SOIL SOLARIZATION OPTIONS in AYDIN STRAWBERRY WITHOUT METHYL BROMIDE

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Introduction

The general climate of Aydin is Mediterranean with mild winters and dry summer. Most of the strawberry production in Aydin centers on Sultanhisar town. Plants are usually set in the summer as either frigo plants or pot-rooted runners using predominantly California cultivars (Camarosa, Sweet Charlie). Most of the production is on raised beds on black plastic mulch in unheated high tunnels.
Since 2000, a project supported by the World Bank (TTGV-P2/29M) has been conducted to introduce alternative products or farming systems to methyl bromide in protected strawberry of Aydin province of Turkey. 1999-2000 trials as well as general data and several results were reported on the last MBAO conference at San Diego (Benlioglu et al., 2001).
The purpose of this research is to apply the best chemical alternative, dazomet and metam sodium, and the best nonchemical alternative, soil solarization, for soilborne pathogen and weed control and crop response over two years on the same strawberry field.

Methods

Four commercial strawberry fields in Sultanhisar were chosen. All four-study sites have loamy soils. At each of four fields four separate treatments were made: (1) standard soil solarization (44 days between 26th June- 9th August), (2) dazomet (50 g / m^2 granular formulation incorporated into soil by rototiller after applying with special granular sprayer and treated soil was mulched with polyethylene (PE, 110 µ thick) film, (3) metam sodium (100ml / m^2 with drip irrigation under the PE, (4) untreated control.
In one location two additional different treatments were also made: (5) raised bed solarization (first strawberry planting beds were prepared and then covered with PE, and solarized for 44 days between 26th June- 9th August), (6) 50 ml / m^2 metam sodium with drip irrigation under PE after 15 days standard soil solarization. In this field, soil temperatures in three different depths (5, 10, 20 cm) and soil moisture were hourly recorded in untreated control and solarization plots by using WatchDog data loggers (Spectrum Technologies, Inc) for the period of solarization.
The plantation with cv. "Camarosa" was carried out in the first half of August and the beds were covered with standard black plastic mulch in mid September. Conventional practices for annual strawberry production and the pest management for the field were followed. Berries were picked for fresh market at least weekly from the beginning of March until June 12th 2002.
Over the course of each field trial, treatments were evaluated for their effects on the following variables: (1) strawberry marketable yield, (2) control of weeds, (3) control of soilborne fungal diseases.

Results

The season total marketable fruit yields from the four trials are reported in Table 1. All treatments resulted in a yield increase, relative to the untreated control, with exception of the metam sodium and solarization + 1/2 metam sodium treatment in location I. However, raised bed solarization requiring no soil cultivation after solarization gave the highest fruit yields in all treatments of location I. Data from the WatchDog units kept on raised bed solarization and control plots are shown in Figure 1 and 2. The maximum soil temperatures at the 5 and 10 cm depth of raised bed solarization plot were about 55 and 50 C° during solarization period, respectively. We also noticed that there was about 10 C° difference between the temperatures at the depth of 5 and 10 cm of raised bed solarization and control plots. The soil temperature differences at the depth of 20 cm stayed about 5 C° between raised bed solarization and control plots.

Table 1. Total marketable and relative yields of Camorosa from harvest 2002 at four locations (I- N. Ozyigit, II- A. Turkoglu, III- D. Aktas, IV- A. Erdogan) in Sultanhisar.

