ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 43(3): 1095-1105, (2005).

EFFECT OF SOIL MULCHING WITH DIFFERENT THICKNESS OF POLYETHYLENE SHEETS ON THE INCIDENCE OF STRAWBERRY ROOT-ROT AND WILT DISEASES

BY

Shalaby, O.Y.M.* and Mohamed, A.A.**

* Agric. Botany Dept., Faculty of Agriculture, Fayoum University

** Agric. Botany Dept., Faculty of Agriculture at Assuit, Al-Azhar University.

ABSTRACT

Strawberry wilt and root-rot, a complex disease, is the most destructive soil borne disease causing huge losses in the yield of many important crop. This investigation aimed to study the effect of soil solarization using polyethylene sheets with different thickness on the incidence of strawberry wilt and root-rot, growth vigour of strawberry plant, populations of soil microorganisms, and the cellulose microbes and Azotobacter. The obtained results revealed that mulching soil with 60 mm thickness polyethylene sheet significantly decreased the infection percentage and disease severity of strawberry wilt and root rot. Soil solarization decreased the frequency of fungi isolated from strawberry plants naturally infected with the strawberry wilt and root-rot.. Soil solarization with 60 mm improved the growth vigour of strawberry plants and resulted in an increase of the obtained yield as 100 fruit weight. Soil solarization significantly decreased the populations of actinomycetes, bacteria and fungi as well as cellulose microbes and Azotobacter compared with the unmulched control.. In conclusion, Slarization is very efficient in controlling strobary wilt and root rot and the effect of solarization on the pathogenic microoranisms in the soil increased as the thickness of polyethylene sheet decreased and vice versa..

Key Words: Strawberry, Wilt and Root rot, Soil solarization, Thickness.

INTRODUCTION

Strawberry (*Fragaria* spp. L.) is considered one of the most important vegetable crops in Egypt and in many countries allover the world. It is attacked by many soilb-orne fungi, i.e. *Fusarium oxysporum*, *F. solani*, *Rhizoctonia solani*, *Verticillium albo-atrum* and *Macrophomina phaseolina*, causing root rot and wilt. (Garret *et al.*, 1939; Brooks, 1958, Zinkermagel, 1970 and Fahim *et. al.*, 1988). By the traditional methods, it is very difficult to control strawberry wilt and root rot. Mulching the soil with transparent polyethylene is considered the most effective method to control these soil-borne diseases. Soil solarization is the most effective method for controlling soil-borne diseases, many weeds and nematodes. Soil mulching with transparent polyethylene is the mean for capturing solar energy to heat soil under field conditions. The use of polyethylene as a preplanting soil treatment allows better control and more effective solarization (Mahrer *et al.*, 1984, Satour, 1998 a and Barakat *et al.*, 1999).

Soil solarization is a relatively new method for controlling soilborne pathogens. It is achieved manually by mulching tilled and irrigated soil with continious transparent polyethylene sheets. It is well known stated that soilborne pests and pathogens could be killed due to physical and biological process. It is an effective approach to control several pathogenic fungi, nematodes, insects, mites and weeds. Soil solarization is a unique treatment which has a long term effect, 4-6 successive crops, if the fields are well kept from recontamination. Soil solarization improves physical and chemical structure of the soil, in addition to the reduction of salinity by 30-50 %. Increasing plant growth and yield is a common phenomena for solarization, even in the absence of known pathogens. Strawberry yield increased by 160 % as result of soil solarization. Several field experiments and demonstration plots at farmers fields have shown satisfactory results for controlling several soil-borne pathogenic fungi including *Rhizoctonia solani* on cucumber and strawberry, *Sclerotium cepivorum* on onion and *Fusarium* spp. on tomato. (Dàvis and Sorenson, 1986 and Abdel-Rahim *et al.*, 1988; Satour, 1998 a; Barakat *et al*, 1999; and Razik *et al*, 2004).

Abu-Blan and Abu-Gharbieh, (1994) found that mulching treatment with transparent or black plastic significantly reduced the population of each of *Alternaria solani*, *Fusarium oxysporum*, *F. solani*, *Phytophthora infestans*, *Pythium debaryanum*, and *Verticillium dahliae* compared with the control. They found that the density levels of *Sclerotinia sclerotiorum* was generally less affected by soil solarization, while the levels of *Rhizoctonia solani* were not significantly differed compared with the control.

