Journal of University of Duhok., Vol. 22, No.1 (Agri. and Vet. Sciences), Pp 312-321, 2019
https://doi.org/10.26682/avuod.2019.22.1.29

IMPACT OF MULCHING AND SOIL AMENDMENTS ON SUPPRESS OF TOMATO *FUSARIUM* DAMPING OFF DURING THREE ROTATION

PAYMAN H. HASSAN, **W**AZEER A. HASSAN and **K**HADEEJA A. SAIDO
College of Agriculture, University of Duhok, Kurdistan Region-Iraq

(Received: May 12, 2019; Accepted for Publication: July 23, 2019)

ABSTRACT

Inorganic mulches of black polyethylene and stone fragments and soil amendments of shredded paper, wood chips, pine leaf litter, ornamental leaves and composted manures of chicken and ovine's were inoculated with a pathogenic *Fusarium solani* before sowing tomato seeds for three rotations with duration of 30 days for each. Incidence of damping off of seedlings, analysis of soil microbial and soil properties were computed.

The results revealed entire reduction of damping off after second rotation when used polyethylene mulch and paper bulb. Wood chips and stone fragments were also reduced disease occurrence significantly with 87 and 89 %, respectively. Physicochemical soil properties was improved to relatively optimal ranges; organic matter >30 %, E.C. 3.8-4.8, C/N 12.6-20.1. Microbial analysis showed increasing of fungal population of 17 cfu / g soil after the first rotation and fleeted to 28 cfu/g soil after 30 days of the second rotation, and then reduced to 16 cfu / g soil after third rotation. In contrast, *F. solani* was suppressed after third rotation through antagonism potential of these organisms. Stone fragments and composted manures contained the highest population of fungal community attained to 28, 30 and 31 cfu / g soil, respectively than 12 and 17 cfu / g soil in control. Shredded paper and stone fragments mulch resulted in high activation of bacterial community reached to 19 and 12 cfu / g soil compared to 10.44 in control. Interaction of rotation and soil amendments appeared the highest colonization of fungi with 46 cfu/ g soil in the chicken manures during first rotation. While pine leaf litter, black polyethylene, and stone fragments encouraged fungal growth to 42 and 39 cfu / g soil during second rotation, the most amendments were supported the bacterial growth to 21- 28 cfu / g soil than 8.66 and 7 cfu / g soil in the control. Microbial communities in most treatments were decreased in the third rotation though continues of fungi growth to 38 cfu / g soil.

***KEY WORDS*:** Mulches, Soil amendments, F. *solani*, Damping off, Soil quality, Microbial community

INTRODUCTION

Fusarium is one of the most serious pathogens throughout the world affecting wide host range and causing damping off and root rot in both nurseries and open field. These diseases mostly caused by *F. oxysporum* Schlecht ,*F. solani* (Mart.) Sacc., *Rhizoctonia solani* Kuhn , and *Sclerotium rolfsii* Sacc. (Benhamou et al., 1994 and El- Mougy, 1995). Controlling such of pathogens mainly depend on fungicides (Rauf, 2000), and resistance of pesticides has rendered certain pesticides ineffective.

F. solani are mostly present in sub tropical regions , the optimum temperature for infection is 27-31 ^{0}c with soil moisture 28-78 % . pH 6-8 (Glen et al., 2003) , and its propagules remain viable in the soil up to 30 years (Thangavelu et al. ,2003). Therefore, the growers need to develop alternative approaches for controlling this soil – borne pathogen (El- Mohamedy et al. , 2013a, and El – Mougy et al. , 2013). Soil solarization proved an efficient method for reducing disease incidence and severity (Adams , 1990 and Campbell, 1990), mulching of the soil surface help to weed control , reserve of soil moisture, reducing soil compaction, and standing a barrier between the plant parts above the ground and soil pathogens , it also helps in creating unfavorable conditions for them.

Organic mulches and soil amendments save the soil temperature in the first 20-30 cm , protects from erosion caused by wind currents and water, and reduce leading of fertilizers particularly on sandy soils (Scarasica – Mugnozza et al., 2006) . Recently different organic mulches, soil

amendments and colored plastic mulches have been used in vegetables for controlling disease through creating unfavorable sites for pathogens development around plants (Mahmoudpoure and Stapleter, 1997), that lead to increasing the irradiance around the plant canopy and pathogens population. The soil coverage with organic mulches of straw , after grain harvest consider the natural method for suppressing soil – borne diseases through antagonism of soil microflora (Liebman and Davis ,2000 and Kosterna ,2014).

The current investigation aimed to evaluate the effects of six types of organic amendments and inorganic mulches of black polyethylene , and stone fragments on the occurrence of *Fusarium solani* damping – off of potted tomato seedlings in addition to soil health, and their – microflora population after three plant rotations.

MATERIALS AND METHODS

Experimental site and treatments: The current work was investigated during 2017-2018 at College of Agriculture, University of Duhok to assess the efficiency of several organic and inorganic mulches covered the soil for two months before planting for reducing tomato damping off caused by *F. solani* .

