ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 46(4): Ho. 499-510, (2008).

EFFECT OF ORGANIC AND BIO-FERTILIZATION AND SOIL SOLARIZATION ON WEED CONTROL AND POTATO YIELD AND ITS COMPONENTS

BY

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ABSTRACT

Diamant potatoes (*Solanum tuberosum* L.) were grown in two successive winter seasons of 2004/2005 and 2005/2006 in the Desert Research Center at EL-Sheikh Zowayed, North Sinai Governorate, to study the effect of organic-fertilizers, *i.e.*, 70 kg N/fed. as a cattle and chicken manures (3 cattle:1 chicken), 70 kg /fed. as a compost and 12 m^3 chicken manure + 46.5 kg P_2O_5 + 82 kg N +48kg K_2O (as a check), bio-fertilizer application (Biogen + Phosphorine + Potassumag) and soil solarization on yield and its component of potato plants. The results indicated that weed characters were drastically affected by soil solarization which significantly reduced number, fresh and dry weight of total weeds after 4 and 8 weeks from potato planting compared with non-solarized. Using cattle manure increased average tuber number, size and yield/plant compared with compost treatment. Check treatment gave the highest values compared with organic treatments. The most pronounced effect of the check treatment was increasing tuber contents of dry matter, specific gravity, starch, protein and nitrate. Soil solarization gave higher values of average tuber size and plant yield, while bio-fertilizers application had no significant effects on all studied characters, except reducing tuber content of total protein and nitrate.

Key words: Potato, Organic-fertilization, Bio-fertilization, Soil solarization, Potato yield, Specific gravity, Dry matter, Starch and Nitrate.

INTRODUCTION

In Egypt potato (*Solanum tuberosum* L.) is considered the second vegetable crop after tomato and the first with regard to exportation (MALR, 2005). Potato is a highly cash crop, so it's managed for production of maximum yield using high rates of N fertilizer which resulted in an imbalanced nutritional status of plants and consequently high nitrate accumulation which is considered a health hazard (Rabie *et al.*, 2002).

The development of agriculture practices focusing on short-term productivity based on intensive use of external inputs, such as chemical fertilizers and pesticides, which may have negative environmental impacts and harmful health hazards for both humans and animals. So, the production of organic agriculture products without inputs of chemical pesticides and synthetic fertilizers has become the profitable area of farming as consumers became more concerned about possible effects of chemicals (Abu-Hussien, 2001).

Increasing N fertilizer levels gave the highest potato yield (EL-Gamal, 1996; Grzeskiewicz and Trawczynski, 1998; Stavrova *et al.*, 2002; Reust and Neyroud, 2003), increased potato tuber dry matter content (EL-Gamal, 1996; Hassandokht and Kashi, 2000), increased starch content (Hassandokht and Kashi, 2000) and increased

protein content (EL-Gamal, 1996; Hassandokht and Kashi, 2000). However, specific gravity was not affected (EL-Gamal, 1996).

On the contrary, the higher N application rates decreased potato tuber dry matter content (Grzeskiewicz and Trawczynski, 1998), decreased potato starch content (Grzeskiewicz and Trawczynski, 1998; Symanowicz and Kalembasa, 1998; Reust and Neyroud, 2003).

Also, increasing N rates increased potato tuber nitrate content (Machnacki and kolpak, 1998; Ilin *et al.*, 2000).

Biswas and Mitra (1987) reported that the residual effect of combination of inorganic-fertilizers + organic manure at 50 Kg N/ha were almost similar to that of 100 Kg N as organic-manure. In addition Biswas *et al.* (1988) found that the highest yield of potato tubers was obtained by the application of 100 Kg/ha, from each of N, P_2O_5 and K_2O (50 % of total N as farmyard manure and the rest as a mineral fertilizer).

Farm yard manure reduced the fertilizer N rates by 54 Kg/ha. (Sharma and Sharma, 1988) or reduced N rates by 35 kg (EL-Gamal, 1996).

In the organic farming methods, potato yields were approximately 30- 40 % less compared with the conventional cropping due to the acute N deficiency (Divis and Vodicka, 1998).