Soil solarization is considered as a disinfestation method based on solar heating of the soil by mulching with transparent polyethylene sheets during the hot months, resulting in killing of pathogens and weeds (Katan *et al*, 1976 and Tamietti and Valentino, 200). Soil solarization is the process of trapping moist soils with clear polyethylene sheets to trap solar radiation and raise soil temperatures to the levels that is lethal to most pathogens and weed seeds. Solarization is most effective when applied for at least 30 days in midsummer (Greer and Diver, 1999). By mulching soil with transparent polyethylene film during July or August, species of *Fusarium* and *Verticillium* were suppressed. there were fewer diseased plant, weeds were controlled, plant stand was improved, and plant growth and yield also increased (Katan et al, 1976).

Locascio *et al.*, (1999) have evaluated soil solarization for strawberry production under higher pest pressure. However, solarization was conducted in late summer and early fall. Soil solarization is a method in which clear plastic is laid on the soil surface to trap solar radiation and heat the soil. Soil solarization as a pre-plant soil treatment to control soil-borne pathogens and pests can be available alternative to methyl bromide for shallow-rooted short-season crops (Katan and DeVay, 1991 and Stapleton, 1996). In addition to disinfecting the soil while reducing or eliminating the need for fumigants, solarization leaves no toxic residues, increases the levels of available mineral nutrients in soils by breaking down soluble organic matter and making it more bioavailable, changes the soil microflora to favor beneficial organisms, conserves water and can serve as a mulch when maintained as a row cover during the growing season (Stapleton, 1994 and Katan and DeVay, 1991, and Ristaino *et al.*, 1991).

The present investigation was carried out to study the effect of soil solarization using different thickness of polyethylene sheets in controlling strawberry wilt and root rot. Also, it aimed to study the effect of soil solarization on the populations of soil microorganisms as well as cellulose microbes and Azotobacter.

MATERIALS AND METHODS

Field experiments were conducted during two growing seasons of 2003 and 2004 at El-Dear province, Kalubeia Governorate in four replications in a randomized block design. These experiments were carried out using basic unit consisting of a bed 7 m wide and 14-24 m long. The plots were divided into two sections, one was mulched by three different thickness of polyethylene sheets, i.e. 60, 90 and 130 mm. The other section was left without mulching to serve as control. The solarization started usually in mid. July and lasted 6 weeks later. Strawberry transplnts, Aika variety kindly obtained from Horticulture Institute, Agricultural Research Center, Giza were used in this investigation. The common agricultural practices prevailing in the locality were carried out during the two seasons 2003 and 2004.

The infection percentage of strawberry wilt and root rot was estimated 45 and 90 days after planting. The obtained data were statistically analyzed according to Snedecore and Cochran (1967).

The different three thickness polyethylene sheets were obtained from Hemaplast and El-Shereef Companies.

Samples of unmulched and mulched soils were randomly taken at 15, 30 and 45 days after the beginning of mulching for isolating the associated actinomycetes, bacteria fungi, cellulose microbes and Azotobacter. Isolation trials were carried out according to the method described by Johnson *et al* (1959). The isolated actinomycetes, bacteria and fungi were counted as hundred thousands, million and thousands of colonies for the three groups, respectively per one gram dry soil. The pathogenic fungi causing strawberry wilt and root rot were isolated at 45 and 60 days after transplanting from naturally infested soils mulched or unmulched for four weeks.

RESULTS

A- Effect of soi l solarization on the frequency of fungi associated with strawberry natural infected with wilt and root rot:

Data in Table (1) represent the frequency of the fungi isolated from strawberry plants naturally infected with wilt and root rot disease. The isolation process took place at 45 and 60 days after planting in soil unmulched or mulched with the desired three thickness polyethylene sheets. The highest frequency was recorded with 130 mm thickness for *Fusarium solani*, and *Macrophomina phaseolina*, being 5.00% for each after 45 days from planting. The lowest frequency in the same respect, was recorded with 60 mm treatment, being 0.00 % for *Fusarium oxysporum*. and *Verticillium albo-atrum*. After 60 days from planting, the highest frequency of the isolated fungi was recorded with 130 mm treatment for *Fusarium solani*, being 9.00 %. The lowest frequency was recorded with 60 mm treatment for *Fusarium oxysporum* and *Vereticillium albo-atrum*, being 0.00 % for each of the two fungi . Total frequency of the isolated fungi after 45 and 60 days increased as the thickness of polyethylene sheets increased.