The field clay soil was sterilized and put up in wooden boxes 1 m^3 at a rate of 10 Kg /box, and mulched for two months from 15 June to 15 August, 2018 the tomato seeds (speedy hybrid) were cultivated under green house in 20 August at a rate of 50 seed / box, the health of tomato seedlings was estimated after a month through computing the incidence of pre and post emergence damping off. The substrate treatments were planted again using the same procedure for second rotation.

Chemical and physical properties of mulched and amended soil were estimated at the end of third rotation.

Biological dynamics of soil microorganisms of fungi and bacteria were analyzed three times at the end of each rotation.

Treatments included six types of organic mulches as follows: shredded paper (SHP), Wood Chips (WCH) of poplar, Pine Leaf Litter (PLL). Ornamental Leaves (OL) , Composted Ovine's Manure (COM), Chicken Manure (CHM), and inorganic mulches of black polyethylene (BP) 10µ thickness , and Stone fragments (SF), all treatments were compared to inoculated non-mulched a bare soil as control, another control treatment included non-mulched with non inoculated soil.

ISOLATION OF *F. SOLANI*

Tomato plants showing wilt and /or root –rot symptoms were thoroughly washed, cut into small pieces and surface sterilized with 0.5 % sodium hypochlorite. Pieces were plated onto PDA Petri dishes. Plates were incubated at 28 ^{0}c for 5 days and examined for fungal growth.

INOCULATION AND MULCHING

Pathogenic inoculum contained a mixture of mycelial fragments , micro and macro conidial suspension prepared from the full growth of 90 mm cultures grown on PDA petri plates for seven days with 100 ml distilled water and blended gently for (30) sec. The soil of each box was drenched with 1000 ml of inoculum suspension before mulching with 10 cm in thickness.

MICROBIAL ANALYSIS

Soil samples were collected from each treatment after 30, 60, 90 days (first, second, and third rotation), respectively to determine microbial account of fungi and bacteria . The synthetic media were PDA for isolation of fungi and Nutrient Agar NA for bacteria, the population of fungi colony was determined using serial dilution method and agar medium.

Average number of fungal colonies was calculated for 1 g dry soil (cfu × 10^3 / g and cfu x10^5 /gram for bacteria).The experiment was stated with 10 g of dry soil which was placed in sterile Erlenmeyer flask with 90ml sterile distilled water and shaking for 30 min. using rotary shaker, 0.1 ml of soil suspension was transferred into each plate, spread well with glass rod before incubation.

Plant materials: After mulches removing, 50 seeds of tomato cv. (speedy hybrid) were sown in a box, each treatment replicated three times. After a month, pre and post – emergence damping off of seedlings were computed. The containers were reseeding again after another 30 days for computing disease occurrence.

Statistical analysis: Systems software (SAS version8, Institute, Inc.) were used for data analysis, subjected to analysis of variance (ANOVA), Mean were compared using Duncan Multiple Range Test at ≤ 0.05.

RESULTS AND DISCUSSION

The incidence of tomato damping off of seedlings grown in the different soil amendments and mulches was evaluated for two rotations of 30 days for each, with computing of disease reduction through trapping pathogenic inoculum of *F. solani*, in addition to analysis of soil properties and the soil microbial after each rotation. The results in (Table 1) showed asignificant reduction in diseases incidence in both rotations compared to non amended control treatments.

In the first rotation , application organic mulches of pine leaf litter , ornamental leaves , chicken manures, and shredded paper resulted in the lowest disease occurrence ranged between 12.5 -26.39 % compared to 44.22 % and 36.11 % in control.These results clarified that both control treatments encouraged pathogens reproduction and increasing inoculum density because of favorability of their substrates for its colonization. Repetition of tomato sowing in the second rotation lead in enhancement reduction of pathogenic inoculum , and subsequently prevented disease occurrence entirely when used black polyethylene and shredded paper mulches,and this may be due to heating soil rhizosphere particularly when mulched by polyethylene sheets and preventing of weed growth that may be colonized by pathogen.

Table (1): % incidence of damping off of potting tomato seedlings after soil mulching

Treatment	% incidence of damping off		% Reduction**
	Rotation 1	Rotation 2	
Stone fragments	26.39 b *	2.78 b	89.47 ab
Shredded paper	16.67 bc	0.0 c	100.0 a
Wood chips	22.23 b	2.78 b	87.49 bc
Black polyethylene	25.0 b	0.0 c	100.0 a
Pine leaf litter	12.5 c	5.56 b	55.52 cd
Ornamental leaves	13.28 c	5.56 b	63.61 c
Composted manure	20.84 b	5.56 b	73.32 c
Chicken manure	15.28 c	5.56 b	63.61 c
Control 1(inoculated with no mulch)	44.22 a	23.61 a	46.61 d
Control 2(non- mulch with non-inoculated)	36.11 a	29.17 a	19.22 e

