp., and *T. harzianum* colonized various amendments soil was initially depressed to 8.19 and 4.29 cfu $\times10^3$ after 45 and 60 days of mulching removal, compared with 13.46 in control non solarized soil though applied with chicken manures, NPK fertilizer,fungicides and biocontrol of T.h. (Table 2).

Over the period of four months, soil fungal community recolonized in solarized soil and their total count was significantly higher than that of control dry soil. The highest total number (20.07 cfu$\times10^3$) was observed in non-mulching organic fertilized soil compared with 8.60 and 5.92 cfu$\times10^3$ after both solarization periods(Table 2), respectively. Fungicide of

(Met. & Ben.) caused great reduction in fungal communities incubated at 28 and 40°C at the end of solarization particularly after 60 days. Reduction of total count of soil microbioata in solarized soil was previously reported by (Stapleton and De Vay, 1984; Keinath, 1995; Abdullah et al., 1998; and Bottross et al., 2000). After two to four months, organic and NPK fertilization for control non mulched soil also had increasingly influence on the diversity of soil fungi communities compared with other solarized soil amendments after both periods.

After 6 – 8 months, significantly higher counts of total fungi (20.03 – 23.59×10^3 were detected in mulched soil amendments even plots treated with chemical fungicides.

The results obtained from the inoculation of soil amendments with a mixture of soilborne pathogens and soil saprobes of *A. terreus, A. niger, Penicillium* spp., and *Rhizopus* sp.*(*Table 3) indicate that application of biocontrol agents of *T.harzianum,* organic manure, and NPK fertilizers diversified the quantitative and qualitative composition of soil fungi communities in spite of pathogenic density propagules for each of *F. proliferatum, M. phaseolina,* or *R. solani*. The lowest total cfu of antagonistic colonies 0.33×10^3 was found in the control soil without amendment. On the other hand, the most numbers population of pathogens 68.5% was obtained. The application of organic fertilization and *T. harzianum* had a positive influence on the diversity of soil fungal communities whereas they record 7.34 and 5.9 cfu×10^3 respectively, and the share of pathogens in these soil amendments were 30.9% and 13.89%, respectively .The application of fungicides inhibited the growth of *R. solani* completely compared to occurrence of *F. proliferatum* and *M. phaseolina* by 25% and 29.17%, respectively. At the same time the lowest number of saprophytic and antagonists fungi 3.13% was isolated from the soil at the same fungicidal treatment. Less numerous shares of pathogens 32.5% in the soil fungi community as compared with control was observed in the soil of mineral NPK fertilization.

4. Discussion

The current studies indicate that more carbon and nitrogen were requested as organic matter in the soil, possibly increasing the sustainability of the agroecosystem, regardless the organic amendment type (Drinkwater et al., 1998). In the post emergence, Seedlings grew healthy in the solarized soil combined with fungicides or T.h., propagules of *Trichoderma* spp. as antagonistic fungi may have attributed to reduce disease by direct parasitism, competition, or antibiotics, disease also was minimized on the seedlings grown in non-solarized soil amendments. Therefore, solarization provides economic control of pre-emergence damping-off and weeds, enhances the physical and chemical properties of the soil, and increases the yield (Davis, 1991; Stapleton and De Vay, 1995). Results indicated that roots of seedlings were relatively free from infection regardless of solar period, properties and the initial soil inoculum potential. It is worthy to mention that the root quality reported as the main criteria used by growers and foresters for assessment of disease severity and as a source of judging seedling health (McGovern et al., 2002). the increased plant growth following soil solarization resulted from not only availability of some soil nutrients plus reduction in number of soilborne pathogens, but may also be due to population shifts in favour of beneficial soil microorganism (antagonists) specially when crops are planted shortly after the plastic film is removed to prevent pathogens recolonization.

The present results indicate that substrate made available by soil solarization was rapidly occupied by the surviving organisms after four months of solarization. This variation in the degree of injury caused by soil heating, and the injured propagules require a time to recover and germination. Pullman et al., (1981) confirmed that solarization cause delays in propagules germination that varies with temperature and duration exposure. Other reports indicate that mineral and manure fertilization is next to the type of crop, rotation system, and applied of plant protection media, a cause of changes in the structure of soil microorganism communities (Spedding et al., 2004; Larkin et al., 2006). Hoitink and Boehn (1999) sustained that in organically fertilized soil the growth of microorganisms is stimulated, they protect plants against soil borne pathogens due to their antibiotic and parasitic influence.

