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GROWTH, YIELD AND CHEMICAL COMPOSITION OF CUCUMBER AS AFFECTED BY USING COMPOST TEA UNDER NUTRIENT FILM TECHNIQUE

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ABSTRACT

In this study an experiment was carried out in plastic house of Soils and Water Department, Faculty of Agriculture, Al-Azhar University (Nasr city, Cairo, Egypt) during successful autumn season of 2010.This study aims to investigate the possibility of using different sources of compost tea (extracted from both chicken manure and El-Obour compost) as organic nutrient supply for producing cucumber yield (*Cucums sativus L.*), cv. USHUAIA HYBRID (DP162) F1 comparing with inorganic Hoagland nutrient solution (control) under Nutrient Film Technique (NFT).The electrical conductivity of the all nutrient solutions was kept at 2.5 dS/m while pH was in the range of 5.5 and 6.5.

The highest vegetative growth parameters (plant height, number of leaves, chlorophyll reading, total fresh and dry weights) and total yield of cucumber plants were observed with inorganic nutrient solution followed by chicken compost tea followed by El-Obour compost tea. Concerning, fruits quality, the highest values of vitamin C content in the fruits were obtained with chicken compost tea followed by El-Obour compost tea and finally Hoagland nutrient solution whereas, titratable acidity in fruits did not reached to a significant level under different sources of solutions. On the contrary, applying Hoagland nutrient solution gave the highest values of nitrate content in cucumber fruits whereas, the lowest values of nitrate content were obtained with El-Obour compost tea followed by chicken compost tea . The highest values of calcium content, average fruit firmness and the lowest percentage of fruit weight loss after harvesting were found with Hoagland nutrient solution, respectively. While, the lowest values of calcium content, average fruit firmness and the highest percentage of fruit weight loss after harvesting were found with El-obour compost tea followed by chicken compost tea, respectively.

This study suggested the possibility of using chicken compost tea and El-obour compost tea as safe feeding sources of organic nutrient solutions under Nutrient Film Technique (NFT).The relatively reduction in the yield can be acceptable if we take into consideration the safe use of the fruits due to low content of nitrate and heavy metals and the high content of vitamin C as well as environmental safety to benefit from these residue.

INTRODUCTION

Organic agriculture is often characterized as a natural way of farming, mostly referring to the absence of synthetic chemical inputs, such as chemical fertilizers, herbicides, and pesticides. Organic agriculture is rapidly growing all over the world and has gained a worldwide reputation during the last 20 years as a new environmentally, socially and economically sound production system. This concept is now fully integrated in the agricultural systems of many developed and undeveloped countries (Hanafi and Kenny, 2001). Compost applications are a commonly used practice in agriculture; however the concept of compost tea is becoming increasingly popular in organic agriculture. The compost tea simply is defined as water extract of compost that is actually brewed and contains soluble nutrients and a diversity of microorganisms such as bacteria and fungi (Ingham, 2005). It's made by adding small amounts of mature compost to water for a definite periods where, the extracted nutrient elements and humic acid will be ready after 1-2 days (Cantisano, 1994). The use of compost tea as an organic source of nutrient solution in agriculture and horticulture has grown rapidly during the last decade.

Nutrient film technique (NFT) can be used to overcome the problems of soil nutrient supply where, plants directly grow in the nutrient solution, so it did not need any disinfection. Under Egyptian conditions, NFT produced higher yield in shorter time when compared with conventional cultivation. As well as, the cost of production by the NFT is similarly to the soil gown crops (Abou-Hadid *et al*., 1989).

Recently, production of vegetables with organic fertilization is very important for human health, environment and exportation. In the near future, most of exported vegetable will be the safety production. Using organic fertilizer for vegetable production is growing now in Egypt to cover the increment requests of Egyptian and European markets where, the consumers are willing to pay higher price for healthy and safety product.

