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Control of Plant Parasitic Nematodes and Soil Borne Fungal Pathogens by Soil Solarization in Northern Region of Libya

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Abstract

Soil Solarization is a new sustainable method that has been shown to be effective in the control of plant parasitic nematodes, soil borne fungal pathogens, and weeds. Organic agriculture could benefit most using such technique to reduce crop losses. The effect of soil solarization in The control of plant parasitic nematodes and soil borne fungal pathogens was studied in two uncovered plastic houses in two private farms by covering the soil with polyethlyne tarps 40um.thick for 30 and 45 days during summer season. Both houses were planted with cucumber ,tomatoes and pepper ,and both were heavily infested with soil borne plant pathogens during previous seasons.Covering the soil for 45 days was more effective in reducing the population of soil borne plant pathogens than covering for 30 days. Covering the soil for 45 days controlled completely Meloidogyna javanica ,Aphelenchus avenae, and Trichodorus sp. .The population of soil fungal pathogens including Fusarium sp., Pythium sp., Asperigillus sp, and Penicillium sp..was significantly reduced by covering the soil for 30 and 45 days. The results of the study have shown soil solarization is an effective method in control of soil borne plant pathogens . The technique could be an effective, inexpensive and practical tool to control soil borne plant pathogens in Libya .

Keywords: Soil solarization; Plant parasitic nematodes; Soil borne fungal pathogens.

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1. Introduction

phytoparasitic nematodes and soil borne plant pathogens are common agents that cause serious damage to agricultural crops in Libya. Production of vegetable crops such as tomato (Lycopersicom esculentum Mill.) , cucumbe (Cucumis sativus L.) and pepper (Capsicum spp. L.) is a growing business in Libya . Soil sterilizaation by methyl bromide is being used to control soil borne pathogens and weeds, This method is undoutedly very effective , but at the same time it is expensive and risky . Therefore , the search for new inexpensive and nonhazardous technique are needed to control these diseases . Soil solarization , which is a new method has been proved to be effective in controlling plant parasitic nematodes [10, 12, 18,21], soil borne plant pathogens and weed [2, 8, 9, 12, 14, 15, 17,19, 20,] ,and to increase plant growth and crop yields [1,4, 11, 12, 13, 22]. It has been reported that microorganisms beneficial to plant growth were stimulated (Rhizobium spp. and Trichoderma spp.] or were less affected (Bacillus spp. And Actinomycetes) by soil soilarization compared to pathogenic organisms [9, 15, 20].The objective of the study was to evaluate the effectiveness of soil solarization against plant parasitic nematodes and soil borne plant pathogens during summer months in northern region of Libya.

2. Materials and Methods

This study was conducted at two privat farms at Garabulli region (65 km east of Tripoli).One uncovered plastic house was treated during July and August . The plastic house in farm no.1 was previously planted with cucumber which showed high infestation of root -knot nematodes , downey mildew, powdery mildew and root rotting diseases . The other plastic house at farm no.2 was planted with tomato and pepper. Tomato plants were having infestation with root knot -_nematodes, early blight (Alternaria solani Ell and martin) and Phytophthora infestans De Bary) . The plastic covers were taken off from both houses , the old plants were removed , the soil has been cleaned ,fertilized ,ploughed ,leveled and irrigated two days before covering the soil with polyethylene tarps of 40 um thickness. Each plastic house was divided into two plots ,one of which was covered with polyethylene tarp while the other was left uncovered and considered as control. Each plot was subdivided into three parts (6x7 m) and soil samples (1-2 kg) were collected from 6-8 spots from each part at a depth of 5-25 cm, before covering and after 30 days and 45 days of covering the soil with polyethylene tarps . Soil samples were brought to the laboratory and kept in the refrigerator until processed within 1 wk. Plant parasitic nematodes were isolated by Cobb, sieving and decanting method [5]. Soil borne fungi were isolated by taking 2 gm of a well mixed soil from each sample and placed into a flask containing 100 ml steril distilled water (1 :50 dilution).Three replicates were used and each sample was processed separately . Serial dilution technique was used and 0.2ml of a proper dilution was transferred to one of four petri plates containing potato dextrose agar (PDA) amended with 30 ppm rose bengal . Inoculated petri plates were incubated for 2-3days at 27c. Number of fungal colonies were recorded from each plate . Representative isolates were identified to the genera. The data were analyzed statistically.

