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PARTIAL SUBSTITUTION OF MINERAL FERTILIZERS BY ORGANIC SOURCES

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ABSTRACT

Two field experiments were conducted during two successive seasons of 2006/07 and 2007/08 to study the effect of substituting part of mineral fertilizers, on plant growth and yield of pepper (*Capsicum annuum* L. cultivar Reda) and cucumber (*Cucumis sativus* L. cultivar Brenji 22-80) under the plastic houses, using organic solution. The treatments consisted of three compost solution treatments injected into drip irrigation system (without, one or twice times per week) and three foliar types of application for organic solution treatments (without, once a week and once every two weeks). The objective of this study was to reduce the amount of the required mineral fertilizer under the greenhouse by injecting organic solution into the drip irrigation system. Data revealed that organic solution improved plant growth and yield during both seasons. Vegetative growth characters (plant height, number of leaves and leaf area) increased with increasing the frequency of organic solution application. The highest yield was obtained when injecting organic solution twice a week followed by once a week. The lowest plant growth and yield were obtained by using mineral fertilizers only. On the other hand, using organic solution to spray cucumber and pepper plants led to increased vegetative growth and fruit yield compared to without spraying treatment. Plant analysis revealed that contents of N, P and K increased with using the organic solution accompanied with mineral fertilizer comparing with using mineral fertilizer only. Economic analysis suggested that the injection of compost solution twice a week combined with foliar application once a week saves 40% of the mineral fertilizer compared to a system with mineral fertilizer application only. This study also indicated that application of compost

solution increased the use efficiency of both organic and mineral nutrient sources. These results suggest that organic solution might lead to reduce environmental hazard due to the reduction of using mineral fertilizers.

Key words: Compost, Foliar Application, Cucumber, Pepper and Organic solution.

INTRODUCTION

Growing concerns about the environmental consequences of mineral fertilizer use and its future cost perspectives emphasize the need to develop new production technologies that are sustainable both economically and ecologically (Lester, 2006). There are concerned efforts worldwide to use green and organic manures to provide the same amount of food with less fossil fuel based inorganic fertilizers. Increased recycling of plant residues, agro-industrial wastes, municipal wastes and animal manures is likely to complement the N availability and reduce dependence on mineral N fertilizers (). In addition, use of chemical fertilizers alone does not sustain productivity under continuous intensive cropping, whereas inclusion of organic materials improves physical soil properties, builds up soil fertility and increases crop yield (Yaduvanshi, 2003 and Lester, 2006).

Combining organic manure with inorganic fertilizer is a wide practice in cucumber cultivation to improve soil physical, chemical and biological properties by organic manure and mineral fertilizers. Abd-El-Kawy (2003) found that cucumber plants receiving 50% chicken manure combining with 50% inorganic fertilizer gave more number of leaves and total leaf area than organic solution only. Application of organic waste increased the fresh and dry weights of cucumber shoots significantly through the autumn and spring seasons at the early and final growth stages. The highest values obtained at early stage were associated with the addition of compost in autumn and spring seasons as well as with addition of chicken manure at the final stage of autumn and spring seasons (Mohy El-Din, 1997 and El-Sheikh and Hegazy, 1998). Increasing chicken manure decreased N and P contents of snap bean leaves compared to control (the recommended chicken manure 21 Kg / plot and 0.440 Kg N added as ammonium sulfate); K content, however, increased when any excess of N was applied as chicken manure. (El-Sayed, 2002 and

Amujoyegbe *et al.*, 2007). Contents of most macro-nutrients in cucumber leaves were in the highest levels when combining either 50% compost or 50% chicken with inorganic fertilizers (Abd-El-Kawy, 2003). Applying organic manure as a nutrient solution affected significantly the total yield of cantaloupe; the highest total yield was recorded with inorganic solution. On the contrary, other results showed that the lowest total yield resulted from plants that received the organic manure solution alone; those plants that received the inorganic + organic manure solution gave highest total yield (Mengel and Kirkby, 2001 and Youssef *et al*., 2001, El-Sayed, 2002 and Abou-El-Hassan , 2003). The aim of this study was the trial to replace part of the mineral fertilizer by using organic nutrient solution into drip irrigation system to enhance plant growth and reduce environment pollution and production cost.