So that the use of NFT with organic nutrient solution will be very important in the near future for environment and human health, while the use inorganic nutrient solution lead to produce vegetables that contains high levels of nitrate which, is hazard for human health (Hill, 1990). For these reasons, the aim of this study is to investigate the possibility of using different sources of compost tea as organic nutrient solutions for producing cucumber yield under Nutrient Film Technique (NFT).

MATERIALS AND METHODS

This study aims to investigate the possibility of using different sources of compost tea as organic nutrient supply for producing cucumber yield. The growth and yield quality as affected by using of this Nutrient Film Technique (NFT) was also taken into consideration. However, the use of this technique (NFT) aim to avoid or reduce inorganic fertilization that used in large scale in Egyptian agriculture speciality with high prices. Also, the use of (NFT) technique for organic nutrient supply lead to produce safe and healthy food for human. Here, the inorganic nutrient solution was used as comparison treatment (control). Based on the above reason an experiment was carried out in plastic house of Soils and Water Department, Faculty of Agriculture, Al-Azhar University, Nasr city, Cairo, Egypt.

The seedlings of cucumber received from Central Laboratory for Agriculture Climate (CLAC) were transplanted on the first week of October 2010 in bags (10 cm diameter x 15 cm length) filled with perlite, where the seeds were germinated on the last week of September in foam trays contain peat moss mixed with vermiculite (1:1 v/v). One plant was planted in each bag. The bags were placed in tubes from plastic (PVC**)**, which rises from the ground a distance of 50 cm and supported by the pot rims in tubes of plastic (PVC). The final plant spacing in the tube was 50 cm, while the distance between the tubes was 40 cm.

The used of Nutrient Film Technique consists tubes from plastic (PVC), nutrient solution tank 50 liter (one tank for every tube) and submersible pumps (40 W) to pump the nutrient solution to the upper end of the plastic tube with slop (1.5%).Two organic nutrient solutions that extracted from both chicken manure and El-Obour compost were used as the main treatments, while Hoagland nutrient solution with ionic strength of 1.25 was used as inorganic comparison treatment (control).The electrical conductivity of the all nutrient solutions was kept at 2.5 dSm^{-1}, while pH was in the range of 5.5 and 6.5. Four salts were used to prepare Hoagland nutrient solution as follows: calcium nitrate, potassium nitrate, potassium mono phosphate and magnesium sulphate. Micronutrients were included according to Hoagland and Arnon (1950).

The composting tea was prepared from either chicken manure as natural source or El-Obour compost as artificial source. C/N ratio for either sources was 9.69 and 13.33 respectively.The organic solutions were prepared by soaking 2.5 and 3 kg from chicken manure and El-Obour compost, respectively with 20 litter of water in water tank with aeration and continuous stirring for 24 hours, the suspensions were filtrated and the net filtrated was supplemented up to 50 litter in water tank. EC level reached 2.5 dS/m for two sources of organic filtrate.

Total nitrogen, total phosphorous and total potassium were determined according to the procedure described by FAO (1989), Watanabe and Olsen (1965) and Chapman and Pratt (1961), respectively.

The supernatant humic substances was isolated by centrifugation for 20 minutes at 6000 rpm. The humic substances were fractionated by acidification of the supernatants to pH 1.5 with 1.0 *N* HCl. The acidic solution was left overnight. The acid-soluble fraction was the fulvic acid, whereas the acid-insoluble fraction was the humic acid. The fulvic acid was separated from the humic acid by centrifugation of acid solution at 6000 rpm for 20 minutes (Kononova, 1966).

Table1: The chemical composition of the used nutrient solutions.

Elements	Hoagland nutrient solution	Chicken compost tea	El-Obour compost tea
Macronutrients (mmol/L)			
N	18.00	14.00	9.50
P	1.25	1.20	1.10
K	7.50	4.75	3.50
Ca	7.31	4.50	3.25
Mg	2.50	1.75	1.50
Micronutrients (µ mol/L)			
Fe	22.00	69.00	7.00
Mn	11.00	40.00	36.00
Zn	1.00	24.50	23.00
Cu	0.50	10.00	7.00
Humic substances (ppm)			
Humic acid	-	80	45
Fulvic acid	-	120	90

The nutrient solutions were completely renewed every one week. After two, four, six, eight, ten, twelve and fourteen weeks from transplanting, plant height (cm), number of leaves/plant and chlorophyll reading in fifth mature leaf from the top using chlorophyll meter (Spad-501, Minolta Co., Japan) were recorded .

