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THE FIRST DECADE (1976-1986) OF SOIL SOLARIZATION (SOLAR HEATING): A CHRONOLOGICAL BIBLIOGRAPHY

J. KATAN[1], A. GRINSTEIN[2], A. GREENBERGER[3], O. YARDEN[1] and J.E. DeVAY[4]

Attempts were made to use solar energy for controlling biotic agents in soil and in plant material already in the ancient civilization of India (7). In 1939, Grooshevoy, who used the term "solar energy for soil disinfection," controlled *Thielaviopsis basicola* upon heating the soil by exposure to direct sunlight (5). Adams (1) proposed to heat the soil for disease control by mulching it with polyethylene during the growing season. Soil solarization (also referred to as solar heating of the soil in earlier publications) is a new soil disinfestation method, first described in 1976 (9), for controlling soilborne pathogens and weeds, mostly as a preplanting soil treatment. It was achieved by covering (mulching, tarping) the soil with transparent polyethylene during the hot season, thereby heating it and killing the pests. The publication (9) described in detail the method, its principles and potential in disease and weed control under field conditions. It presented the results of studies initiated in 1973 and first presented at a meeting of the Phytopathological Society of Israel in February 1975 (8). However, only the detailed 1976 publication (9) enabled researchers to reproduce and examine the method under their local conditions.

Soil solarization is the third approach for soil disinfestation; the two other main approaches, soil steaming and fumigation, were developed at the end of the 19th Century. The idea of soil solarization was based on observations by extension workers and farmers in the Jordan Valley, who noticed the intensive heating of the polyethylene-mulched soil. The involvement of biological control mechanisms in pathogen control and the possible implications were indicated in the first publication (9). In that publication and in the second one (10), the emphasis was given to the control of Verticillium wilt of solanaceous crops. In 1977, American scientists from the

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[1] Dept. of Plant Pathology and Microbiology, The Hebrew University of Jerusalem, Faculty of Agriculture, Rehovot 76100, Israel.
[2] Dept. of Pesticide Application, ARO, The Volcani Center, Bet Dagan 50250, Israel.
[3] Dept. of Vegetable Crops, ARO, The Volcani Center, Bet Dagan 50250, Israel.
[4] Dept. of Plant Pathology, University of California, Davis, CA 95616, U.S.A.

University of California at Davis reported the control of *Verticillium* in a cotton field (11), based on studies started in 1976, thus denoting, for the first time, the possible wide applicability of this method. It should be emphasized that the use of polyethylene for soil solarization differs in principle from the traditional use of polyethylene in agriculture. With solarization, soil is mulched during the hottest months (rather than the coldest, as in conventional plasticulture which is aimed at protecting the crop) in order to increase the maximal temperatures in an attempt to achieve lethal levels.

In the years following the first publication, soil solarization was investigated in at least 24 countries (Fig. 1), mostly in the hot regions, although there were some important exceptions. These studies demonstrated the effectiveness of solarization with various crops (vegetables, field crops, ornamentals and fruit trees) against many pathogens, weeds and a soil arthropod (4,7,12). Pathogens and weeds which are not controlled by solarization were also detected. In parallel, the biological, chemical and physical changes taking place in the solarized soil during and after the solarization process, computerized simulation models, interactions with other methods of control and many other topics, were investigated. Some findings, *e.g.* long-term effects, biological control and increased growth response were verified in various climatic regions and soils. This demonstrates involvement of general mechanisms in solarization. Studies of the improvement of solarization by integrating it with other methods or by solarizing in closed glasshouses, or studies concerning commercial application by developing mulching machines (3,6), were also carried out. The use of solarization in existing orchards (*e.g.* controlling *Verticillium* in pistachio plantations) is an important departure from the standard preplanting method and was reported as early as 1979 (2). The reproducibility of the solarization results has been shown in repeated field experiments. Solarization is applied commercially in various countries, *e.g.* Israel, the U.S.A. and Japan.

This brief introduction is not aimed to review the whole subject but rather to give several selected examples of the proliferation of work on this subject since 1976. This is also demonstrated in Fig. 1, in which sites and countries where solarization was studied are depicted. Two belts of solarization, one in each hemisphere, can be noted. The distribution of the sites reflects the agricultural and climatic regions suitable for solarization. In this map the northernmost site is at Wellsbourne, UK (at approx. 52°N latitude) and the southernmost is at southern Victoria, Australia (at approx. 38°S latitude). The lowest point is near the Dead Sea in Israel (−400 m) and the highest is in Peru (approx. +2000 m).

