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Effect of Using Organic Nutrient Solution on Growth and Yield of Cucumber grown in Different Substrates

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THE STUDY was conducted in the Central Laboratory for Agricultural Climate (CLAC) during 2002 and 2003 seasons. The experiment was aimed to investigate the possibility of using chicken manure-tea as an organic nutrient solution compared to the mineral nutrient solution on growth and yield of cucumber cv. "Gianco RZ" grown in different substrates mixes.

Nine substrate mixes were used in this study as follows: Perlite 100% (Pe) (control), Peat moss + perlite (1 :1 v/v) (Pt: Pe), Peat moss + sand (1 :1 v/v) (Pt: S), Peat moss + vermiculite (1:1 v/v) (Pt: V), Faba straw compost + perlite (1 :1 v/v) (FSC: Pe), Faba straw compost + sand (1 :1 v/v) (FSC:S), Rice husk compost + perlite (1 :1 v/v) (RHC: Pe), Rice husk compost + sand (1 :1 v/v) (RHC:S), Rice husk (used after soaking in water for 48 Hrs.)+Chicken manure (9 :1 v/v) (RH: ChM).

Plant length, number of leaves, total leaf area, total fresh weight of plant, chlorophyll, early and total yields were determined. The mineral analysis of leaves (N, P and K) and fruit (Pb, Ni, Co) were also measured.

The results showed that faba bean straw compost plus perlite recorded the highest values of vegetative and yield measurements. Using organic nutrient solution reduced vegetative and yield measurements comparing with using mineral nutrient solution (control). On the other hand, using mineral nutrient solution for cucumber plants grown in faba straw compost + perlite recorded the highest values of vegetative and yield characters while the lowest records were obtained plants cultivated in perlite and irrigated by organic nutrient solution.

There were significant differences among the treatments regarding plant length, number of leaves, early & total yield, chemical composition of leaves and fruits.

Keywords : Perlite, Peat moss, Rice husk, Compost, Faba bean straw, Cucumber, Bags culture, Organic nutrient solution and Inorganic nutrient solution.

Cucumber is one of the most important crops especially under protected cultivation; it can be a profitable business for progressive growers. More than seventy percent of the green houses in Egypt are cultivated by cucumber.

Over the last few years, the demand for organically grown products is rapidly increasing due to increased concern for environment and health. Hence, hydroponic procedures from different countries attempt to adapt organic practices in soilless culture as an option (Morgan, 2000a, b and Paul, 2000). In China, organic manure is widely used in substrate culture for plant production at commercial level and this technique is named as eco-organic soilless culture. This system is reported to be low cost compared to inorganic nutrient solution systems and is recommended for developing countries (Zhang, 1999 and Xing & Meng, 1999).

The interest in organic nutrient solution for use in agriculture and horticulture has grown rapidly during the last decade as reported by Merrill and Mckeon (1998). Many scientists suggest that certain liquid extractions of manures or composts "Organic Teas" at various stages of decay, can supply plants with at least four major benefits, namely a source of plant nutrients, a source of beneficial organic compounds, an ability to suppress certain plant diseases and a way to build soil structure when applied as a drench (BioCycle staff, 1996; Kai 1990 and Weltzein 1988 & 1991). Organic nutrient solution also proved to be successful in lettuce (*Lactuca sativa* L.) production in nutrient film technique (NFT) (El-Shinawy *et al.*, 1999, Abd-Elmoniem *et al.*, 2001 and Atkin & Nichols, 2004).

Although different organic nutrient sources exist for plant nutrition, poultry manure is among the most desirable natural fertilizers because of its high nutrient content (Mengel and Kirby, 2001).

The composition of nutrients in the organic tea depends on the type and freshness of the manure used. The nutrients extracted from fresh manure teas tend to be soluble salts, especially macronutrient (N, P, K, Ca, Mg, S) plus micronutrients (Fe, Zn, Mn and Cu) .

Although nutrients from more decomposed feedstock such as young or unstable compost contains some available nutrients not yet fixed in microbial biomass, but they also provide organic nutrients like sugars and amino acids, plus organic chelating agents (humic and fulvic acids) that carry the extracted micronutrients, *e.g.*, iron, zinc, manganese and copper, to plants as described by Merrill and Mckeon (1998) mentioned.

On the other hand, intensive cultivation with vigorous growth for crops like cucumber and continuous cropping inevitably leads to pest and disease problems in the soil. The accumulation of these problems may lead to a loss of yield and

eventually failure of the crop. Cropping can only continue if some form of soil sterilization is economically viable. The use of methyl bromide as a main method of disinfection method is banned in many countries (Burrage, 1999). However, alternatives to methyl bromide can also have adverse effects on human health and environment (Ozeker *et al.*, 1999).