On the other hand, after two, four and six weeks (up to pollination and young fruit stage) from transplanting, one plant was taken to determine the total fresh and total dry weight. The total yield recorded as g/plant. Fruit quality including physical and chemical properties were determined at 8 weeks after transplanting and measured as follows:

Physical properties:

a- Average number of fruit / plant

b- Average fruit weight (g/plant)

c- Dry matter percentage of fruit

d- Average fruit firmness (Kg/cm^2) was measured by Ballouf Pressure Tester.

e- The percentage of fruit weight loss was determined at room temperature for nine days after harvesting.

Chemical properties:

a- Vitamin C was determined in fruit juice as described in AOAC (1990) and expressed as mg/100g.

b- Titratable acidity was determined in fruit juice as (%) according to AOAC (1990).

c- Nitrate content in fruits was determined as ppm where, nitrate content in the fruits was extracted from the samples by 0.04 N $CuSO_4.5H_2O$ then determined by the Brucine method reported by Holty and Potworowski (1972).

d- Calcium and heavy metals (Cd, Pb, Co and Ni) in the fruits were determined using atomic absorption spectrophotometer as described by Chapman and Pratt (1961).

All fruit samples were dried at 70 $^{\circ}$C for 72 h, before analysis the samples were re-dried overnight at 70^{o}C. Samples were digested in the sulphuric acid and hydrogen peroxide digestion according to the method described by FAO Soil Bulletin (1989).The experiment was arranged in a completely randomized block design. Statistical analysis was carried out by MSTATC and comparison of means was made using Duncan's multiple range test.

RESULTS AND DISCUSSION

Vegetative growth of cucumber plant as affected by different sources of composting tea and inorganic nutrient supply

The results of vegetative growth parameters of cucumber plant including plant height, number of leaves and chlorophyll reading as affected different sources of organic and inorganic nutrient solution are presented in Table 2. At the first growth stage (after two weeks from transplanting), there were no significant differences among different sources of nutrient solution (organic and inorganic) on plant height and number of leaves, but there were a significant differences between different sources of nutrient solution on chlorophyll reading of leaves. Where, the highest value of chlorophyll reading of leaves was obtained with Hoagland nutrient solution followed by chicken compost tea while, the lowest values were recorded with El-obour compost tea. At the following growth stages (after four, six, eight, ten, twelve and fourteen weeks from transplanting) Hoagland nutrient solution gave the highest values of plant height, number of leaves and chlorophyll reading of leaves followed by chicken compost tea and finally El-obour compost tea. These results were based on the variation in the compositions of nutrient solution that led to variation in growth parameters and yield of cucumber plant. So that, Hoagland nutrient solution had the best results for vegetative growth characters of cucumber plant followed by chicken compost tea while, El-obour compost tea recorded the lowest results.

On the other hand, it remarked that the highest values of chlorophyll reading in leaves of cucumber were recorded during the first six weeks from transplanting after that chlorophyll readings were progressively decreased at the begging of small fruits stage, until it reaches the lowest values at 14 weeks after transplanting. This was true for both sources of nutrient solution (organic or inorganic). This may be due to the fruit is the main nutrients consumer at these stages. These results agree with those of Abd-El-Kawy (2003). Data in Table 3 represent the effect of different sources of nutrient solution (organic or inorganic) on total fresh and dry weights of cucumber plants up to six weeks (up to pollination and young fruit stage) from transplanting. At all vegetative growth stages, there were a significant differences among all different sources of nutrient solution on total fresh and dry weights of cucumber plants. The highest values of both total fresh and dry weights of cucumber plants were recorded with Hoagland nutrient solution (control) followed by chicken compost tea while, the lowest values were recorded with El-obour compost tea. it may be worth to mention that, water soluble organic substances (fulvic and humic acids) especially fulvic acid relatively lead to increase the absorptions of nutrients by plant roots. Where, fulvic acid is known to be surface active, cause an increase the permeability of root membranes and so enhanced nutrient uptake. Additional plausible explanations for the activity of fulvic acid are that it contains structures that act like hormones (Rauthan and Schnitzer, 1981).

