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LONG TERM EFFECTS OF SOIL SOLARIZATION, BIO- AND ORGANIC FERTILIZERS ON SEQUENCE MAIZE CROP

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ABSTRACT

During two successive seasons (2003 and 2004), field experiments were carried out to determine the long-term effects of soil solarization with application of organic and bio-fertilizers on maize (*Zea mays* L.) grown after faba bean.

The results showed that the residual effect of solarization reduced significantly the number and dry weight of annuals weeds after 8 weeks from maize sowing compared with the non-solarized treatment. On the other hand, the number of perennial weeds significantly increased with solarization, while the dry weight of perennial weeds did not reach the significant effect.

The residual effect of solarization and organic fertilizer improved growth of maize plants (plant height and number of leaves per plant) after 90 days from sowing.

Solarization increased significantly number of maize ears/plant, grain weight/plant, straw weight/plant, 1000-kernel weight, ear length, ear diameter, ear weight and grains weight per ear. Bio-fertilizer increased significantly grain weight/plant, ear length and ear diameter. Organic fertilizer increased significantly grain weight/plant, straw weight/plant, 1000-kernel weight, grain yield/fad. and straw yield/fad. The combination between organic fertilizer × bio-fertilizer × solarization significantly increased straw yield/fad.

Keywords: Solarization, organic fertilizer, bio fertilizers, maize (*Zea mays* L.)

INTRODUCTION

Soil solarization has long-term effect (2-3 years) in controlling several soil-born pathogens, weeds and other pests and improved plant growth and yield (Chaube and Dhananjay, 2003). Mauromicale *et al.*, (2001) reported that the effectiveness of soil solarization for controlling *Orobanche crenata* in heavily naturally infested fields and improvement of growth and seed yield of faba bean were maintained in the next year.

Solarization was beneficial in increasing yield of fall-grown bell pepper. When muskmelon was grown in spring after bell pepper, its yield was improved by 15% due to increased fruit number. Improved melon yield was attributed to residual solarization effects initially applied to bell pepper soil (Hartz *et al.*, 1985).

Abdel-Rahim *et al.*, (1988) and Abdallah, (1999) reported that yield of faba bean (third crop after solarization) was higher and *Orobanche* spp. were almost absent in the initially solarized plots compared to non-solarization. Tomato yield (second crop after solarization) was higher (due to increase fruit weights but not numbers) in initially solarized plots. Moreover, Satour *et al.*, (1989) found that soil solarization improved onion growth and yield in the following years, solarized plots maintained superiority of total and quality yield and reduced disease incidence indicating a long term effect of solarization.

Sauerborn *et al.*, (1989) reported that solarization controlled broomrape and other weeds in the following two seasons when the soil was left undisturbed during the season of the treatment. Moreover, Mudalagiriyappa *et al.*, (1999) found that weed numbers and potato yield were similar from 15 days under transparent film or 45 days under black polyethylene. Weed control was best, and crop yield highest, after 45 days under either thickness of transparent film, with potato yields similar to the weed-free controls.

The application of farmyard manure has been reported to improve soil physical and chemical conditions and to help conserve soil moisture (Sattar and Gaur, 1989). One-time application of farmyard manure increased wheat yields for up to 3 successive crop cycles, when applied in conjunction with inorganic N fertilizers, and for up to four years with the addition of P fertilizers under hot and humid conditions in Bangladesh (Mian *et al.*, 1985).

Different authors (Goldstein, 1986 and Singh *et al.*, 2004) reported increasing crop yield due to inoculation with phosphate dissolving bacteria. Phosphorus biofertilizers in the form of microorganisms can help in increasing the availability of accumulated phosphates for plant growth by solubilization. In addition, the microorganisms involved in P solubilization as well as better scavenging of soluble P can enhance plant growth by increasing the efficiency of biological nitrogen fixation, enhancing the availability of other trace elements and by production of plant growth promoting substances (Gyaneshwar *et al.*, 1998).

Therefore the present study was focused on the long-term effects of soil solarization with application of organic and bio fertilizers on maize (*Zea mays* L.) grown after faba bean.

MATERIALS AND METHODS

Field experiments were carried out during two successive seasons (2003 and 2004), to determine the long term effects of soil solarization with application of organic and bio-fertilizers before cultivation of faba bean (*Vicia faba*, L.) on the subsequent crop (*Zea mays* L.).

Organic fertilizer:

The organic fertilizer (sheep manure at 15m^3/fad.) was applied before the cultivation of faba bean, to study the long term effect of sheep manure on the subsequent maize crop, The chemical composition of the sheep manure used in this study in both seasons is presented in Table (1).

