SOLARIZATION EFFECTS ON YIELD AND QUALITY OF SWEET CORN

Rawia.E.I. El-Bassiouny[1], I.I. El-Oksh[2] and M.M.Attia[1]

[1] Vegetable Handling Department, Horticulture Institute, Agriculture Research Center, Giza.
[2] Horticulture Department, Faculty of Agriculture, Ain Shams University, Cairo.

ABSTRACT

This work was conducted at a private Farm at Ayatt, Giza Governorate in 1997 and 1998. Plots naturally infested with seed and soil pests, were solarized during 6 weeks of July and August before sowing sweet corn, F_1 hybrids, Challenger and Dynasty.

Soil solarization raised the average maximum soil temperature at 0 and 5 cm depths to 52.5 and 46.3°C, respectively. These represent an increase of 10.7 and 8.3°C over the non-solarized treatment respectively as average of both seasons. Solarization increased soil content of N, P, K, Zn, Fe, Cu, Mg^{++} and $SO^{=}$ and decreased that of K^+, Na^+, Cl^- and EC. Solarization significantly reduced *Fusarium* spp., total bacteria and fungi infestations and phytoparasitic nematodes. Solarized plots gave the lowest number and weight of annual weeds/m^2, compared to the untreated plots. Solarization gave 98.6% and 92.6% weed reduction in sweet corn for annual broad-leaved weeds and annual grasses 4 weeks after solarization, as averages of both seasons. Solarization improved sweet corn plant growth. Solarized treatment recorded the maximum values for plant height, stem diameter, number of leaves per plant and plant fresh weight. However, Dynasty hybrid was susceptible to late wilt disease compared to Challenger.

Yield of sweet corn ears, average ear weight, diameter, length and number of kernels per ear row were increased by solarization over control treatment.

Challenger hybrid recorded the highest yield and ear characters, and the lowest total sugars, reducing sugar and sucrose percentage on kernels as compared with Dynasty hybrid.

Key Words: Sweet corn, soil solarization, Challenger hybrid, Dynasty hybrid

INTRODUCTION

Sweet corn (*Zea mays* L.) is one of the important newly introduced vegetable crops in Egypt. Many soil borne diseases have the potential to cause serious economic losses in sweet corn. Soil solarization, a nonpesticide technique, is used to control soil pests and reduce weed emergence (Katan, 1997; Elmore *et al.*, 1997). Solarization is the term coined for heating soil using clear polyethylene traps to trap solar energy during the hot summer months. It increases the temperature at all depths compared to non-solarized soils (Horowitz *et al.*, 1983;Abdallah, 1991). Such increase in soil temperature decreases in the deeper soil depths compared to the top layer (Mohamed, 1990; Abdallah, 1991; Ahmed *et al.*, 1998; Abdallah, 2000). The maximum peak of soil temperature ranges between 2 to 4 pm (Horowitz *et al.*, 1983; Abdallah, 1991; Zahran, 2001). Moreover, solarization increases soil nitrogen, potassium and calcium contents (Stapleton and DeVay, 1994; Ahmed *et al.*, 1998). It also increases the available micronutrients, such as, Fe, Cu and Mn (Stapleton *et al.*, 1985; Ahmed *et al.*, 1998). Reduction in EC value and concentrations of Na^+ and Cl^- in the soil are also reported (Abdel-Rahim *et al.*, 1988; Satour *et al.*, 1991).

Soil solarization is shown to be the best method for controlling target pest organisms. It affects many fungal pathogens (Stapleton and DeVay, 1995; Katan, 1997; Abdallah *et al.*, 1998; Stopleton, 1998; Zahran, 2001), especially *Fusarium* spp. (Ahmed *et al.*, 1996; Mahmoud, 1996; Abdallah, 1998; Zahran, 2001), some bacterial pathogens (Stapleton and DeVay, 1995; Antoniou *et al.*, 1997; Zahran, 2001) and phytoparasitic nematodes (Satour *et al.*, 1991; El-Haddad, 1994; Elmore *et al.*, 1997; Bisheya *et al.*, 1998).

Soil solarization up to 6 weeks is found to be successful for controlling various weeds (Abdallah, 1991 and 1998; Horowitz *et al.*, 1983; Elmor *et al.*, 1997). However, annual weeds are usually more sensitive than perennials (Elmore *et al.*, 1997; Abdallah, 1998 and 1999).