For production to continue, there is inevitably a trend towards some forms of soilless or soil replacement cultivation. These do not, however, remove all the problems; it simply creates a new set (Burrage, 1999).

On the other hand, methyl bromide will not be permitted after few years in Egypt as a result of Monterial Environmental Agreement UNEP (2000).

Substrate culture offers a valuable alternative to crop production in soil, and has been widely adopted by specialist producers of greenhouse crops in the world, particularly for high-value crops such as cucumber and tomato (Winsor and Baudion, 1991). The properties of different materials used as growing substrates exhibit direct and indirect effects on plant growth and production (Verdonck *et al.*, 1981).

The growing medium used in the substrate culture must have good nutrient and water holding characteristics, and provide good aeration to the root system. Light weight is another important consideration so that filling bags can be easily handled. Growing media should be also free of pathogens and substances that are toxic to plant. The principal materials that meet these requirements are few (Wilson, 1983 and Johnson, 1999).

The selection of particular materials depends on its availability, cost, recycling and local experience of its use (Klougart, 1983 and Verdonck *et al.*, 1983). Soilless culture in plastic bags filled with local substrates (sand, gravel, perlite or pumice) improved vegetable production (Martinez and Abad, 1992).

Verdonck *et al.* (1981) reported that the physical and chemical properties of the different horticultural substrates can differ very much, therefore it is very important to know these properties from the beginning in order to adjust them for the different circumstances of use. The formerly used growth medias were put together to imitate the conditions, under which the plants were growing naturally.

Reis *et al.* (2001) reported that plant growth was significantly correlated with the physical and chemical properties of the substrates mainly in the mixtures and under higher level of radiation.

Perlite and pumice are substrates, which locally available in the Mediterranean region and very promising and easily adopted by growers. Pumice is a cheap alternative to other inert growing media such as rockwool or perlite. Its low water holding capacity necessitates that irrigation has to be adjusted to give frequent watering with a small amount at a time.

Bas (1991) tested different substrates (perlite, volcanic scoria, fresh rice hull, sawdust, sand, chopped wheat straw, 1:1 perlite + crumbled lignite and soil) for cucumber production in PE bags. It was reported that perlite, sand and volcanic scoria can be alternative substrates to soil.

The aim of this study was to investigate the possibility of using organic nutrient solution instead of inorganic nutrient solution for producing cucumber in substrate culture. The study also aimed to determine the best local substrate for producing cucumber.

Material and Methods

The experiment was conducted in the experimental station at the Central Laboratory for Agricultural Climate (CLAC), Agriculture Research Center (ARC), Egypt, during the autumn seasons of 2002 and 2003. Seeds of cucumber (Cucums sativus L.) Gianco F1 hybrid were sown on 15th and 20th of September 2002 and 2003, respectively, in polystyrene trays. At the fifth true leaf stage, the transplants were planted in an unheated plastic house (9 x 60 x 3.2 m) in an open system of substrate culture.

Open-topped black plastic bags (10 L) were filled with 8 L of the tested substrates. Bags were placed in double rows. The final plant spacing was 50 cm in the row, 60 cm between the rows and 70 cm in between the beds.

Two types of nutrient solution were tested in the experiment namely manure tea (organic nutrient solution) (OS) comparing with mineral nutrient solution (MS)(control).

Also, different substrate types (organic and inorganic)were tested in this experiment to figure out the best substrate mixture can be used to produce cucumber under experimental conditions and at the same time to study the ability of using local substrates in cucumber production.

The nine substrate mixes in this experiment were: perlite 100% (Pe) (control), peat moss mixed with perlite (1 :1 v/v) (Pt: Pe), peat moss mixed with sand (1 :1 v/v) (Pt: S), peat moss mixed with vermiculite (1:1 v/v) (Pt: V), faba bean straw compost mixed perlite (1 :1 v/v) (FSC: Pe), faba bean straw compost mixed with sand (1 :1 v/v) (FSC:S), rice husk compost mixed with perlite (1 :1 v/v) (RHC: Pe), rice husk compost mixed with sand (1 :1 v/v) (RHC:S) and rice husk (used after soaking in water for 48 Hrs.) mixed with chicken manure (9 :1 v/v) (RH: ChM).

The stock nutrient solutions of the chicken manure (manure-tea) were prepared by soaking 20 kg of chicken manure in water tank (100 L) for 24 hours, then diluting these stock solutions in water tank (1m^3), the EC levels reached 2.5 m.mhos^{-1}. Filtration was made before using the compost-tea to get the clear

solution for fertilizing the cucumber (El-Shinawy *et al.* 1999). Mineral nutrient solution (control) had an E.C of 2.5 m.mhos^{-1} (El-Behairy, 1994). The chemical analysis of the different nutrient solutions as adjusted by EC meter are presented in Table 1.

