EFFECT OF CULTURAL MEDIA AND NUTRIENT SOLUTION ON QUALITY AND PRODUCTION OF CUCUMBER BY USING HYDROPONIC SYSTEM

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ABSTRACT

The aim of this study to improve the growth, production, and fruits quality of cucumber, Two experiments were carried out. firstly; a field experiment to produce cucumber by the soilless culture system. This experiment was to study effect of nutrients solution (A_1, A_2), growth media (C_1, C_2, C_3, and C_4), and methods of flowering management (B_1, B_2, B_3 and B_4). Second experiment was conducted to study the effect of storage methods on the yield of 32 field treatments combination (ABC), for a week in four cases of storage as follows: S_1 represented the storage by using perforated polyethylene bags at 25°C, while S_2 at 7°C. S_3 storage by using non-perforated bags at 25°C, and S_4 represented the storage by using non-perforated bags at 7°C. The results were revealed that the plant nutrition by using standard solution (A1) had significantly superior in percentage calcium in the leaves (%3.4), firmness (9.27kg.cm^2), and TSS% (%5.81) of fresh fruits. Commercial solution (A_2) results indicated significantly superior in number of the fruits (54.24 fruit.plant^{-1}) and plastic house production (9.46 tons). The highest yield was 10.84 ton.house^{-1} produced at the $A_2B_2C_1$ field treatment combination. The best quality (TSS%) was 5.51% in the case of a storage S_2 and the lowest fruits weight loss was 1.90% in the case of S4.

Keywords: soilless culture, Fertigation, Commercial Fertilizer, Seaweeds, Storage.
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تأثير الوسط الزرعي والمحلول المغذي في جودة وإنتاج الخيار بنظام الزراعة المائية

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المستخلص

كان هدف هذه الدراسة لتحسين النمو والإنتاج وجودة الثمار للخيار ،نفذت تجربتين ، الأولى تجربة حقلية لإنتاج الخيار بنظام الزراعة من دون تربة وتضمنت دراسة تأثير عوامل محاليل التغذية (A_1 وA_2) وأوساط الزراعة (C_1 وC_2 وC_3 وC_4) وإدارة الإزهار (B_1 وB_2 وB_3 وB_4) . التجربة الثانية نفذت لدراسة تأثير طرائق التخزين لأسبوع على حاصل توافيق معاملات التجربة الحقلية (ABC) الـ32 في أربعة حالات خزنية كانت كالآتي: S_1 تمثل الخزن باكياس بولي اثيلين مثقبة بدرجة حرارة 25ْم، بينما S_2 بدرجة حرارة 7ْم. S_3 تمثل الخزن بأكياس غير مثقبة بدرجة حرارة 25ْم، بينما S_4 الخزن بأكياس غير مثقبة بدرجة حرارة 7ْم . أشارت النتائج الى أن تغذية النبات بالمحلول القياسي (A_1) أنتجت تفوقا معنويا في النسبة المئوية للكالسيوم في الأوراق و TSS ودرجة صلابة الثمار الطازجة. أنتج المحلول التجاري (A_2) تفوقا معنويا في عدد الثمار (54.24ثمرة.نبات$^{-1}$) وإنتاجية البيت البلاستيكي (9.46 طن.بيت$^{-1}$).الإنتاجية الأعلى كانت (10.84 طن.بيت$^{-1}$) لتوافيق المعاملة الحقلية A2B2C1. ألجودة الأفضل كانت في حالة الخزن S_2 إذ بلغت الـ TSS 5.51 % وأقل نسبة فقد وزن كانت 1.90% في حالة الخزن S_4 .