Solarization also increases growth, yield and yield quality of sweet corn and other vegetable (Mohamed, 1992; Vizantinopculos and Katrins, 1993; Grüenzwrg *et al.*, 1993; Ahmed *et al.*, 1996; Abdallah, 1998, 2000a and 2000b).

This work was designed to test the impact of soil solarization on weeds, soil pests and sweet corn yield and quality.The potential application of soil solarization for reducing or eliminating the use of chemicals in the production of sweet corn will also be assessed.

MATERIALS AND METHODS

Two field experiments were conducted in 1997 and 1998 in an open field naturally infested with weeds and pests, at a private farm, El-Ayatt, Giza Governorate, The soil of the farm field was clay in texture with a pH of 7.8. In early July of both seasons, the field was cleaned, fertilized with organic manure, plaughed, levelled, and divided into plots, 21 m^2 each. All plots were then pre-irrigated to field capacity. On July 15th, in both seasons, 4 strips of 60 μm thick clear polyethylene plastic were randomly placed on 4 plots for solarization for each sweet corn cultivar. Another 4 plots for each cultivar were untreated and hand weeded during growing season as controls. A split plot system with 4 replications was also conducted. The cultivars were assigned in main plots and soil solarization were devoted for as sub plots. Every 2 weeks the soil temperature was measured every during day time at 0 and 5 cm depths, and the maximum day temperature was then calculated. After 6 weeks of solarization, soil samples were collected from all plots from 10 cm top, and the total counts of each of fungi (*Fusarium* spp.), bacteria, and phytoparasitic nematodes were recorded. Samples were also taken for soil chemical analysis of N, P, K, Fe, Cu, Zn and Mn.

September 18th and 9th, in 1997 and 1998 seasons, sweet corn (*Zea mays*, L.) seeds of the 2 super sweet yellow F_1 hybrids, Challenger and Dynasty (Shrunken$_2$-type), were directly sown, with minimum soil disturbance, in the plots after plastic removal. The same procedure was also conducted in non-solarized plots. Each plot comprised 10 rows, each was 3 m long and 70 cm apart. Seedlings were thinned to a distance of 25 cm.

Weed species and their fresh weight were recorded after 4 and 8 weeks from sowing using a quadrate of 50 cm x 50 cm randomly thrown 4 times in each plot. At harvest, samples of 15 sweet corn plants were randomly taken from each plot to study the plant character. The yield and its components were recorded at harvest from the inside of 5 undisturbed rows. Data were statistically analyzed as a split plot design (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

Solarization Effects on Soil :

(a) Soil Temperature :

The biweekly absolute maximum soil temperature at 0 and 5 cm depths for the solarized and non-solarized treatment, over the 6 weeks solarization period in both seasons are presented in Table (1). The data showed that soil temperature under plastic or uncovered area peacked at 3 pm (1500 hr). Many solarization experiments showed similar results (Horowitz *et al.*, 1983; Abdallah, 1991; Zahran, 2001).

Table (1): Maximum soil temperature (C°) at 0 and 5 cm depth for solarized and control plots during 2 seasons.