The significance of mycobiota recolonization may be attributed to stimulation of their activities by ammonia sulphuric compounds such as isothio cyanates, alcohols, aldehydes and other substances able to promote the growth of microorganisms (Cartia and Di Primo, 2004) even after 120 days following solarization (Katan, 1998). Therefore, the long term effects of solarization in conjunction with IPM

approaches (soil fumigants, manures, fertilizers) and the strong evidence that the microbial population dynamics could stimulate the antagonistic microflora (Gristein and Ausher, 1991) could be used as (cleaning tool) once every 3 – 5 years throughout the entire crop rotation. Kuter et al., (1988) documented that variability in suppression of damping – off caused by *R. solani* and *Fusarium* spp., in substrates amended with mature composts is due in part to random recolonization of fertilized soils by microorganisms including the predominant of hyperparasites of *T. harzianum* after peak – heating.

The evidence of a shift in the soil microflora as a result of mulching in our study confirmed that important biological and chemical elements also come to play. Although, primary mode of action of solar is the physical heating of soil, and additional benefit may be recolonization of the soil antagonistic microorganisms such as *T. harzianum* specially when presented as artificial inoculum in our study, to subsequently invading nematodes, pathogens, or weed propagules in soil exposed to such high temperature, short exposure solarization (Stapleton, 2000). Therefore, the coupling with fungi or bacterium antagonists applied directly to the soil or inoculated on the root apparatus at the transplanting time is interesting particularly there are a major presence of *Aspergillus*, *Fusarium*, *Penicillium*, and *Trichoderma* species in the solarized soil (Cartia and Di Primo, 2004). It is possible that in IPM, shorter solarization period could be sufficient for the control soil resistant parasites difficult to contain or to eradicate throughout changes in the physical properties of the soil or by absorbing phytotoxic compounds produced by soil microorganisms (Tilston et al., 2002; Gur et al., 1998).

It is worthily to mention, that the tolerance of T.h. to ammonia induced mycotasis leading to successful use of this species as a broad spectrum biocontrol agent (Papavizas, 1985). This type of control is based on the activities of biological control agents within the cortex of microbial communities and their response to soil and plant introduced energy reserves (Hoitink and Boehn, 1999). However, the concentration and availability of carbohydrates in lignocellulosic substances, chitin, lipids……etc. within the soil organic matter, moisture content, salinity and C:N ratio play a critical role in regulating these activities. (Quarless and Grossmann, 1995).

The mechanism of biological control of *R. solani* and *Fusarium* damping-off involved competition, antibiosis, hyperparasitism and the induction of systemic acquired resistance in host plant (Loockwood, 1988).

Table (1): Effect of soil solarization and combined treatments on the occurrence of damping-off and the pine vigour.

Solar period	Soil amendments	% damping- off		Disease severity %	Pine vigor			
		Pre-emergence	Post-emergence		Wet weight (g)	Dry weight(g)	Shoot Length (cm)	Root Length (cm)
Control (non solarized)	Control	83.33* a	10.00 a	60.00 b	0.31 de	0.06 e	6.10 a	12.47 de
	Chicken manures	66.67 b	6.67 ab	81.00 A	0.33 cde	0.08 b-e	6.4 a	10.56 e
	Met.& Ben	60.00 bc	2.67 ab	32.33 C	0.29 de	0.07 cde	6.12 a	10.43 e
	T.harzianum.	53.33 cd	5.00 ab	16.50 D	0.28 e	0.06 de	6.27 a	10.40 e
	(NPK) Fertilizer	66.67 b	10.00 a	81.42 A	0.27 e	0.06 e	5.97 a	13.67 de
45 day	Control	45.00 de	5.00 ab	11.67 De	0.48 a-d	0.09 a-e	6.83 a	24.20 ab
	Chicken manures	35.00 ef	3.33 ab	3.08 ef	0.56 ab	0.1 abc	6.97 a	26.47 ab
	Met.&Ben.	35.0 ef	0.00 b	2.25 ef	0.52 abc	0.11 ab	6.77 a	22.73 ab
	T.harzianum	25.00	0.00	1.58	0.4	0.08	6.13	14.73