Table (1): Chemical composition of the sheep manure used in this study.

Season	pH	EC Mmhos /cm	O.M %	N %	P %	K %	Fe ppm	Mn ppm	Zn ppm	Cu ppm	Pb ppm	Ni ppm
1st	6.9	5.6	21.7	0.8	0.49	0.96	961	432	184	32	4.15	2.8
2nd	7.97	4.7	32.6	0.82	0.74	1.86	1750	235	182.3	38	1.04	2.1

Biofertilizers

Phosphorine at a rate of 300 g/fad. was used for inoculation seeds of the previous crop (*Vicia faba*, L.) to study the long term effect of such treatment on maize plants.

Solarization:

Randomized plots to be solarized were pre-irrigated to field capacity. on August 1st for both seasons, strips of 80 µm thickness polyethylene plastic were randomly placed on plots for solarization for 6 weeks during August and September. Soil temperature was measured weekly. After 6 weeks of solarization, the plastic sheets were removed, then, faba bean was cultivated, at the end of its life cycle, maize was cultivated.

Grains of maize (*Zea mays*, L.) single cross 10 hybrid (SC 10) were used in this investigation. Seeds of this hybrid were kindly provided by Maize Research Dept., Agricultural Research Center, Giza, Egypt.

Following faba bean experiments, the weeds were removed close to soil surface in all plots. Non-solarized plots were hoed before planting, but plots of solarized ones were not hoed. The variety Hybrid 10 of maize was sown in rows spaced 70 cm wide and 30 cm between hills on 26th and 27th May 2003 and 2004, respectively. The previously solarized plots, were not hoed during the growing season while the non-solarized plots, were hoed twice after 4 and 8 weeks from sowing to control weeds. Normal cultural practices for maize production were carried out.

Data recorded:

1. Soil weeds

Weed species were hand pulled randomly in area of 1m² of each plot after 4 and 8 weeks after maize sowing. The weeds were separated and classified into two groups: annual weeds and perennial weeds. Numbers and dry weight of weeds were used as indication of weed infestation.

2. Maize growth

After sowing by 12 weeks, a sample of ten maize plants was taken at random from each plot to study the following plant growth characters:

2.1. Plant height (cm): was measured from the soil surface to end of tassel.
2.2. Number of green leaves per plant.

3. Yield and yield attributes

3.1. Number of ears/plant.
3.2. Grain weight/plant (gm).
3.3. Straw weight/plant (gm).
3.4. 1000-kernel weight (gm).
3.5. Number of plants at harvest/fad.
3.6. Grain yield (ard /fad.). Ardab = 140 kg.
3.7. Straw yield (t/fad.).

4. Physical quality

4.1. Ear length (cm).
4.2. Ear diameter (cm).
4.3. Ear weight (gm).
4.4. Ear grains weight (gm).

5. Statistical analysis

The field data were statistically analyzed as split split plot design (Snedecor and Cochran 1980). The combined analysis of the data in all experiments was followed for both seasons. Least significant differences (LSD) at the level of 5 % were calculated significance.

RESULTS AND DISCUSSION

1-Long term effects of soil solarization, bio- and organic fertilizers on weeds distribution (number and dry weight):

The results in Table (2) showed that soil solarization reduced significantly the number and dry weight of annual weeds after 4 weeks from maize sowing (second crop after solarization) compared with the non-solarized treatment. The reduction percentages of the number and dry weight of these weeds were 78.3 and 75.0%, respectively. On the other hand, the number and dry weight of perennial weeds significantly increased with solarization. The increasing percentages of the number and dry weight of these weeds were 59.0and 25.6%, respectively, compared to non-solarized. These finding confirm the previous results obtained by Sauerborn *et al.*, (1989); Abdallah, (1999); Mudalagiriyappa *et al.*, (1999); Mauromicale *et al.*, (2001) and Chaube and Dhananjay, (2003).

Bio-fertilizer results (Table, 2) indicated no significant differences on number of annual and perennial weeds and on dry weight of perennial weeds, while the dry weight of annual weeds significantly increased with bio-fertilizer compared to non- bio-fertilizer. The increasing percentage of the dry weight of annual weeds was 57.8% compared to non-biofertilizer.

For organic fertilizer, results indicated that there are no significant differences on number and dry weight of annual and perennial weeds.