Table (1): Frequency of fungi isolated from naturally infested strawberry wilt and root rot plants collected from unmulched and mulched soil with different thickness polyethylene sheets 45 and 60 days after planting.

Isolated Fungi	After 45 days				After 60 days			
	60 mm	90 mm	130 mm	Control	60 mm	90 mm	130 mm	Control
F. oxysporum	0.00	0.00	3.00	7.00	0.00	0.00	3.00	11.00
F. solani	1.00	3.00	5.00	9.00	1.00	4.00	5.00	15.00
Rhizoctonia solani	1.00	2.00	3.00	7.00	2.00	4.00	3.00	13.00
Verticillium alboatrum	0.00	0.00	1.00	3.00	0.00	0.00	1.00	5.00
Macrophomina phaseolina	2.00	4.00	5.00	8.00	3.00	6.00	5.00	6.00
Total	4.00	9.00	17.00	34.00	6.00	14.00	17.00	60.00

B- Effect of soil solarization on the infection percentage of strawberry wilt and root rot diseases:

Data in Table (2) revealed that the infection percentage of strawberry wilt and root rot decreased as the thickness of polyethylene decreased. In contrast, the infection percentage of the studied disease increased as the thickness of polyethylene increased. The lowest infection percentage of strawberry wilt and root rot were recorded with 60 mm treatment, being 0.00, 0.00; 2.50 and 4.00 for wilt and root rot estimated after 45 and 90 days, respectively in 2003 growing season. Data in Table (2) also revealed that the lowest infection percentage of strawberry wilt and root rot in 2004 growing season showed the same trend. It was obtained with 60 mm treatment, being 0.00, 0.00; 2.60 and 4.30, respectively in the same respect mentioned above. Concerning the highest infection percentage of the studied diseases in 2003 growing season recorded 45 and 90 days after planting were recorded with 130 mm, being 4.00, 3.00; 7.00 And 17.00 %, respectively . Data in the same table, revealed that the same trend of 2003 season was recorded in 2004 one concerning the highest infection percentage of the desired diseases. It was 4.50, 3.5; 7.50 and 17.50 %, respectively for strawberry wilt and root rot with 130 mm recorded 45 and 90 days after planting.

C- Effect of soil solarization on plant growth and the weight of 100 fruits:

Data in Table (3) proved that soil solarization significantly increased the growth vigour of strawberry plants and the obtained yield estimated as weight of

100 fruits. The use of polyethylene sheets with 60 mm thickness resulted in the best plant growth, rated ++++ and the highest weight of 100 fruits, being 200.50 g. and 210.40, respectively for the two growing seasons 2003 and 2004.

The use of plyethylene sheets with 90 mm thickness occupied the second situation as recorded +++ growth vigour and 180.45 and 182.40 g, respectively in the two seasons 2003 and 2004. The treatment of 130 mm thickness came in the last situation recording ++ growth vigour, 160.15 and 163.30 g for 100 fruits in the two desired seasons, compared with the control.

Table (2): Infection percentage of strawberry wilt and root rot 45 and 60 days after planting in soil unmulched / mulched with different thickness polyethylene sheets in two successive seasons, 2003/2004.

Treatments	2003				2004			
	After 45 days		After 90 days		After 45 days		After 90 days	
	Wilt	Root Rot	wilt	Root Rot	wilt	Root Rot	wilt	Root Rot
Mulched with 60 mm polyethylene sheets	0.00	0.00	2.50	4.00	0.00	0.00	2.60	4.30
Mulched with 90 mm polyethylene sheets	0.00	2.50	4.50	9.00	0.00	2.70	4.70	9.50
Mulched with 130 mm polyethylene sheets	4.00	3.00	7.00	17.00	4.50	3.50	7.50	17.50
Control (non-mulched)	10.00	2.00	16.00	34.00	11.00	2.40	16.80	35.00
LSD at 0.05 %	0.34	0.32	0.98	1.13	0.79	0.43	1.09	1.64

Table (3): Effect of soil solarization on plant growth vigour and the weight of 100 fruits in 2003 and 2004 seasons.

Treatments	Season 2003		Season 2004	
	Growth. Vigour*	100 fruits' Weight**	Growth Vigour	100 fruits' Weight
Mulched with 60 mm polyethylene sheets	++++	200.50	++++	210.40
Mulched with 90 mm polyethylene sheets	+++	180.45	+++	182.40
Mulched with 130 mm polyethylene sheets	++	160.15	++	163.30
Control (non-mulched)	+	150.20	+	152.20

* = Growth vigour as morphological appearance.