		fgh	b	f	b-e	b-e	a	cde
	(NPK) Fertilizer	41.67 de	5.00 ab	6.67 ef	0.51 abc	0.07 cde	6.2 a	18.63 bcd
60 day	control	53.33 cd	5.00 ab	10.42 def	0.51 abc	0.09 a-e	5.87 a	23.87 ab
	Chicken manures	25.00 fgh	4.17 ab	1.67 f	0.54 ab	0.1 a-d	6.5 a	22.93 ab
	Met.& Ben.	20.00 gh	0.00 b	0.92 f	0.59 ab	0.10 abc	6.67 a	21.53 abc
	T.harzianum	15.00 h	0.00 b	0.50 f	0.64 a	0.11z ab	6.77 a	28.97 a
	(NPK) Fertilizer	28.33 fg	3.33 ab	4.50 ef	0.57 ab	0.12 a	6.07 a	25.03 Ab

*Mean in the same column followed by the same letter isn't significantly different ($p<0.05$)

(Table 2): Recolonization of saprophytic fungi in the solarized and combined soil amendments after mulching removal

Solar period (day)	Soil amendments	Saprophytic Fungi (cfu×10^3)****					
		After mulching removal		60 days	120 days	180 days	240 days
		28c*	40c°***				
Control	**Control**	15.16* b	19.27 bc	19.33 b	21.53 cd	18.86 c	20.03 bc
	Chicken manure	20.07 a	29.44 a	27.94 a	32.17 a	15.89 cd	16.81 c
	Fungicides	7.2 def	12.78 de	8.96 de	22.44 cd	12.40 de	12.96 d
	T..harzianum	13.39 bc	13.86 de	13.36 bcd	22.05 cd	14.13 cd	14.36 c
	NPK fertilizer	11.41 bd	16.49 cd	16.72 bc	27.87 b	14.45 cd	15.22 c
	Mean**	13.46 a	18.37 a	17.27 a	25.21 a	15.15 c	15.88 c
45	Control	5.00 fg	4.09 g	10.42 cd	19.30 de	20.26 b	20.51 bc
	Chicken manure	8.60 def	20.63 bc	13.58 cd	23.32 c	24.50 a	25.04 a
	Fungicides	6.27 efg	4.20 g	9.75 de	16.43 ef	19.64 bc	20.48 b
	T..harzianum	10.77 cd	4.00 g	9.17 de	13.00 fg	14.42 cd	20.76 b
	NPK fertilizer	10.32 cd	14.50 de	10.30 cd	16.77 ef	21.36 b	22.53 a
	Mean	8.19 b	9.49 b	10.64 b	17.77 b	20.04 b	21.86 b
60	Control	2.62 g	10.82 ef	6.89 de	12.63 gh	20.50 b	21.77 ab
	Chicken manure	5.92ef	21.50 b	7.72 de	12.72 gh	24.22 a	24.59 a
	Fungicides	2.85 g	7.51 c-f	6.08 e	10.35 h	21.91 ab	21.93 ab
	T..harzianum	5.58 fg	4.08 g	11.21 cde	13.13 gh	23.31 a	25.21 a
	NPK fertilizer	4.52 fg	12.00 def	7.67 de	15.00 fg	22.61 a	24.44 a
	Mean	4.29 c	11.18 b	7.92 b	12.77 c	22.51 a	23.59 a

*Data in the same column followed by the same letter isn't significantly different ($p<0.05$)
**Mean of solarization periods were compared individually
***Saprobes thermotolerant comparison
****Average of *A.terreus, A.niger, Rhizopus* sp.*, Penicillium* spp.*, and T.harzianum*

Table (3): Frequency occurrence of different soilborne pathogens and antagonistic in autoclaved soil caltivated with *R. pseudoaccacia* in growth chamber for 7 days.