*Means followed by the same letters in each column were not significant according to Duncan's Multiple Range (P= 0- 0.5).

$$** \% \text{ Reduction} = \frac{\% \text{ Dis. Incidence in control 1} - \% \text{ dis. Incidence in control 2}}{\text{Dis. Incidence in rotation 1}} \times 100$$

Other treatments were also decreased disease incidence to 2.78 % -5.56% compared to 23.61% and 29.17 % in both control treatments. Therefore, the percentage of disease reduction augmented to 87.49% and 89.47% compared to 46.16 % and 19.22 % in control. In this aspect ,we agree with Moursy et al. , 2015 when reported that black polyethylene sheets is the most common mulches because it retards weed growth , increased soil temperature for 4-5^{0}C , and reduced soil compaction and evaporation

Soil coverage with different organic mulches such as straw, leaf litter, and manures consider the natural efficient methods when used with best thickness on the soil surface (Zagarova, 2003 and Kosterna, 2014). Therefore, physical control of solarization, soil disinfection and cultural methods particularly of ground mulches in combination with biological measures consider as fungicide alternatives against soil – borne pathogens, since vegetable produces in particular confronted with the challenges of managing fungal pathogens have the opportunity to these methods. Recently, there are strict regulations on chemical pesticides use, and there is political pressure to remove the most hazardous of chemicals (El- Mohamady et al., 2014).

In general ,the soil –borne pathogens causing damping-off affect greatly by mulches especially when applied in the nursery or in container .Thus , there are sufficient data by several authors indicate that organic amendments and inorganic mulches can reduce the incidence of damping off and root rots caused by *Fusarium* spp. ,

Phytophthora , and several soil – borne pathogens such as *Pythium ultimum* , *Verticillium dahlia* , and *Rhizoctonia solani* (Bonilla et al., 2007 and Bonilla et al., 2012 and Pane et al., 2011).

PHYSICAL AND CHEMICAL SOIL PROPERTIES

Several physicochemical parameters of the soil such as soil pH, electrical conductivity E. C., bulk density, soil moisture, organic matter OM, and C/N have been related to disease suppression according to results in (Table 2). The pH values in different treatments including control were within the optimal range for the development of bacteria 6- 7.9 and fungi 5.5 – 8 (Zorpas et al., 2003). Therefore, we found that no relationship between amendment pH and disease suppression though the impact of soil pH on the nutrients availability.

Table (2) : Physical and chemical properties of amended and mulched soils

Treatments	pH	Ec dsm^{-1}	Bulk density g/cm	% Porosity	% OM	% OC	% Moist.	%TN	C/N	Avail P mg/l^{-1}
Stone fragments	7.95	4.8	1.32	50.2	37.5	11.22	39.4	0.89	12.61	3.7
Shredded paper	7.93	4.4	1.25	52.76	37.9	16.2	42.2	0.91	17.80	6.9
Wood chips	7.99	4.8	1.18	55.47	30.5	17.7	41.3	0.90	19.67	4.8
Black polyethylene	7.89	4.4	1.22	57.02	31.4	12.4	38.9	0.82	15.12	5.5
Pine leaf litter	7.93	4.3	1.30	53.41	34.9	15.9	44.3	0.88	18.07	8.1
Ornamental leaves	7.99	3.8	1.18	54.5	39.7	14.2	45.6	0.85	16.71	5.7
Composted manure	7.91	4.6	1.19	59.4	31.6	18.1	43.8	0.99	18.28	6.1
Chicken manure	7.89	4.4	1.20	55.61	38.2	19.5	44.5	0.97	20.10	6.5
Control 1	7.76	5.4	1.29	51.28	24.0	13.9	39.3	0.69	20.14	2.8
Control 2	7.88	6.8	1.17	56.01	22.0	17.7	40.7	0.72	24.58	3.1

Electrical conductivity of examined substrates were moderately saline 4-6 ds/m. Available phosphorus was more important to improve plant healthy in most examined amendment ,thereafter,the plant vigor with stand or tolerate pathogen's attack . Furthermore, application of soil amendments will increase the stable N and humic carbon which also improve available nutrients for plant growth.

The C/N ratio in different treatments was relatively in optimal ratio ranged between 12.6 and 20.1 than 24.5 in control 2 . The increasing of total N 0.82-0.99 % may be attributed to decreasing of substrates carbon in most treatments and loss of Co_2 because of decomposition of the organic matter. The latter chemically bound with nitrogen and their stabilized amounts reflected greatly on microbial dynamics (Soumare et al., 2002 and Zorpas et al. , 2003). Thus, the soil OM , one of the main indicators of soil quality , and plays critical role in global biochemical cycles (Fonte et al., 2009).Worthily , OM decompose and transform to stable humic compounds had a capacity to buffer pH and act as apotential source of nutrients for plant. However, the direct addition of organic amendments to crop soils can improve soil aeration, structure, drainage, water holding capacity, nutrient availability and ecology of soil microorganisms (Bailey and Lazarovits, 2003). Subsequently, most pathogens are unable to survive for long periods in the amended or mulched soils due to creating unfavorable conditions for their inhabitation (Ajilogba and Babalota, 2013a).