** = 100 fruits' weight.

D- Effect of soil solarization on the soil microorganisms:

Data in Table (4) represent the population of actinomycetes, bacteria and fungi as affected by soil solarization using different thickness of polyethylene sheet for 15, 30 and 45 days determined at 5 and 20 cm depth. As general view, the obtained data showed an increase in the populations of the three groups as the experimental period increase. The lowest counts of actinomycetes, bacteria and fungi were recorded using polyethylene sheets with a thickness of 60 mm, being 0.00, 0.00 and 1.94 for the three groups, respectively at 5 cm depth. The highest counts were recorded with 90 mm polyethylene sheets for actinomycetes at 5 cm depth after 45 days, being 15.54, 13.37 for bacteria with 60 mm thick polyethylene sheet at 20 cm depth for 45 days, and 17.70 for fungi with 130 mm at 20 cm depth after 30 days. The obtained data revealed that there was an increase of actinomycetes, bacteria and fungi counts by the increase of the thickness of polyethylene sheet.

Table (4): Effect of soil solarization using different thickness polyethylene sheets on the population of actinomycetes, bacteria and fungi at 5 and 20 cm depths after 15, 30 and 45 days after planting.

Treatments	Depth cm	Actinomycetes			Bacteria			Fungi		
		15 Days	30 Days	45 Days	15 Days	30 Days	45 Days	15 Days	30 Days	45 Days
Mulched with 60 mm polyethylene sheets	5	0.00	2.80	6.42	0.00	3.17	3.36	1.94	2.85	9.17
	20	0.00	5.60	9.75	0.86	1.47	13.37	3.44	4.42	6.58
Mulched with 90 mm polyethylene sheets	5	13.96	6.80	15.54	0.57	2.26	7.62	1.71	2.91	3.04
	20	0.00	3.12	11.32	1.27	1.23	7.64	3.49	3.41	8.26
Mulched with 130 mm polyethylene sheets	5	7.25	3.39	10.50	4.83	2.77	5.54	10.88	4.32	2.33
	20	1.79	11.51	10.70	2.98	4.13	4.14	10.45	17.70	13.15
Control (non-mulched)	5	2.70	5.61	22.85	6.61	16.27	5.01	15.34	74.63	28.70
	20	2.77	5.91	26.02	1.54	30.17	3.50	15.74	60.94	21.63

剁 Hundred thousands, million and thousands colonies / g dry soil, for Actinomycetes, bacteria and fungi, respectively.

E- Effect of soil solarization on Azotobacter and cellulose microbes:

Data in Table (5) proved that soil solarization using different thickness polyethylene sheet significantly decreased the populations of Azotobacter and cellulose microbes estimated at 5 and 20 cm depth determined 15, 30 and 45 days after planting, compared with the control. Concerning Azotobacter, the lowest count, being 1555/g dry soil (as million colonies) was recorded with 60 mm mulched for 15 days at 5 cm depth. While the highest one, being 61573 / g dry soil (as million colonies) was recorded with 90 mm mulching for 15 days at 5 cm depth. The lowest count of cellulose microbe, being 0.00 was recorded with 60 mm polyethylene sheets after 15 days at 5 cm depth. The highest count of cellulose microbes, being 2560 / g dry soil (as thousand colonies) was recorded with 90 mm polyethylene sheets mulched for 45 days estimated at 5 cm depth. There was no relations between the counts or populations of Azotobacter and cellulose microbes and the mulching period, wherease the counts at 5 cm depth were higher than those of 20 cm depth.

Table (5): Effect of soil solarization using different thickness polyethylene sheets on the population of cellulose microbes and Azotobacter at 5 and 20 cm depths after 15, 30 and 45 days after planting.

Treatments	Depth cm	Cellulose Microbes *			Azotobacter **		
		15 Days	30 Days	45 Days	15 Days	30 Days	45 Days
Mulched with 60 mm polyethylene sheets	5	0.00	5.800	220.00	1555.00	5717.00	2447.00
	20	630.00	425.00	3011.00	2408.00	472.00	4893.00
Mulched with 90 mm polyethylene sheets	5	0.00	1063.00	2560.00	61573.00	5058.00	2439.00
	20	571.00	693.00	0.00	309999.00	5346.00	244.00
Mulched with 130 mm polyethylene sheets	5	483.00	1728.00	700.00	3143.00	4814.00	1073.00
	20	215.00	802.00	440.00	19158.00	1416.00	489.00
Control (non-mulched)	5	216.00	505.00	1890.00	2406.00	12345.00	1025.00
	20	246.00	0.00	0.00	43209.00	21301.00	970.00

Cellulose Microbes * = Thousands colonies / g dry soil.
Azotobacter ** = Million colonies / g dry soil.