The interaction between organic fertilizer and bio-fertilizer was significant on number of annual weeds. However, the interaction between non-organic fertilizer and without bio-fertilizer gave the lowest value (10.67 weed/m^2) of number of annual weeds.

The interaction between solarization and bio-fertilizer gave the lowest value (3.85 gm/m^2) of dry weight of annual weeds. The interaction between non-organic fertilizer without bio-fertilizer and non-organic fertilizer without bio-fertilizer with solarization gave the significant lowest values of the number of annual weeds by 10.67 and 4.50 weed/m^2, respectively. Meanwhile, solarization with and without bio-fertilizer gave the lowest value of dry weight of annual weeds were 3.85 and 4.25 gm/m^2, respectively. The results in (Table, 3) showed that the residual effect of soil solarization reduced significantly the number and dry weight of annual weeds after 8 weeks from maize sowing (second crop after solarization) compared with the non-solarized treatment. The reduction percentage of the number and dry weight of these weeds was 61.5 and 67.1%, respectively.

Table (2): Long-term effects of soil solarization, bio- and organic fertilizers on number and dry weight of annual and perennial weeds after 4 weeks from maize sowing (Average of two seasons).

Treatments		Number/m²						Dry weight (gm/m²)					
		Annual weeds			Perennial weeds			Annual weeds			Perennial weeds		
		Bio-fertilizer											
		Without	With	Mean	Without	With	Mean	Without	With	Mean	Without	With	Mean
Non-organic fertilizer	Non -Solarized	16.84	45.50	31.17	50.0υ	47.67	48.84	9.05	20.03	14.54	40.46	43.52	41.99
	Solarized	4.50	7.67	6.09	69.50	96.67	83.09	3.40	3.06	3.23	48.89	45.63	47.26
Mean		10.67	26.59	18.63	59.75	72.17	65.96	6.23	11.55	8.89	44.68	44.58	44.63
Organic fertilizer	Non-Solarized	43.84	23.84	33.84	50.83	41.84	46.34	13.90	21.86	17.88	36.83	46.95	41.89
	Solarized	8.84	7.17	8.01	60.00	76.50	68.25	5.10	4.63	4.87	50.47	65.66	58.07
Mean		26.34	15.51	20.92	55.42	59.17	57.29	9.50	13.25	11.37	43.65	56.31	49.98
Non -Solarized		30.34	34.67	32.51	50.42	44.76	47.59	11.48	20.95	16.21	38.65	45.24	41.94
Solarized		6.67	7.42	7.05	64.75	86.59	75.67	4.25	3.85	4.05	49.68	55.65	52.66
Mean		18.51	21.05	19.78	57.58	65.67	61.63	7.86	12.40	10.13	44.16	50.44	47.30
LSD at 5 %:													
Organic fertilizer				N.S			N.S			N.S			N.S
Bio-fertilizer				N.S			N.S			S			N.S
Solarization				S			S			S			S
Organic fertilizer × Bio-fertilizer				S			N.S			N.S			N.S
Organic fertilizer × Solarization				N.S			N.S			N.S			N.S
Bio-fertilizer × Solarization				N.S			N.S			S			N.S
Organic fertilizer × Bio-fertilizer × Solarization				S			N.S			N.S			N.S

N.S= Not Significant ($p < 0.05$).

Table (3): Long-term effects of soil solarization, bio- and organic fertilizers on number and dry weight of annual and perennial weeds after 8 weeks from maize sowing (Average of two seasons).

Treatments		Number/m²						Dry weight (gm/m²)					
		Annual weeds			Perennial weeds			Annual weeds			Perennial weeds		
		Bio-fertilizer											
		Without	With	Mean	Without	With	Mean	Without	With	Mean	Without	With	Mean
Non-organic fertilizer	Non-Solarized	14.00	17.50	15.75	74.50	60.00	67.25	21.46	42.08	31.77	44.75	31.03	37.89
	Solarized	8.00	4.50	6.25	77.50	90.50	84.00	8.33	7.95	8.14	33.15	41.85	37.50
Mean		11.00	11.00	11.00	76.00	72.25	75.63	14.90	25.02	19.96	38.95	36.44	37.70
Organic fertilizer	Non-Solarized	25.50	17.00	21.25	51.00	75.50	63.25	41.34	28.01	34.68	28.50	41.97	35.24
	Solarized	11.00	5.00	8.00	70.50	90.50	80.50	19.85	7.54	13.70	41.57	40.91	41.24
Mean		18.25	11.00	14.63	60.75	83.00	71.88	30.60	17.78	24.19	35.04	41.44	38.24
Non-Solarized		19.75	17.25	18.50	62.75	67.75	65.25	31.40	35.05	33.22	36.63	36.50	36.56
Solarized		9.50	4.75	7.13	74.00	90.50	82.25	14.09	7.75	10.92	37.36	41.38	39.37
Mean		14.63	11.00	12.81	68.38	79.13	73.75	22.75	21.40	22.07	36.99	38.94	37.97
LSD at 5 %:													
Organic fertilizer				N.S			N.S			N.S			N.S
Bio-fertilizer				N.S			N.S			N.S			N.S
Solarization				S			S			S			N.S
Organic fertilizer × Bio-fertilizer				N.S			N.S			N.S			N.S
Organic fertilizer × Solarization				N.S			N.S			N.S			N.S
Bio-fertilizer × Solarization				N.S			N.S			N.S			N.S
Organic fertilizer × Bio-fertilizer × Solarization				N.S			N.S			N.S			N.S