Application of organic-fertilizers provides a slightly lower yield (Raupp and Lockeretz, 1997) but with higher quality (Marks *et al.*, 2001) as determined by starch, dry matter and nitrate levels Divis and Vodicka, 1998; Rembialkowska, 1999) compared with the traditional fertilizer application. Also, application of organic- and mineral fertilizers increased the density and species diversity of weed populations (Borowiec *et al.*, 1986; Ifenkwe *et al.*, 1987). While, on table beet, Hamada (2002) decided that organic-fertilizer had no significant effect on weed density (number, fresh and dry weight).

Bio fertilizers are environment friends which are decreased agriculture costs with maximum output. Application of multi-bio-fertilizer and bio control inoculants significantly improved the yield of potato plants (Yassen, 2002).

Application of bio-fertilizer alone or combined with mineral fertilizers at lower rates increased potato yield and improved tuber quality which were determined as starch (Mahendran and Kumer, 1998), dry matter (EL-Gamal, 1996; Mahendran and Kumer, 1998) and nitrate content (Abu-Hussein *et al.*, 2002; Rabie *et al.*, 2002) compared with application of mineral fertilizers alone.

Soil solarization, a procedure used primarily for the disinfestations of soil, was described over 20 years ago and quickly became of intense interest because it was non-chemical, environment friendly, and an affective approach for integrated pest management (De Vay and Stapleton, 1998).

Triki *et al.* (2001) decided that potato yield was improved in solarized plots compared with non-solarized and all the annual weeds were eradicated by solar heating but not the perennial weeds. In addition Sharma and Singh (2003) studied the effect of solarized or unsolarized soil on potato. They found that total tuber yield and number of healthy potato tubers were higher in solarized than non-solarized soil.

MATERIALS AND METHODS

The present study was carried out during two successive seasons of 2004/2005 and 2005/2006 in the Experimental Station, Desert Research Center at El-Sheikh Zowayed (30 Km east of Al-Arish), North Sinai Governorate, to evaluate the effect of bio and organic-fertilization as well as soil solarization on potato yield and its components of potato plants grown in sandy soil and irrigated with drip irrigation system. Potato, cv. Diamant (medium late cultivar) was used in the present investigation and the experiment was arranged

in split split plot design with four replicates the plot area 10.5 m^2. The bio- and organic-fertilizers treatments were placed in the main and sub main plots respectively, while the soil solarization was placed in sub sub plots.

The physical and chemical properties of the experimental soil and water are presented in Tables (1 and 2) . The analysis of organic fertilizers in this experiment is shown in Table (3).

Table (1): physical and chemical properties of the soil surface (0 – 40 cm soil depth).

Particle size distribution (%) (Dray sieving)														
Coarse sand			Medium sand				Fine sand			Very fine sand				
1.0-			0.5-				0.25-			0.10-				
0.5			0.25				0.10			0.05				
mm			mm				mm			mm				
0.12			82.37				16.03			1.48				
DP, g/ cm	Db, g/ cm	Total por osisity, %	F.C, at 10.06 bar	W. P., at 15 bar	A. W., %	S.P., %	pH	EC, ppm	ESP%	Caco3	CEC(Meq/ 100gm.soil)	Total N, ppm	Organic carbon %	Organic mater %
2.65	1.66	37.35	5.29	0.94	4.35	16.0	7.81	435	16.53	1.45	0.70	38.0	0.12	0.21

Dp: Particle density **A. W.:** Available water **E.C.:**Eelectronic conductivity
Db: Bulk density **S.P.:** soil saturation percent **ESP:** Exchangeable sodium percentage
F. C.: Field capacity **pH:** soil pH of soil past **CEC:** Cation exchange capacity
P. W. P.: Parameters wiling percentage

Table (2): Chemical analysis of the irrigation water

pH	Sodium adsorption	Electronic conductivity	Soluble cation meq/l				Soluble anion meq/l			
			Ca	Mg	Na	K	Co3	HCO_3	SO_4	Cl
7.4	5.45	0.763	1.44	1.70	3.92	0.18	–	1.66	3.29	2.29

Table (3): Analysis of cattle, compost and chicken manure used.