MATERIALS AND METHODS

Two experiments were carried out in the two successive seasons of 2006/07 and 2007/08 at El-Bosaily Protected Cultivation Experimental Farm, Agricultural Research Center, located at the North Coast of Egypt. The treatments comprised three injected compost solution intervals into soil (without, once or twice week) and three spraying intervals of organic solution (without, once or twice a week) on pepper (*Capsicum annuum* L. cv. Reda) and cucumber (*Cucumis sativus* L cv. Brenji 22-80) plants under the greenhouse conditions. The experiment design was a split plot with three replications. Seeds of pepper were sown June 18 and 21 of 2006 and 2007, for the first and the second seasons, respectively and seedlings were transplanted 45 days after sowing. Cucumber seeds were sown Jan. 15 and 19 of 2007 and 2008, for the first and the second seasons, respectively and seedlings were transplanted 24 days after sowing. Chemical properties of the experimental soil were analyzed before cultivation according to Chapman and Pratt (1961) and the results were as follows: pH =7.89; EC, ds/m=3.00; Ca^{++} meq/l =30; Mg^{++} meq/l= 10; Na^{+} ,meq/l=14.26; K^{+} meq/l= 1.66; HCO_3^{-} meq/l = 2.5 ; Cl^{-}, meq/l =12.6; FC % = 16.77; PWP % = 5.65; bulk density g/cm^3=1.44; clay % = 4.30; silt % = 0.36; sand % =95.31; and soil texture was sandy. Plant distances were 50 cm apart. Drip irrigation was used from the first to the end of the seasons. The stock nutrient

solution of compost was prepared by soaking 50 kg compost in 1000 liter of water for two days and the clear solution was used to prepare the nutrient solution of compost (El-Shinawy *et al.,* 1999). All other agricultural practices of cultivation were performed as recommended by the Ministry of Agriculture. Ten plants were randomly selected of each experimental plot to determine growth parameters of plant height, number of leaves per plant, leaf area, early and total yield. For chemical analysis, leaves were dried then digested in sulphuric acid and hydrogen peroxide according to the method described by Allen (1974) and the digest was used for assay of the concerned elements. Total nitrogen was determined by Kjeldahl method according to the procedure described by FAO (1980). Phosphorus content was determined using spectrophotometer according to Watanabe and Olsen (1965). Potassium content was determined photometrically using flame photometer as described by Chapman and Pratt (1961). The chemical composition of the collected irrigation water from drip irrigation system after injecting organic nutrient solutions as well as the foliar spray solution (ppm) is tabulated in Table (1and 2). Statistical analysis of variance was performed according to the procedure described by Snedecor and Cochran (1981). For economical analysis, after considering the cost of organic materials application, the incomes from cucumber and pepper yield were used (Cimmyt, 1988) according to the formula: Net Income = value of obtained yield - cost of mineral/organic / biological nutrient sources; Value cost ratio (VC) = value of yield obtained / cost of mineral / organic/biological nutrient sources. Relative increase in income (RII) = (net income /income of control) x 100.

The incomes were estimated based on Egyptian pounds according to the prevailing currency rate (years 2006–07 and 2007-08).

Table (1): The chemical analysis of the collected water from drip irrigation after injecting organic nutrient solutions (ppm)

Elements (ppm)	**N**	**P**	**K**	**Ca**	**Mg**	**Fe**	**Zn**	**Mn**	**Cu**	**B**
	145.2	28.1	194	85.5	19.4	1.40	0.20	0.30	0.11	0.20

Table (2): The chemical analysis of the foliar spray organic manure (ppm)

Elements (ppm)	N	P	K	Ca	Mg	Fe	Zn	Mn	Cu	B
	165.3	32.4	216	109	21.5	1.40	0.22	0.33	0.14	0.24

RESULTS AND DISCUSSION

Vegetative growth of grown plants:

Regarding the effect of different applied organic solutions into drip irrigation system for both pepper and cucumber plants (Tables 3 and 4, respectively), data showed that using organic solution twice a week instead of mineral fertilizer led to increase significantly pepper and cucumber plant height, number of leaves, and leaf area followed by using organic solution into drip irrigation once weekly.