N.S= Not Significant ($p < 0.05$).

On the other hand, the number of perennial weeds significantly increased with solarization, while the dry weight of perennial weeds did not reach the significant level. The increasing percentage of the number of perennial weeds was 26.1% compared to non-solarized. These results confirm the findings of Sauerborn *et al.*, (1989); Abdallah, (1999); Mudalagiriyappa *et al.*, (1999); Mauromicale *et al.*, (2001) and Chaube and Dhananjay, (2003).

Concerning the effect of bio- and/or organic fertilizers on number and dry weight of annual and perennial weeds after 8 weeks from maize sowing, results in (Table, 3) indicated no significant differences with the control on number and dry weight of annual and perennial weeds. All interactions between solarization, bio-fertilization and organic fertilization treatments showed non-significant effects on number and dry weight of annual and perennial weeds after 8 weeks from maize sowing. Generally, solarization had a residual effect to weed control when the soil was left undisturbed during the season of the treatment.

Many weed species were reported to be controlled by soil solarization (Singh *et al.*, 2004). In studies on weed seeds from different soil depths after 6 weeks of solarization, Abdallah, (2000) reported 100% control of weeds down to 5 cm of soil depth (average maximum temperature at that depth was 55°C.). About 51% of weeds were controlled in soil samples collected from 5-10 cm depth (average maximum temperature was 47°C). Soil samples below 10 cm (43°C) showed increased seed germination (144 % of control) following solarization. The enhanced effect of heat treatments upon seeds in moist soil compared to seeds in dry soil was due to the higher moisture content of seeds. However, high soil temperatures may reduce weed seed populations by killing heat-susceptible seeds and by breaking dormancy of hard seeds followed by thermal kill of seedling (Egley, 1990).

Weed emergence after solarization was a function of weed tolerance to solar heating effect, the depth at which weeds seeds are localized, and the ability of the germinated seeds to emerge from that layer may explain that seeds of weed species which able to germinate and emerge from deeper layers would grow in the solarized soils (Abu-Irmaileh and Thahabi, 1998).

2. Long term effects of soil solarization, bio- and organic fertilizers on maize plant growth:

Data reported in Table (4) showed the Long-term effects of soil solarization, bio- and organic fertilizers on maize growth (plant height (cm) and number of leaves per plant). Soil solarization had significant residual effect on plant height and Number of leaves per plant after 90 days from sowing. Maize plant height and Number of leaves per plant increased by 1.7% and 1.4% compared to non-solarization. Similar results were obtained by Abdel-Rahim *et al.*, (1988); Satour *et al.*, (1989); Abdallah, (1999); Mauromicale *et al.*, (2001) and Chaube and Dhananjay, (2003). On the other hand bio-fertilizer after 90 days from sowing indicated no significant differences on maize plant height and Number of leaves per plant.

Table (4): Long-term effects of soil solarization, bio- and organic fertilizers on maize plant height and number of green leaves after 90 day from sowing (Average of two seasons).