Day Time	Soil depth (cm)							
	1997				1998			
	Control		Solarized		Control		Solarized	
	0	5	0	5	0	5	0	5
	2 Weeks after Solarization							
7 a.m.	26.30	24.75	29.00	28.00	26.50	25.00	29.00	27.50
9 a.m.	28.50	26.50	33.50	31.50	29.00	27.00	35.00	33.00
11 a.m.	34.00	30.00	39.50	36.00	33.00	29.00	38.00	35.00
1 p.m.	37.00	32.00	45.50	41.00	35.00	30.00	42.00	37.00
3 pm	40.50	37.50	50.00	45.00	38.00	35.00	49.00	44.00
5 pm	36.00	33.00	48.00	42.00	36.00	31.00	47.00	40.00
7 pm	34.00	30.00	42.50	37.50	33.00	29.00	40.00	35.00
	4 Weeks after Solarization							
7 a.m.	26.00	24.00	28.00	26.50	26.50	23.75	29.00	27.50
9 a.m.	28.00	26.00	34.00	32.00	28.50	26.00	34.00	32.00
11 a.m.	33.00	29.00	40.00	35.00	34.50	31.00	40.50	35.50
1 p.m.	35.00	30.00	42.50	40.0	37.00	35.00	46.30	43.50
3 p.m.	40.00	34.00	47.00	4300	40.00	33.75	49.50	45.50
5 p.m.	38.00	32.00	39.00	35.00	38.00	33.50	44.00	40.00
7 p.m.	35.00	30.00	36.00	32.00	35.00	30.50	40.50	36.50
	6 Weeks after Solarization							
7 a.m.	24.00	22.00	28.50	26.00	25.50	23.00	28.75	27.00
9 a.m.	27.00	24.00	32.00	30.00	28.50	26.00	33.50	31.50
11 a.m.	31.00	28.00	37.00	34.00	35.00	31.50	41.00	36.50
1 p.m.	35.00	30.00	45.00	40.00	38.50	33.50	49.50	44.00
3 p.m.	39.00	33.00	47.00	42.00	43.00	38.50	55.00	47.50
5 p.m.	36.00	31.00	43.00	39.00	40.50	35.50	47.00	43.00
7 p.m.	33.00	29.00	39.00	35.00	38.00	34.00	42.00	38.00

The maximum difference in soil temperatures at 0 and 5 cm depth between trapped and undraped plots was 9.5°C and 9.0°C in 1997 season and 12°C and 11.7°C in 1998 season, respectively. Data demonstrated that the heating effect of the plastic on soil decreased with soil depth. In fact, in 1997 and 1998, the maximum temperature at 5 cm depth was 5°C and 7.5°C, respectively, lower than that measured at soil surface of 0 cm depth.

The increase in soil temperature is found to be directly correlated with solarization and inversely correlated with soil depth (Mohamed, 1990; Abdallah, 1991; Ahmed *et al.*, 1998; Abdellah, 2000).

(b) Soil Chemical Changes:

The most important chemical changes accompanying soil solarization were included an increase in nitrogen, phosphorus and potassium contents, as well as an increase in the avilable micronutrients, such as Fe, Zn and Cu. (Table 2). These findings agree wuth those of others (Stapleton *et al.*,1985; Stapleton and Devay, 1995; Ahmed *et al.*, 1998). Concerning soil salinity, data showed reductions in EC value and concentration of Na^+ and Cl^- in solarized compared to non-solarized soil (Table 2). These results are in accordance with those reported by Abdel-Rahim *et al.* (1988) and Satour *et al.* (1991).

Solarization Effects on Microorganisms and Nematodes:

Data presented in Table (3) showed that total fungi and bacteria population were drastically reduced in solalrized treatments in both 1997 and 1998 seasons. The highest total fungi values (20.7 X 10^4 cfu/g. dw. Soil) was encountered in the unsolarized (control) treatment in 1998 season. In contrast, the lowest mean density was detected in solarized treatment (0.5 X 10^4 cfu/g.dw. soil) in 1997 season. Moreover, a 92.5% reduction as average of propagules of *Fusarium* spp. by solarization was noticed in both seasons compared to control treatment (Table 3).

On the other hand, soil solarization with transparent polyethylene sheets decreased number of total bacteria by about 91.3% as average of both seasons. Although, the methods used counted the mesophylic bacteria, it did not count the thermophylic ones. Therefore, the efficiency of solarization in controlling soil borne pathogens may be attributed to the fact that the majority of these pathogens are mesopphylic bacteria which are mostly affected by the high temperature recorded in solarized soil (Table 1). Similar results were also reported (Stapleton and DeVay, 1995; Mahmoud, 1996; Antonio *et al.*, 1997; Abdallah *et al.*, 1998; Zahran, 2001).

Data also revealed that soil solarization have reduced the counts of nematodes (Table 4). Similar results were reported on the effects of solarization on phytoparasitic nematodes by Satour *et al.* (1991), El-Haddad (1994), Elmore *et al.* (1997) and Bisheya *et al.* (1998).

Table (2): Effect of soil solarization on soil chemical analysis in 1997 and 1998 seasons.