Soil amendment	*%F.proliferatum*	*%M.phaseolina*	*%R.solani*	Mean	*T.harzianum*	Antagonistic saprobes**	Mean
					10^3 cfu		
Control	58.33* abc	63.89 ab	83.30 a	68.5 a	0.33 e	2.33 d	1.33 b
Chicken manure	45.83 b-d	11.11 de	33.33b-e	30.9 b	7.01 a	7.67 a	7.34 a
Met.&Ben.	25.00 cde	29.17 b-e	0.00 e	18.06 c	1.33 c	4.93 b	3.13 b
T.harzianum	25.00 cde	12.50 de	4.17 e	13.89c	5.90 a	4.10 b	5.00 a
NPK fertilizer	37.50 b-e	36.67 b-e	23.33cde	32.5 b	2.40 bc	7.17 a	*4.79 a*

* Means with the same letter aren't significantly different ($p<0.05$)

**Average of *A.terreus, A.niger, Rhizopus* sp*., Penicillium* spp*., and T.harzianum*

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استعادة استيطان الفطريات الرمية في الترب المبسترة شمسيا والمصلحة

الخلاصة

اختبرت تأثير البسترة الشمسية باستخدام البولي اثيلين الشفاف النافذلاشعة uv بسمك 25µ لتغطية التربة المدعمة بسماد الدواجن 12 طن/ هكتار ,خليط المبيدين ميتالاكسيل 2 غم و البنليت 1.5 غم/لتر ماء ,عامل المقاوم الحيوي *Ttrichoderma harzianum* والسماد المركب *NPK 180 كغم /هكتار و ذلك خلال صيف 2008 لحساب مجموع الكثافة السكانية للفطريات المتحملة للحرارة و هي: Rhizopus , A. Terreus, Aspergillus niger .. Penicillium spp.,sp. Ttrichoderma harzianum* المستوطنة للتربة المبسترة و المدعمة و ذلك بعد ازالة البولي اثيلين ثم كررت بعد كل 60 يوما حتى مايس 2009 .

انخفضت مجموع الكثافة العددية لفطريات التربةالمدروسةالى 18.9 و4.29×10^3 cfu و ذلك بعد انتهاء فترتي البسترة 45 و 60 يوما يقابلها 13×10^3 cfu في الترب غير المبسترة, اظهر استخدام خليط المبيدين بنليت و ميتالاكسيل اختزالا واضحا في كثافة الفطريات المستوطنة بينما وجد أعلى كثافة لهذه الفطريات(20.07×10^3)في الترب غير المبسترة والمسمدة بسماد الدواجن.

بعد مرور 6-8 أشهر استعادت هذه الفطريات الرمية نموها و بشكل معنوي في الترب المبسترة والمصلحة حتى في الترب المعاملة بخليط المبيدين المذكورين.

اظهرت معاملات الترب غير المبسترة والمزروعة ببذور الصنوبر اصلبتها بموت البادرات بنسبة 83.33% و شدة مرضية 60% بينما اختزلت البسترة ظهور المرض بنسبة 45-53.33% وشدة مرضية 12.42- 11.67%.

عموما فان سماد الدواجن وخليط المبيدين والمقاوم الحيوي *T. h.* سيطرت على ظهور المرض بمديات اقل في التربة المبسترة لفترة 60 يوما مقارنة ببقية المعاملات ، حيث بلغت فعالية هذه الاضافات على ظهور المرض 29.17, 20, 15و 28.33% على التوالي.

و اخيرا أدى استخدام سماد الدواجن والمقاوم الحيوي *T. h.* في غرفة الانبات الى زيادة المحتوى الكمي للفطريات الرمية بمقدار 7.34 و 5 ×10^3 رغم تلقيح عينات الترب المستخدمة بخليط من اللقاح الممرض للفطريات *Fusarium proliferatum, Macrophomina phaseolina* و *Rhizoctonia solani* في الوقت الذي ظهرت هذه الممرضات بنسب 13.89 و 30.9 % في كلا من سماد الدواجن و المقاوم الحيوي على التوالي.