Treatments		Plant height (cm)			Number of green leaves per plant		
		Bio-fertilizer					
		Without	With	Mean	Without	With	Mean
Non-organic fertilizer	Non - Solarized	307.30	312.31	309.80	15.99	16.28	16.13
	Solarized	314.10	315.60	314.85	16.49	16.40	16.44
Mean		310.70	313.95	312.32	16.24	16.34	16.29
Organic fertilizer	Non - Solarized	313.62	315.68	314.65	16.48	16.55	16.51
	Solarized	319.57	320.85	320.21	16.67	16.67	16.67
Mean		3.16.59	318.26	317.43	16.57	16.61	16.59
Non - Solarized		310.46	313.99	312.22	16.23	16.41	16.32
Solarized		316.83	318.22	317.53	16.58	16.53	16.55
Mean		313.64	316.11	314.87	16.40	16.47	16.44
LSD at 5 %:							
Organic fertilizer				N.S			S
Bio-fertilizer				N.S			N.S
Solarization				S			S
Organic fertilizer × Bio-fertilizer				N.S			N.S
Organic fertilizer × Solarization				N.S			N.S
Bio-fertilizer × Solarization				N.S			N.S
Organic fertilizer × Bio-fertilizer × Solarization				N.S			N.S

N.S= Not Significant ($p < 0.05$).

Also, the organic fertilizer no significant differences on maize plant height while residual increasing percentage of number of maize leaves by 1.8% compared to non-organic fertilizer. All interactions between solarization, bio-fertilizer and organic fertilizer showed that no significant effect on Plant height and number of leaves.

3- Long term effects of soil solarization, bio- and organic fertilizers on maize yield and yield attributes:

Data reported in Tables (5&6) showed the Long term effects of soil solarization, bio- and organic fertilizers on maize yield and yield attributes (number of ears per plant, grain weight per plant (gm), dry straw weight per plant (gm), 1000-kernel weight (gm), number of plants at harvest per faddan ,grain yield (ardab per faddan) and straw yield (ton per faddan). The results also, showed that the residual effect of soil solarization increased significantly number of ears, grain and dry straw weight, 1000-kernel weight, number of plants at harvest and Grain yield. The increasing percentages were 3.4%., 3.2%, 11.9%, 3.5%, 3.7%, 7.0%, and 15.6% respectively.

Bio-fertilizer (phosphorine) had no significant effect on number of ears, dry straw weight, and 1000-kernel weight, number of plants at harvest and grain yield. While had significant effect on grain weight .The increasing percentage was 3.6% compared to non-biofertilizer. Organic fertilizer had significant effect on grain weight, dry straw weight, 1000-kernel weight, grain yield and Straw yield. The increasing percentages were 9.9%, 19.1%, 1.5%, 11.3%, and 20.4% respectively. All interactions between solarization, bio-fertilization and organic fertilization treatments showed no significant effects on maize yield and yield attributes except interaction between organic fertilizer × bio-fertilizer × soil solarization, which had significant effect and gave the highest value (6.30 ton/fad).

4-Long term effects of soil solarization, bio- and organic fertilizers on maize physical ear quality:

Data reported in Table (7) showed the Long-term effects of soil solarization, bio- and organic fertilizers on maize physical ear quality *i.e.* ear length (cm), ear diameter (cm), ear weight (gm) and grains weight (gm/ear). The results in showed that the residual effect of soil solarization increased significantly ear length, ear diameter, ear weight and grains weight by 1.5%, 0.8%.3.2 % and 3.8% respectively compared to non-solarized treatment.

Bio-fertilizer had significant effect on ear length and ear weight. The increasing percentage were 0.8% and 2.3%, respectively, compared to compared to non- biofertilizer.while had no significant effect on ear and grains weight. Organic fertilizer had no significant effect on ear length and ear diameter but increased significantly ear weight and grains weight by 2.3% and 2.6%, respectively, compared to non-organic fertilizer. All interactions among solarization, bio-fertilizer and organic fertilizer showed no significant effects on maize physical quality. Generally, the increases in maize yield and improve of physical ear quality with long-term effect of soil solarization might be due to the negative Impact of solarization on weeds.

Table (5): Long-term effects of soil solarization, bio- and organic fertilizers on number of ears, grain weight, straw dry weight and 1000-kernel weight (Average of two seasons).