A decade is not a magic number. However, a 10-year period justifies the attempt to compile a list of the literature on this still expanding subject in the hope that it will be of benefit to interested researchers and will improve communication among the groups involved in this research. The works published during the 10-year period following the first publication are listed below (although for 1986 the list is not complete). The list includes a total of 173 articles, reviews and abstracts, mostly in English, and a limited number of publications in French, Italian, Spanish and Portu-

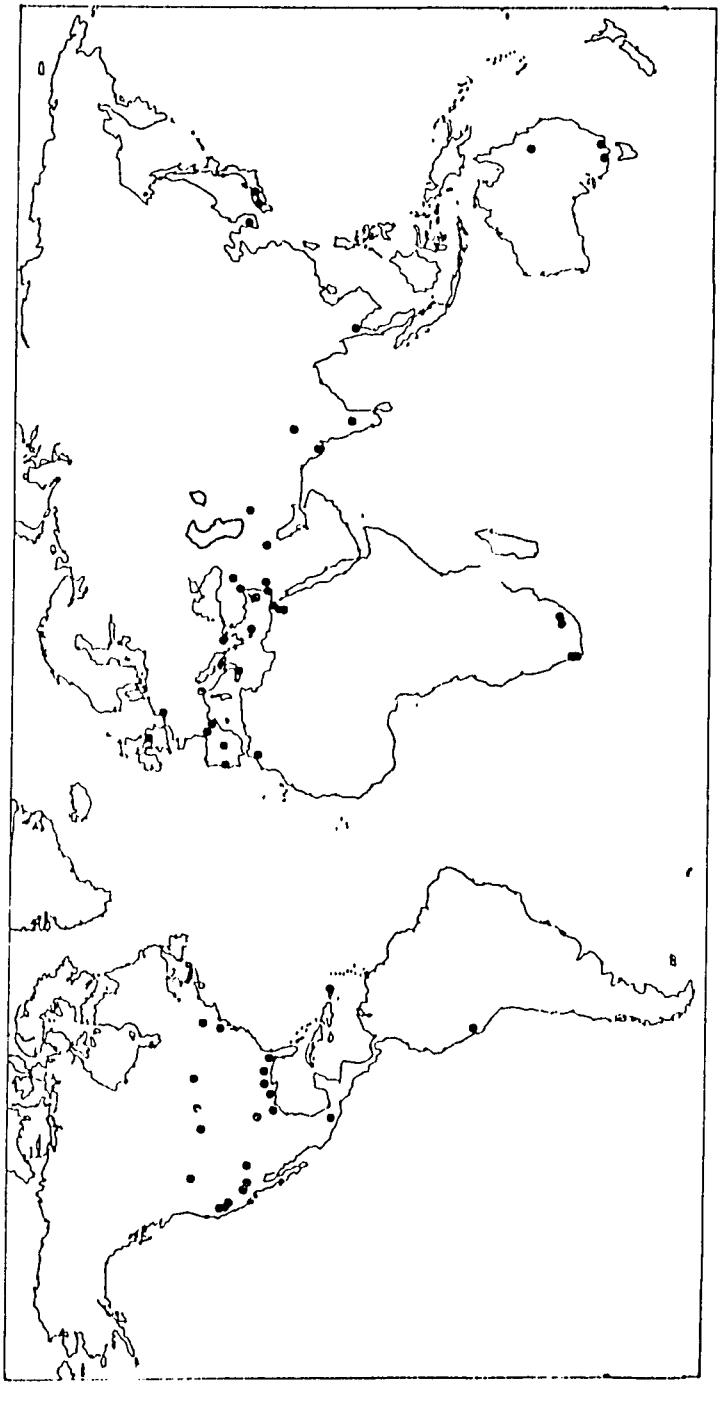

Fig. 1. World distribution of sites (indicated as black dots) where solarization has been investigated.

guese. It does not cover publications in other languages, *e.g.* Hebrew, Arabic and Japanese. In very few cases we also included works dealing with subjects closely related to solarization but which do not deal directly with it, *e.g.* heat sensitivity of pathogens. Except for one case, M.Sc. and Ph.D. theses were not included in the list, since not all of them were available to us. We know about more than 20 theses on solarization which have been completed or are at various stages of progress. Parts of some of these theses have already appeared as regular publications which are listed herein. Abstracts which resulted later in full articles were not included in the list unless they contained additional data or information. However, overlapping between publications on the one hand, and omission of others through oversight on the other hand, are unavoidable when compiling for the first time the publications on such a broad subject. We would like to express in advance our apologies for that. The yearly number of publications increased steadily from two in 1976 to 40 in 1986. The next decade of solarization will probably reveal the long-run pattern of publications and the points of proliferation, stabilization or decline of this subject.