On the other hand, spraying cucumber and pepper by using the organic solution once a week gave the highest vegetative growth characters during both seasons. The lowest vegetative growth was obtained by without spray treatment.

Regarding the interaction effect between injecting organic solution into drip irrigation system and spraying organic solution as foliar nutrition, data showed that the highest vegetative growth characters was obtained by applying organic solution into drip irrigation system twice a week combined with spraying organic solution on plants once a week followed by organic solution into drip irrigation system twice a week combined with spraying organic solution once every two weeks. On the other hand, the lowest vegetative growth characters were obtained by using mineral fertilizer only as nutrient source without spray treatment.

When the organic manure solution was supplemented with inorganic solution, the vegetative growth increased compared to using either mineral or organic solution only (El-Shinawy *et al.,* 1999, Abd-Elmoniem *et al.,* 2001 and Lester, 2006).

Table (3) Effect of different injecting and spray organic solution treatments on plant height, number of leaves and leaf area of cucumber plants during the 2007and 2008 seasons.

Plant height (cm)				
2007 season				
Treatments	**no spray**	**spray at 7 day**	**spray at 15 day**	**Mean A**
No inject.	270G	300F	324E	298C
1 injection /week	303F	327E	339D	323B
2 injection /week	345C	360B	387A	363.9A
Mean B	306 C	329.1 B	350 A	
2008 season				
No inject.	294H	318G	339F	317 C
1 injection /week	339F	357E	384D	360 B
2 injection /week	360C	381B	405A	382 A
Mean B	330.9C	351.9B	376.2A	
Number of leaves/plant				
2007 season				
Treatments	**no spray**	**spray at 7 day**	**spray at 15 day**	**Mean A**
No inject.	32.0G	33.4F	34.7E	33.3 C
1 injection /week	34.2E	35.8D	37.2C	35.7 B
2 injection /week	36.7C	38.5B	40.1A	38.4 A
Mean B	34.3C	35.9B	37.3A	
2008 season				
No inject.	33.4G	34.9F	36.2D	34.9 C
1 injection /week	35.7E	37.4D	38.9C	37.3 B
2 injection /week	38.4C	40.2B	41.9A	40.2 A
Mean B	35.8C	37.5B	39.0A	
Total leaf area(m^2)				
2007 season				
Treatments	**no spray**	**spray at 7 day**	**spray at 15 day**	**Mean A**
No inject.	10440G	10980G	12600D	10800 C
1 injection /week	11340F	12420E	13860C	12600 B
2 injection /week	12600D	14220B	15300A	14040 A
Mean B	11460C	12540B	13920A	
2008 season				
No inject.	10800G	11340F	12960E	11700 C
1 injection /week	11700	13500D	13860C	12960 B
2 injection /week	12998E	14669B	15783A	14484 A
Mean B	11833C	13170B	14201A	

Mean A: means of injecting organic solution treatments.
Mean B: means of spraying organic solution treatments.

Table (4) Effect of different injecting and spray organic solution treatments on plant height, number of leaves and leaf area of pepper plants during the 2006/07and 2007/08 seasons