DISCUSSION

Soil solarization is a method in which clear plastic is laid out on the soil surface for traping solar radiation and heating the soil. Solarization as a preplanting soil treatment to control soil-borne pathogens and pests. It could be an viable alternative to methyl bromide for shallow-rooted, short season crops (Katan and DeVay, 1991 and Stapelton, 1996).

Solarization traps solar radiation and thereby rises the soil temperature in order to suppress or eliminate the growth of soil-borne pests and pathogens (Sherwood 1970; Katan, 1981 and Stapleton et al 2005).

Many investigators reported that soil solarization significantly controlled soil-borne pathogens, weeds, insects, nematodes and increase plant growth and subsequently the obtained yield (Satour, 1998 b; Katan, 1981; Katan and DeVay, 1991; Hartz *et al.*, 1993; Stapleton, 1994 and Chase, 2004).

Ristaino *et al.* (1991) reported that soil solarization promotes increases in plant growth and development, crop quality and yield by increasing the availability of plant nutrients and the relative populations of beneficial organisms such as rhizosphere bacteria (*Bacillus* spp. and *Pseudomonas* spp.)

Satour (1998) a found that soil solarization decreased the incidence of diseases attacking many crops including onion, strawberry, broad bean, tomato, potato, cucumber and pepper. The obtained yield increased from 8.00 to 12.20 ton/acr. in non-solarized and solarized, respectively strawberry plantations.

Solarization significantly decreased the frequency of the fungi isolated from strawberry field compared with the non-solarized control. The frequency of the isolated fungi increased with the increase of polyethylene thickness as well as with the increase of the period after which the isolation process was carried out. The obtained results may be due to the accumulation effect of radiation and heat. Al-Chaabi *et al.*, (1994) reported that soil solarization inhibited the growth of *Pythium* spp. and *Phytophthora* spp and reduced the number of propagules.

In both the two seasons 2003 and 2004, soil solarization significantly decreased the percentage of infection of strawberry wilt and root rot. These results are in a harmony with those reported by Katan and DeVay (1991), Satour (1998 a), Locascio (1999) and Stapleton *et al*(2005).

In this respect, Palai and Cinar (2004) reported that soil solarization significantly reduced strawberry root rot caused by *Rhizoctonia solani* Kuchn. The elimination rates of the pathogen were 100, 92.50, 81.25 and 76.17 % at 10, 20, 30, and 40 cm soil depth, respectively.

In the present investigation, soil solarization with the different thickness polyethylene treatment clearly increased the growth vigour of strawberry plants. Also, it resulted in an increase in the 100 fruits weight and these increases were parrallel with the decrease of polyethylene sheets. The obtained results are in agreement with those reported by Satour (1989 a); Fahim *et al* (1994); Razik (2004); and Palai and Cinar (1994). This may be due to the beneficial effect of solarization on microorganisms in the soil and subsequently the improvement of plant's growth.

In our investigation, soil solarization significantly decreased the populations of actinomyetes, bacteria and fungi isolated 15, 30, and 45 days after planting at 5 and 20 cm depths compared with the control. In this respect, Mahmoud (1994) found that soil solarization caused clear reduction in the population density of *Rhizoctonia leguminosarum* biovar *viceae*. He added that total number of actinomycetes, bacteria and fungi were decreased in solarized soil.

Soil solarization significantly reduced the populations of cellulose microbes and Azotobacter compared with the control treatment. The obtained results are similar to the results obtained by Mahmoud (1994); Shalaby (1993); Sultan *et al*. (1997) and Satour (1998 a) . This significant reduction may be due to the effect of high temperature because of soil mulching with the different thickness polyethylene sheets.

In conclusion, it could be concluded that, solarization could be an effective method of controlling the soil-borne diseases as strawberry wilt and root rot . It could be also noticed that the efficiency of solarization increased as the thickness of the used polyethylene sheets reduced.