Treatments		No. of ears/plant			Grain weight/plant (gm)			Straw weight/plant (gm)			1000-kernel weight (gm)		
		Bio-fertilizer											
		Without	With	mean	Without	With	mean	Without	With	mean	Without	With	mean
Non-organic fertilizer	Non-Solarized	1.13	1.16	1.15	234.6	243.0	238.8	263.5	277.6	270.6	385.8	387.5	386.7
	Solarized	1.15	1.20	1.18	246.2	253.3	249.8	302.3	303.0	302.7	396.9	403.7	400.3
Mean		1.14	1.18	1.16	240.4	248.2	244.3	282.9	290.3	286.6	391.4	395.6	393.5
Organic fertilizer	Non-Solarized	1.22	1.15	1.19	260.6	271.2	265.9	321.0	325.5	323.3	390.0	394.9	392.5
	Solarized	1.23	1.24	1.24	266.1	275.9	271.0	342.1	376.9	359.5	404.8	407.9	406.4
Mean		1.23	1.20	1.21	263.4	273.6	268.5	331.6	351.2	341.4	397.4	401.4	399.4
Non-Solarized		1.18	1.16	1.17	247.6	257.1	252.4	292.3	301.6	296.9	387.9	391.2	389.6
Solarized		1.19	1.22	1.21	256.2	264.6	260.4	322.2	340.0	332.1	400.9	405.5	403.3
Mean		1.18	1.19	1.19	251.9	260.9	256.4	307.2	320.8	314.0	394.4	398.5	396.4
LSD at 5 %:													
Organic fertilizer				N.S			S			S			S
Bio-fertilizer				N.S			S			N.S			N.S
Solarization				S			S			S			S
Organic fertilizer × Bio-fertilizer				N.S			N.S			N.S			N.S
Organic fertilizer × Solarization				N.S			N.S			N.S			N.S
Bio-fertilizer × Solarization				N.S			N.S			N.S			N.S
Organic fertilizer× Bio-fertilizer × Solarization				N.S			N.S			N.S			N.S

N.S= Not Significant ($p < 0.05$).

Table (6): Long-term effects of soil solarization, bio- and organic fertilizers on number of plants at ha[illegible] rain and straw yields (Average of two seasons).

Treatments		No. of plants at harvest			Grain yield (ard./fad.)			Straw yield		
		Bio-fertilizer								
		Without	With	mean	Without	With	mean	Without	With	mean
Non-organic fertilizer	Non-Solarized	16083.4	16083.5	16083.5	26.93	27.87	27.40	4.22	4.43	4.33
	Solarized	16749.9	16750.0	16750.0	29.50	30.29	29.90	5.05	5.08	5.07
Mean		16416.7	16416.8	16416.7	28.22	29.08	28.65	4.64	4.76	4.70
Organic fertilizer	Non - Solarized	16416.5	16333.4	16375.0	30.56	31.60	31.08	5.25	5.30	5.28
	Solarized	17000.1	16833.3	16916.7	32.33	33.09	32.71	5.78	6.30	6.04
Mean		16708.3	16583.4	16645.8	31.45	32.35	31.90	5.52	5.80	5.66
Non - Solarized		16250.0	16208.5	16229.2	28.75	29.74	29.24	4.74	4.87	4.80
Solarized		16875.0	16791.7	16833.3	30.92	31.69	31.30	5.42	5.69	5.55
Mean		16562.5	16500.1	16531.3	29.83	30.71	30.27	5.08	5.28	5.18
LSD at 5 %:										
Organic fertilizer				N.S			S			S
Bio-fertilizer				N.S			N.S			N.S
Solarization				S			S			S
Organic fertilizer × Bio-fertilizer				N.S			N.S			N.S
Organic fertilizer × Solarization				N.S			N.S			N.S
Bio-fertilizer × Solarization				N.S			N.S			N.S
Organic fertilizer × Bio-fertilizer × Solarization				N.S			N.S			S

N.S= Not Significant ($p < 0.05$).

Table (7): Long-term effects of soil solarization, bio- and organic fertilizers on ear parameters (Average of two seasons).

Treatments		Ear length (cm)			Ear diameter (cm)			Ear weight (gm)			Grains weight (gm/ear)		
		Bio-fertilizer											
		Without	With	mean	Without	With	mean	Without	With	mean	Without	With	mean
Non-organic fertilizer	Non-Solarized	21.03	21.21	21.12	4.81	4.84	4.82	270.0	274.5	272.2	232.1	235.8	233.9
	Solarized	21.41	21.46	21.43	4.86	4.89	4.87	280.5	282.9	281.7	241.9	243.0	242.4
Mean		21.22	21.33	21.27	4.83	4.86	4.85	275.2	278.7	276.9	237.0	239.4	238.2
Organic fertilizer	Non-solarized	21.22	21.45	21.33	4.86	4.86	4.86	277.3	280.9	279.1	237.5	241.7	239.6
	Solarized	21.52	21.73	21.62	4.89	4.91	4.90	286.8	287.9	287.3	248.1	250.1	249.1
Mean		21.37	21.59	21.48	4.87	4.88	4.88	282.0	284.4	283.2	242.8	245.9	244.3
Non - Solarized		21.25	21.33	21.22	4.83	4.85	4.84	273.6	277.7	275.6	234.8	238.7	236.7
Solarized		21.46	21.59	21.53	4.87	4.90	4.88	283.6	285.4	284.5	245.0	246.5	245.7
Mean		21.29	21.46	21.37	4.85	4.87	4.86	278.6	281.6	280.1	239.9	242.6	241.2
LSD at 5 %:													
Organic fertilizer				N.S			N.S			S			S
Bio-fertilizer				S			S			N.S			N.S
Solarization				S			S			S			S
Organic fertilizer × Bio-fertilizer				N.S			N.S			N.S			N.S
Organic fertilizer × Solarization				N.S			N.S			N.S			N.S
Bio-fertilizer × Solarization				N.S			N.S			N.S			N.S
Organic fertilizer × Bio-fertilizer × Solarization				N.S			N.S			N.S			N.S