TABLE 1. The Chemical composition of the different nutrient solutions.

Elements	Mineral nutrient solution at 2.5 mmhos^{-1}	Organic nutrient solution at 2.5 mmhos^{-1}
Macro elements (ppm)		
N	175	136
P	45	33
K	350	380
Ca	200	89
Mg	50	25
Micro elements (ppm)		
Fe	3.0	5.2
Zn	0.25	3.1
Mn	0.75	0.45
Cu	0.15	0.50
B	0.25	0.45
Heavy metals (ppm)		
Cd	0.012	0.01
Pb	0.65	0.63
Co	0.012	0.022
Ni	0.014	0.023

The physical and chemical properties of different substrate mixtures are illustrated in Tables 2 & 3. Substrate physical properties, *i.e.*, bulk (apparent) density (B.D), total pore space (T.P.S), water hold capacity (W.H.C), fresh weight (FW), dry weight (DW), air porosity (A.P), were estimated according to Wilson (1983) and Raul (1996).

The compost heaps of faba bean straw and rice husk were made during the summer season, each heap was placed in 1.25 x 2.5 x 0.75 m^3.The first heap consisted of faba bean straw (1.8 m^3) and 0.2 m^3 chicken manure. The second heap consisted of rice husk (1.8 m^3) and 0.2 m3 of chicken manure covered by plastic sheet. The composting procedures were done according to Abd-El-Wahab (1999).

The experimental design was a split plot with 3 replicates. Each experimental plot contained 10 plants. The two sources of nutrient solution were assigned as main plots and substrates as subplots.

The fertigation was programmed to work 10 times / day and the duration of irrigation time depended upon the season.

Plant length, number of leaves, total fresh weight of plant were recorded at 15 weeks from planting. Early and total yield per plant were measured. The nutrient contents of leaves (after 9 weeks of transplanting) (N, P and K %) and fruits (Pb, Ni and Co) were determined. Total nitrogen was estimated by Kjeldahl method. Phosphorus and potassium were determined according to the methods of Chapman and Pratt (1961). Phosphorus was determined by spectrophotometer and potassium by flame photometer. The heavy metals (Cd, Pb, Co and Ni) in the fruits were determined using Phillips Unicum Atomic Absorption spectrophotometer as described by Chapman and Pratt (1961).

Crop management practices were in accordance with standard recommendations for commercial growers.

TABLE 2. The physical properties of different substrates mix

Treatment	Bulk density (g/l)	Total pores space %	Water holding capacity %	A.P %
Pe	119.8	92.3	20.1	72.2
Pt: Pe	264.4	64.4	30.97	33.47
Pt: S	662.2	37.78	32.58	5.2
Pt: V	354.3	55.56	41.21	14.34
FSC: Pe	280.9	66.67	34.29	32.38
FSC: S	862.2	42.2	18.06	24.16
RHC: Pe	224.6	81.3	21.8	69.5
RHC: S	745.3	44.2	23.7	21.5
RH: ChM	312	71.0	28.7	42.3

TABLE 3. The chemical properties of different substrates mix.

Treatment	E.C m.mhos/cm	pH	C.E.C Meq/100g	O.M %
Pe	0	7.2	2	0
Pt: Pe	0.45	7.6	74	19.8
Pt: S	0.55	7.8	38	19.0
Pt: V	1.35	7.7	115	23.8
FSC: Pe	3.25	7.6	135	27.1
FSC: S	3.3	7.7	136	27.8
RHC: Pe	2.46	7.7	49	19.6
RHC: S	2.51	7.8	53	20.1
RH: ChM	1.68	7.6	91	12.3

Results

Vegetative growth

Data presented in Table 4 showed that using organic nutrient solution significantly reduced plant length of cucumber compared with using mineral nutrient solution, in both seasons. On the other hand, using faba bean straw compost mixed with perlite significantly increased plant length followed by peat mixed with vermiculite comparing with the other studied substrates, whereas using pure perlite gave the lowest plant height. Regarding the effect of the interaction between nutrient solution type and substrate type, data showed that mineral nutrient solution plus faba bean straw compost mixed with perlite followed by mineral nutrient solution plus faba bean straw compost mixed with sand gave significantly the highest values of plant length. The lowest value was obtained by organic nutrient solution plus perlite followed by organic nutrient solution plus rice husk mixed with chicken manure during the studied seasons.

TABLE 4. Effect of nutrient solution types and substrates on plant height (cm).