Plant height (cm)				
2006/2007 seasons				
Treatments	**no spray**	**spray at 7 day**	**spray at 15 day**	**Mean A)**
No inject.	150G	153FG	163E	155C
1 injection /week	156F	169D	174C	167B
2 injection /week	168D	178B	189A	178A
Mean B (inject)	158C	166B	175A	
2007/2008 seasons				
No inject.	143G	149.5F	156E	149C
1 injection /week	158.6E	167.7D	176.8C	167B
2 injection /week	166.4D	170.3B	182A	172A
Mean B	156C	162.5B	171.6A	
Number of leaves/ plant				
2006/2007 seasons				
Treatments	**no spray**	**spray at 7 day**	**spray at 15 day**	**Mean A**
No inject.	375F	391.5E	412.5C	393C
1 injection /week	399D	409.5D	420B	409.5B
2 injection /week	412.5C	421.5B	432A	421.5A
Mean B	395.5C	407.5B	421.5A	
2007/2008 seasons				
No inject.	390G	406.5E	415.5C	405.4C
1 injection /week	397.5F	411D	418.5C	408.4B
2 injection /week	415.5C	427.5B	447A	429.9A
Mean B	400.1C	416.4B	426.9A	
Total leaf area(cm^2)				
2006/2007 seasons				
Treatments	**No spray**	**Spray at 7 day**	**Spray at 15 day**	**Mean A**
No inject.	3255G	3420E	3525C	3400B
1 injection /week	3321F	3451.5D	3681B	3485B
2 injection /week	3472.5D	3625.5B	3819A	3639A
Mean B	3350C	3499B	3675A	
2007/2008 seasons				
No inject.	3128F	3167F	3428C	3240C
1 injection /week	3285E	3413D	3533B	3410B
2 injection /week	3434C	3522B	3677A	3544A
Mean B	3282C	3367B	3546A	

Mean A: means of injecting organic solution treatments.
Mean B: means of spraying organic solution treatments.

Yield:

The effect of different treatments on pepper and cucumber yields was presented in Tables (5 and 6, respectively).

Referring to the effect of different organic solution injecting times, data showed that using organic solution twice a week into the drip irrigation system led to increase both early and total yields significantly followed by organic solution once a week comparing with using mineral fertilizer only.

Regarding the effect of spraying organic solution as foliar nutrient for pepper and cucumber plants on both early and total yields, data showed that the highest values were obtained by spraying organic fertilizer once a week followed by spraying organic solution once every two weeks with significant difference between them. The lowest early and total yields were obtained by without spray treatment.

Table (5) Effect of different injecting and spray organic solution treatments on early and total yield of cucumber plants during the 2007and 2008 seasons

Early yield (g/plant)				
2007 season				
Treatments	**no spray**	**spray at 7 day**	**spray at 15 day**	**Mean A**
No inject.	600H	670G	710F	660C
1 injection /week	705F	740E	789C	744.7B
2 injection /week	750D	798B	835A	794.3A
Mean B	685C	736B	778.1A	
2008 season				
No inject.	642H	674G	678G	664.6C
1 injection /week	714F	768E	799C	728.6B
2 injection /week	764D	809B	842A	805A
Mean B	706C	750.3B	773A	
Total yield (kg/plant)				
2007 season				
Treatments	**no spray**	**spray at 7 day**	**spray at 15 day**	**Mean A**
No inject.	3.10F	3.50E	3.70C	3.3C
1 injection /week	3.40D	3.70C	4.10B	3.7B
2 injection /week	3.80C	4.10B	4.50A	4.23A
Mean B	3.43C	3.77B	4.1A	
2008 season				
No inject.	2.9G	3.2F	3.5E	3.2C
1 injection /week	3.4E	3.8D	4.2B	3.8B
2 injection /week	3.7D	4.0C	4.4A	4.03A
Mean B	3.33C	3.67B	4.03A	

Mean A: means of injecting organic solution treatments.
Mean B: means of spraying organic solution treatments.

Table (6) Effect of different injecting and spray organic solution treatments on total yield of pepper plant during the 2006/07and 2007/08 seasons.

Total yield kg/plant				
2006/2007 seasons				
Treatments	**No spray**	**spray at 7 day**	**Spray at 15 day**	**Mean A**
No inject.	3.36F	3.43E	3.52D	3.4C
1 injection /week	3.57D	3.78C	4.06B	3.8B
2 injection /week	3.71C	4.06B	4.34A	4.04A
Mean B	3.6C	3.8B	4.0A	
2007/2008 seasons				
No inject.	2.94G	3.15F	3.36D	3.2C
1 injection /week	3.29E	3.50C	3.71B	3.5B
2 injection /week	3.36D	3.71B	4.06A	3.7A
Mean B	3.2C	3.5B	3.7A	

Mean A: means of injecting organic solution treatments.
Mean B: means of spraying organic solution treatments.