REFERENCES

Abdel-Rahim, M.; Satour, M.; Mickail, K.Y.; Grienstein, A.; Rabiwitch, H. and Katan, J. (1988): Long term effects of soil solarization in Furrow and sprinkler irrigated soil in Egypt and Israel. 7 th Congress of the Mediterranean Phytopathology Union.

Abu-Plan, H.A. and Abu-Gharbieh, W.L. (1994): Effect of soil solarization on winter planting of potato, cauliflower and cucumber in the central Jordan Valley. Dirasat Series B. Pure and Applied Science. 21: 3, 208-213.

Al-Chaabi, S.; Matrod, L. and Faddoul, J. (1994): Solarization for controlling soilborne fungi in plastichouse. http://www.uckac.edu/wgss posters.htm

Barakat, M.I.; Shalaby, O.Y.; El-Refaei, M.I.; Aly, M.M. and Mohamed, A.A. (1999): Effect of soil solarization on some fungal potato tuber diseases under field and storage conditions. Fayoum J. Agric. Res. And Dev., Vol. 13 No. 1, 1999.

Brooks, A.N. (1958): Annual Report for the Agricultural Experimental Station, Florida for'the year-ending June 30, 1958 (C.F. Rev. Appl. Mycol, 39, 214, 1960.

Chase Carlene, A. (2005): Soilborne plant pathogen and pest Management with soil solarization. http://swfrec.ifas.ufl.edu/LIV/groups/ cultural/ pests /solar.htm.

Davis, J.R. and Sorenson, L.H. (1986): Influence of soil solarization at moderate temperatures on potato genotypes with differing resistance to Verticillium dahliae. Phytopathology, 76: 10, 102-106.

Fahim, M.M.; Attia, M.F.; Okasha, A.K. and Abada, K.A. (1994): Control of strawberry root rot disease by soil fumigation. Egyt. J. Phytopathology, Vol. 22 No. 1, 1-15, 1994.

Garrett, S.D.; Mary-Glynne, D.; Hickman, C.; Williams, P. and Oglive, L. (1939): Symptoms and discussion on root rots Trans. Brit. Mycol. Soc., 23 (2) pp 209-213 (C.F.,Rev. Appl. Mycol., 18, 809.

Greer, L. and Diver, S. (1999): Integrated pest management for greenhouse crops. http:// attra.ncat.org//attar –pub/pdf/greenhouseipm pdf

Hartz, T.; DeVay, J. and Elmore, C. (1993): Solarization is an effective soil disinfestation tecknique for strawberry production. Hort Science, 28 (2) pp 104-106.

Johnson, L.; Curl, E.; Bond, J. and Filourg, H. (1959): Methods for studying soil microflora-plant diseases relationships. Burgess Publishing Co., USA pp 178.

Katan, J.; Greenberger, A.; Alon, H. and Grinstein, A. (1976): Solar heating by polyethylene mulching for the control of diseases caused by soilborne pathogens. Phytopathology 66: 683-688.

Katan, J. and DeVay, J. (1991): Soil solarization CRC Press Inc. Boca Raton, Ann Arbor, London.

Katan, J. (1981): Solar heating(solarization)of soil for control of soilborne pests. Annual Review of Phytopathology., Vol.19, pp 211-36.

Locascio, S.J.; Olson, S.M.; Chase, C.A.; Sinclair, T.R.; Dickson, D.W.; Mitchell, D.J. and Chellemi, D.O. (1999): Strawberry production with alternatives to methyl bromide fumigation. Proc. 28 th National Agricultura Plastics Congress pp 148-152.

Mahmoud, S.M. (1994): Effect of soil solarization on population densities of some soil microorganisms. http://www.uckac.edu/wgss posters.htm

Mahrer, H.; Naot, O.; Rawiz, E. and Katan, J. (1984): Temperature and moisture regimes in soils mulched with transparent polyethylene. Soil Sc. Soc., Am. J., 48: 362-367.

Palai, H. and Cinar, A. (1994): Effect of solarization against strawberry root rot disease in the east mediterranean region of turkey. http://www .uckac. edu/ wgss posters.htm

Razik, A.; Grinstein, A.; Zeydan, O.; Rubin, B.; Tal, A. and Katan, J. (2004): Soil solarization and fumigation of strawberry plots. ISHS Acta Hortiulturae 265: International strawberry symposium. www.actahort.org.

Ristaino, J.B.; Perry, K.B. and Lumsden, R.D. (1991): Effect of soil solarization and *Gliocladium virens* on sclerotia of *Sclerotium rolfsii*, soil microbiota and the incidence of southern blight in tomato. Phytopathology, 81: 1117-1124.