Table 2: Effect of different sources of nutrient solution on plant height (cm),number of leaves and chlorophyll readings (Spad) of cucumber plants under NFT technique.

Treatments	Plant height (cm)						
	Weeks after transplanting						
	2	4	6	8	10	12	14
Hoagland nutrient solution	49.40[ns]	107.00[a]	150.50[a]	186.50[a]	206.20[a]	228.00[a]	242.00[a]
Chicken compost tea	48.70[ns]	95.00[b]	133.00[b]	171.00[b]	192.50[b]	208.00[b]	219.00[b]
El-obour compost tea	48.50[ns]	83.50[c]	116.00[c]	156.00[c]	178.50[c]	190.00[c]	198.00[c]
Number of leaves							
Hoagland n utrient solution	10.00[ns]	17.00[a]	25.00[a]	30.00[a]	33.00[a]	35.00[a]	37.00[a]
Chicken compost tea	9.00[ns]	14.00[b]	20.00[b]	25.00[b]	26.00[b]	28.00[b]	30.00[b]
El-obour compost tea	9.00[ns]	11.00[c]	14.00[c]	17.00[c]	20.00[c]	21.00[c]	22.00[c]
Chlorophyll readings (Spad)							
Hoagland nutrient solution	30.80[a]	43.10[a]	46.70[a]	44.50[a]	42.25[a]	37.66[a]	34.50[a]
Chicken compost tea	26.80[b]	36.70[b]	42.85[b]	40.17[b]	36.75[b]	33.51[b]	29.80[b]
El-obour compost tea	24.00[c]	34.20[c]	36.30[c]	34.28[c]	32.75[c]	29.00[c]	27.35[c]

Means followed by different letters in each column are significantly different at 5 % level

Table 3: Effect of different sources of nutrient solution on total fresh and dry weights of cucumber plants (g plant^{-1}) under NFT technique.

Treatments	Total fresh weight			Total dry weight		
	Weeks after transplanting			Weeks after transplanting		
	2	4	6	2	4	6
Hoagland nutrient solution	42.30[a]	92.32[a]	159.13[a]	7.48[a]	17.40[a]	33.60[a]
Chicken compost tea	35.09[b]	66.87[b]	118.40[b]	6.31[b]	13.85[b]	26.00[b]
El-obour compost tea	24.17[c]	48.70[c]	85.90[c]	4.93[c]	9.90[c]	17.75[c]

Based on the aforementioned results it noticed that, the use of inorganic Hoagland nutrient solution (control) gave superiority effect on vegetative growth of cucumber plants expressed as plant height, number of leaves, chlorophyll reading, total fresh and dry weights followed by chicken compost tea while, the lowest values were recorded with El-obour compost tea. This results could be attributed to the released N from organic source of fertilizer mainly as NH_4 and little as NO_3 while, the released N from inorganic source of fertilizer is mainly as NO_3 as mentioned by Smith and Hadley (1989). On the other hand, Kirkby and Mengel (1967) and Abd-El-Moniem *et al.,* (1997) found that, N supplied in the form of NO_3 is frequently much more effective on the plant growth than NH_4 form. Similar findings were found by Abd-El-Aziz (2003), he mentioned that using compost tea of organic manure as organic nutrient solution reduced vegetative growth of cantaloupe plants under nutrient film technique (NFT) comparing with inorganic nutrient solution.