MICROBIAL ACCOUNT: Microbial dynamics in the soil are diverse along each of soil amendments or mulches applied, and their duration. Thus, microbiological analysis of the soil substrates for three rotations of tomato seedlings clarified that the fungal population was 17.60 cfu /g soil in the first rotation, and increased to 28.13 cfu/ g soil in the second one, whereas declined to 16.37 in the third rotation.

In contrast , the sustenance of such most colonized bacteria as *Bacillus spp*.,and *Pseudomonas spp*. in the second rotation were overcome when isolated with 18.33 cfu /g soil compared to 5.97 and 6.46 cfu / g soil in both first and second rotation , respectively (Figure 1).

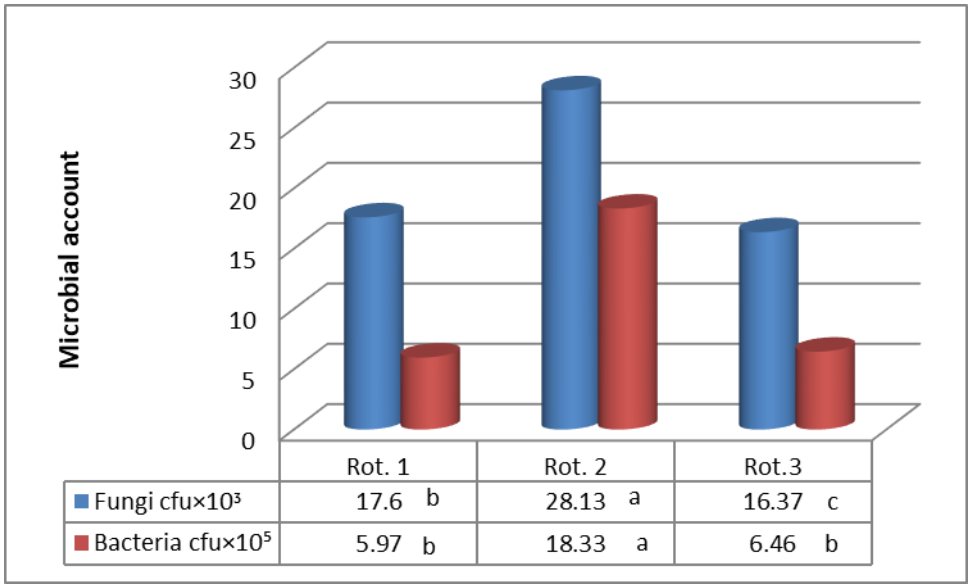

Fig. (1): Microbial population in mulched and amended soil after three rotation of tomato seedlings.

The most frequently obtained fungi that may potentially be antagonistic microorganisms were *Aspergillus* , *Trichoderma* , *Rhizopus* , *Stemphylium* , *Penicillium* and *Cladosporium* .The gradual increasing of fungi and bacteria such as *Bacillus spp*.,and *Pseudomonas spp*. during second rotation may be attributed to nutrients available in the substrates after first 30 days which exhausted during third rotation , and subsequently microbial activities declined .In contrast, almost pathogenic inoculum of *F. solani* were weakened or killed through antagonism potential of the soil microorganisms that supported by unfavorable soil conditions .

The data represented in (Figure 2) revealed that disease suppressiveness has usually been related to a global increase in the soil microbial biomass and this depend on the type of organic matter , plant host , and a pathogen species (Bailey and Lazarovits , 2003). Thus , stone fragments , composted ovine's and chicken manures consisted of the highest and significant population of fungi reach to more than 28 and 31 cfu / g soil compared to 12.67 and 17.22 cfu/ g soil in the control non amended treatments, respectively. Mulches of black polyethylene and pine leaf litter were also showed comparable fungal content. Shredded paper and stone fragments activated the bacterial community and attained to 19.22 and 12.55 cfu/ g soil than 10.44 cfu/ g soil in control. Worthily,stones content of calcium carbonate and organic matter of shredded paper may be activated the bacterial population. However, the enhancement of microbial biomass is one of the aims of some cultural practices such as addition of organic composts , manures, and decomposed leaf litters of forest and ornamental trees (Janiver et al., 2007).

The entrancement culturally of heterotrophic bacteria and most pathogenic fungi including *Fusarium* spp. , has been shown to be affected by the animal and vegetal commercial compost (Bonilla et al.,2012 ,Bulluck and Ristaino, 2002).