Treat-ment	Season	Macro and Micro Elements (mg/ Kg soil)							Cation (meq /liter)									
		N	P	K	Zn	Mn	Fe	Cu	K^+	Na^+	Mg^{++}	Ca^{++}	SO_4^{--}	Cl^-	HCO_3^-	CO_3^{--}	SP	EC
Solarzed	1997	66.20	1.53	265.20	1.20	2.10	7.53	3.13	0.24	7.83	8.10	9.80	12.60	8.10	5.30	-	51.30	2.40
	1998	89.20	2.83	327.60	1.50	4.87	12.20	3.60	0.28	7.62	3.40	4.90	6.89	6.10	3.30	-	55.00	1.60
	Average	77.70	2.18	296.20	1.34	3.51	9.85	3.40	0.26	7.73	5.80	7.40	9.80	7.10	4.30	-	53.20	2.01
Check	1997	70.00	1.07	265.20	1.10	4.40	9.60	3.20	0.36	9.30	4.50	8.60	1.70	8.10	3.94	-	52.00	2.20
	1998	56.00	2.63	312.00	1.60	3.20	8.20	3.10	0.48	11.10	6.90	7.40	14.50	8.10	3.30	-	50.70	2.40
	Average	63.00	1.90	288.60	1.23	3.80	8.90	3.13	0.42	10.19	5.71	8.00	8.12	8.10	3.60	-	51.40	2.30

Table (3): Population densities of *Fusarium* spp., total fungi and total bacteria determined at the end of solarization period for 1997 and 1998 experiments.

Treatment	Season	*Fusarium* sp. x 10^3 CFU/g dw soil	Total Fungi x 10^4 CFU/g dw soil	Total Bacteria x 10^5 CFU/g dw soil
Solarized	1997	0.90	0.50	1.70
	1998	0.70	5.30	0.16
	Average	0.80	2.90	0.93
Check	1997	6.11	4.20	20.40
	1998	15.00	20.70	1.03
	Average	10.60	12.45	10.70

Table (4): Population density of total nematodes spp. determined at the end of solarization period for 1997 and 1998 experiments.

Treatment	Genus of Nematodes	Total count of nematodes at 50 ml		
		1997	1998	Average
Solarized	Free living	100.00	42.50	142.50
	Tylenchorlynchus	0.27	-	0.14
Check	Free living	1366.50	-	683.30
	Pratylenchus	70.00	290.60	180.30
	Tylenchorhynchus	370.00	85.10	227.00
	Tylenchus	-	31.00	15.50
	Heterodora	-	43.30	21.70
	Ditylenchus	-	157.50	78.80
	Merilinus	-	239.90	119.95

Solarization Effects on Weed Control:

Data showed that soil solarization for a period of 6 weeks was strongly effective in controlling annual broad-leaved weeds emerging from the soil surface (Table 5). After 4 and 8 weeks from seed sowing, solarization resulted in 97% reduction in 1997 season and a 99-100% reduction in 1998 season. These findings are in accordance with those of others who attributed the specific sensitivity of this group of weeds to the high temperature gained by solarization (Horowitz *et al.*, 198; Abdallah, 1991 and 2000).

Table (5): Effect of seed-bed solarization on number and fresh weight of weeds (g/m²) after 4, 8 weeks from sowing.

Season	Character	4 wk from Sowing						8 wk from Sowing					
		Number of weeds/m²			Fresh weight of weeds			Number of weeds/m²			Fresh weight of weeds		
	Treatment	Annual broad leaved weeds	Annual grasses	Perennial weeds	Annual broad leaved weeds	Annual grasses	Perennial weeds	Annual broad leaved weeds	Annual grasses	Perennial weeds	Annual broad leaved weeds	Annual grasses	Perennial weeds
1997	Solarized	1.00	4.00	56.00	4.00	11.00	82.00	2.00	9.00	122.00	2.50	28.00	94.00
	Check	36.00	34.00	11.00	380.50	156.00	15.00	60.00	40.00	26.00	454.00	230.00	34.00
	L.S.D at 0.05 level	31.27	13.36	42.60	127.04	28.50	52.50	24.55	15.31	31.16	84.90	193.60	19.56
1998	Solarized	3.00	2.00	63.00	17.00	5.00	110.00	0.00	0.00	84.00	5.00	0.00	93.00
	Check	249.00	47.50	42.00	1827.00	133.00	80.00	104.30	12.00	40.00	134.50	71.00	68.50
	L.S.D at 0.05 level	208.33	30.22	N.S	479.20	57.75	N.S	74.60	3.34	N.S	91.50	44.90	N.S