With respect the interaction effect between injecting in the irrigation system and spraying organic solution on grown plants; data showed that the highest early and total yields were obtained by using organic solution twice a week into the drip irrigation combined with spraying organic solution on plants once a week followed by using organic solution twice a week combined with spraying organic solution once every two weeks. The lowest early and total yields were obtained by using mineral solution only as nutrient source combined with without spray treatment. Similar results were found by El-Shinawy *et al.* (1999), Abd-Elmoniem *et al.* (2001), Abou-El-Hassan (2003) and Amujoyegbe *et al.* (2007). The superiority of using organic solution mixed with inorganic nutrient solution may result from balance between macro and micro elements. Moreover, organic solution has positive effect on plant both growth and early yield (El-Sheikh and Hegazy 1998 and Yaduvanshi, 2003).

Mineral content of grown plants:

Data in Tables (7 and 8m respectively) showed the effect of using different injecting and spraying organic solution treatments on N, P and K percentages in grown plants. The highest values were obtained by injecting organic solution twice a week for pepper and

cucumber plants; the lowest values, on the other hand, were obtained by using mineral fertilizer only.

Regarding the spraying treatments the highest N, P and K percentage of pepper and cucumber leaves were obtained by using organic solution for foliar application once a week followed by once every two weeks during the two tested seasons.

Referring to interaction effect between using compost as nutrient solution and foliar application, data showed that the highest values of N, P and K percentages were obtained by injecting organic solution in the irrigation system twice a week combined with using organic solution for foliar application on plants once a week. The lowest values of N, P and K percentages, on the other hand, were obtained by using only mineral fertilizer without spraying nutrient solution treatment.

Solid organic compost application (normal application) resulted in lower yields compared to inorganic nutrient solution; the use of organic nutrient solution gave higher yield than using solid organic manure. Yield reductions in solid organic manure treatment are in agreement with the yields obtained. These findings indicate that plants preferably take up the mineral nutrients dissolved in the soil solution, which are easily accessible to the roots (Mohy El-Din, 1997 and El-Shinawy *et al.,* 199).

Generally, the percentage of plant nutrients (N, P and K) in cantaloupe leaves increased with applying inorganic solution. This effect could be resulted from the more soluble element concentrations in the inorganic solution. Similar results were found by Mohy El-Din (1997), El-Shinawy *et al.* (1999), Abd-Elmoniem *et al.* (2001), El-Sayed (2002), Abd-El-Kawy (2003) and Lester (2006).

Mengel and Kirkby (2001) stated that plants supplied with organic fertilizers initially take up the inorganic fractions of these organic materials, thus the solution that is directly available to plant roots is of particular importance. Relatively low availability of nitrogen in organic matter is well known. Cited authors also reported that the amounts of nutrients which contact directly plant roots are rather small compared to the overall nutrient demand. Therefore, transportation of nutrients towards the rhizosphere and root surface by mass flow and diffusion are more important than interception.

Table (7) Effect of using different injecting and spraying organic solution treatments on N, P and K percentage of cucumber plants.

N %				
2007 season				
Treatments	**no spray**	**spray at 7 day**	**spray at 15 day**	**Mean A**
No inject.	4.30G	4.50F	4.70D	4.5C
1 injection /week	4.60E	4.90C	5.14B	4.9B
2 injection /week	4.70D	5.12B	5.30A	5.04A
Mean B	4.53C	4.84B	5.05A	
2008 season				
No inject.	4.17F	4.36E	4.56D	4.37C
1 injection /week	4.46E	4.75C	4.98B	4.73B
2 injection /week	4.55D	4.96B	5.14A	4.89A
Mean B	4.40C	4.69B	4.90A	
P%				
2007 season				
Treatments	**no spray**	**spray at 7 day**	**spray at 15 day**	**Mean A**
No inject.	0.61F	0.64E	0.67D	0.64C
1 injection /week	0.65E	0.69C	0.73B	0.69B
2 injection /week	0.67D	0.73B	0.75A	0.71A
Mean B	0.64C	0.69B	0.72A	
2008 season				
No inject.	0.59F	0.61E	0.64D	0.61C
1 injection /week	0.62E	0.67C	0.70B	0.66B
2 injection /week	0.64D	0.70B	0.72A	0.69A
Mean B	0.62C	0.66B	0.69A	
K%				
2007 season				
Treatments	**no spray**	**spray at 7 day**	**spray at 15 day**	**Mean A**
No inject.	3.23F	3.38E	3.53D	3.38C
1 injection /week	3.45E	3.68C	3.86B	3.66B
2 injection /week	3.53D	3.84B	3.98A	3.78A
Mean B	3.40C	3.63B	3.79A	
2008 season				
No inject.	3.25G	3.40F	3.56D	3.40C
1 injection /week	3.48E	3.71C	3.89B	3.69B
2 injection /week	3.56D	3.87B	4.01A	3.81A
Mean B	3.43C	3.66B	3.82A	