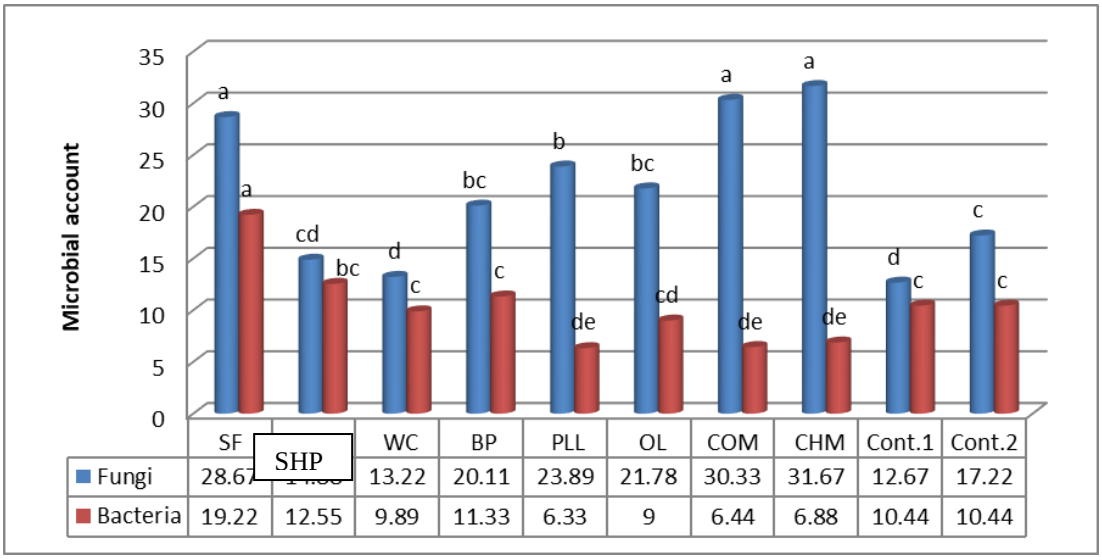

Fig.(2): microbial population in the mulched and amended soil

Statistical analysis of interaction rotation and soil amendments (Table 3) showed the highest colonization of fungal communities with 46 cfu / g soil in the chicken manure during first rotation followed by 29 cfu / g soil in the ornamentals leaf litter.

The inoculum of *F. solani* continued their pathogenicity in both first and second rotations and occurred in all treatments in except of control non- inoculated treatment.

Table (3) : Pre and post damping- off percentage of Tomato seeds planted in soil treated with plants extractions.

Rotation	Amendments & Mulching	Fungi ×10 ^{3}	Bacteria ×10 ^{5}	*F . solani*
Rotation 1	Stone fragments	9.00 e *	5.0 e	+
	Shredded paper	10.33 e	6.33 de	+
	Wood chips	16.33 d	5.67 e	+
	Black polyethylene	14.00 de	3.0 e	+
	Pine leaf litter	13.67 de	4.0 e	+
	Ornamental leaves	29.0 bc	3.0 e	+
	Composted manure	23.0 c	5.0 e	+
	Chicken manure	46.0 a	14.0 cd	+
	Control 1	11.33 e	8.0 d	+
	Control 2	12.33 e	5.67 e	-
Rotation 2	Stone fragments	39.0 ab	45.0 a	+
	Shredded paper	24.33 e	28.0 b	+
	Wood chips	11.0 e	21.0 bc	+
	Black polyethylene	39.67 ab	23.33 bc	+
	Pine leaf litter	42.33 ab	10.33 e	+
	Ornamental leaves	32.0 b	21.0 bc	+
	Composted manure	35.0 ab	10.66 d	+
	Chicken manure	58.0 a	8.33 d	+
	Control 1	11.0 e	8.66 d	+
	Control 2	10.0 e	7.0 d	-
Rotation 3	Stone fragments	38.67 ab	7.66 d	-
	Shredded paper	10.0 e	3.33 e	-
	Wood chips	12.33 e	3.0 e	-
	Black polyethylene	6.67 f	7.66 d	-
	Pine leaf litter	15.67 d	14.66 cd	-
	Ornamental leaves	15.33 d	10.33 d	-
	Composted manure	13.0 de	3.67 e	+
	Chicken manure	11.0 e	6.66 de	+
	Control 1	15.67 d	4.66 e	+
	Control 2	6.33 f	3.0 e	-

*Means followed by the same letters in each column were not significant according to Duncan's Multiple Range (P= 0- 0.5).

In the second rotation, the bacterial community in stone fragments was increased significantly to 45 cfu/g soil, and fungi to 42.33 and 39 cfu / g soil in the amendments of pine leaf litter and stone fragments mulch, respectively. The latter was similar with black polyethylene in their fungi population.

Organic amendments of shredded paper, wood chips , and ornamentals leaf litter were also contained remarkable bacterial communities ranged between 21-28 cfu/ g soil compared to 8.66 and 7 cfu /g soil in control. In third rotation, the soil microbial declined greatly in most treatments though a significant fungi account of 38.67 cfu / g soil computed under stone fragments mulch corresponds to 14.66 cfu / g soil of bacterial account in the amendment of pine leaf litter. *F. solani* disappeared in the most treatments; . Its existence was confined in the both forms of manures.