3. Results

The bioassay of the soil before the beginning of the experiment showed that the soil was naturally infested with four species of plant parasitic nematodes , i.e. , Tylenchorhynchus goffarti Sturhan, Meloidogyne javanica (

Treub) Chitwood), Aphelenchus avenae Bastian , and Trichodorus spp. and with several species of plant pathogenic fungi including Rhizoctonia solani, Kuhn., Fusarium spp., Phytophtora infestans De Bary.,Pythium spp., and Asperigillus spp., The results of the study showed that covering soil with polyethylene tarps gave an effective control of nematodes and soil borne fungi as compared to uncovered soil .

Table 1. Effect of soil solarization on nematodes

No. of nematodes / 250 gm soil

	Farm No.1				Farm No.1			
Duration	M. javanica	T.goffarti	Trichodorus sp.	A.avenae	M.javanica	T.goffarti	Trichodorus sp.	A.avenae
0 days	132	42	146	23	303	80	116	105
30 days	ab++	ab	ab++	ab	ab++	ab++	ab++	ab++
covered	0	20	23	0	3	50	20	16
uncovered	16	20	36	0	60	73	23	33
45 days	ab++	ab	ab++	ab	ab++	ab++	ab++	ab++
covered	0	16	0	0	16	13	6	0
uncovered	10	13	13	3	33	26	30	0
L.S.D. between duration at 0.05	5.3	8.3	8.2	8.5	10.4	9.3	2.6	7.5
L.S.D. between methods at 0.05	7.3	5.5	15,8	4.6	7.4	3.3	7.1	4.5

ab++, significant difference between methods and duration at 0.05 -ab non-significant difference