Data also revealed that the total number of annual grasses that emerged, in 1997 growing season, at 4 and 8 weeks after sweet corn sowing in solarized plots were 12% and 23%, respectively, of the control count (Table 5). The growth (fresh weight) of the emerged grass weed in solarized plots at 4 and 8 weeks was 40% and 46% lower than that of control plots, respectively. The growth reduction of grass weeds in solarized plots may be due to its deeper emergence (Abdallah, 1991 and 2000).

Concerning perennial weeds, data in Table (5) showed that number and fresh weight of perennial weeds was not significantly affected by soil solarization in 1998 growing season. However, in 1997 growing season, solarization increased emergence of perennial weeds after 4 and 8 weeks from sowing 409% and 369%, respectively, compared to that of control. These perennial weeds emerging from deep may partly has escaped the solarization effect probably due to the limited soil depth where solarization temperature reaches lethal levels (Horowitz *et al.*, 1983; Abdallah, 2000).

Solarization Effects on Sweet Corn :

(a) Vegetative Growth :

This study showed that solarization improved sweet corn plant growth (Table 6). Soil solarization for 6 weeks gave the higher rate of growth parameters of sweet corn, i.e., at harvest days after planting compared to the non-solarized (control) plant height, stem diameter, number of leaves per plant and fresh weight treatment.

Increased plant growth after solarization was noticed (Grüenzweig *et al.*, 1993; Vizantinopculos and katrins, 1993; Ahmed *et al.*, 1996; Abdallah, 1998, 2000a and 2000b). The phenomena may be due indirecty to the control of weeds and soil pests and to changes in soil properties by soil solarization and its effects on increased plant growth and development (Elmore, 1997; Katan, 1997; Stapleton, 1998), or directly as solarization effects on endogenous hormone biosynthesis and action (Grünzweig *et al.*, 1993 and Abdallah, 2000) may also play a role in this respector due to combination of different factors.

Dynasty hybrid had thicker stem diameter, higher number of leaves per plant and heavier plant fresh weight than Challenger in one growing season (Table 6). Genitial differences between cultivars under the study conditions may be responsible.

Table (6) : Effect of soil solarization, hybrids and their interactions on plant growth parameters.

Hybrids	Character	Stem diameter (cm)		Plant height (cm)		Leaf number		Plant fresh weight (gm)		% of plan affected by late wilt	
	Treatment	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Challenger	Solarized	1.48	1.48	151.42	153.50	8.76	9.82	162.90	157.90	0.99	0.45
	Check	1.29	1.33	148.15	143.98	8.67	9.15	158.53	119.10	12.15	6.22
	Mean	1.39	1.41	149.79	148.74	8.72	9.49	160.72	138.50	6.57	3.34
Dynasty	Solarized	1.50	1.66	151.50	149.60	9.11	10.83	248.90	157.70	8.31	8.56
	Check	1.40	1.54	136.33	149.50	8.23	10.10	190.26	132.30	21.52	35.96
	Mean	1.45	1.60	145.42	149.55	8.70	10.47	219.60	145.00	14.99	22.26
Mean treatment	Solarized	1.49	1.57	152.96	151.55	8.94	10.33	205.90	157.80	4.65	4.51
	Check	1.35	1.44	142.24	146.74	8.45	9.63	174.40	125.70	16.84	21.09
L.S.D at 0.05 level	Hybrids	N.S	0.08	N.S	N.S	N.S	0.29	39.70	N.S	6.034	7.14
	Treatments	N.S	0.08	7.7	N.S	N.S	0.29	N.S	17.30	6.034	7.14
	Interaction	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	NS	10.1

Data also demonstrated that the interaction between hybrids and solarization treatments did not significantly affect growth characters of sweet corn in both growing seasons (Table 6).

Concerning the percentage of sweet corn plants affected by late wilt disease, data in Table (6) indicated that, in 1997 and 1998 growing seasons, soil solarization decreased the percentage of affected plants by 72.4% and 78.6%, respectively, compared to control. However, Challenger hybrid showed less susceptibility (more tolerant) to such disease than Dynasty. Moreover, the highest late wilt percentage was shown in Dynasty hybrid in control treatment (unsolarized). These results may be due to the negative impact of solarization on soil borne disease, especially *Fusarium* wilt as presented in Table (2).