N.S= Not Significant ($p < 0.05$).

...ults showed that soil solarization has long-term effect in ...several soil borne pathogens, weeds and other pests and ...proved plant growth and yield. Such results were reported by many authors ...artz *et al.*, 1985; Abdel-Rahim *et al.*, 1988; Satour *et al.*, 1989; Sauerborn *et al.*, 1989; Abdallah, 1999; Mudalagiriyappa *et al.*, 1997; Mauromicale *et al.*, 2001 and Chaube and Dhananjay, 2003). On the other hand, bio-fertilizer (phosphorine) did not have a long-term effect on maize yield. Also, the increases in maize yield with long-term effect of organic fertilizer may be due to the positive impact of organic fertilizer residuals on mineral nutrient availability for growing maize plants. Similar results on long-term effect of organic fertilizer were reported by (Sharma and Vyas, 2001 and Rao and Shaktawat, 2002). This result may be due to the decrease of number or efficiency of active microorganisms on the long-term. So, bio-fertilizer should be added with every crop.

REFERENCES

Abdallah, M.M.F. (1999): No tillage sweet corn production following solarized faba bean and effect of Orobanche seeding depth. Bull. Fac. Agric., Cairo Univ., 50 PP: 416-435.

Abdallah, M.M.F. (2000): Improving vegetable transplants using soil solarization. 3-Tomato (*Lycopersicon esculentum*). Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo. 8(3) PP: 719-733.

Abdel-Rahim, M.F.; M.M. Satour; K.Y. Mickail; S.A. El-Eraki; A. Grinstein; Y. Chen and J. Katan (1988): Effectiveness of soil solarization in furrow-irrigated Egyptian soils. Plant Disease, 72 (2) PP: 143-146.

Abu-Irmaileh, B.E. and S. Thahabi (1998): Comparative solarization effects on seed germination of *Cuscuta* and *Orobanche* species. FAO Plant Production and Protection Paper 147, PP: 227-239.

Chaube, H.S. and S. Dhananjay (2003): Soil solarization: an ecofriendly and effective technique for the management of soil borne pests in nurseries. Botany Abstracts, 23(3) PP: 191-203.

Egley, G.H. (1990): High ternperature effects on germination and survival of weed seeds in soil. Weed Sci., 38 PP: 429-435.

Goldstein A.H. (1986). Bacterial phosphate solubilization: Historical perspective and future prospects. Am.J. Alt. Agric 1,57-65.

Gyaneshwar P., Naresh Kumar G. and Parekh L.J. (1998). Effect of buffering on the phosphate solubilizing ability of microorganisms. World J.Microbiol. Biotechnology. 14. 669-673.

Hartz, T.K.; C.R. Bogle and B. Villalon (1985): Response of pepper ar muskmelon to row solarization. Hort. Sci. 20 (4) PP: 699-710.

Mauromicale, G.; G. Restuccia and M. Marchese (2001): Soil solarizatio non-chemical technique for controlling *Orobanche crenata* improving yield of faba bean. Agronomie. 21 (8) PP: 757-765.

Mian, M.I.A., M.A. Rouf, M.A. Rashid, M.A. Mazid, and M. Eaqub Residual effects of triple super phosphate (TSP) and farmyar (FYM) under renewed application of urea on the yield of some chemical properties of soil. Bangladesh J. Agric. Sc 109.

Mudalagiriyappa; C.A. Agasimani; H.K. Veeranna … (1997): Growth analysis and pattern of dry matter accum… (*Arachis hypogaea*) as influenced by phosphate soli… Research Hisar. 13 (3) PP: 541-546.

Mudalagiriyappa; H.V. Nanjappa and B.K. Ramachandrappa (1999): Residual effect of soil solarization on growth and yield of potato. Journal of the Indian Potato Association. 26 (1-2) PP: 63-64.