Treatments	**Locations**							
	I*		**II**		**III**		**IV**	
	Total Yield kg/ha	Relat. Yield**	Total Yield kg/ha	Relat. Yield	Total Yield kg/ha	Relat. Yield	Total Yield kg/ha	Relat. Yield
Standard Solarization	41490	101	59860	109	43410	105	41890	113
Raised Bed Solarization	53760	131	-	-	-	-	-	-
Dazomet	46040	111	62690	115	47170	114	44120	119
Metam Sodium	40640	99	60070	110	55130	133	46500	125
Solarization + 1/2 M. sodium	39990	98	-	-	-	-	-	-
Untreated control	40990	100	54720	100	41520	100	37110	100

(*) Plot sizes at each location are 75, 65, 55 and 55 m long tunnels containing 4 raised planting beds, respectively
(**) Relative yield = % of productivity versus control

The effect of fumigants and soil solarization on emergence of native weed populations was evaluated periodically observing the soil coverage of weed species in a wooden frame (50 x 50 cm) by randomly using 9 times in each plot. The coverage of each weed species in total weed infestation was given as a percentage and the effect of each treatment was found by comparison with untreated control (Boz et al., 2002). Common weeds in 4 experimental fields were common purslane (*Portulaca olearecea*), purple nutsedge (*Cyperus rotundus*), annual blue grass (*Poa annua*), horseweed (*Conyza canadensis*) and redroot pigweed (*Amaranthus retroflexus*) (Table 2 and 3). All fumigants and soil solarization treatments reduced annual blue grass population. Likewise raised bed solarization and dazomet were found to be highly effective on common purslane. Standard solarization and metam sodium showed contradictory effect to common purslane while 15-day-solarization plus half dosage of metam sodium gave promising effect to the same weed species. However, none of the treatments could control purple nutsedge and horseweed in all locations.

Table 2. The effect of alternative fumigants and soil solarization on common purslane, purple nutsedge and redroot pigweed at three locations in Sultanhisar

Treatments	Locations				
	I	II		III	
	Common purslane	Common purslane	Purple nutsedge	Common purslane	Redroot pigweed
	August 27, 2001*	August 27, 2001		September 12, 2001	
Standard Solarization	**28.10 (00.0)	5.67 (03.7)	38.33 (00.0)	9.34 (72.7)	2.50 (70.0)
Raised Bed Solarization	1.34 (93.7)	-	-	-	-
Dazomet	1.79 (91.6)	0.50 (91.5)	43.89 (00.0)	11.8 (65.5)	1.45 (82.6)
Metam Sodium	3.58 (83.3)	1.22 (79.3)	45.00 (00.0)	11.3 (67.0)	2.61 (68.7)
Solarization + 1/2 M. sodium	0.88 (95.9)	-	-	-	-
Untreated control	21.42	5.89	22.89	34.2	8.33

(*) Weed sampling was performed on the raised planting beds just before covering black mulch.
(**) The percentage of coverage of each weed species, the numbers in brackets show the percentage weed control

Table 3. The effect of alternative fumigants and soil solarization on common purslane, purple nutsedge and annual blue grass and horseweed at four locations in Sultanhisar

Treatments	Locations							
	I		II			III	IV	
	Annual blue grass	Common Purslane	Common Purslane	Horseweed	Purple nutsedge	Horseweed	Annual blue grass	Horseweed
	August 15, 02 *	May 15, 02 June 12, 02	May 1, 02	April 3, 02	April 3, 02 May 1, 02	March 3, 02	Feb. 20,02 April 3, 02	April 3, 02
Standard Solarization	0.3(99.3)**	31.41 (1.2)	7.22 (15.7)	5.92 (0.0)	15.53 (0.0)	12.80 (0.0)	0.0 (100)	7.33 (14.3)
Raised Bed Solarization	0.00 (100)	4.08 (87.2)	-	-	-	-	-	-
Dazomet	8.58 (81.9)	6.30 (80.2)	2.11 (75.3)	3.00 (34.5)	2.49 (56.6)	16.70 (0.0)	0.38 (97.0)	12.21 (0.0)
Metam Sodium	3.08 (93.5)	45.9 (00.0)	0.44 (94.9	9.00 (0.0)	5.42 (5.6)	7.43 (0.0)	0.0 (100)	7.38 (13.7)
Solarization + 1/2 M. sodium	0.25 (99.5)	8.96 (71.8)	-	-	-	-	-	-
Untreated control	47.50	31.78	8.56	4.58	5.74	5.33	12.48	8.55

(*) Weed sampling was performed between the raised planting beds just after covering black mulch and all weeds were removed by hoeing after every s ampling.
(**) The percentage of coverage of each weed species, the numbers in brackets show the percentage weed control.