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	186.0	171.3	178.67	203.0	187.7	195.33
Pt: Pe	232.3	211.0	213.50	259.0	233.3	246.17
Pt: S	242.3	207.7	225.00	258.0	240.0	249.00
Pt: V	245.0	237.0	241.00	256.3	247.3	251.83
FSC: Pe	298.0	251.3	274.67	302.7	260.7	281.67
FSC: S	264.0	219.7	241.83	277.0	237.3	257.17
RHC: Pe	239.7	212.0	225.83	272.3	233.7	253.00
RHC: S	246.3	240.0	243.17	278.7	248.3	263.50
RH:ChM	210.3	195.0	202.67	222.7	201.7	212.17
Mean	240.44	214.3		258.85	232.22	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	13.2	3.8	3.8	8.45	4.58	4.58

As for leaf number, data in Table 5 showed that using mineral nutrient solution increased leaf number of cucumber plants in comparison with organic nutrient solution. The results illustrated also that using faba bean straw compost mixed with perlite gave the highest leaf number. Whereas, using rice husk mixed with chicken manure produced the lowest leaf number during the first season while using perlite recorded the lowest in the second season. The interaction showed that mineral nutrient solution plus faba bean straw compost mixed with perlite produced the highest leaf number during the first season while the lowest records were obtained by organic nutrient solution plus perlite. Similar trend was observed in the second season.

TABLE 5. Effect of nutrient solution types and substrates on number of leaves.

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	29.33	28.33	28.83	31.0	27.7	29.33
Pt: Pe	34.00	29.67	31.84	34.0	31.0	32.50
Pt: S	33.00	27.00	30.00	33.7	31.7	32.67
Pt: V	34.67	31.00	32.84	34.0	32.0	33.00
FSC: Pe	36.00	34.33	35.17	38.0	35.3	36.67
FSC: S	29.33	29.00	29.17	38.3	36.0	37.17
RHC: Pe	35.67	25.33	30.50	34.3	33.3	33.83
RHC: S	33.33	27.00	30.17	34.7	34.7	34.67
RH: ChM	30.00	26.33	28.17	33.3	30.3	31.83
Mean	32.81	28.67		34.59	32.44	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	0.6	1.10	1.10	0.99	0.60	0.60

Similar to the previous results, using mineral nutrient solution significantly increased total leaf area of cucumber plants in comparison with using organic nutrient solution in both seasons. In addition, faba straw compost mixed with perlite gave the highest total leaf area of cucumber plants in comparison with the other substrate mix during both seasons as presented in Table 6. The lowest record was given by perlite followed by rice husk mixed with chicken manure during both seasons. The interaction showed that mineral nutrient solution plus faba bean straw compost mixed with perlite treatment gave the highest total leaf area in both seasons followed by mineral nutrient solution plus peat moss mixed with perlite treatment in the first season and mineral nutrient solution plus peat moss mixed with vermiculite treatment in the second season. The lowest values were recorded by organic nutrient solution plus perlite followed by organic nutrient solution plus rice husk mixed with chicken manure treatment in both seasons.

TABLE 6. Effect of nutrient solution types and substrates on total leaf area cm^2.

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	4891.6	3135.7	4013.64	4080.0	3587.7	3833.83
Pt: Pe	7303.5	4459.8	5881.67	5604.7	4359.8	4982.23
Pt: S	5170.1	3063.4	4116.77	5593.2	4195.9	4894.53
Pt: V	5904.8	4577.8	5241.27	5898.1	4377.8	5137.94
FSC: Pe	8280.0	7015.3	7647.67	6156.0	5723.0	5939.50
FSC: S	4213.1	4195.4	4204.29	5542.7	4849.8	5196.22
RHC: Pe	7085.9	4897.7	5991.80	5366.7	5089.3	5227.99
RHC: S	6289.0	4372.4	5330.69	5667.3	5051.7	5359.50
RH:ChM	5049.9	3151.3	4100.61	4299.7	3911.3	4105.49
Mean	6020.9	4318.75		5356.4	4571.8	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	54.40	183.30	183.30	97.42	81.76	81.76

Data presented in Table 7 show the effect of different types of nutrient solution, different substrates and their interaction on chlorophyll reading (Spad) of cucumber leaves. Chlorophyll was significantly reduced when organic solution was used compared with using mineral nutrient solution in both season. On the other hand, using faba bean straw compost mixed with sand increased chlorophyll followed by faba bean straw mixed with perlite treatment compared with using the other studied substrate, while using perlite gave the lowest chlorophyll reading. The interaction indicated that the highest chlorophyll reading was obtained by mineral nutrient solution plus faba bean straw mixed with sand followed by mineral nutrient solution plus faba bean straw compost treatment. The lowest reading was obtained by organic nutrient solution plus perlite.

TABLE 7. Effect of nutrient solution types and substrates on chlorophyll content (Spad).