(b) Yield :

The data of 1997 and 1998 seasons showed that soil solarization increased total husked and unhusked ears yield per plot as compared with control treatment (Table 7). The husked ears yield per unit area increased by 21.1% and 41.7% in 1997 and 1998 seasons, respectively, by solarization than hand weeding control. The unhusked ears yield increased by 24.8% and 45.2% in both seasons, respectively.

Yield increase following solarization is repeatedly recorded in corn (Mohamed, 1992; Vizantinopuculas and Katranis, 1993; Ahmed *et al.*, 1996; Abdallah, 1999).

Concerning hybrids, data in Table (7) indicated that, in the 1998 season, unhusked and husked yield of Challenger hybrid was higher by 42.9% and 46.3%, respectively, than that of the Dynasty hybrid.

The interaction between hybrids and solarization showed no statistically significant difference either for husked or unhusked yield per plot (Table 7). The increases in Challenger hybrid yield vs. Danasty may be attributed to its partial tolerant end to late wilt disease and other soil-borne diseases.

(c) Ear characteristics :

Data indicated that ear diameter and length, number of kernels row and unhusked ear weight were significantly higher in plants grown in solarized soil than those grown in control (Table 8). The husked ear weight was significantly higher in both seasons, but on the other hand solarization has no effect on the fresh and dry weight of 1000 kernels. Similar results were also reported (Mohamed, 1992; Ahmed *et al.*, 1996).

Table (7): **Effect of soil solarization hybrids and their interactions on total yield/plot.**

Hybrids	Treatment	Unhusked Total Yield/plot (kg/2/m^2)		Husked Ears Yield/Plot (kg/2/m^2)	
		1997	1998	1997	1998
Challenger	Solarized	21.80	30.50	18.17	26.67
	Check	19.50	20.57	16.43	18.05
	Mean	20.65	25.50	17.30	22.36
Dynasty	Solarized	21.15	20.87	18.18	17.47
	Check	14.95	14.84	13.58	13.10
	Mean	18.05	17.85	15.88	15.28
Mean treatment	Solarized	21.49	25.70	18.17	22.07
	Check	17.22	17.70	15.01	15.57
L.S.D. at 0.05 level	Hybrids	NS	3.69	NS	2.36
	Treatments	3.20	3.69	2.04	2.36
	Interaction	NS	NS	NS	NS

Challenger had significantly higher values than Dynasty hybrid in ear diameter and length, number of kernels/row, unhusked ear weight and fresh weight of 1000 kernels in one growing season (Table 8). Data showed a significant increase in husked ear weight and dry weight of 1000 kernels in both growing seasons.

The interactions between hybrids and solarizations revealed no statistically significant difference in all ear characters (Table 8). These findings suggest that both factors may have independed effects.

(d) Kernels Chemical Contents :

No significant difference in total sugars, sucrose %, starch and dry matter content in kernels was noticed between those produced from solarized compared to unsolarized treatments (Table 9). In 1998 growing season, kernels obtained from the solarized treatment had a lower percent of reducing sugars compared to those of control treatment. Similar results were reported by Abdallah *et al.* (1998b) who found that carbohydrate decreased with solarization.

Concerning hybrid, Dynasty kernels had significantly higher total sugars, reducing sugars and sucrose % than those of Challenger. There was no significant difference between hybrids on kernel starch and dry matter

Table (8): Effect of soil solarization, hybrids and their interactions on ear parameters.