Satour, M.M. (1998 a): Soil solarization as a model for introducing new technology in traditional agriculture. BARD workshop on soil-borne plant pathogens. Jerusalem, Israel March 1-5, 1998.

Satour, M. M. (1998 b): Soil solarization: a nonchemical approach for control of soilborne pathogens and pest in Egypt. www. mevic.grg/papers solarization htm.

Shalaby, O.Y. (1993): Studies on Fusarium wilt of muskmelon caused by *Fusarium oxysporum* f. sp. *melonis* in Fayoum. Ph. D. Thesis, Agric. Botany Dept. Agric. Fac. at Fayoum, Cairo Univ.

Sherwood, R.T. (1970): Pages 69-92 in J. R. Parameter Jr. ed. *Rhizoctonia solani*-Biology and Pathology. Univ. of California Press, Perkeley, 255 pp.Statistical Methods Sixth Edition, Iowa State Univ Press, Iowa, USA.

Stapleton, J.J. (1994): Solarization as a framwork for alternative soil disinfestation strategies in the interior valleys for california. In proceedings of the 1994 Annual International Research Conference on Methyl Bromide Alternative and Emissions Reductions.

Stapleton, J.J. (1996): Fumigation ans solarization practice in plasticulture systems. Hort Technology 6 No. 3 pp 189-192.

Stapleton, J.; James, J.; E. DeVay and Clyde L. Elmore (2005): Soil Solarization andIntegrated Management of Pests. New Delhi, Daya, 657 pp.

Sultan, M.Y.; Satour, M.M. and El-Haddad, S.A. (1997): Impact of the quality of polyethylene on the economic of soil solarization technology. 2nd Int. Conf. On soil Solar and Integrated Management on soil-borne Pests, Syria, March 16-21.

Tamietti, G. and Valentino, D. (2000): Effectiveness of soil solarization against soilborne pathogens and weeds in piedment (northern Italy). Acta Horticulture (2000), 532, 151-156.

Zinkernagel, V. (1970): Soil-borne diseases in N. Germany, Strawberry crops and their causes, II. Strawberry root-rot and rhizomarot. Z. Pflanzenkh., Pflschutz, 77 (2-3): 65-75.(C.F. Rev. Plant Path., 50, 803, 1971).

تأثير التشميس باستخدام رقائق مختلفة السمك من البولي‌إيثيلين على أمراض الذبول وأعفان الجذور في الفراولة

أسامة يوسف محمد شلبى * ، عبد العال عبد الحليم محمد **

* قسم النبات الزراعى ، كلية الزراعة ، جامعة الفيوم.
** قسم النبات الزراعى ، كلية الزراعة بأسيوط ، جامعة الأزهـر.

يعتبر الذبول وأعفان الجذور فى الفراولة من الأمراض الكامنة فـى التربـة وأكثرها تدميرا ويسبب خسارة جسيمة لهذا المحصول الهام. يهدف هذا البحث لدراسة تأثير تشميس التربة باستخدام رقائق مختلفة السمك من البولى إيثيلين علـى كـل مـن حدوث هذا المرض ، و تعداد الكائنات الدقيقة فى التربـة ، والفطريـات الممرضـة المعزولة من النباتات المصابة ، وقوة نمو النباتـات والمحصـول النـاتج ، وعلـى الميكروبات المحللة للسليلوز والأزوتوباكتر. أثبتت النتائج التى تم الحصول عليهـا أن تشميس التربة برقائق البولى إيثيلين مختلفة السمك أدى إلى نقص معنوى فى حـدوث الإصابة بالذبول وأعفان الجذور فى الفراولة كنسبة مئوية للإصابة وكشـدة إصـابة، وكذلك إلى نقص الفطريات الممرضة المعزولة من نباتات الفراولة المصـابة بالـذبول وأعفان الجذور . كما أدت إلى نقص فى تعداد الكائنـات الدقيقـة (أكتينوميسـيتات ، بكتيريا ، وفطريات) فى التربة. أدى تشميس التربة أيضا إلى زيادة قوة نمـو نباتـات الفراولة ووزن مائة ثمرة. أدى تشميس التربة برقائق البولى إيثيلين مختلفة السمك إلى نقص فى تعداد الميكروبات المحللة للسليلوز والأزوتوباكتر.