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	30.3	29.4	29.88	30.9	30.8	30.85
Pt: Pe	32.5	31.3	31.88	32.8	31.8	32.32
Pt: S	32.7	31.6	32.18	33.9	34.0	33.93
Pt: V	33.0	31.9	32.45	36.2	33.4	34.82
FSC: Pe	34.8	33.2	33.98	36.9	35.6	36.25
FSC: S	35.2	33.9	34.58	37.5	36.7	37.07
RHC: Pe	33.7	32.5	33.08	33.9	33.9	33.93
RHC: S	33.7	33.2	33.45	34.8	33.7	34.25
RH: ChM	30.5	29.8	30.13	32.1	30.8	31.47
Mean	32.94	31.87		34.33	33.42	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	0.21	0.29	0.29	0.68	0.50	0.50

Yield

Using inorganic nutrient solution increased early and total yield of cucumber in comparison with using organic nutrient solution as illustrated in Tables 8&9.

Data showed that using faba bean straw compost mixed with perlite gave the highest early and total yields, followed by peat moss mixed with sand in the first season and faba bean straw compost mixed with sand treatment in the second season. The lowest early and total yield was obtained by using perlite in both seasons.

Concerning the interaction effect between the different nutrient solution sources and substrates, data showed that the highest early and total yield were recorded by mineral nutrient solution plus faba bean straw compost mixed with perlite followed by mineral nutrient solution plus faba bean straw compost mixed with sand then by mineral nutrient solution plus peat moss mixed with sand in the first season. The highest early and total yield in the second season was obtained mineral nutrient solution plus faba bean straw compost mixed with perlite

followed by mineral nutrient solution plus peat moss mixed with sand then by mineral nutrient solution plus faba bean straw compost mixed with sand. The lowest early and total yield were obtained by organic nutrient solution plus perlite treatment followed by organic nutrient solution plus rice husk mixed with chicken manure in both seasons. The differences among the mentioned treatments and the other treatments were significant.

TABLE 8. Effect of nutrient solution types and substrates on cucumber early yield.

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	417.18	378.30	397.74	454.57	397.67	426.12
Pt: Pe	602.07	505.34	553.70	614.47	535.37	574.92
Pt: S	647.70	542.82	595.26	639.00	553.00	596.00
Pt: V	552.03	479.52	515.78	620.67	532.67	576.67
FSC: Pe	688.77	598.36	643.57	704.20	626.00	665.10
FSC: S	630.62	569.97	600.30	664.63	586.33	625.48
RHC: Pe	601.13	544.74	572.94	622.00	570.67	596.33
RHC: S	429.59	423.29	426.44	611.00	535.67	573.33
RH: ChM	415.93	377.94	396.94	500.00	423.33	461.67
Mean	528.97	603.39		553.89	491.14	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	40.85	13.84	16.25	15.76	9.03	12.32

TABLE 9. Effect of nutrient solution types and substrates on cucumber total yield.

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	1668.70	1513.22	1590.96	1818.27	1590.67	1704.47
Pt: Pe	2408.27	2021.37	2214.82	2457.87	2141.47	2299.67
Pt: S	2590.82	2171.28	2381.05	2556.00	2212.00	2384.00
Pt: V	2208.11	1918.10	2063.10	2482.67	2130.67	2306.67
FSC: Pe	2755.09	2393.45	2574.27	2816.80	2504.00	2660.40
FSC: S	2522.50	2279.89	2401.19	2658.53	2345.33	2501.93
RHC: Pe	2404.53	2178.95	2291.74	2488.00	2282.67	2385.33
RHC: S	1718.36	1693.14	1705.75	2444.00	2142.67	2293.33
RH: ChM	1663.73	1511.75	1587.74	2000.00	1693.33	1846.67
Mean	1964.57	2215.57		2413.57	2115.87	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	76.42	55.37	87.21	63.05	36.11	48.25

Chemical composition

Nitrogen, phosphorus and potassium % in cucumber leaves

Table 10 showed that using inorganic nutrient solution led to a significant increase of N % in cucumber leaves compared to organic nutrient solution. In addition, perlite, peat moss mixed with sand and faba bean straw compost mixed with perlite treatments gave the highest N % in the leaves comparing with the other treatments. The interaction indicated that using mineral nutrient solution plus peat moss mixed with sand treatment recorded the highest N % followed by mineral nutrient solution plus faba bean straw compost mixed with perlite treatment. On the other hand, using organic nutrient solution plus rice husk mixed with chicken manure treatment followed by organic nutrient solution plus peat moss mixed with sand treatment gave the lowest values in the first season while using organic nutrient solution plus faba bean straw compost mixed with sand gave the lowest values in the second season.

TABLE 10. Effect of nutrient solution types and substrates on leaves content of N (%).