The first decade of solarization should be characterized as the decade of exploration since the potential and mode of action of solarization, mainly in the hot regions, were intensively investigated. It is hoped that in the next decade of solarization attempts will be made to make solarization available for regions in which this method is climatically or economically marginal. We should also aim to detect possible negative and positive side effects. It is hoped that some of the questions raised in the publications of the first decade will be reasonably answered in the next one, thus paving the road for the more advanced questions and challenges.

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It is only with the help of many workers in the field of solarization, that this compilation has been made possible. We shall be most grateful to those who will assist us in keeping the contents of the list accurate and up-to-date. Reprints of works on solarization are solicited.

ACKNOWLEDGMENTS

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3. Ashworth, L.J. Jr., Morgan, D.P., Gaona, S.A. and McCain, A.H. (1983) Control of Verticillium wilt of pistachio. *Plasticulture* **58**:33-44.
4. Gerson, U., Yathom, S. and Katan, J. (1981) A demonstration of bulb mite control by solar heating of the soil. *Phytoparasitica* **9**:153-155.
5. Grooshevoy, S.E. (1939) Disinfection of seed-bed soil in cold frames by solar energy. *Rev. appl. Mycol.* **18**:635-636 (abstr.).
6. Hetzroni, A., Grinstein, A., Alper, Y. and Frankel, H. (1984) A continuous plastic film covering and welding machine for soil solarization. *Acta Hort.* **152**:259-265.
7. Katan, J. (1981) Solar heating (solarization) of soil for control of soilborne pests. *Ann. Rev. Phytopath.* **14**:211-236.
8. Katan, J., Greenberger, A., Alon, H. and Grinstein, A. (1975) Increasing soil temperatures by mulching for the control of soil-borne diseases. *Phytoparasitica* **3**:69-70 (abstr.).
9. 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.
10. Katan, J., Greenberger, A., Grinstein, A. and Alon, H. (1976) Additional studies on the control of *Verticillium dahliae* by polyethylene mulching. *Proc. 2nd Int. Verticillium Symp.* (Berkeley, CA), p. 27 (abstr.).
11. Pullman, G.S. and DeVay, J.E. (1977) Control of *Verticillium* by plastic tarping. *Proc. Am. phytopath. Soc.* **4**:210 (abstr.).
12. Stapleton, J.J. and DeVay, J.E. (1986) Soil solarization: a non-chemical approach for management of plant pathogens and pests. *Crop Prot.* **5**:190-198.

No.	Author(s)	Country*	Title of research	Locus of article
			1976	
76-1	Katan, J., Greenberger, A., Alon, H. & Grinstein, A.	IL	"Solar heating by polyethylene mulching for the control of diseases caused by soilborne pathogens"	*Phytopathology* 76:683-688 (1976)
76-2	Katan, J., Greenberger, A., Grinstein, A. & Alon, H.	IL	"Additional studies on the control of *Verticillium dahliae* by polyethylene mulching"	*Proc. 2nd Int. Verticillium Symp.* (Berkeley, CA), p. 27 (1976) (abstr.)
			1977	
77-1	Pullman, G.S. & DeVay, J.E.	USA	"Control of *Verticillium dahliae* by plastic tarping"	*Proc. Am. phytopath. Soc.* 4:210 (1977) (abstr.)
			1978	
78-1	Gilead, D.	IL	"A controllable photodegradable polyethylene film for agriculture"	*Int. J. polymer. Mater.* 6:185-196 (1978)
78-2	Pullman, G.S., DeVay, J.E. & Garber, R.H.	USA	"Effects of plastic tarping on soil temperatures and survival of soil-borne propagules of *Verticillium dahliae* and *Pythium* sp."	*Proc. Beltwide Cotton Res. Conf. National Cotton Council* (Memphis, TN), p. 28 (1978)
			1979	
79-1	Al-Raddad, A.M.M.	JOR	"Soil disinfestation by plastic tarping"	*M.Sc. thesis, Univ. of Jordan*, 95 pp. (1979)
79-2	Ashworth, L.J. Jr.	USA	"Polyethylene tarping of soil in a pistachio nut grove for control of *Verticillium dahliae*"	*Phytopathology* 69:913 (1979) (abstr.)