Rao, S.S. and M.S. Shaktawat (2002): Residual effect of organic manure, phosphorus and gypsum application in preceding groundnut (Arachis hypogaea) on soil fertility and productivity on Indian mustard (Brassica juncea). Indian, Journal of Agronomy. 47 (4) PP: 487-494.

Satour, M.M.; M.F. Adel-Rahim; T. El-Yamani; A. raduran; H.D. Rabinowitch; J. Ratan and A. Grinstein (1989): Soil solarization in onion fields in Egypt and Israel: Short and long -term effects. Acta Hort., 255 PP: 151-159.

Sat… r, M.A., and A.C. Gaur (1989). Effect of VA-mycorrhiza and phosphate dissolving microorganism on the yield and phosphorus uptake of wheat (*Triticum vulgare*) in Bangladesh. Bangladesh J. Agric. Res. 14(3):233–239.

Sauerborn, J.; K.H. Linke; M.C. Saxena and W. Koch (1989): Solarization; a physical control method for weeds and parasitic plants (Orobanche spp) in Mediterranean agriculture. Weed Research. 29 (6) PP: 391-397.

Sharma, S.C. and A.K. Vyas (2001): Residual effect of phosphorus fertilization and farmyard manure on productivity of succeeding wheat (Triticum aestivum) after soybean (Glycine max). Indian Journal of Agronomy. 46 (3) PP: 416-420.

Singh, V.P.; A. Dixit; J.S. Mishra and N.T. Yaduraju (2004): Effect of period of soil solarization and weed control measures on weed growth and productivity of soybean (Glycine max). Indian Journal of Agricultural Sciences. 74(6) PP: 324-328.

Snedecor, G.W. and W.G. Cochran (1980): Statistical Method 7th Ed., Iowa state. Univ. Press, Ames Iowa, USA.

J. Agric. Sci. Mansoura Univ., 31 (9), September, 2006

التأثيرات الممتدة للتشميس والسماد الحيوي والعضوي علي المحصول اللاحق "الذرة الشامية"

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أجريت تجربتان حقليتان بمزرعة القرما بمدينة قليوب محافظة القليوبية خلال الموسم الزراعي ٢٠٠٣/٢٠٠٤ لدراسة التأثير الممتد لكل من طريقة التشميس والسماد الحيوي والعضوي علي محصول الذرة الشامية باعتباره محصولا لاحقا للفول البلدي الذي استخدم في إنتاجه كل من التعقيم الشمسي والتسميد الحيوي والعضوي.

وقد أوضحت النتائج أن استخدام تشميس التربة لمدة ٦ أسابيع قبل الفول البلدي (المحصول الأول) أدي إلي انخفاض معنوي في عدد ووزن الحشائش بعد ٤ و٨ أسابيع من زراعة الذرة الشامية (المحصول التالي بعد التعقيم).

كما أدي التأثير الممتد للتلقيح بالفوسفورين إلي زيادة معنوية في الوزن الجاف للحشائش المعمرة كما أظهر التفاعل بين التأثير الممتد لكل من الأسمدة العضوية والتلقيح بالفوسفورين تأثيرا معنويا علي أعداد الحشائش الحولية وأظهر أيضا التأثير الممتد للتفاعل بين التشميس والتلقيح بالفوسفورين إلي انخفاض معنوي في الوزن الجاف للحشائش بعد ٤ و٨ أسابيع من زراعة الذرة الشامية.

كما أظهرت النتائج التأثيرات الممتدة لكل من التشميس والتسميد العضوي حيث أدت إلي تحسين النمو الخضري لنباتات الذرة الشامية والذي انعكس علي زيادة طول النبات وعدد الأوراق بعد ٩٠ يوم من الزراعة وكذا عدد الكيزان ومحصول الحبوب والقش ووزن الـ ١٠٠٠ حبة مقارنة بالمعاملة دون تشميس. وإضافة إلي هذا أدي التأثير الممتد للتلقيح بالفوسفورين إلي زيادة محصول الحبوب وتحسين صفات الكوز من حيث طوله وقطره، كما أدي التأثير الممتد للتفاعل بين التشميس والتلقيح بالفوسفورين والتسميد العضوي إلي زيادة معنوية لمحصول الفدان من القش.

وعموما أبرزت النتائج أهمية التأثير الممتد لعوامل الدراسة السابق الإشارة إليها علي المحصول اللاحق للفول البلدي وهو الذرة الشامية.