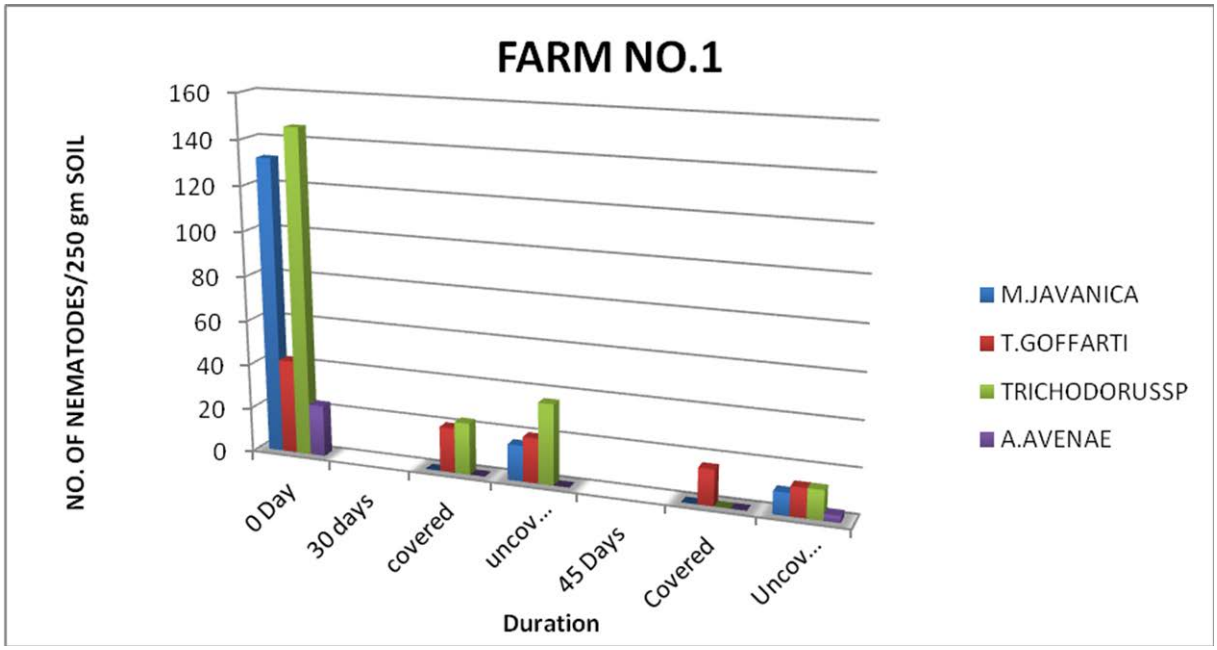

Figure (1) Effect of soil solarization on nematodes

The population of all four species of plant parasitic nematodes was reduced considerably at both farms by covering the soil with thin transparent polyethylene tarps (table no. 1 , figure. 1.2).

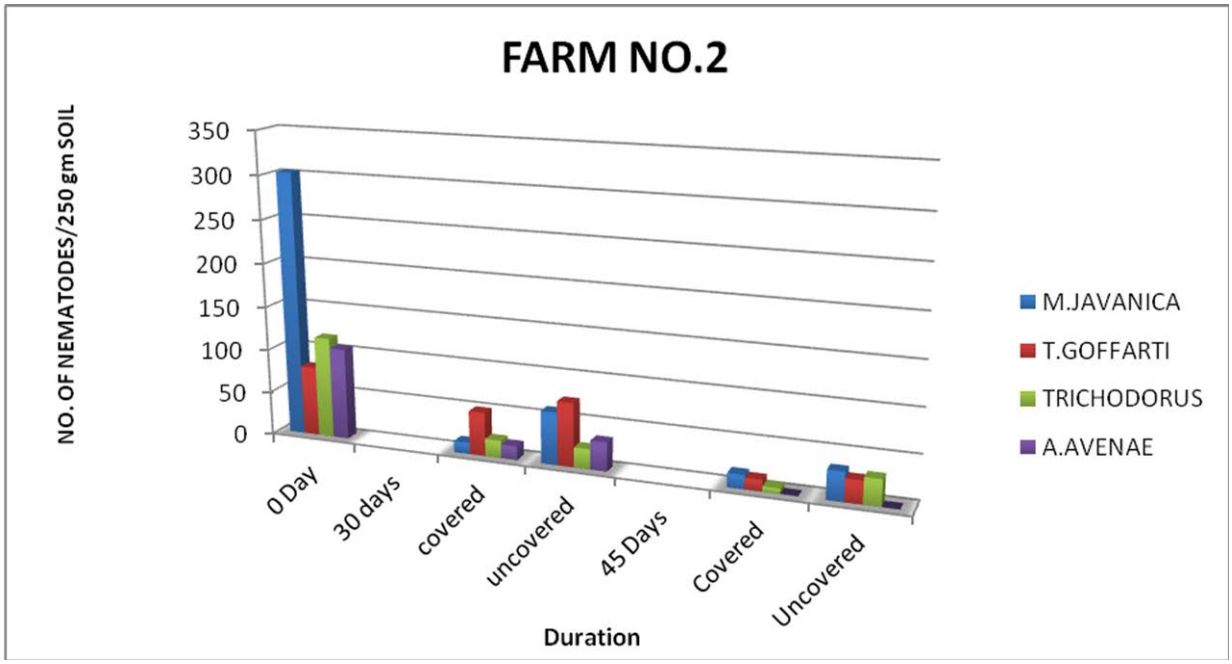

Figure (2) effect of soil solarizarion on nematodes

Aphelenchus avenae was affected most by soil solarization followed by larvae of Meloidogyne javanica ,and Trichodorus spp.,While Tylenchorhynchus goffarti was affected least.The period of covering also had a significant effect on reducing the population of nematodes . Covering the soil for 45 days at farm no. 1 controlled completely Aphelenchus avenae , Trichodorus spp, and Meloidogyne javanica. but not Tylenchorhynchus goffarti. At farm no.2 the reduction of the population of A.avenae., Trichodorus spp. , M. javanica .,and T.goffarti., was 100% , 80%, 51.5%, and 50%, respectively compared with the control.