*AUSTL=Australia, BEL=Belgium, EGY=Egypt, FR=France, GRE=Greece, IL=Israel, IRAQ=Iraq, IRAN=Iran, IT=Italy, JP=Japan, JOR=Jordan, KOR=Korea, MOR=Morocco, NL=The Netherlands, PAK= Pakistan, PERU=Peru, POR=Portugal, SA=South Africa, SPA=Spain, TUR=Turkey, UK=United Kingdom, USA=United States of America, USVI=US Virgin Islands.

79-3	Grinstein, A., Katan, J., Abdul-Razik, A., Zeidan, O. & Elad, Y.	IL	"Control of *Sclerotium rolfsii* and weeds in peanuts by solar heating of soil"	*Pl. Dis. Reptr* **63**:1056-1059 (1979)
79-4	Grinstein, A., Orion, D., Greenberger, A. & Katan, J.	IL	"Solar heating of the soil for the control of *Verticillium dahliae* and *Pratylenchus thornei* in potatoes"	*In:* Schippers, B. and Gams, W. [Eds.] *Soilborne Plant Pathogens.* Academic Press, London. pp. 431-438 (1979)
79-5	Kodama, T. & Fukui, T.	JP	"Solar heating sterilization in the closed vinyl house against soil-borne diseases. I. The movements of soil temperature and determination of thermal lethal conditions for some soil-borne pathogens"	*Bull. Nara Pref. agric. Exp. Stn* **10**:71-82 (1979) (Japanese, with English summary)
79-6	Kodama, T., Fukui, T. & Nakanishi, Y.	JP	"Solar heating sterilization in the closed vinyl house against soil-borne diseases. II. Effects of solar heating sterilization in commercial vinyl house and basic methods for estimating the effects obtained by the treatment"	*Bull. Nara agric. Exp. Stn* **10**:83-89 (1979) (Japanese, with English summary)
79-7	Mahrer, Y.	IL	"Prediction of soil temperature of a soil mulched with transparent polyethylene"	*J. appl. Met.* **18**:1263-1267 (1979)
79-8	Pullman, G.S., DeVay, J.E., Garber, R.H. & Weinhold, A.R.	USA	"Control of soil-borne pathogens by plastic tarping of soil"	*In.* Schippers, B. and Gams, W. [Eds.] *Soilborne Plant Pathogens.* Academic Press, London. pp. 439-446 (1979)

No.	Author(s)	Country*	Title of research	Locus of article
79-9	White, G.J. & Buczacki, S.T.	UK	"Observations on suppression of clubroot by artificial or natural heating of soil"	*Trans. Br. mycol. Soc.* **73**:271-275 (1979)
			1980	
80-1	Barone, L.	IT	"Indagine sul riscaldamento del suolo, con utilizzazione diretta dell 'energia solare, per la disinfestazione dei terreni"	*Atti Giorn. Fitopat.* **1**:465-472 (1980) (Italian, with English summary)
80-2	Chen, Y. & Katan, J.	IL	"Effect of solar heating of soils by transparent polyethylene mulching on their chemical properties"	*Soil Sci.* **130**:271-277 (1980)
80-3	Elad, Y., Katan, J. & Chet, I.	IL	"Physical, biological and chemical control integrated for soilborne diseases in potatoes"	*Phytopathology* **70**:418-422 (1980)
80-4	Hejazi, M. J., Kastler, J.D. & Norris, R.F.	USA	"Control of yellow nutsedge by tarping the soil with clear polyethylene plastic"	*Proc. west. Soc. Weed Sci.* **38**:120-125 (1980)
80-5	Jacobsohn, R., Greenberger, A., Katan, J., Levi, M. & Alon, H.	IL	"Control of Egyptian broomrape *(Orobanche aegyptiaca)* and other weeds by means of solar heating of the soil by polyethylene mulching"	*Weed Sci.* **28**:312-316 (1980)
80-6	Katan, J.	IL	"Solar pasteurization of soils for disease control: status and prospects"	*Pl. Dis.* **64**:450-454 (1980)
80-7	Katan, J.	IL	"Solar heating of soil by polyethylene mulching for the control of plant diseases and weeds"	*Plasticulture* **46**:2-6 (1980)