Yield

The data in Table 4 show that, the use of El-obour compost tea gave the lowest values of both total and early yield of cucumber (950 and 237.50 g plant^{-1}) comparing with those obtained by either of chicken compost tea or Hoagland nutrient solution. While, Hoagland nutrient solution gave the highest values of total and early yield (1750 and 437.50 g plant^{-1}) followed by chicken compost tea (1415 and 353.75 g plant^{-1}). The difference between these treatments were high significant. This superiority for inorganic nutrient solution may be due to its high concentration of macro and micronutrients. These results were agreement with Abou-El-Hassan *et al.* (2008), they reported that using inorganic nutrient solution gave the highest total yield of cantaloupe under nutrient film technique when compared with compost tea as organic source of nutrient solution. Similar trends were obtained with strawberry crop by El-Behairy *et al.* (2008).

Fruit quality

Physical properties

With regard to physical properties of cucumber plant (average number of fruits/plant, average fruit weight, dry matter percentage and average fruit firmness) as affected by different sources of nutrient solution (organic or inorganic) it noticed that, the same trend of both early and total yield was obtained. Where, Hoagland nutrient solution gave the highest values of average number of fruits/plant, average fruit weight, dry matter percentage and average fruit firmness followed by chicken compost tea while, El-obour compost tea gave the lowest values. It remarked that, the increase of firmness of fruits which increase the storage period after harvesting was associated with their high contents of calcium as shown in Table 6 which translocate from leaves to fruits during the period of fruits development. For this reason, average fruit firmness have similar trends as their contents from calcium. Where, increase of calcium concentration cause a strong membranes structure. Since a high proportion of Ca in plant tissue is located in the middle lamella, which gives the strength to the cell walls (Marschner, 1995).

Table 4: Effect of different sources of nutrient solution on early yield, total yield and physical properties of fruits under NFT technique.

Treatments	Early yield (g/plant)	Total yield (g/plan)	Av. number of fruits / plant	Av. fruit weight (g)	Dry matter (%) of fruit	Av. fruit firmness (Kg/cm2)
Hoagland nutrient solution	437.50^{a}	1750.00^{a}	19.00^{a}	92.11^{a}	5.60^{a}	2.40^{a}
Chicken compost tea	353.75^{b}	1415.00^{b}	17.00^{b}	83.24^{b}	3.10^{b}	1.50^{b}
El-obour compost tea	237.50^{c}	950.00^{c}	14.00^{c}	67.86^{c}	0.85^{c}	0.60^{c}

Table 5: Effect of different sources of nutrient solution on percentage of fruit weight loss during nine days after harvesting.

Treatments	Initial weight	Time (days) after harvesting		
		3 days	6 days	9 days
Hoagland nutrient solution	86.00[a]	5.81[a]	16.05[a]	17.65[a]
Chicken compost tea	77.55[b]	17.47[b]	18.75[b]	21.15[b]
El-obour compost tea	60.66[c]	20.87[c]	22.92[c]	27.03[c]

Concerning, the effect of organic and inorganic sources of nutrient solution on percentage of fruit weight loss for nine days after harvesting were illustrated in Table 5. Generally, weight loss of kept fruits at room temperature gradually increased with increasing keep period. Hoagland nutrient solution gave the lowest percentage of fruit weight loss followed by chicken compost tea while, El-obour compost tea gave the highest percentage of fruit weight loss. This was true for all treatments and during all periods. This result is due to the increase of calcium concentration in fruits tissues produced from these solutions. Since a high proportion of Ca in fruit tissue is located in the middle lamella, which give the strength to the cell wall, which causes a slower rate of ripening by decreasing the respiration rates and ethylene production as mentioned by Ferguson (1984). Also Lester and Grusak (1999), reported that fruit softening was associated with muskmelon fruits weight loss. Calcium ion may be playing an important role in maintaining fruit more firms during storage and subsequently reducing fruit weight loss.