Organic fertilizers	Moisture, %	O.M, %	C, %	C/N ratio	N, %	P, %	K, %
2004							
Cattle	28.55	25.14	17.41	37.85	0.46	0.72	1.18
Compost	8.59	23.07	12.15	10.39	1.17	0.75	1.14
Chicken	11.10	26.47	19.32	16.24	1.19	0.65	1.87
2005							
Cattle	32.00	24.02	16.94	33.22	0.51	0.74	1.12
Compost	17.40	22.65	12.27	9.82	1.25	0.77	1.35
Chicken	15.80	26.15	21.43	17.86	1.20	0.43	2.11

N, % Total nitrogen (%) O.M, % Organic matter (%)
P, % Total phosphorus (%) C, % Total carbon (%)
K, % Total potassium (%) C/N ratio The ratio of carbon to nitrogen

Treatments

Bio-fertilizers.

The bio-fertilizers are commercial products purchased by the General Authority of Agricultural Funds and Equalization. These products named Biogeen (a symbiotic nitrogen fixing bacteria), Phosphorin (phosphate solubilizing bacteria) and Potassiumag (potassium solubilizing bacteria). The bio-fertilizers were applied twice directly after planting date and 30 days later as a suspension at a rate of 4 liter /fed., The control plots were not treated.

Organic- fertilizers.

Cattle and chicken manures (3 cattle: 1 chicken) at a rate of 70 kg organic nitrogen/fed. = (15.904 cattle + 1.664 chicken) and (15.140 cattle +1.732 chicken) ton/fed. in two seasons + 46.5 kg/fed. P_2O_5 as a rock phosphate + 48 kg/fed. K_2O as a rock potassium.

Compost at a rate of 70 kg nitrogen/fed. = (6.524 and 6.780) ton/ fed. in two seasons + rock phosphate and rock potassium as the previous treatment.

Chicken manure at a rate of 12 m^3/ fed. + the recommended dose of mineral fertilizers, i.e., 46.5 kg/fed. calcium superphosphate (15.5% P_2O_5) was added 30 days before planting date, 82 kg/fed. ammonium sulphate (20.5%N) at 5 times (before planting, 30, 45, 60 and 75 days after planting) and 48 kg/fed. potassium sulphate (48%K_2O) at 4 times (30, 45,60 and 75 days after planting) as a control.

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Soil solarization

Soil was flooded (irrigated abundantly) before covering with clear polyethylene traps of 50 μ thickness for 6 weeks during August and September and the control treatment was uncovered.

Agronomic practices

During July the soil experiment was ploughed and divided into rows, each row was 1m width and 10.5m length. Organic-fertilizers, rock phosphate, rock potassium were applied for all plots, except the control plots. In control treatment, calcium super-phosphate was applied, then the organic and natural fertilizers were incorporated in rows and leveling before trickle irrigation lines was installed. Spacing between trickle laterals was 1m and spacing between inline (GR) emitters was 30 cm.

Potato seed tubers were hand planted at 10 cm below the soil surface on October 1 in the two growing seasons, and then the bio-fertilizers were applied directly after planting, and at 30 days later.

Data recorded.

Weed measurements.

Total weeds (broad leaved and narrow) were taken from a randomly quadratic meter after 4 and 8 weeks from planting date to determine the average number, fresh and dry weight of total weeds

Yield and its components.

At harvest time (120 days after planting), ten plants were taken from each plot to determine average tuber number/plant, average tuber size and average total yield /plant.

After curing, a random sample of ten tubers were taken from each plot, and then dried at 65°C until constant weight to determine the following data:

Dry matter content:

Dry matter content was determined by using the standard method illustrated in A.O.A.C. (1990).

Specific gravity and starch content:

The dry matter content was used to calculate specific gravity and starch amount as described by Burton (1948).

Nitrate content:

The nitrate content was colorimetrically determined by using the stander method which was illustrated by ASTM (2002).

Statistical analysis

Data were subjected to analysis by M-STATC (Russel, 1991). The differences among the means were performed by least significant difference (LSD) at 5% level.

RESULTS AND DISCUSSION

Number, fresh and dry weight of total weeds after 4 weeks.