Microbial isolates recovered from the diseased strawberry plants and seedlings indicated that the most frequent soilborne fungi were *Rhizoctonia* spp., *Phytophthora cactorum* and *Verticillium dahliae* in our strawberry fields. Farmers usually lose most of the strawberry plants when they get the second crop from the same field for the next year. The effect of fumigants and soil solarization to soilborne diseases of strawberry after one year from the onset of application is presented in Table 4.

Table 4. The percentage of dead strawberry plants in the experimental plots of location I on August 29, 2002

Treatments	Dosage or solarization time	Dates	Dead Plant (%)
Standard Solarization	44 days	June 26 – August 9, 2001	44.44 ab**
Raised Bed Solarization	44 days	June 26 – August 9, 2001	25.04 c
Dazomet	50 g / m^2	August 2 – August 8, 2001	38.41 b
Metam Sodium	100 ml / m^2	July 26 – August 8, 2001	45.71 ab
Solarization + 1/2 M. sodium	15 days + 50 ml / m^2	July 12 – July 26, 2001	51.18 a
Untreated control			42.06 ab

(*) Dead strawberry plants were counted in each raised bed of four bed tunnel plots in Location I and the percentage of dead plant were counted in comparison with untreated control.
(**) Values in the column with different letters show significant differences at P=0.05 according to the Fisher's least significant difference (LSD) test. Data are means of four replicates.

Conclusions

Our studies on methyl bromide alternatives have been underway. Raised bed solarization gave the most satisfactory results and was found to be good alternative to methyl bromide and our treatments in a cost effective manner. Raised bed solarization requires minimum soil cultivation, gives efficient control to weeds except purple nutsedge until black plastic mulch is wrapped on raised planting beds. Recently, raised bed solarization has began to be very popular among the farmers in our region due to the applicability with used polyethylene sheets and resulting better plant growth and yield. Although we did not detect any plant parasitic nematode (*Meloidogyne* spp. or *Aphelenchoides fragariae*) in our demonstration fields, some weed species (purple nutsedge and horseweed) and soilborne diseases of strawberry are still major problem in our strawberry growing areas and need further investigation.

References

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Boz, O., M. N. Dogan, F. Albay. 2002. Determination of weed species on strawberry growing areas in Aydin province of Turkey. Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz, Sonderheft XVIII, 147-153.