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	2.92	3.36	3.14	3.27	3.52	3.39
Pt: Pe	2.88	3.05	2.96	3.03	2.96	3.00
Pt: S	2.01	4.55	3.28	2.13	4.79	3.46
Pt: V	2.78	3.43	3.11	2.55	3.49	3.02
FSC: Pe	2.77	3.90	3.33	2.57	3.90	3.24
FSC: S	2.03	3.43	2.73	1.86	3.73	2.79
RHC: Pe	2.52	3.06	2.79	2.98	3.10	3.04
RHC: S	2.80	3.21	3.00	2.82	3.24	3.03
RH: ChM	1.71	2.45	2.08	1.70	2.22	1.96
Mean	2.49	3.38		2.54	3.44	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	0.277	0.404	0.404	0.181	0.187	0.187

Concerning P %, using organic nutrient solution had a positive effect on the P% in cucumber leaves comparing with inorganic nutrient solution as illustrated in Table 11. The application of organic nutrient solution to perlite and faba bean straw compost mixed with perlite treatments recorded the highest value of P% in the leaves whereas rice husk mixed with chicken manure treatment gave the lowest one. The interaction effect showed that using organic nutrient solution plus peat moss mixed with sand gave the highest P% in the leaves followed by organic nutrient solution plus perlite in the first season while in the second season the highest results were recorded by organic nutrient solution plus peat moss mixed with vermiculite followed by organic nutrient solution plus perlite. The lowest values were recorded by mineral nutrient solution plus rice husk mixed with chicken manure in both seasons.

On the contrary, K % in cucumber leaves was increased using mineral nutrient solution comparing with using organic nutrient solution. The difference between both treatments was significant in both seasons.

TABLE 11. Effect of nutrient solution types and substrates on leaves content of P (%).

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	0.94	1.01	0.97	1.02	1.00	1.01
Pt: Pe	0.57	0.90	0.74	0.58	0.98	0.78
Pt: S	0.63	1.03	0.83	0.56	1.06	0.81
Pt: V	0.57	0.98	0.78	0.58	0.99	0.78
FSC: Pe	0.95	0.93	0.94	1.03	0.98	1.01
FSC: S	0.78	0.74	0.76	0.92	0.80	0.86
RHC: Pe	0.72	0.68	0.70	0.83	0.82	0.83
RHC: S	0.74	0.72	0.73	0.79	0.82	0.81
RH: ChM	0.45	0.82	0.63	0.45	0.75	0.60
Mean	0.71	0.87		0.75	0.91	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	0.084	0.12	0.12	0.079	0.053	0.053

Regarding to the effect of substrate, data showed that peat moss mixed with vermiculate treatment followed by perlite treatments gave the highest K % in cucumber leaves significantly comparing with the other treatments in both seasons. The lowest values in the first season were recorded by faba bean straw compost mixed with perlite and faba bean straw compost mixed with chicken manure treatments while in the second season rice husk compost mixed with perlite treatment followed by faba bean straw compost mixed with perlite gave the lowest K% in the leaves. The interaction effect illustrated that the highest K% was obtained using organic nutrient solution followed by mineral nutrient solution plus peat moss mixed with vermiculite treatment. The lowest K% was obtained by mineral nutrient solution plus rice husk mixed with chicken manure, as presented in Table 12.

Heavy metal concentration in cucumber fruits

Data showed that using mineral nutrient solution increased Pb concentration in cucumber fruits compared to inorganic organic nutrient solution. Table 13. The obtained data showed also that using rice husk compost mixed sand treatment and rice husk mixed with chicken manure treatments gave the highest Pb concentration in the fruits while the lowest values were recorded by faba bean straw compost mixed with sand and perlite treatments. The interaction showed that using organic nutrient solution plus rice husk mixed with chicken manure treatment recorded the highest value in both seasons. On the other hand, the lowest value was recorded by organic nutrient solution plus either faba bean straw compost mixed with sand and perlite treatments in both seasons.

TABLE 12. Effect of nutrient solution types and substrates on leaves content of K (%).

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	3.79	4.58	4.18	3.39	4.66	4.02
Pt: Pe	3.89	2.74	3.32	4.01	2.94	3.47
Pt: S	4.57	3.36	3.97	4.32	3.37	3.85
Pt: V	4.64	4.95	4.80	4.75	5.00	4.87
FSC: Pe	3.56	2.67	3.11	3.58	2.81	3.20
FSC: S	3.60	2.80	3.20	3.70	2.86	3.28
RHC: Pe	3.66	2.98	3.32	3.76	2.53	3.14
RHC: S	3.18	3.36	3.27	3.20	3.44	3.32
RH: ChM	2.62	3.61	3.11	2.64	3.81	3.23
Mean	3.72	3.45		3.71	3.49	
LSD at 5 %	Nut. sources	Substrates	interaction	Nut. sources	Substrates	Interaction
	0.634	0.33	0.33	0.362	0.125	0.125

TABLE 13. Effect of nutrient solution types and substrates on fruit content of Pb (ppm).