80-8	Katan, J.	IL	"Survival of soilborne plant pathogens, with special reference to their control by solar heating: short and long term effects"	*Proc. 5th Congr. Mediterranean Phytopathological Union* (Patras), pp. 77-80 (1980) (abstr.)
80-9	Katan, J., Rotem, I., Finkel, Y. & Daniel, J.	IL	"Solar heating of the soil for the control of pink root and other soilborne diseases in onions"	*Phytoparasitica* 8:39-50 (1980)
80-10	Kodama, T., Fukui, T. & Matasumoto, Y.	JP	"Solar heating sterilization in the closed vinyl house against soilborne diseases. III. Influence of the treatment on the population level of soil microflora and the behavior of strawberry yellow pathogen, *Fusarium oxysporum* f. sp. *fragariae*"	*Bull. Nara Pref. agric. Exp. Stn* 11:41-52 (1980) (Japanese, with English summary)
80-11	Pullman, G.S., DeVay, J.E. & Garber, R.H.	USA	"Thermal sensitivity and death of *Verticillium dahliae* in relation to soil solarization and cotton lint yields"	*Proc. Beltwide Cotton Res. Conf. National Cotton Council* (Memphis, TN), p.16 (1980)
80-12	Smith, S.N., Pullman, G.S. & Garber, R.H.	USA	"Effect of soil solarization on soilborne populations of *Fusarium* species"	*Proc. Beltwide Cotton Res. Conf. National Cotton Council* (Memphis, TN), pp. 17-18 (1980)
80-13	Tjamos, E.C. & Faridis, E.	GRE	"Control of soilborne pathogens by solar heating in plastic houses"	*Proc. 5th Congr. Mediterranean Phytopathological Union* (Patras), pp. 82-84 (1980) (abstr.)
			1981	
81-1	Ashworth, L.J. Jr.	USA	"Use of polyethylene tarps for control of Verticillium wilt in a pistachio nut grove"	*Phytopathology* 71:200 (1981) (abstr.)

No.	Author(s)	Country*	Title of research	Locus of article
81-2	Chen, Y., Solovitch, T., Navrot, J. & Katan, J.	IL	"The effect of solar heating of soils on their chemical characteristics and plant growth stimulation"	*Phytoparasitica* 9:236 (1981) (abstr.)
81-3	Fukui, T., Kodama, T. &Nakanishi, Y.	JP	"Solar heating sterilization in the closed vinyl house against soil-borne disease. IV. Solar heating sterilization by polyethylene mulching in the open field"	*Bull. Nara Pref. agric. Exp. Stn* **12**:109-119 (1981) (Japanese, with English summary)
81-4	Gerson, U., Yathom, S. & Katan, J.	IL	"A demonstration of bulb mite control by solar heating of the soil"	*Phytoparasitica* 9:153-155 (1981)
81-5	Katan, J.	IL	"Solar heating (solarization) of soil for control of soilborne pests"	*A. Rev. Phytopath.* **19**:211-236 (1981)
81-6	Katan, J.	IL	"Solar heating of soil and other economically safe methods of controlling soilborne pests for increasing food production"	*In:* Kommedahl, T. [Ed.] *Proc. IX Plant Protection Congr.* (Washington, DC), vol. 1, pp. 26-30 (1981)
81-7	Katan, J., Grinstein, A., Fishler, G., Frank, Z.R., Rabinowitch, H.D., Greenberger, A., Alon, H. & Zig, U.	IL	"Long-term effects of solar heating of the soil"	*Phytoparasitica* 9:236 (1981) (abstr.)
81-8	Mahrer, Y. & Katan, J.	IL	"Spatial soil temperatures regime under transparent polyethylene mulch: numerical and experimental studies"	*Soil Sci.* **131**:82-87 (1981)