Data presented in Table, 4 show the effect of organic- and bio-fertilization and soil solarization on weed number, fresh and dry weight of total weeds after 4 weeks from planting. Soil solarization significantly reduced number, fresh and dry weight of total weeds after 4 weeks compared with non-solarization. The reduction percentages of these traits i.e., number, fresh and dry weight of weeks were 83.67, 78.99 and 73.47% respectively.

Table (4): Effect of bio-, organic-fertilization and soil solarization on number, fresh and dry weight of total weeds/ m^2 after 4 weeks from planting. (combined analysis of two seasons).

Bio-Fertilization	Organic Fert.	Number of total weeds/m^2			F.W. of total weeds (g)			D. W. of total weeds (g)		
		Solarization		Means	Solarization		Means	Solarization		Means
		Sol.	Non Sol.		Sol.	Non Sol.		Sol.	Non Sol.	
With Bio-	Manure	7.50	56.13	**31.82**	85.63	537.75	**311.69**	15.46	78.80	**47.13**
	Compost	9.50	56.13	**32.82**	109.88	978.88	**544.38**	19.94	128.98	**74.46**
	Control	8.88	45.63	**27.26**	91.67	423.88	**257.78**	18.50	58.98	**38.74**
Means		**8.63**	**52.63**	**30.63**	**95.73**	**646.84**	**371.28**	**17.97**	**88.92**	**53.44**
Without Bio-	Manure	7.50	55.75	**31.63**	180.75	600.00	**390.38**	31.78	87.54	**59.66**
	Compost	10.25	55.88	**33.07**	155.38	639.17	**397.28**	26.14	96.80	**61.47**
	Control	6.63	38.25	**22.44**	98.21	254.13	**176.17**	17.86	37.68	**27.77**
Means		**8.13**	**49.96**	**29.04**	**144.78**	**497.77**	**321.27**	**25.26**	**74.01**	**49.63**
	Manure	7.50	55.94	**31.72**	133.19	568.88	**351.03**	23.62	83.17	**53.40**
	Compost	9.88	56.01	**32.94**	132.63	809.03	**470.83**	23.04	112.89	**67.97**
	Control	7.76	41.94	**24.85**	94.94	339.01	**216.97**	18.18	48.33	**33.26**
Means		**8.38**	**51.30**		**120.25**	**572.30**		**21.61**	**81.46**	
		L.S.D. at: 0.05			**L.S.D. at: 0.05**			**L.S.D. at: 0.05**		
Bio-Fert.		**NS**			**NS**			**NS**		
Organic-Fert.		**NS**			**NS**			**NS**		
Solarization		**15.84**			**165.43**			**5.30**		
Bio X Org.		**NS**			**NS**			**4.20**		
Bio X Solarization		**NS**			**NS**			**NS**		
Org. X Solarization		**NS**			**NS**			**NS**		
Bio X Org. X Sol.		**NS**			**NS**			**3.20**		

F.W. = Fresh weight D.W. = Dry weight NS = Not significant

Organic- and bio-fertilization had no significant influences on weeds characters, while the interaction between them had significant effect on weeds dry weight compared with the control treatment (without bio-fertilization) which gave the highest reduction percentage when compared with compost application with bio-fertilization as an average of two seasons.

Concerning, the interaction between organic- and bio-fertilization and soil solarization. Manure fertilizer application with bio-fertilization in solarized plots gave the highest reduction percentage of total weed dry weight, while compost with bio-fertilization in non-solarized plots gave the lowest reduction percentage as an average of two seasons (Table 4).

Number, fresh and dry weight of total weeds after 8 weeks.

Data presented in Table 5 show the effect of organic and bio-fertilization and soil solarization on weed number, fresh and dry weight of total weeds after 8 weeks from planting.

Table (5): Effect of bio-, organic-fertilization and soil solarization on number, fresh and dry weight of total weeds/ m^2 after 8 weeks from planting. (combined analysis of two seasons).