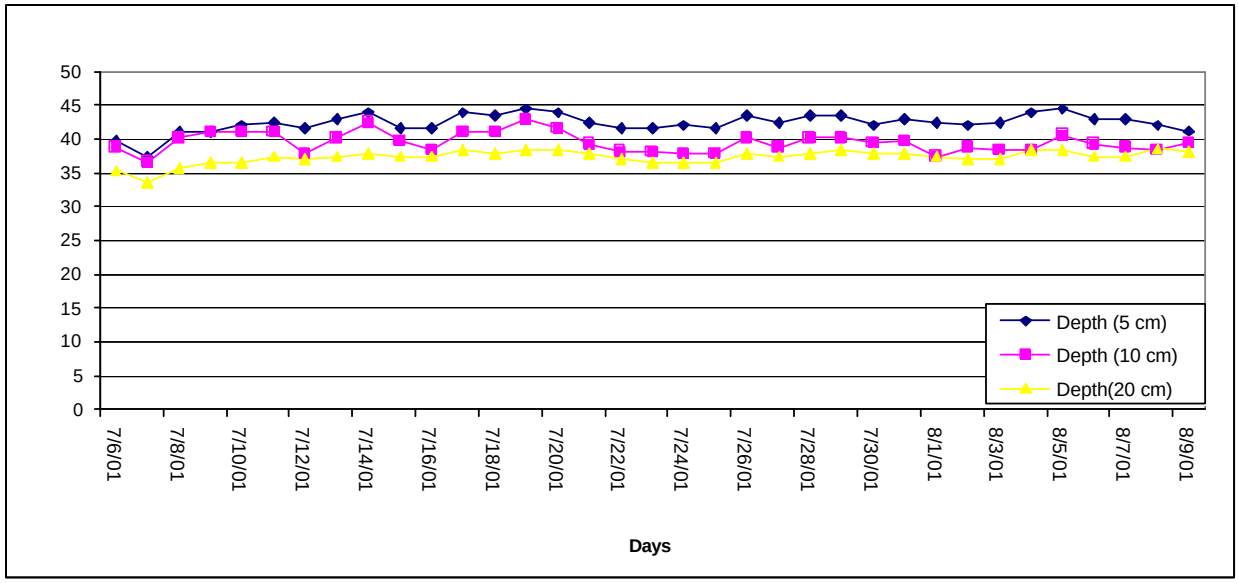

Figure1. Daily temperature values (16^{00}pm) at three different depth of control plot in location 1 between 6^{th} July and 9^{th} August 2001.

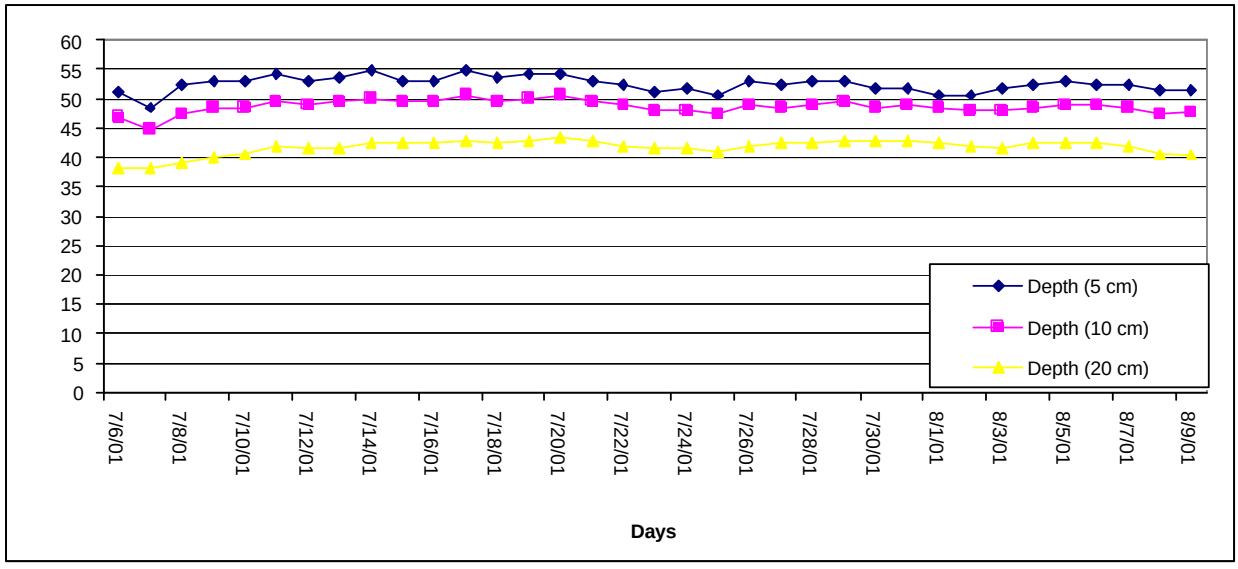

Figure 2. Daily temperature values (16^{00}pm) at three different depth of raised bed solarization plot in location 1 between 6^{th} July and 9^{th} August 2001.