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	5.77	5.77	5.77	5.51	5.51	5.51
Pt: Pe	9.62	9.62	9.62	9.34	9.35	9.35
Pt: S	5.77	9.62	7.69	5.85	6.24	6.04
Pt: V	13.46	5.77	9.62	11.70	6.80	10.25
FSC: Pe	13.46	3.85	8.65	10.20	4.82	9.01
FSC: S	7.69	3.85	5.77	7.87	4.47	6.17
RHC: Pe	11.54	5.77	8.65	11.57	6.45	9.01
RHC: S	9.62	13.46	11.54	9.87	13.84	11.86
RH: ChM	10.77	15.38	10.58	9.91	14.77	12.34
Mean	9.81	8.03		9.00	8.21	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	0.927	0.642	0.642	0.748	0.761	0.761

As for Co, Table 14 illustrated that there was no significant effect for the nutrient solution sources on Co concentration in cucumber fruits in both seasons. Also, data showed that the highest values were obtained by rice husk mixed with chicken manure substrate treatment while the lowest value was recorded in perlite treatment, in both seasons. The interaction indicated that the highest Co concentration was recorded by organic nutrient solution plus rice husk mixed with chicken manure treatment. On the other hand, mineral nutrient solution plus perlite and organic nutrient solution plus perlite treatments gave the lowest concentrations.

TABLE 14. Effect of nutrient solution types and substrates on fruit content of Co (ppm).

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	0.00	0.00	0.00	0.56	0.56	0.56
Pt: Pe	1.04	0.52	0.78	1.11	0.56	0.83
Pt: S	1.04	1.04	1.04	1.11	1.67	1.39
Pt: V	1.04	1.56	1.30	1.67	1.11	1.39
FSC: Pe	1.56	1.04	1.30	1.67	1.67	1.67
FSC: S	1.56	1.56	1.56	0.72	1.11	0.92
RHC: Pe	0.00	1.04	0.52	0.72	1.11	0.92
RHC: S	0.52	1.04	0.78	0.92	2.22	1.57
RH:ChM	1.04	2.08	1.56	1.47	2.08	1.78
Mean	1.04	1.1		1.10	1.34	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	N.S	0.642	0.642	N.S	0.363	0.363

Concerning Ni, using organic nutrient solution had a reduction effect on Ni in cucumber fruit in comparison with using inorganic nutrient solution. The significant difference was true in the second season only. Regarding the effect of substrate, data illustrated that using perlite, peat moss mixed with sand, faba bean straw compost mixed with perlite and rice husk mixed with chicken manure treatments recorded zero value in the first season while in the second season, the lowest record was obtained by perlite treatment. The highest values were recorded by rice husk compost mixed with sand. The interaction indicated that many treatments recorded zero values of Ni concentrations in cucumber fruits in both seasons as presented in Table 15.

TABLE 15. Effect of nutrient solution types and substrates on fruit content of Ni (ppm).

Substrate	First season			Second season		
	MS	OS	Mean	MS	OS	Mean
Pe	0.00	0.00	0.00	0.00	0.00	0.00
Pt: Pe	0.00	1.04	0.52	0.00	0.38	0.19
Pt: S	0.00	0.00	0.00	0.19	0.00	0.09
Pt: V	1.04	0.00	0.52	1.14	0.00	0.57
FSC: Pe	0.00	0.00	0.00	0.56	0.00	0.28
FSC: S	1.04	0.00	0.52	1.14	0.00	0.57
RHC: Pe	1.04	0.00	0.52	1.14	0.00	0.57
RHC: S	0.00	1.04	0.52	0.57	1.14	0.85
RH:ChM	0.00	0.00	0.00	0.75	0.00	0.38
Mean	0.35	0.23		0.61	0.17	
LSD at 5 %	Nut. sources	Substrates	Interaction	Nut. sources	Substrates	Interaction
	N.S	N.S	N.S	0.455	0.33	0.33

Discussion

From the overall results it is clear that using organic nutrient solution reduced early and total yield significantly. This is could be a result of the vegetative growth reduction obtained in the work. These results agree with those of Abou-El-Hassan *et al.* (2002), Abou-El-Hassan (2003) and Mohamed (2005).

The reduction of the vegetative growth resulted from using organic nutrient solution could be a result of that the plants preferably take up mineral nutrients dissolved in the water, which are easily accessible to the roots as mentioned by Gull *et al.*, (2007) and Mengel & 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. They also reported that the amount of nutrient which contacts directly with the plant root is rather small within the overall nutrient demand. Therefore, the transportation of nutrients towards the rhizosphere and root surface by mass flow and diffusion are more important than interception.