		Number of total weeds/m^2			F.W. of total weeds (g)			D. W. of total weeds (g)		
Bio-Fertilization	Organic Fert.	Solarization		Means	Solarization		Means	Solarization		Means
		Sol.	Non Sol.		Sol.	Non Sol.		Sol.	Non Sol.	
With Bio-	Manure	8.63	87.13	**47.88**	143.50	1066.25	**604.88**	24.70	79.21	**51.96**
	Compost	10.63	63.63	**37.13**	135.67	1307.15	**721.41**	10.91	97.75	**54.33**
	Control	11.75	89.75	**50.75**	133.63	984.38	**559.01**	11.76	70.45	**41.11**
Means		**10.34**	**80.17**	**45.25**	**137.60**	**1119.26**	**628.43**	**15.79**	**82.47**	**49.13**
Without Bio-	Manure	8.75	81.00	**44.88**	137.17	1054.75	**595.96**	10.89	77.60	**44.25**
	Compost	11.88	61.75	**36.82**	210.34	618.38	**414.36**	17.12	47.48	**32.30**
	Control	16.50	77.00	**46.75**	235.75	1105.50	**670.63**	19.39	77.88	**48.64**
Means		**12.38**	**73.25**	**42.81**	**194.42**	**926.21**	**560.32**	**15.80**	**67.65**	**41.73**
	Manure	8.69	84.07	**46.38**	140.34	1060.50	**600.42**	17.80	78.41	**48.10**
	Compost	11.26	62.69	**36.97**	173.01	962.77	**567.89**	14.02	72.62	**43.32**
	Control	14.13	83.38	**48.75**	184.69	1044.94	**614.82**	15.58	55.83	**35.70**
Means		**11.36**	**76.71**		**166.01**	**1022.74**		**15.80**	**68.95**	
		L.S.D. at: 0.05			**L.S.D. at: 0.05**			**L.S.D. at: 0.05**		
Bio-Fert.		**NS**			**NS**			**NS**		
Organic-Fert.		**NS**			**NS**			**NS**		
Solarization		**21.51**			**675.62**			**25.55**		
Bio X Org.		**NS**			**NS**			**NS**		
Bio X Solarization		**NS**			**NS**			**NS**		
Org. X Solarization		**NS**			**NS**			**NS**		
Bio X Org. X Sol.		**NS**			**NS**			**NS**		

F.W. = Fresh weight D.W. = Dry weight NS = Not significant

Soil solarization significantly reduced the number, fresh and dry weight of total weeds after 8 weeks from potato planting when compared with non-solarized. The reduction percentage of the number, fresh and dry weight were 85.19, 83.77 and 77.09%, respectively. These results confirm the previous results obtained by Abdallah *et al.* (1998) and El-Sheshtawy, (2006).

Concerning, effect of organic- and bio-fertilizer application and their interactions; the effect among treatments was not significant on weeds number, fresh and dry weight after 8 weeks as an average of both growing seasons. Similar results were obtained by Hamada, (2002). This effect may be due to the temperature under plastic sheet which was high enough to kill or eradicate all weed seeds which are buried in the soil (Triki *et al.*, 2001).

Average number of tubers per plant.

The results in Table 6 show that control treatment significantly increased average numbers of tubers per plant compared with organic treatments. Whereas, cattle manure gave the highest number of tubers per plant compared with compost treatment. Soil solarization, bio-fertilization and all the interactions among treatments were not significant as an average of two seasons.

Average tuber size.

Data presented in Table 6 indicate that average tuber size was significantly affected by both soil solarization and organic-fertilization as an average of two seasons. Soil solarization treatment increased average tuber size as compared with non-solarized

Concerning, the effect of organic fertilizers, control and cattle manure treatments increased average tuber size compared with compost treatment application, which gave the lowest average tuber size as an average of two seasons. However, the application of bio-fertilizers and all interactions between treatments were not significant (Table 6).

Table (6): Effect of bio-, organic-fertilization and soil solarization on average size of potato tuber (cm^3) and average number of tubers (combined analysis of two seasons).