Mean A: means of injecting organic solution treatments.
Mean B: means of spraying organic solution treatments.

Table (8) Effect of using different injecting and spraying organic solution treatments on N, P and K percentage of pepper plants.

N %				
2006/2007 seasons				
Treatments	no spray	spray at 7 day	spray at 15 day	Mean A
No inject.	3.50G	3.57F	3.63E	3.6C
1 injection /week	3.58F	3.65DE	3.87B	3.7B
2 injection /week	3.67D	3.78C	4.01A	3.8A
Mean B	3.58C	3.67B	3.84A	
2007/2008 seasons				
No inject.	3.79G	3.87F	3.93E	3.86C
1 injection /week	3.88F	3.95DE	4.19B	4.01B
2 injection /week	3.97D	4.09C	4.34A	4.14A
Mean B	3.88C	3.97B	4.16A	
P %				
2006/2007 seasons				
Treatments	no spray	spray at 7 day	spray at 15 day	Mean A
No inject.	0.49E	0.51D	0.52C	0.51C
1 injection /week	0.51D	0.52C	0.55B	0.53B
2 injection /week	0.52C	0.54B	0.57A	0.55A
Mean B	0.51C	0.52B	0.55A	
2007/2008 seasons				
No inject.	0.47G	0.48F	0.49E	0.48C
1 injection /week	0.48F	0.49E	0.52B	0.50B
2 injection /week	0.50D	0.51C	0.54A	0.52A
Mean B	0.49C	0.50B	0.52A	
K %				
2006/2007 seasons				
Treatments	no spray	spray at 7 day	spray at 15 day	Mean A
No inject.	3.01G	3.07E	3.12E	3.07C
1 injection /week	3.08	3.14DE	3.33B	3.18B
2 injection /week	3.16DE	3.25C	3.45A	3.29A
Mean B	3.08C	3.15B	3.30A	
2007/2008 seasons				
No inject.	3.19F	3.25E	3.30D	3.245
1 injection /week	3.26E	3.32D	3.52B	3.366
2 injection /week	3.34D	3.44C	3.65A	3.475
Mean B	3.26C	3.37B	3.49 C	

Mean A: means of injecting organic solution treatments.
Mean B: means of spraying organic solution treatments.

On the other hand, Ahmad (1994) previously reported a positive interaction between organic and mineral fertilizers, which increased the efficiency of fertilizers and thereby reduced their loss to environment.

Economic consideration:

Data in Tables (9 and 10) indicate that addition of organic solution increased the financial income. Addition of organic solution for cucumber and pepper plants increased the net income, value cost ratio and Relative increase in income (RII) during the two studied seasons. The net income of injecting and spraying organic solution treatments was higher than the net income of using only mineral fertilizer during the two tested seasons.