Smith and Hadley (1989) and Abou – Hassan *et al.* (2008) reported that the reduction of vegetative growth early and total yield was due to that the available N in the organic nutrient solutions was mainly as NH_4 and little as NO_3 comparing with the inorganic fertilizers where N was mainly as NO_3 where the plants prefer the nitrogen source of NO_3

On the other hand, data showed that using faba straw compost mixed with perlite or sand gave the highest vegetative growth, early and total yield comparing with the other substrate treatments. This could be a result of the optimum physical and chemical properties for the cucumber (Tables 2 and 3) where the ratio between water holding capacity and total pore space are 0.51 and 0.43 in both substrates, respectively, comparing with 0.21 and 0.40 in perlite and rice husk mixed with chicken manure treatments, respectively. Although the rice husk mixed with manure treatment has the ratio mostly like faba bean straw compost mixed with sand treatment but the CEC and OM % in this substrate was low comparing with faba bean straw compost mixed with perlite and faba bean straw compost mixed with sand treatments. These physical and chemical properties gave a good supply of air, water and nutrients for cucumber plants which reacted on vegetative growth, early and total yield. Verdonck *et al.* (1981) reported that the physical and chemical properties of the different horticultural substrates can differ very much, therefore it is very important to know these properties from the beginning in order to adjust them for the different circumstances of use. The formerly used growth media were put together to imitate the conditions, under which the plants were growing naturally.

Reis *et al.* (1998) reported that plant growth was significantly correlated with the physical and chemical properties of the substrates mainly in the mixtures and under higher level of radiation. Mohy El-Din (1997) reported that addition of organic waste significantly increased the yield of cucumber fruits through autumn and spring seasons at the early and final growth stages. Alphonse and Saad (2000) reported that

applying organic manure to growing media of cucumber plant significantly increased plant length, number of leaves and fresh weight.

Conclusion

It could be concluded that the using of chemical nutrient solution gave the best results in vegetative growth and yield but using manure-tea as a nutrient solution is more save for low heavy metal content of fruit. On the other hand, using faba bean straw compost mixed with perlite and faba bean straw compost mixed with sand could be used as good substrates for cucumber production. Many studies are needed to continue this work, in case of investigating the effect of handling and using the chicken manure and its manure-tea on the public health of growers and consumers for microorganism and microbes. However, local substrates and compost need more work to turn the plant wastes to compost or substrate and studying the possibilities of using them.

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تأثير إستخدام المحلول المغذى العضوى على نمو ومحصول الخيار النامى فى بيئات مختلفة

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تم اجراء التجربة فى الموقع البحثى الخاص بالمعمل المركزى للمناخ الزراعى خلال موسمى ٢٠٠٢و ٢٠٠٣ تهدف التجربة إلى دراسة إمكانية إستخدام منقوع سماد الدواجن كمحلول مغذى عضوى مقارنة بالمحلول المغذى المعدنى عند تركيز ٢و٥ ملليموز على إنتاجية ونمو الخيار النامى فى مخاليط مختلفة من البيئات تم إستخدام تسعة خلطات من البيئات وهى كالتالى :

البرليت (المقارنة) ، البيت موس مع البرليت (١:١ حجم / حجم) ، البيت موس مع الرمل (١:١ حجم/حجم) ، البيت موس مع الفيروموكيوليت (١:١ حجم /حجم)، كمبوست قش الفول مع البرليت (١:١ حجم/حجم)، كمبوست قش الفول مع الرمل (١:١ حجم /حجم) ، كمبوست سرس الأرز مع الرمل (١:١ حجم/حجم) بالإضافة الى سرس الأرزبعد نقعه فى الماء لمدة ٤٨ ساعة مع سماد الدواجن (١:٩ حجم/حجم). وقد تم قياس طول النبات ، عدد الأوراق ، المساحة الكلية للأوراق ، الوزن الطازج للنبات ، المحتوى من الكلورفيل ، المحصول المبكر والكلى بالإضافة إلى قياس النسبة المئوية للنتروجين ، الفوسفور ، البوتاسيوم ، الكالسيوم والماغنسيوم فى الأوراق. وقد أوضحت النتائج ان استخدام كمبوست قش الفول مع البرليت أدى إلى الحصول على أعلى قيم للقياسات الخضرية والمحصول. وأدى إستخدام المحلول المغذى العضوى إلى انخفاض القياسات الخضرية والمحصول مقارنة بإستخدام المحلول المغذى المعدنى (المقارنة) ومن ناحية أخرى أدى إستخدام المحلول المغذى المعدنى لنباتات الخيار النامية فى خليط كمبوست قش الفول مع البرليت (١:١ حجم/حجم) إلى تسجيل أعلى قياسات للنمو الخضرى والمحصول بينما أدى إستخدام المحلول المغذى العضوى لنباتات الخيار النامية فى بيئة البرليت إلى الحصول على أقل قياسات للنمو الخضرى والمحصول .