Chemical properties

Data of Table 6 show that, there were no significant differences among all different sources of nutrient solution on percentage of titratable acidity. This could possibly due to growing plants in NFT, where one of the main advantage of NFT is that plants did not exposed to water stress. While, exposing plants to water stress leads to increase the percentage of titratable acidity in fruit as reported by Ezzo (1998). In contrast to above, using of chicken compost tea and El-obour compost tea as organic source of nutrient solutions increased fruit content of vitamin C and these increases were higher than in case of using Hoagland nutrient solution. The highest content of vitamin C in fruits was associated by using chicken compost tea followed by El-obour compost tea, while the lowest content of vitamin C in fruits was obtained when cucumber plants treated with Hoagland nutrient solution (27, 18 and 11 mg/100g, respectively).

Similar results were obtained by Hargreaves *et al.* (2009), they found that the application of compost tea made from municipal solid waste compost with strawberries plants led to increase vitamin C content in the fruits of strawberries plants this effect might be due to a positive correlation with applying organic compost tea and vitamin C.

Table 6: Effect of different sources of nutrient solution on chemical properties of fruits under NFT technique.

Treatments	Titratable acidity (%)	Vitamin C (mg/100)	Ca (%)	No_3 (ppm)	Cd (ppm)	Ni (ppm)	Pb (ppm)	Co (ppm)
Hoagland nutrient Solution	0.11^{ns}	11^{c}	1.65^{a}	3890^{a}	0.00^{a}	0.00^{a}	0.11^{c}	0.080^{c}
Chicken compost tea	0.11^{ns}	27^{a}	1.26^{b}	355^{b}	0.00^{a}	0.00^{a}	1.75^{b}	0.129^{b}
El-obour compost tea	0.11^{ns}	18^{b}	0.89^{c}	200^{c}	0.05^{b}	0.04^{b}	4.20^{a}	0.170^{a}

Regarding, the calcium content of fruits data in Table 6 show that, calcium content in fruits had the same trend of the average fruit firmness as mentioned before . The highest content of calcium in fruits was obtained when cucumber plants treated with Hoagland nutrient solution followed by chicken compost tea while, the lowest content of calcium in fruits was observed with El-obour compost tea (1.65, 1.26 and 0.89 %, respectively). These results are in harmony with the increase of firmness of fruits which indicated that calcium cause an increase in firmness of fruits. Where it gives strength the cell wall, which cause a slower rate of ripening by decreasing the respiration rates and ethylene production then reducing losses in the weights during storage, Ferguson (1984).

Concerning, nitrate content in fruits of cucumber, the data in Table 6 showed that, Hoagland nutrient solution gave the highest values of nitrate content in fruits of cucumber as compared with either chicken compost tea or El-obour compost tea treatments (3890, 355 and 200 ppm, respectively).The low nitrate content in fruits of cucumber under organic nutrient solutions of El-obour compost tea and chicken compost tea may be due to the release of available N from organic fertilizers is mainly as NH_4 while, high nitrate content in fruits of cucumber under inorganic nutrient solution may be due to the release of available N mainly as NO_3 as mentioned by Smith and Hadley (1989).These results are in good accordance with those of Abou-El-Hassan *et al.* (2002 and 2008), Abd-El-Aziz (2003), El-Shinawy *et al.* (2007) and El-Behairy *et al.* (2008). On the other hand, Keeney (1982) noted that, high nitrate in the fresh vegetables have been found to be responsible for methemoglobinemia particularly in babies. Moreover, evidence-relating exposure to NO_3 or NO_2 to the incidence of cancer is available, Olson and Kartz (1982). Also, Karlowski (1990) reported that vegetables grown were divided into 4 groups depending on their ability to accumulate nitrates in their tissues and critical limits for the nitrate content in each group were proposed. The proposed limits for cucurbitacea (group III) are 500 mg/Kg (in fresh matter) mean 5000 mg/kg approximately (in dry matter).