81-9	Old, K.M.	AUSTL	"Solar heating of soil for the control of nursery pathogens of *Pinus radiata*"	*Aust. For. Res.* **11**:141-147 (1981)
81-10	Overman, A.J.	USA	"Off-season land management and soil fumigation for tomato on sandy soil"	*J. Nematol.* **13**:455 (1981) (abstr.)
81-11	Pullman, G.S., DeVay, J.E. & Garber, R.H.	USA	"Soil solarization and thermal death: logarithmic relationship between time and temperature for four soilborne plant pathogens"	*Phytopathology* **71**:959-964 (1981)
81-12	Pullman, G.S., DeVay, J.E., Garber, R.H. & Weinhold, A.R.	USA	"Soil solarization: effects on Verticillium wilt of cotton and soilborne populations of *Verticillium dahliae*, *Pythium* spp., *Rhizoctonia solani* and *Thielaviopsis basicola*"	*Phytopathology* **71**:954-959 (1981)
81-13	Rabinowitch, H.D., Katan, J. & Rotem, I.	IL	"The response of onion to solar heating, agricultural practices and pink root disease"	*Scient. Hort.* **15**:331-340 (1981)
81-14	Tamietti, G. & Garibaldi, A.	IT	"Control of corky root in tomato by solar heating of the soil in greenhouse in Ligure (Northern Italy)"	*Difesa Piante* **3**:143-150 (1981) (Italian, with English summary)
			1982	
82-1	Aharonson, N., Rubin, B., Katan, J. & Benjamin, A.	IL	"Effects of methyl bromide or solar heating treatment on the persistence of pesticides in the soil"	*In:* Miyamoto, J. & Kearny, P.C. [Eds.] *Pesticide Chemistry*. Pergamon Press, Oxford. pp. 189-194 (1982)
82-2	Ashworth, L.J. Jr. & Goana, S.A.	USA	"Evaluation of clear polyethylene mulch for controlling Verticillium wilt in established pistachio nut groves"	*Phytopathology* **72**:243-246 (1982)

No.	Author(s)	Country*	Title of research	Locus of article
82-3	Ashworth, L.J. Jr., Morgan, D.P., Gaona, S.A. & McCain, A.H.	USA	"Polyethylene tarping controls Verticillium wilt in pistachio"	*Calif. Agric.* **36**:17-18 (1982)
82-4	Borges, M.L.V.	POR	"Soil solarization: a new method of soil pasteurization"	*Revta Cienc. agrar.* **5**:1-15 (1982) (Portuguese, with English summary)
82-5	Chet, I., Elad, Y., Kalfon, A., Hadar, Y. & Katan, J.	IL	"Integrated control of soilborne and bulbborne pathogens in iris"	*Phytoparasitica* **10**:229-236 (1982)
82-6	Horiuchi, S., Hori, M., Takashi, S. & Shimuzi, K.	JP	"Factors responsible for the development of clubroot suppressing effect in soil solarization"	*Bull. Chugoku natn. agric. Exp. Stn* **20E**:25-48 (1982)
82-7	Katan, J., Grinstein, A. & Greenberger, A.	IL	"Biological control involved in solar heating"	*Phytoparasitica* **10**:119 (1982) (abstr.)
82-8	Kodama, T. & Fukui, T.	JP	"Solar heating in closed plastic house for control of soilborne diseases. V. Application for control of Fusarium wilt of strawberry"	*Ann. phytopath. Soc. Jap.* **48**:570-577 (1982) (Japanese, with English summary)
82-9	Krikun, J., Orion, D., Nachmias, A. & Reuveni, R.	IL	"The role of soilborne pathogens under conditions of intensive agriculture"	*Phytoparasitica* **10**:247-258 (1982)

82-10	McCain, A.H., Bega, R.V. & Jenkinson, J.L.	USA	"Solar heating fails to control *Macrophomina phaseolina*"	*Phytopathology* 72:985 (1982) (abstr.)
82-11	Pullman, G.S., DeVay, J.E., Elmore, C.L. & Hart, W.H.	USA	"Feasibility of soil solarization for pathogen and pest control"	*Phytopathology* 72:984 (1982) (abstr.)
82-12	Siti, E., Cohn, E., Katan, J. & Mordechai, M.	IL	"Control of *Ditylenchus dipsaci* in garlic by bulb and soil treatments"	*Phytoparasitica* **10**:93-100 (1982)
82-13	Stapleton, J.J. & DeVay, J.E.	USA	"Effect of soil solarization on populations of selected soilborne microorganisms and growth of deciduous fruit tree seedlings"	*Phytopathology* **72**:323-326 (1982)
82-14	Tamietti, G. & Garibaldi, A.	IT	"Tentativi di lotta contro *Pyrenochaeta lycopersici* e *Verticillium dahliae* mediante pacciamtura riscaldante del terreno"	*Atti Giorn. Fitopat.* **2**:455-463 (1982) (Italian, with English summary)
82-15	Usmani, S.M.H. & Ghaffar, A.	PAK	"Polyethylene mulching of soil to reduce viability of sclerotia of *Sclerotium oryzae*"	*Soil Biol. Biochem.* **14**:203-206 (1982)
			1983	
83-1	Ashworth, L.J. Jr., Morgan, D.P., Gaona, S.A. & McCain, A.H.	USA	"Control of Verticillium wilt of pistachio"	*Plasticulture* **58**:33-34 (1983)
83-2	Besri, M.	MOR	"Solar heating (solarization) of tomato supports for control of *Didimella lycopersici* stem canker"	*Phytopath. Z.* **108**:333-340 (1983) (French, with English summary)