Table (9).Comparative analysis of various treatments for their potential to give an optimum economic yield of cucumber plants during the 2007and 2008 seasons

Treatments		Yield	Gross income	Mineral cost	Organic cost	Total cost	Net income	Value cost ratio	RII %
Inject	Spray	2007 season							
without inject.	without spray	3720	3407	780	0	780	2627.1	4.4	0.0
without inject.	once a week	4440	4067	780	48	828	3238.6	4.9	23.3
without inject.	once/ two weeks	4200	3847	780	96	876	2970.7	4.4	13.1
once a week	without spray	4080	3737	624	54	678	3058.8	5.5	16.4
once a week	once a week	4920	4506	624	104	728	3778.2	6.2	43.8
once a week	once/ two weeks	4440	4067	624	74	698	3368.6	5.8	28.2
twice a week	without spray	4564	4180	468	108	576	3603.8	7.3	37.2
twice a week	once a week	5400	4946	468	148	616	4329.8	8.0	64.8
twice a week	once/two weeks	4920	4506	468	128	596	3910.2	7.6	48.8
Treatments		2008 season							
without inject.	without spray	3480	3865	936	0	936	2928.9	4.1	0.0
without inject.	once a week	3840	4265	936	50.4	986.4	3278.3	4.3	11.9
without inject.	once/ two weeks	4200	4665	936	100.8	1036.8	3627.8	4.5	23.9
once a week	without spray	4080	4531	748.8	56.7	805.5	3725.8	5.6	27.2
once a week	once a week	4560	5064	748.8	109.2	858	4206.4	5.9	43.6
once a week	once/ two weeks	5040	5597	748.8	77.7	826.5	4771.0	6.8	62.9
twice a week	without spray	4440	4931	561.6	113.4	675	4256.1	7.3	45.3
twice a week	once a week	5280	5864	561.6	155.4	717	5147.0	8.2	75.7
twice a week	once/ two weeks	4800	5331	561.6	134.4	696	4634.9	7.7	58.2

RII: Relative increase in income

Table (10). Comparative analysis of various treatments for their potential to give an optimum economic yield of pepper plants during the 2007and 2008 seasons

Treatments		Yield	Gross income	Mineral cost	Organic cost	Total cost	Net income	Value cost ratio	RII %
		2006/2007 seasons							
Without inject.	without spray	4032	6518	1361	0	1361	5157.3	4.8	0.0
Without inject.	once a week	4116	6654	1361	92	1453	5201.1	4.6	0.8
Without inject.	once/ two weeks	4224	6829	1361	46	1407	5421.7	4.9	5.1
Once a week	without spray	4284	6926	1089	113	1202	5723.7	5.8	11.0
Once a week	once a week	4536	7333	1089	163	1252	6081.0	5.9	17.9
Once a week	once/ two weeks	4872	7876	1089	159	1248	6628.2	6.3	28.5
Twice a week	without spray	4452	7197	817	226	1043	6154.2	6.9	19.3
Twice a week	once a week	4872	7876	817	318	1135	6741.2	6.9	30.7
Twice a week	once/ two weeks	5208	8419	817	272	1089	7330.4	7.7	42.1
Treatments		2007/2008 seasons							
Without inject.	without spray	3528	5881	1633.2	0	1633.2	4247.9	3.6	0.0
Without inject.	once a week	3780	6301	1633.2	96.6	1729.8	4571.3	3.6	7.6
Without inject.	once/ two weeks	4032	6721	1633.2	48.3	1681.5	5039.7	4.0	18.6
Once a week	without spray	3948	6581	1306.8	118.65	1425.45	5155.7	4.6	21.4
Once a week	once a week	4200	7001	1306.8	171.15	1477.95	5523.3	4.7	30.0
Once a week	once/ two weeks	4452	7421	1306.8	166.95	1473.75	5947.6	5.0	40.0
Twice a week	without spray	4032	6721	980.4	237.3	1217.7	5503.5	5.5	29.6
Twice a week	once a week	4872	8121	980.4	285.6	1266	6855.5	6.4	61.4
Twice a week	once/ two weeks	4452	7421	980.4	333.9	1314.3	6107.0	5.6	43.8