Table no. 2 Effect of soil solarization on population density of soil fungi .

No. of colony forming units / gm soil

Duration	Farm No.1	Farm No.2
0 day	14678.75	23472
30 days covered uncovered	ab++ 1804.5 20619.5	ab++ 11562.5 18695
45 days covered uncovered	ab++ 2151.5 25068.5	ab++ 5916 6597
L.S.D.between duration at 0.05	91.05	84.11
L.S.D. betwen methods at 0.05	32.75	77.4

ab++ -significant difference between methods and duration at 0.05 non-dignificant difference

Significant reduction in the population of soil borne fungi was also obtained at both farms (table no. 2 figure 3.4). Covering the soil with polyethylene sheets for 30 days and 45 days reduced the population of soil fungi considerably . At farm no. 1. the level of fungal population in covered soil was approximately 12 times lower than the population in the uncovered soil in both treatments of 30 and 45 days .No significant difference was observed between the two covering At farm no. 2. the population of soil borne fungi showed significant reduction ,38.15 percent after 30 days . After 45 days population densities were further reduced with 17.9 percent compared with uncovered control. The representative genera that have been identified include Alternaria sp. Pythium sp. Fusarium sp. Phytophtora sp. Asperigillus sp. and Rhizoctonia solani.

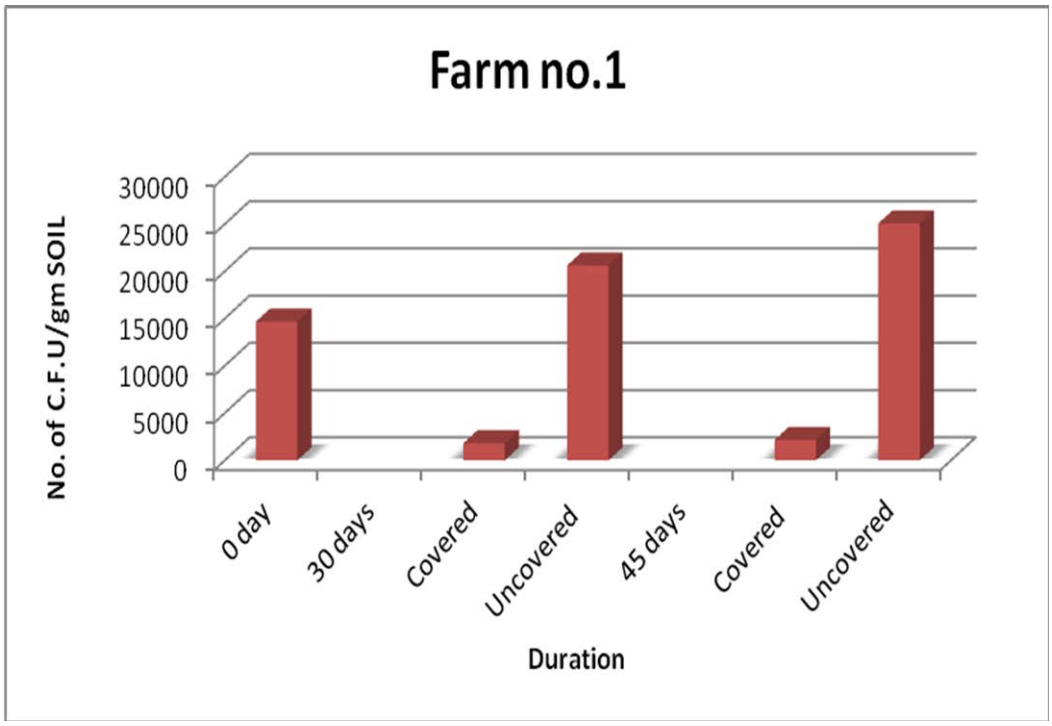

Figure (3) Effect of soil solarization on soil fungi

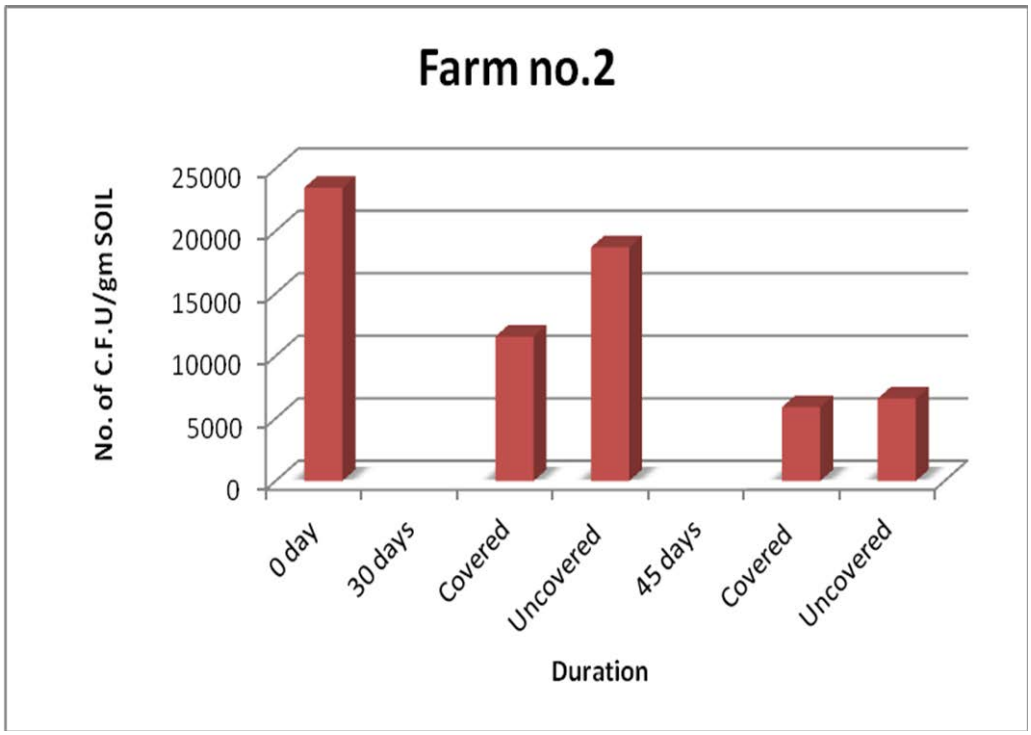

Figure (4) Effect of soil solarization on soil fungi

4. Discussion

The results of the study showed that solar heating had a significant effect on the reduction of plant parasitic nematodes and soil borne fungi .The effect of soil solarization on the reduction of soil borne pathogens at 0-25 cm depths could be the result of many factors involved [7]. It had been reported that mulching soil with polyethylene tarps increases soil temperature by 7-14 C than in uncovered soil [11 ,15] ,influences the chemical changes and physical properties of the soil [3, 6 ,12. 16], induces the production of volatile compounds [12, 21] , and antibiotics [16 , 20]. All the above factors may play a possible role in reducing soil borne diseases through the effect of physical and chemical characteristics and through the changes in biological constituents of the soil in favors of antagonists.

5. Conclusion

The results of the study showed that soil solariztion is an effective method for controlling plant parasitic nematodes and soil borne plant pathogen fungi . The technique is simple , inexpensive and nonhazardous and does not involve toxic residues.

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