No.	Author(s)	Country*	Title of research	Locus of article
83-3	Conway, K.E., Martin, M.J. & Melouk, H.A.	USA	"The potential of soil solarization to control *Verticillium dahliae* in Oklahoma"	*Proc. Okla. Acad. Sci.* **63**:25-27 (1983) (abstr.)
83-4	Eagley, G.H.	USA	"Weed seed and seedling reduction by soil solarization with transparent polyethylene sheets"	*Weed Sci.* **31**:404-409 (1983)
83-5	Elmore, C.L.	USA	"Solarization for weed control in vegetable crops"	*Weed Sci. Soc. Am. Abstr.* p. 32 (1983) (abstr.)
83-6	El-Yamani, T., Abdel-Rahim, M.F., Mickail, K.Y., Grinstein, A. & Katan, J.	EGY	"Soil solarization – a potential method for controlling white rot and other soilborne diseases in onions"	*Proc. 2nd Int. Workshop on Allium White Rot* (Beltsville, MD), p. 126 (1983) (abstr.)
83-7	Frank, Z.R., Ben-Yephet, Y., Katan, J. & Ashri, A.	IL	"Control of delimited shell spots of peanut pods by integrated soil treatments, and breeding for resistance"	*Phytoparasitica* **11**:205 (1983) (abstr.)
83-8	Heald, C.M. & Thomas, C.E.	USA	"Nematode control by soil solarization"	*Nematropica* **13**:114 (1983) (abstr.)
83-9	Horiuchi, S. & Hori, M.	JP	"Control of clubroot disease of crucifers, with reference to the soil solarization technique"	*Jap. agric. Res. Q.* **17**:1-5 (1983)
83-10	Horowitz, M., Regev, Y. & Herzlinger, G.	IL	"Solarization for weed control"	*Weed Sci.* **31**:170-179 (1983)

83-11	Katan, J., Fishler, G. & Grinstein, A.	IL	"Short and long term effects of soil solarization and crop sequence on Fusarium wilt and yield of cotton in Israel"	*Phytopathology* **73**:1215-1219 (1983)
83-12	Lifshitz, R., Tabachnik, M., Katan, J. & Chet, I.	IL	"The effect of sublethal heating on sclerotia of *Sclerotium rolfsii*"	*Can. J. Microbiol.* **29**:1607-1610 (1983)
83-13	Malathrakis, N.E. & Kapetanakis, G.E.	GRE	"Experimental data on the brown root rot of tomato during the 1982-83 crop season"	*First Hellenic Congr. on Plant Diseases and Pests* (Athens), pp. 15-16 (1983) (abstr.)
83-14	Malathrakis, N.E., Kapetanakis, G.E. & Linardakis, D.C.	GRE	"Brown root rot of tomato and its control in Crete"	*Ann. appl. Biol.* **102**:251-256 (1983)
83-15	Martinez Garcia, P.F., Cenis, J.L., Aragon, R.P. & Gonzalez-Benavente, A.	SPA	"Physical factors in soil solarization"	*I. Congr. Nacional de Ciencias Horticolas* (Valencia, Spain), pp. 839-848 (1983) (Spanish, with English summary)
83-16	Myers, D.F., Campbell, R.N. & Greathead, A.S.	USA	"Thermal inactivation of *Plasmodiophora brassicae* Woron. and its attempted control by solarization in the Salinas Valley of California"	*Crop Prot.* **2**:325-333 (1983)
83-17	Porter, I.J. & Merriman, L.R.	AUSTL	"Effects of solarization of soil on nematode and fungal pathogens at two sites in Victoria"	*Soil Biol. Biochem.* **15**:39-44 (1983)
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