CONCLUSION

This result indicate that crop rotation provides numerous benefits to plant health and it is essential to reduce the buildup of soil –borne pathogens through variety of mechanisms including changes in soil microbial communities which induce conserving of replenishing soil resources such as OM, changes in soil chemical, physical, and biological properties in addition to soil fertility and structure.

Mulches and soil amendments might contribute to suppression of the soil – borne pathogens including *Fusarium* spp. , beyond increasing of antagonistic fungi , and bacteria particularly in rotating farm through trapping and direct killing or weakness their pathogenic inoculum. The introduction of these practices in the integrated control to plant diseases could also help in maintenance of soil organic matter , improving soil quality and manipulation of the microbial community that lead to reproducible suppressive amendment the assurance for provide healthy seedling.

REFERENCES

– Adams, P.B. ,1990. The potential of mycoparasites for biological control of plant disease. Ann. Rev. Phytopathol., 28: 59-72.
– Ajigbola, C.F. and O.O., Babalola, 2013a. Integrated Management Strategies for Tomato *Fusarium* Wilt. *Biocontrol Sciences*. Vol. 18 (3): pp 117-127.
– Benhamou, N., P.J. Lafontaine, and M. Nicole, 1994. Seed treatment with chitosan induces systemic resistance to Fusarium crown and root rot in tomato plants. Phytopathology 84:1432-1444.
– Bulluck, L.R., J.B. Ristaino, 2002. Effect of synthetic and organic soil fertility amendments on southern blight, soil microbial communities, and yield of processing tomatoes. *Phytopathology*, *92*,181–189.
– Bailey, K.L., G. Lazarovits, 2003. Suppressing soil-borne diseases with residue management and organic amendments. *Soil Tillage Res.*, *72*, 169–180.
– Bonilla, N., J.A.Torés, J.M. Hermoso, J.González, F.M. Cazorla, A. de Vicente,2007. Biological control of avocado root rots by suppressive organic amendments. In *IOBC/wprs Bulletin: Biological control of fungal and bacterial plant pathogens*; Elad, Y., Maurhofer, M., Keel, C., Gessler, C., Duffy, B., Eds.; Interlaken, Switzerland ; Vol. 43, pp. 231–234.
– Bonilla, N., F.M. Cazorla, M. Martínez-Alonso, J.M. Hermoso, J. González-Fernández, N. Gaju, B.B. Landa, A. de Vicente, 2012. Organic amendments and land management affect bacterial community composition, diversity and biomass in avocado crop soils. *Plant Soil*, *357*, 215–226.
– Campbell, R. ,1990. Biological control of soilborne diseases, some present problems and different approaches. Crop. Protection, 13: 4-13.
– El-Mougy, N.S. ,1995. Studies on wilt and root rot diseases of tomato in Egypt and their control by modern methods. M.Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt, pp. 178.
– El-Mougy, N.S., F. Abdel-Kareem, M.M. Abdel-Kader, Y.O. Fatouh, 2013. Long term effect of applied compost and bio-agents as integrated treatment for controlling bean root rot disease in solarized soil under field conditions. Plant Pathology & Quarantine, 3(1), 41–52.
– El-Mohamedy, R.S.R., M.M. Abdel-Kader, F. Abd-El- Kareem and El-Mougy, N.S. ,2013a. Inhibitory effect of antagonistic bio-agents and chitosan on the growth of tomato root rot pathogens In vitro. *Journal of Agricultural Technology*, 9 (6):1521-1533.
– El-Mohamady R.S.R, S. E. Nehal, M. M. Abdel-Kader and D. Mejda, 2014. Physical and Biological Treatments as Integrated Control Measures against Tomato Root Diseases under Field Conditions. International Jour. Of

Engineering and Innovative Technology (IJEIT).Vol.3, Issue 12 , pp. 2277-3754.

– Fonte ,S. J., E. Yeboah , P. Ofori , G.W. Quansah, B. Vanlauwe , J. Six , 2009. Fertilizer and residue quality effects on organic matter stabilization in soil aggregates. Soil Sci. Soc. Am. J., 73 961-966.

– Glen, H., H. Y-Dow, and L. Susan, 2003. *Characterization of soybean pathogens and Disease Management*, pp. 1-4, Australian Plant Pathology Society, Australia.

– Janvier, C., F.Villeneuve, C. Alabouvette, V. Edel-Hermann, T. Mateille, C. Steinberg, 2007. Soil health through soil disease suppression: Which strategy from descriptors to indicators? *Soil Biol. Biochem.*, *39*, 1–23

– Kosterna, E., 2014. The effect of soil mulching with organic mulches, on weed infestation in broccoli and tomato cultivated under polypropylene fiber, and without a cover. J. Plant Prot. Res. 54(2): 188−198.