		Average tuber number/ plant			Average tuber size		
Bio-Fertilization	Organic Fert.	Solarization		Means	Solarization		Means
		Sol.	Non Sol.		Sol.	Non Sol.	
With Bio-	Manure	6.27	6.22	**6.25**	108.44	80.86	**94.65**
	Compost	6.19	5.64	**5.92**	96.58	80.69	**88.635**
	Control	6.87	6.41	**6.64**	101.82	95.41	**98.615**
Means		**6.44**	**6.09**	**6.27**	**102.28**	**85.65**	**93.96**
Without Bio-	Manure	5.96	5.94	**5.95**	103.93	91.72	**97.83**
	Compost	5.62	6.06	**5.84**	93.97	75.69	**84.83**
	Control	6.50	6.55	**6.53**	95.83	90.69	**93.26**
Means		**6.03**	**6.18**	**6.11**	**97.91**	**86.03**	**91.97**
	Manure	6.12	6.08	**6.10**	106.19	86029	**96.24**
	Compost	5.91	5.85	**5.88**	95.28	78.19	**86.73**
	Control	6.69	6.48	**6.58**	98.83	93.05	**95.94**
Means		**6.24**	**6.14**		**100.10**	**85.84**	

	L.S.D. at: 0.05	L.S.D. at: 0.05
Bio- Fert.	NS	NS
Organic-Fert.	0.37	6.20
Solarization	NS	5.03
Bio X Org.	NS	NS
Bio X Solarization	NS	NS
Org. X Solarization	NS	NS
Bio X Org. X Sol.	NS	NS

NS = Not significant

Average plant yield

The results are presented in Table 7 show the effect of organic- and bio-fertilization and soil solarization on average potato yield per plant. Soil solarization gave the heaviest tuber yield per plant as an average of two seasons compared with non-solarized treatment. This may be due to the better conditions resulted from solarization such as physical and chemical soil properties and absence of weed effect. Increasing potato yield after soil solarization agree with results reported by Abu-Blan and Abu-Gharbieh (1994), Triki *et al.* (2001) and Sharma and Singh (2003).

Table (7): Effect of bio-, organic-fertilization and soil solarization on potato plant yield (g) and tuber dry matter (%) (combined analysis of two seasons).

Bio-Fertilization	Organic Fert.	Potato plant yield(g)			Tuber dry matter (%)		
		Solarization		Means	Solarization		Means
		Sol.	Non Sol.		Sol.	Non Sol.	
With Bio-	Manure	702.56	587.88	**645.22**	20.79	20.66	**20.73**
	Compost	523.04	539.20	**531.12**	20.35	20.74	**20.55**
	Control	713.07	651.96	**682.52**	21.76	21.03	**21.40**
Means		**646.22**	**593.01**	**619.62**	**20.97**	**20.81**	**20.89**
Without Bio-	Manure	712.37	588.36	**650.37**	20.60	20.89	**20.75**
	Compost	570.58	514.62	**542.60**	20.87	21.21	**21.04**
	Control	703.89	665.55	**684.72**	21.61	21.53	**21.57**
Means		**662.28**	**589.51**	**625.90**	**21.03**	**21.21**	**21.12**
	Manure	707.47	588.12	**647.79**	20.70	20.78	**20.74**
	Compost	546.81	526.91	**536.86**	20.61	20.98	**20.79**
	Control	708.48	658.76	**683.62**	21.69	21.28	**21.48**
Means		**654.25**	**591.26**		**21.00**	**21.01**	

	L.S.D. at: 0.05	L.S.D. at: 0.05
Bio- Fert.	**NS**	**NS**
Organic Fert.	**41.25**	**0.43**
Solarization	**24.10**	**NS**
Bio X Org.	**NS**	**NS**
Bio X Solarization	**NS**	**NS**
Org. X Solarization	**NS**	**NS**
Bio X Org. X Sol.	**NS**	**NS**

NS = Not significant

Adding compost fertilizer gave significantly lower potato yield per plant compared with cattle manure or the control treatments (Table 5). This might be related to the favorable effects of nitrogen which enhance and improve the plant growth characters, and possibly, increased the efficiency of photosynthesis and resulted in more accumulation of stored food in the tubers. Bio-fertilizer application and all the interactions showed no significant effects on potato yield per plant (Table 7).

Tuber dry matter content

Data in Table 7 show that tuber dry matter content was significantly affected by organic-fertilizer. In this regard, control treatment produced the highest value compared with cattle manure or compost treatments which were gave the lowest dry matter content as an average of both seasons under study. Similar results were found by other workers (EL-Gamel, 1996; Hassandokht and Kashi, 2000). While soil solarization and bio-fertilizer application and all interactions among treatments showed no significant effects on this character.