Hybrids	Character	Ear Diameter (cm)		Ear Length (cm)		Number of kernels/Row		Unhusked Ear Weight (gm)		Husked Ear Weight (gm)		Fresh Weight/1000 grains (gm)		Dry Weight/1000 grains (gm)	
	Treatment	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Challenger	Solarized	3.88	4.35	18.27	17.85	29.31	32.58	222.50	181.66	173.69	165.22	299.23	301.73	73.00	70.45
	Check	3.86	3.94	18.02	17.73	29.19	29.77	215.90	173.66	165.00	151.90	283.70	270.18	67.00	66.08
	Mean	3.87	4.14	18.15	17.79	29.35	31.18	219.20	177.66	169.35	158.57	291.47	285.90	70.00	68.27
Dynasty	Solarized	3.88	4.13	18.02	17.53	27.74	31.62	177.35	170.78	146.41	145.76	269.33	263.13	62.90	62.65
	Check	3.65	3.79	17.06	17.19	25.25	26.57	155.95	157.5	132.69	132.01	227.95	266.50	60.43	57.8
	Mean	3.77	3.96	17.54	17.36	26.49	29.09	166.65	164.14	139.55	138.89	248.60	264.82	61.67	60.23
Mean treatment	Solarized	3.88	4.24	18.15	17.69	28.53	32.10	199.93	176.22	160.05	155.49	284.30	282.40	67.95	66.55
	Check	3.76	3.87	17.54	17.46	27.22	28.17	185.93	165.58	148.85	141.96	255.80	268.34	63.62	61.94
L.S.D at 0.05 level	Hybrids	N.S	0.11	0.45	N.S	1.58	1.85	10.25	N.S	8.65	10.79	34.40	N.S	7.98	6.82
	Treatments	N.S	0.11	0.45	N.S	N.S	1.85	10.25	N.S	8.65	10.79	N.S	N.S	N.S	N.S
	Interaction	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Table (9): Effect of soil solarization hybrids and their interactions on kernels chemical content of kernels.

Hybrids	Character	Total sugars % gm/100 g fresh weight		Reducing sugars % gm/100 gm fresh weight		Sucrose % gm/100 gm fresh weight		Starch % gm/100 gm fresh weight		Dry matter % gm/100 gm fresh weight	
	Treatment	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Challenger	Solarized	9.16	9.79	0.31	0.33	8.85	9.47	11.85	11.5	21.12	21.04
	Check	9.44	10.04	0.52	0.62	8.92	9.42	12.64	11.9	19.79	20.96
	Mean	9.3	9.92	0.42	0.48	8.89	9.45	12.25	11.7	20.46	21
Dynasty	Solarized	11.7	13.21	0.79	0.54	10.92	12.7	11.44	9.85	20.96	20.2
	Check	11.49	11.72	0.56	0.64	10.9	9.5	12.37	9.95	19.65	19.91
	Mean	11.59	12.47	0.68	0.59	10.91	11.1	11.77	9.77	20.31	20.06
Mean treatment	Solarized	10.43	11.5	0.55	0.44	9.89	12.09	11.65	10.15	21.04	20.62
	Check	10.47	10.88	0.54	0.63	9.91	9.46	12.37	10.93	19.72	20.44
L.S.D. at 0.05 level	Hybrids	1.18	1.66	0.19	N.S	1.08	1.62	N.S	N.S	N.S	N.S
	Treatments	N.S	N.S	N.S	0.16	N.S	N.S	N.S	N.S	N.S	N.S
	Interaction	N.S	N.S	0.27	N.S	N.S	N.S	N.S	N.S	N.S	N.S

%. Moreover, the interaction between hybrids and solarization was not significant indicating that the studied factors are independent in their effect.

Generally, the increase in sweet corn yield and improve of physical ear quality with soil solarization may be due to the negative impact of solarization on weeds (Elmore, 1997; Abdallah, 1998) as presented in Table (5) and/or on soil borne disease (Stapleton and DeVay, 1995; Katan, 1997) especially *Fusarium* wilt as presented in Table (3). It may also be explained by the positive impact of soil solarization on mineral nutrient availability for the growing plants (Table 2) particularly during early stages of plant growth and development. Moreover, soil solarization may replace pesticides for non-chemical sweet corn production because this new method has advantages over pesticides in that, it is a non-chemical method. In addition, there is no harmful residual effect especially for export crops such as sweet corn, and the soil pests and weed-killing effect of solarization may extend to the deeper soil layers.

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الملخص العربى

تأثيرات التعقيم الشمسى على المحصول والجودة فى الذرة السكرية

راوية البسيونى ابراهيم [1] – ابراهيم ابراهيم العكش [2] – منال محمد عطية [1]

١– قسم بحوث تداول الخضر – معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة.
٢– قسم البساتين – كلية الزراعة – جامعة عين شمس – القاهرة.