– Liebman, M. and A.S. Davis. ,2000. Integration of soil, crop and weed management in low-external-input farming system. Weed Research. 40:27-47

– Mahmoudpour, M. A. and J. J. Stapleton, 1997. Influence of sprayable mulch colour on yield of eggplant (*Solanum melongena* L. cv. Millionaire). Scientia Horticulturae, 70: 331–338.

– Moursy F. S.,F. A. Mostafa and N. Y. Solieman , 2015 . Polyethylene and rice straw as soil mulching : feflection of soil mulch type on soil temperature , soil borne diseases , plant growth and yield of tomato.Global Journal of advance research , Vol- 2 , Issue- 10 , PP. 1497- 1519.

– Pane, C., R. Spaccini, A. Piccolo, F. Scala, Bonanomi, 2011 . Compost amendments enhance peat suppressiveness to *Pythium ultimum*, *Rhizoctonia solani* and *Sclerotinia minor*. *Biol. Control* , *56*, 115–124.

– Rauf, B.A. ,2000. Seed-borne disease problems of legume crops in Pakistan. Pak. J. Sci. and Industrial Res., 43:249-254.

– Soumare, M., A. Demeyer, F.M.G. Tack and M.G. Verloo, 2002 . Chemical characteristics of Malian and Belgian solid waste composts. *Bioresour. Technol.* 81, 97–101.

– Scarascia-Mugnozza, G., E. Schettni, G. Vox, M. Malinonico, B. Immirzi and S. Pagliar, 2006. Mechanical properties decay and morphological behavior of biodegradable films for agricultural mulching in real scale experiment. Polym. Degrad. Stab. 91:2801-2808.

– Thangavelu, R., A. Palaniswani, and R. Velazhahan, 2003. Mass production of *Trichoderma harzianum* for managing *Fusarium* wilt of banana. *Agric. Ecosyst. Environ*., 103, 259-263.

– Zorpas, A.A., D. Arapoglou, and K. Panagiotis, 2003 . Waste paper and clinoptilolite as a bulking material with dewatered an aerobically stabilized primary sewage sludge (DASPSS) for compost production. *Waste Manage*. 23, 27–35.

– Zagaroza, C., 2003. Weed management in vegetables. Food and Agriculture Organization of the United Nations.Plant Production and Protection. 120: 1.

Journal of University of Duhok., Vol. 22, No.1 (Agri. and Vet. Sciences), Pp 312-321, 2019
https://doi.org/10.26682/avuod.2019.22.1.29

كارتێكرنا نخافتنا نه ئورگانیكی وراستقەكرنێن ئاخێ ل سەر كیمكرنا ئێشا مرنا نماما فیوزارمی ل سەر باجان سورکێ ل دە می سی خولان

پوختە

هندەك نخافتنێن نە ئورگانیكی هاتنە تاقیكرن ئەوژی پولی اسیلینا رەش و پرتێن بەرا و راستقەكرنا ئاخێ ب پاشماییێت كاغەزی وپاشماییێت داری وپاشماییێت بەلگێت رووەكێت جوانیێ و ژبلێ كومپوستی ژ زبلێ مریشكا و پە زی ئەوێن هاتینە ڤاكسینكرن ب **F. solani** بەری چاندنا توڤێ باجان سورکێ بو سێ خولان هەر ئێك ژوان بو دەمێ **30** روژان. ریژەییێن توشبوونێ ب ئێشا مرنا نماما فیوزارمی هاتنە تومارکرن و دیسان ساخلەتێن ئاخێ ییێت ئو بیكهاتی مایكروبی هاتنە تاقیكرن. ئەنجامان كێمكرنەكا بەرچاڤ دیاركرن دهەبوونا ئێشا مرنا نماما دەدەمێ بكارئینانا نخافتنا پولی اسیلین و پاشماییێت كاغەزی. دیسان بكارئینانا هەر ئێك ژپاشماییێت داری و پرتێن بەرا بوویە ئەگەرێ كێمكرنەكا بەرچاڤ دریژەییێن توشبوونێ دا و گەهشتیە **87** و**89%** ل دویف ئێك دا. ساخلوتێن فیزوكیمیائی ییێت ئاخێ باشتر لێ هاتن وگەهشتنە ئاستێت نورمال، كەرەستێن ئورگانیكی > **30 %**، گەهاندنا ئلكتریكی **3,8- 4,8**، ریژەیا نتروجینی بو كاربونی **12,6- 20,1.** شلوقەكرنا مایكروبی زێدەبوونا ژمارەیا كەرووا دیاركر وگەهشتە **17 /cfu** غم ئاخ پشتی خولا ئێكێ وگەهشتە **28 /cfu** غم ئاخ پشتی **30** روژان دخولا دووێ دا وپشتی هینگێ هاتە خار بو **16 /cfu** غم ئاخ دخولا سیێ دا. ژئالەكێ دی ڤە، **F. solani**هاتە كونترولكرن پشتی خولا سیێ برێكا شیانێن هەڤدژ د ناڤ ئەڤان زیندەوران. پرتێن بەرا و زبلێ كومپوستی مەزنترین ژمارا كەرووا بخوڤە گرتن وگەهشتنە **28** و**30** و**31 /cfu** غم ئاخ ل دویف ئێك دا دەدەمێ بەراوەردكرنێ دگەل **12** و**17 /cfu** غم ئاخ دكونترولی دا. نخافتن ب پاشماییێت كاغەزی وپرتێن بەرا بووینە ئەگەرێ چالاككرنەكا مەزن د ژمارێن بەكتریا دا وگەهشتنە **19** و**12 /cfu** غم ئاخ دەدەمی د كونترولی دا گەهشتیە **10,44 /cfu** غم ئاخ. لێكدان دنافبەرا خولان و راستقەكرنێن ئاخێ بوویە ئەگەرێ بدەستڤەئینانا مەزنترین ژمارێن كەرووا وگەهشتە **46 /cfu** غم ئاخ دناف زبلێ مریشكا د خولا ئێكێ دا. پاشماییێت بەلگێت كاژا وپولی اسیلینێ رەش و پرتێن بەرا پشتەڤانیا شینبوونا كەرووان كریە و گەهشتە **42** و**39 /cfu** غم ئاخ د خولا دووێ دا. زوربەی راستقەكرنان پشتەڤانیا شینبوونا بەكتریای كریە وگاهاندیە **21- 28 /cfu**غم ئاخ دەدەمێ گەهشتیە بتنێ **8,66** و**7 /cfu** غم ئاخ د كونترولی دا. ژمارێن مایكروبی د زوربەی سەرەدەریان دا هاتینە كێمكرن دەدەمی خولا سیێ وگەهشتیە **38 /cfu** غم ئاخ.