Specific gravity

The effects of organic- and bio-fertilization and soil solarization and its interactions are presented in Table 8.

Concerning, of organic-fertilization, control treatment significantly increased specific gravity of potato tubers as an average of two seasons compared with cattle manure or compost treatments. These results agrees with those obtained by Hassandokht and Kashi (2000) but dos not agree with those of EL-Gamal (1996). Soil solarization, bio-fertilization and their interactions showed no significant effect.

Starch content

Control treatment gave the highest starch content of potato tubers compared with cattle manure or compost treatments as an average of both seasons (Table 8).

Concerning, the interactions effect it is clear that the control treatment with soil solarization gave the highest values compared with cattle manure or compost treatments. Moreover, the control treatment with bio-fertilization and soil solarization gave the highest value.

Table (8): Effect of bio-, organic-fertilization and soil solarization on specific gravity (g/cm3) and starch content (g/100 g dry weight) of potato tuber (combined analysis of two seasons).

Bio-Fertilization	Organic Fert.	Specific gravity			Starch content		
		Solarization		Means	Solarization		Means
		Sol.	Non Sol.		Sol.	Non Sol.	
With Bio-	Manure	1.083	1.082	**1.082**	69.52	69.88	**69.70**
	Compost	1.081	1.083	**1.082**	69.31	69.71	**69.51**
	Control	1.087	1.084	**1.086**	70.89	70.18	**70.54**
Means		**1.084**	**1.083**	**1.083**	**69.91**	**69.92**	**69.92**
Without Bio-	Manure	1.082	1.083	**1.083**	69.70	70.13	**69.92**
	Compost	1.083	1.085	**1.084**	69.95	70.30	**70.13**
	Control	1.087	1.086	**1.086**	70.85	70.73	**70.79**
Means		**1.087**	**1.085**	**1.084**	**70.17**	**70.39**	**70.28**
	Manure	1.082	1.083	**1.082**	69.61	70.01	**69.81**
	Compost	1.082	1.084	**1.083**	69.63	70.01	**69.82**
	Control	1.087	1.085	**1.086**	87.70	70.46	**70.66**
Means		**1.084**	**1.084**		**70.04**	**70.16**	

	L.S.D. at: 0.05	L.S.D. at: 0.05
Bio- Fert.	**NS**	**NS**
Organic-Fert.	**0.002**	**0.78**
Solarization	**NS**	**NS**
Bio X Org.	**NS**	**NS**
Bio X Solarization	**NS**	**NS**
Org. X Solarization	**NS**	**0.66**
Bio X Org. X Sol.	**NS**	**1.06**

NS = Not significant

Total protein content

The effect of and bio organic-fertilization and soil solarization and their interactions on total protein of potato tubers are shown in Table (9). Such data show that, the control treatment gave the highest total protein of potato tubers, while cattle manure and compost treatments gave the lowest total protein content.

Concerning, bio-fertilizer application, significantly reduced total protein content compared with no bio- fertilizer application. Soil solarization and all the interactions between treatments had no significant effect on this character.

Tuber nitrate content

Data presented in Table 9 show the effect of bio organic and fertilization and soil solarization and their interactions on potato tuber nitrate content.

Potato tuber nitrate content was drastically affected by organic-fertilization, while the control treatment gave the highest value compared with cattle manure or compost treatment which gave the lowest values. Similar results were found by some workers (Machnacki and kolpak, 1998; Rembialkowska, 1999; Ilin *et al.*, 2000).

Table (9): Effect of bio-, organic-fertilization and soil solarization on total protein (g/100g dry weight) and nitrate content (ppm) of potato tuber (combined analysis of two seasons).