الكلمات المفتاحية: زراعة بدون تربة ،رسمدة،سماد تجاري ، أعشاب بحرية، ، تخزين.
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INTRODUCTION

The cucumber *Cucumis sativus* L. belongs to the Cucurbitacea family and it is one of the very important crop, due to the increasing demand by the consumers. The aim is to increase the production and to improve the quality of fruits using modern techniques and to benefit from various sciences in the development of this crop production processes (11). In the greenhouses are often concentrated in a relatively small area, and sometimes have adverse effects on the environment caused by the excessive use of the materials, and consumer of large amounts of water as well as many problems in the agriculture by the minerals soils, the increase in salinity and water sources (7). Therefore the world has moved to adopt soilless culture (16), it means planting in the media that do not contain soils minerals (20). These methods aim to provide the crops with sufficient quantities of crops management (10 , 15). Composition of the growing media is important in the process of supplying plants that are developing in the growth media with a process called fertigation (8 , 9). There are different ranges in concentrations of mineral elements found within nutrition solutions. The usefulness of these ranges is to provide a wide range that can be used to prepare a formula of the nutrient solutions for the same plant (7). Mostly, they are similar except N/K ratio due to differences in the plant needs for growth requirements depending on the species, oldest, intensity of the light and temperature (4). The problem of Farmers in the production of the vegetable crops in greenhouses; is how to manage the growth of the female cucumbers used in the protected environment (5). The pruning of the cucumber is still a low-diffusion technique due to the limited knowledge of farmers and the importance of the process of directing the plant towards positive growth and increase the yield (18 , 19). Foliar application of plants by Biostimulatores produces significant increases of the plants yield (3). Conservation of the fruits quality with the longest shelf-life of the marketing an important goal of the farmers and savers (13). Pre-harvest factors affect the quality of the fruits for many plant species, the most important is cultivar and soil type (growing environment) and the amount of the nutrients and irrigation water available to plants as well as spraying the plants by the natural growth hormones. It's important to use polyethylene bags with the appropriate permeability to the gases (CO_2 output and O_2 input) to allow minimal respiration and not to allow the stimulation of fermentation enzymes (2 , 12). Calcium has been shown to have a positive effect on improving the viability of fruits by reducing the percentage of fruit weight loss and increased their frimness (1,17). The packaging reduced the weight loss, retained the freshness, color and firmness of cucumber without any decay (5 , 14). The objective of this study to investigate the effect of cultural media and nutrient solution on cucumber production by Hydro-ponic systems.

MATERIALS AND METHODS

A field experiment was carried out in the greenhouse (9m *40m) of the College of Agriculture/ University of Baghdad during spring season 2017 by using a hydroponic system. The substrates were used in the growing media are: pearlite, peat moss, corn cob compost, wheat straw and wood straw, the chemical compositions are shows in Table 1. From these components were synthesized a growing media as follows C1(Peat+pearlite (1:1)) as a standard media, C2 (wood straw + peat + corn cob compost (1:1:1)), C3 (wheat straw+Peat+corn cob compost (1:1:1)) and C4 (Corn cob compost + wheat straw (1:1)). The standard solution was prepared by using the dissolve standard salts * in 10 liters of water to prepare the concentrated solution and completed the size to 1000 liters within the tank, the concentration of nutrients is shows in Table 2.

Table 1. Chemical properties for the growth media components

Property	not-supported peat moss	corn cob compost	wheat straw
%N	0.595	0.823	0.662
%P	0.17	0.19	0.19
%K	0.395	1.540	1.059
%Ca	0.879	0.879	0.915
%OM	55.19	54.50	44.16

Table 2. Compositional of standard solution A_1 ($ml.l^{-1}$) and summation of the dry salts weight ($g.l^{-1}$).

N	P	K	Mg	Fe	Mn	Zn	Cu	B	Mo	pH	EC	sum (g)
200	50	250	50	3	1	0.1	0.1	0.3	0.1	6.67	2.5	2.229

Commercial solution system A_2 is a fertigation that includes the Injector to inject the commercial fertilizer* is placed in the injector to prepare the commercial solution (A_2) and then it was injected with the irrigation water to give diluted solution (Table 3). The commercial fertilizer was determined on the basis of the relative relationship between the size of the standard solution absorbed by the plant at each nutrition and the weight of dissolved salt in the solution (Table 4).

Table 3. Compositional of Commercial solution A_2 ($ml.l^{-1}$).