Regarding, the content of fruits from heavy metals, results in Table (6) clearly showed that, Cadmium (Cd) and Nickel (Ni) not detected in fruits of cucumber that produced by Hoagland nutrient solution and chicken compost tea while, the concentrations Cd and Ni reached to 0.05 and 0.04 ppm, respectively in fruits of cucumber that produced by El-obour compost tea but the concentrations of Cd and Ni are still less than the critical levels permitted to be found in normal vegetable fruits (<0.50, 1-10 mg/kg respectively) as mentioned by Turkdogan *et al.* (2002).The highest contents of lead (Pb) and Cobalt (Co) were found in fruits that produced by El-obour compost tea (4.20 and 0.170 ppm, respectively) followed by chicken compost tea (1.75 and 0.129 ppm, respectively) while the lowest concentrations of lead (Pb) and Cobalt (Co) were found in fruits that produced by Hoagland nutrient solution (0.11, 0.080 ppm, respectively). These concentrations from Pb and Co in fruits are still less than the critical levels permitted to be found in normal vegetable fruits (6-9 mg kg^{-1}) for lead and (0.02-0.50 mg kg^{-1}) for Co as mentioned by Turkdogan *et al.* (2002).

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نمو ومحصول والتركيب الكيماوي لنباتات الخيار تحت تأثير استخدام منقوع الكمبوست تحت نظام الفيلم المغذي

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أجريت هذه الدراسة في صوبة بلاستيكية بقسم الاراضى والمياه - كلية الزراعة جامعة الأزهر(مدينة نصر- القاهرة - مصر) خلال موسم الخريف لعام ٢٠١٠ وذلك لدراسة مدى إمكانية استخدام مصادر مختلفة من منقوع الكمبوست (سماد الدواجن و سماد العبور) كمحاليل غذائية لمصادر عضوية على إنتاج وجودة محصول الخيار هجين USHUAIA (DP162) مقارنة مع محلول هوجلاند كمصدر غذائى معدنى (معاملة كنترول) تحت نظام الفيلم المغذي(NFT) حيث تم ضبط درجة التوصيل الكهربى لجميع المحاليل عند ٢.٥٠ *ديسيسيمنز*/ م بينما تم ضبط رقم الحموضة مابين ٥.٥ الى٦.٥.

وقد أشارت النتائج المتحصل عليها ، أن استخدام محلول هوجلاند كمصدر معدنى أعطى زيادة معنوية في القياسات الخضرية (ارتفاع النبات ، عدد الأوراق ، الكلورفيل الكلى فى الأوراق ، الوزن الطازج ، الوزن الجاف للنبات) و كذلك المحصول الكلي ، مقارنة مع منقوع سماد الدواجن و منقوع سماد العبور على التوالي . وبدراسة صفات الجودة لوحظ أنه لم يكن هناك اختلافات معنوية بين المعاملات فى الحموضة المعايرة بالثماربينما أدى استخدام محاليل منقوع كمبوست الدواجن والعبور إلى الحصول على أعلى محتوى للثمار من فيتامين ج فى حين أن محلول هوجلاند أعطى أقل محتوى منه بالثمار .على العكس من ذلك، فان أعلى محتوى من النترات فى الثمار وجد مع استخدام محلول هوجلاند في حين تم الحصول على اقل محتوى من النترات فى الثمار مع محاليل منقوع كمبوست العبور و الدواجن على التوالي .استخدام محلول هوجلاند أعطى أعلى محتوى من الكالسيوم ، أعلى متوسط لصلابة الثمار وأقل نسبة فقد فى وزن الثمار و ذلك بالمقارنة مع منقوع سماد الدواجن و منقوع سماد العبور ، على التوالي.

وأخيرا توصى الدراسة بإمكانية استخدام منقوع كل من سماد الدواجن والعبور كمحاليل غذائية لمصادر عضوية للتغذية بصورة آمنة فى نظام الفيلم المغذي وان الانخفاض النسبى فى المحصول يمكن قبوله إذا أخذنا فى الاعتبار الاستخدام الآمن للثمار نتيجه لنقص محتواها من النترات و العناصر الثقيلة وارتفاع محتواها من فيتامين ج ناهيك عن الأمان البيئي بالاستفادة من هذه المخلفات.

قام بتحكيم البحث

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