تأثير التغطية اللاعضوية وتعديلات التربة في تضبيط مرض موت البادرات الفيوزارمي على الطماطة خلال \ ثلاث دورات زراعية

الخلاصة

تم اختبار تأثير التغطية اللاعضوية المكونة من البولي أثلين الأسود وقطع حجرية وتعديلات التربة ببقايا ورقية ونشارة الخشب وبقايا أوراق الصنوبر وأوراق نباتات الزينة وسماد الكومبوست من فضلات الدواجن والاغنام والملقحة بالمسبب المرضي *F. solani* قبيل زراعة بذور الطماطة لثلاث دورات ولمدة 30 يوماً لكل منها. تم احتساب نسب الاصابة بمرض موت البادرات الفيوزارمي وتحليل صفات التربة ومحتوى الميكروبية. أظهرت النتائج انخفاضاً كلياً في ظهور مرض موت البادرات عند استخدام التغطية بالبولي أثلين والبقايا الورقية. كما أظهر استخدام كل من نشارة الخشب والقطع الصخرية انخفاضاً ملحوظاً في نسب الاصابة ووصلت الى 87 و89% على التوالي. تحسنت الصفات الفيزوكيميائة للتربة الى حدود المستويات المثالية، المادة العضوية > 30%، التوصيل الكهربائي 3.8- 4.8، نسبة النتروجين الى الكاربون 12.6- 20.1. التحليل الميكروبي أظهر زيادة في تعدادات الفطريات ووصلت الى 17 cfu/ غم تربة بعد الدورة الأولى ووصلت الى 28 cfu/ غم تربة بعد 30 يوماً في الدورة الثانية ومن ثم انخفضت الى 16 cfu/ غم تربة بعد الدورة الثالثة. من جهة أخرى، فإن *F. solani* تم تثبيطه بعد الدورة الثالثة من خلال القدرة التضادية لهذه الكائنات. احتوت القطع الصخرية والاسمدة الكومبوستية على اكبر المستوطنات الفطرية ووصل الى 28 و30 و31 cfu/ غم تربة على التوالي بالمقارنة مع 12 و17 cfu/ غم تربة في معاملات المقارنة. التغطية بالبقايا الورقية والقطع الصخرية أدت الى تنشيط عالي في مستعمرات البكتريا وصلت الى 19 و12 cfu/ غم تربة بالمقارنة مع 10.44 cfu/ غم تربة في معاملة المقارنة. التداخل بين الدورة وتعديلات التربة أدى الى الحصول على أكبر المستعمرات الفطرية وصلت الى 46 cfu/ غم تربة في اسمدة الدواجن في الدورة الأولى. بقايا أوراق الصنوبر والبولي أثلين الأسود والقطع الصخرية شجعت نمو الفطر لتصل الى 42 و39 cfu/ غم تربة خلال الدورة الثانية. معظم التعديلات شجعت نمو البكتريا الى 21- 28 cfu/ غم تربة مقارنة بـ 8.66 و7 cfu/ غم تربة في معاملات المقارنة. المستعمرات الميكروبية في معظم المعاملات تم تقليلها خلال الدورة الثالثة لتصل الى 38 cfu/ غم تربة.