أجريت تجربتان على استخدام التعقيم الشمسى فى حقل الذرة السكرية هجين (شالنجر – داينستى) فى مزرعة خاصة بمركز العياط – محافظة الجيزة فى أرض تنتشر بها الحشائش وآفات التربة طبيعيا خلال موسمى النمو ١٩٩٧ ، ١٩٩٨ ، وفى كلا التجربتين تم تقسيم الأرض الى أحواض (٢١ م^{٢}) تم ريها ثم غطيت أحواض معاملات التعقيم الشمسى جيداً بأستخدام البولى اثيلين الشفاف بسمك ٦٠ ميكرون فى منتصف شهر يوليو من كل عام واستمرت تغطية الأحواض لمدة ٦ أسابيع تركت خلالها أحواض المقارنة بدون تغطية لاجراء العزيق والنقاوة اليدوية للحشائش خلال موسمى النمو للمحصول وخلال فترة التعقيم تم تسجيل أعلى درجة حرارة يومية كل أسبوعين عند سطح التربة على عمق ٥ سم وعقب انتهاء مدة التعقيم الشمسى تم رفع الغطاء البلاستيك وأخذت عينة من التربة من كل الأحواض من

الطــبقة السطحية لتقدير عدد الفطريات والبكتريا والنيماتودا الى جانب التحليل الكيماوى للتربة ، ثم رى الأحــواض جمـــيعا قبل زراعة حبوب الأذرة يومى ١٨ ، ٩ سبتمبر فى موسمى الزراعة على الترتيب بدون اثارة التربة ماأمكن.

وأظهــرت النــتائج أن معاملة التعقيم الشمسى أدت الى ارتفاع متوسط درجة الحرارة العظمى للــتربة خــلال فــترة التعقيم الى ٥٢,٥ و ٤٦,٣°م على سطح التربة وعمق ٥ سم على الترتيب بزيادة حوالــى ١٠,٧ ، ٨,٣°م أعلــى مــن درجة حرارة التربة بدون تعقيم على التوالى وأدى التعقيم الشمسى لــزيادة محــتوى الــتربة مــن النيتروجيــن والفوسفور والبوتاسيوم والزنك والحديد والنحاس وأيونات الماغنسيوم والكبريتات والبيكربونات وأدت الى قلة أيونات البوتاسيوم والصوديوم والكلوريد كما أدت الى إنخفــاض معــامل التوصــيل الكهــربى (الملوحة) وبالنسبة لآفات التربة ، فقد أدى التعقيم الشمسى إلى إنخفاض معنوى فى أعداد الفيوزاريوم والبكتريا والفطريات الكلية وكذلك النيماتودا وأدى التعقيم الشمسى الــى إنخفــاض أعــداد الحشائش الحولية فى وحدة المساحة الى حوالى ٩٨,٦% من الحشائش الحولية العريضة و ٩٢,٦% من الحشائش الحولية ضيقة الأوراق بعد ٤ أسابيع من الزراعة .

وأظهــرت معاملة التعقيم الشمسى أيضا تفوقا للنمو الخضرى لنباتات الأذرة حيث إزدادت نمو النباتات من حيث الطول وقطر الساق وعدد أوراق النبات والوزن الطازج والجاف للنبات وأظهر الهجين داينستى حساسية للذبول المتأخر مقارنة بالهجين شالنجر ، كما زاد محصول الكيزان ومتوسط وزن الكوز وطــول وقطــر الكــوز وعدد الحبوب للصف بمعاملة التعقيم الشمسى أكثر من معاملة المقارنة وسجل الهجيــن شــالنجر أعلــى محصول وصفات لجودة الكوز وأقل محتوى من السكريات الكلية والسكريات المختزلة والسكروز فى الحبوب مقارنة بالهجين داينستى.

ومــن النــتائج المتحصل عليها تأكد أهمية استخدام التعقيم الشمسى كطريقة ناجحة فى مقاومة الحشــائش الحولية وآفات التربة وتحسين انتاج الأذرة السكرية دون اللجوء لأستخدام المبيدات من ناحية الــى جانــب توافرمواصــفات الجــودة وكمية الانتاج من المحصول الخالى من المبيدات ذات الأهمية التصديرية .