RII: Relative increase in income

The highest yield, net income and relative increase in the income were more with injecting organic solution twice a week combined with spraying once a week followed by injecting twice a week combined with spraying once every two weeks for cucumber and pepper plants during the two tested seasons. The net income of using organic solution were higher in the second season due to higher mineral fertilizer during the 2007/08 season after considering the cost of organic solution used in different organic solution treatments and the save of almost 33% of mineral fertilizer costs by the integrated use of organic solution through injection twice a week. In addition to economic benefit of 40% save in mineral fertilizer, a significant favorable effect should be expected on the environment, human health, energy conservation, soil quality and health. These results agree with findings of Yaduvanshi (2003). Similarly, Roy *et al*. (2002) previously reported that 25% of the crop N requirement could be met

through farmyard manure and legume green manure, thereby reducing N fertilizer requirements by 25%. Similar results were previously reported by Hussain *et al*. (1999) who estimated a 38% saving in mineral fertilizer by the use of organic materials.

CONCLUSION

It was concluded that injecting nutrient solution derived from organic compost can be a promising technique compared to solid manure application for substitution part of inorganic by organic nutrition. Results indicated that this specific agricultural practice was successfully used in cucumber and pepper plant as vegetable crops have high nutrient demands and long vegetation season, and thus can be used also for other species. The results also showed that such practices save mineral fertilization which has potential effects on sustainable agricultural production in soils particularly those low in organic matter. In addition, the possibility of sustaining soil ecology and environment cannot be ignored. The highest concentration of NPK in plants (with both mineral and organic nutrients) demonstrated more efficient use of applied nutrients by integrated organic and inorganic fertilizers. More intensive and systematic studies are required to provide a better understanding of the usefulness of organic solution technology in making crop production a more profitable income thus generating activity for farmers.

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استبدال جزء من التسميد المعدني بالتسميد العضوي

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تـم إجـراء تجربتـان حقليتـان خـلال الموسـمين 2007/2006 و 2008/2007 بمنطقـة البوصـيلي محافظـة البحيـرة بهـدف دراسـة تـأثير استبدال جـزء مـن التسميد المعدني بمحلـول مغذي من التسميد العضوي علـى نمو وإنتاجيـة نباتـات الفلفل الحلو و الخيـار المنـزرع تحت الصوب البلاستيكية. تشتمل التجربة علـى ثـلاث معـاملات حقن الكمبوست خـلال شبكة الـري بالتنقيط (بدون ، مرة كل أسبوعياً ، مرتين أسبوعيا) و ثلاث معاملات رش بالمحلول المغذي العضـوي (بدون، مرة أسبوعيا و مرة كل أسبوعين). أشارت النتـائج إلـى أن استخدام المحلـول المغذي العضوي أدى إلى تحسين النمو الخضري و المحصول خـلال موسمي الزراعـة لكل مـن الخيـار والفلفـل. زادت صـفات النمـو الخـضري (طـول النبـات، عـدد الأوراق و مـساحة الأوراق) بزيـادة المعاملـة بـالمحلول المغـذي العـضوي. بحيـث كانـت معاملـة حقـن المحلـول المغذي العضوي مرتين الافضل تلتها معاملة حقن المحلول المغذي خلال شبكة الـري بـالتنقيط مرة واحدة أسبوعيا ، و كان اقل محصول تم الحصول عليه باستخدام المحلـول المعدني بـدون الاستبدال مع المحلول المغذي العضوي. و على الجانب الأخر استخدام المحلـول المغذي رشـا على نباتات الخيار و الفلفل أدى إلى زيادة النمو الخضري و المحصول مقارنـه بمعاملـة بـدون رش. اخيرا أشارت نتائج التحليل الاقتصادي لمعـاملات التسميد المختلفـة إلـى أن معاملـة حقن المحلول المغذى العضوي مرتين أسبوعيا مع الرش بالمحلول العضوي مرة أسبوعيا أدت إلـى تـوفير 40% مـن الـسماد المعـدني الكلـى المـضاف لنباتـات الفلفـل والخيـار خـلال موسـمي الزراعة. كما اشارت بيانات تطبيق حقن ورش السماد العضوي إلـى أن هذه المعـاملات أدت إلى تحسين كفـاءة استخدام الأسمدة المعدنيـة والعضوية. كمـا تـشير النتـائج الـى امكانيـة تقليل التلوث البيئي نتيجة لتقليل استخدام الاسمدة المعدنية.