Bio-Fertilization	Organic Fert.	Total protein			Nitrate content		
		Solarization		Means	Solarization		Means
		Sol.	Non Sol.		Sol.	Non Sol.	
With Bio-	Manure	9.36	9.63	**9.50**	370.63	376.25	**373.44**
	Compost	10.38	9.35	**9.87**	371.88	370.38	**371.13**
	Control	9.63	10.32	**9.98**	409.13	413.13	**411.13**
Means		**9.79**	**9.77**	**9.78**	**383.88**	**386.59**	**385.23**
Without Bio-	Manure	9.28	9.54	**9.41**	380.25	384.00	**382.13**
	Compost	9.59	9.90	**9.75**	375.75	379.38	**377.57**
	Control	11.46	11.46	**11.46**	423.88	428.75	**426.32**
Means		**10.11**	**10.30**	**10.21**	**393.29**	**397.38**	**395.34**
	Manure	9.32	9.59	**9.45**	375.44	380.13	**377.78**
	Compost	9.99	9.63	**9.81**	373.82	374.88	**374.35**
	Control	10.55	10.89	**10.72**	416.54	420.94	**418.72**
Means		**9.95**	**10.03**		**388.59**	**391.98**	

	L.S.D. at: 0.05	L.S.D. at: 0.05
Bio- Fert.	**0.42**	**6.06**
Organic- Fert.	**0.56**	**4.42**
Solarization	**NS**	**NS**
Bio X Org.	**NS**	**NS**
Bio X Solarization	**NS**	**NS**
Org. X Solarization	**NS**	**NS**
Bio X Org. X Sol.	**NS**	**NS**

NS = Not significant

Bio-fertilizer application significantly decreased potato tuber nitrate content. These results are in agreement with those of Awad and Hegazi (2002), who reported that the nitrate levels in tubers were generally lower in bio-fertilizer application and the concentration depended upon the level of nitrogen application. They also recommended that the nitrate levels should be kept as low as possible with maximum yields. This can be accomplished by increase awareness of the importance of organic- and biological-fertilization using.

Soil solarization and all the interactions treatments showed no significant effects on potato tuber nitrate content.

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تأثير التسميد العضوى والحيوى والتعقيم الشمسى للتربة على مقاومة الحشائش ومحصول البطاطس ومكوناته

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تمت زراعة درنات البطاطس صنف ديامونت شتاءاً خلال الموسم الشتوي لعامي ٢٠٠٤ /٢٠٠٥، ٢٠٠٥/٢٠٠٦ بمحطة بحوث الشيخ زويد ، محافظة شمال سيناء التابعة لمركز بحوث الصحراء وذلك لدراسة تأثير إستخدام الأسمدة العضوية والتى شملت: سماد الماشية مخلوطاً مع سماد الدواجن بنسبة ٣: ١وذلك بمعدل ٧٠ وحدة نيتروجين/فدان ، سماد الكمبوست بمعدل ٧٠ وحدة نيتروجين/فدان ، إستخدام معاملة المقارنة والتى شملت السماد المعدنى الموصى به (٤٦,٥ كجم فو٢أ٥+ ٨٢ كجم نيتر ، حبن+ ٤٨ كجم بو٢أ) بالإضافة الى ١٢ متر مكعب من سماد الدواجن. كما تم دراسة تأثير إجراء عدم التعقيم الشمسى للتربة وكذلك إستخدام الأسمدة الحيوية على المحصول ومكوناته لنباتات البطاطس.

وقد أظهرت النتائج أن اجراء التعقيم الشمسى للتربة قد أثر بشدة على إنبات ونمو الحشائش والذى أدى إلى نقص معنوى فى عدد والوزن الطازج والجاف للحشائش الكلية بعد ٤ و٨ أسابيع من الزراعة مقارنة بعدم إجراء التعقيم الشمسى و ظهر أن إستخدام سماد الماشية مخلوطاً مع سماد الدواجن أدى إلى زيادة عدد وحجم الدرنات وكذلك المحصول مقارنة بسماد الكمبوست. بينما أظهرت معاملة المقارنة أعلى القيم بالنسبة لمعظم الصفات المدروسة خاصة بالنسبة لمحتوى الدرنة من المادة الجافة والنشا والبروتين والنترات ، وكذلك زيادة الكثافة النوعية وذلك مقارنة بالمعاملات العضوية. كما أدى إجراء التعقيم الشمسى للتربة إلى زيادة ملحوظة فى حجم الدرنات وكذلك المحصول ، بينما ظهر أن الأسمدة الحيوية لم يكن لها أى تأثير على الصفات المدروسة بإستثناء النقص الواضح فى محتوى الدرنة من البروتين والنترات.