دوبارەکرنا ئاکنجی بونا گەرووێت رمێ یت ئاخێ بشتی بەستەرەکرنا روژێ و ب زیادکرنا کارلێکریا پوختە

کارتێکرنا بەستەرا روژێ ٍ هاتە تێست کرن بکارئینانا کەرستێ پولی اسیلینێ رون (تیژکا روژێ UV دەرباسبیت) ب ستیراتیا 25 M بو داپوشینا ئاخێ ئەوا هاتیە کارلێکرن ب زبلێ مریشکا 12 تەن \ هکتار ، هەردوو قەبرێت تێکهەل : میتالاکسیل 2 غم وبنلیت 1.5 غم بو هەر لیترەکا ئاڤێ ، فاکتەرت بەرهنکاریا بایوتیکی *Trichoderma. harzianum*. و زبلێ لیکدای NPK 180 کغم \ هکتار ئەڤ قەکولینە هاتەکرن ل هاڤینا 2008 بو هژمارتنا سەرجەمێ تیراتیا هژماری یا گەرووییان بەهنگار بو گەرمێ وەکی *Aspergillus niger* , *A. terreus* , *Rhizopus sp.* , *Penicillium spp* , *Trichoderma harzianum* ئەوێت ئاکنجی لناڤ ئاخا بەستەرکری و ئاخا کارلێکری ، بشتی راگرنا پولی اسیلین ، وئەڤ هژمارتن هاتە دووبارەکرن بشتی 60 روژ تا مەها گولاناسالا 2009 ێ .

سەرجەمێ تیراتیا هژماری هاتە کێمکرن یا گەرووێت ئاخێ بو 18.9 و 4.29×10^3 cfu بشتی هەردوو دەمێت بەستێ 45 و 60 روژ بەرامبەرێ وێ بونە 13×10^3 cfu بو ئاخا نەیا بەستەرەکری ، بکارئینانا تێکەل یا هەردوو قەبرا (بنلیت + میتالاکسیل) بو ئەگەرێ کێمکرنا بەرچاڤ ل تیراتیا هژماری یا گەرووێت ئاکنجی ، لێ بلنترین تیراتیا ڤان گەروویا (20.07×10^3) هاتە تومارکرن ل ناڤ ئاخا نە بەستەرەکری و یا کارلێکری بزبلێ مریشکا .

بشتی بورینا 6 – 8 هەیڤا ، ڤان گەرووییان شینبونا خو زڤراندەڤە وبشێوەیەکێ بەرجاڤ لناڤ ئاخا بەستەرەکری یا کارلێکری ب زبلێ وڤەبرا ئەوێت هاتیەگوتن لسەری . کارلێکیت ئاخا نەیا بەستەرەکری ویا چاندی بتوڤێ کاژێ دیارکر بتوشبونا مرنا نەمامکا بریژا 83.33 ٪ وەشدەیا ئیشێ بریژا 12.42 و 11.67 ٪ .

هەر چاوابیت زبلێ مریشکا و ڤە بریت کیماوی و بەرهنکاریا بایوتیك *T. h.* بو ئەگەرێ کونترولکرنێ لسەر پەیدابونا ئیشێ لناڤ ئاخا بەستەرەکری ل ماوێ 60 روژا ب ریژیت کێمتر ، بەراوەری ب هەمێ کارلێکێت دی وئەڤ ریژیت هەێ کەهشتنە 29.17 ، 20 ، 15، 28.33 ٪ لدویڤ ئیك .

ل دوماهیکێ بکارئینانا زبلێ مریشکا و بەرهنکاریا بایوتیکی *T. h.* ل روژا شینبونێ بو ئەگەرێ زیدەبوونا هژمارا چەندی یا گەرووێت رمی بریژا 7.34 و 5×10^3 سەرباری بیسکرنا سامبلێت ئاخێ ب لقاحا ئیشێ یا ڤان گەرووییان *Fusarium* , *Proliferatum* , *Macrophomina phaseolina* , *Rhizoctonia solani* ل وی دەمی کو ئەڤ ئەگەریت ئیشێ دیاربون بریژا 13.89 و30.9 ٪ ل هەردوو کارلێکێت دی ، زبلێ مریشکا و بەرهنکاریا بایوتیکی لدویڤ ئیك.