N	P	K	Mg	SO4	Fe	Mn	Zn	Cu	B	Mo	pH	EC
130.9	77.39	481	45.47	149.34	1.78	1.11	0.67	0.09	0.56	0.11	5.59	2.8

***Commercial fertilizer: (NO_3 and NH_4 (undefined)) ,P2O5, K2O, MgO, SO_3, (Fe)EDDHA , (Mn)EDTA, (Zn)EDTA, (Cu)EDTA, H3BO3, $(NH_4)_6MO_7O_{24}$-$4H_2O$.**

Table 4. Weight of the salts consumed in gram for 384 plants according to rate of discharge of solution in A1

Rate of drainage of the standard solution that expected at one plant trough ones process during the season (Liter).	0.5	1	1.5	2	nutrition
The dry weight of the salts consumed in the standard solution ($g.plant^{-1}$).	1.115	2.229	3.344	4.458	
The dry weight of the salts which added by the fertigation to 384 plants within A_2.	427.97	855.94	1283.9	1711.9	

Management of the flowering applied using four methods: B1 removal of the side branches from the main stem (pruning) without foliar application, while B_2 removal of the side branches from the main stem with foliar application by Biozyme. B_3 keep one node from the side branch connected with the main stem without foliar application, while B_4 keep one node from the side branch connected to the main stem with foliar application. The field experiment was carried out according to the Nested-Factorial experiment design, where the plants were divided into two groups represented the nutrition factor (A). In both systems (A1 and A2) the plants were divided into three replicates, within these replicates. Factorial experiment was carried out according to RCBD design and included two factors (4B×4C). The results were analyzed and the means were compared using LSD test at 5% probability.

Second field experiment storage (ABC):

This experiment was carried out using four storage treatments in order to determine the appropriate packing and storage conditions to preserve the quality of the cucumber fruits and their shelf life. The storage treatments as follows:

S1- a Storage by using perforated polyethylene bags (16 cm^2 .kg^{-1} fruits) for a week at 25°C.

S2- Storage by using perforated polyethylene bags (16 cm^2 .kg^{-1} fruits) for a week at 7°C.

S3 - Storage by using non-perforated polyethylene bags for a week at 25°C.

S4- Storage by using non-perforated polyethylene bags at 7°C.

The storage experiment conducted according to the Nested design and the means were compared using LSD test at 5% probability. The storage methods (S) represented the main parts and the interstitial combination of the field experiment treatments (ABC) 32 treatments in three Replicates, the experimental units were randomly distributed within the experimental area. The study of plant charactericetics for the field experiment were as follows:

A- Percentage of calcium in the leaves: estimated by Flame photometer .
B- Concentration of chlorophyll in leaves(mg.100 g^{-1}wet weight)
C- Total leaves area of the plant (M^2. plants $^{-1}$).
D- fruits number . $plant^{-1}$.
E- Production of the plastic house (ton.$house^{-1}$) (1730 plants).
F- Percentage of total soluble solids (T.S.S %).
G- Fruit firmness (kg.cm^2) without removing the peel of the fruit.
The study traits for the store experiment were follows
A- Percentage of weight loss in the fruits after the storage.
B- Percentage of total soluble solids (T.S.S %) after the storage

RESULTS AND DISCUSSION

Effect of field experiment combinations (ABC) on the growth and yield:

Results in Table 5-A shows a significant effect of two types of nutrient solution on the growth (vegetative, yield and fruits quality). The plants treated with the standard solution (A_1) had the highest percentage of calcium in the leaves at 3.40%, the percentage of total soluble solids (5.81%) and the fresh fruits stiffness (9.27 kg/cm^2), when compared to a commercial solution (A_2) that had following values for the above characteristics (3.14%), (5.60%TSS) and (8.88 kg/cm^2) respectively. The commercial solution A_2 produced significant increases in concentration of the total chlorophyll in the leaves (302.97 mg), leaves area (1.98 m^2), fruits number (54.24 fruits) and the productivity (9.46 tons. $House^{-1}$) compared to the standard solution A_1, which produced 275.92 mg, 1.89 m^2, and 48.31 fruits, respectively. Foliar application by the Biozyme (B_2 and B_4) produced a significant increasing in fruits number.$plant^{-1}$ (52.27 and 53.48) respectively in comparison to (B_1 and B_3) that produced 49.31 and 50.05 fruit. $Plant^{-1}$ respectively. The highest production resulted from that plants under B2 treatment, the yield was 8.96 tons. $house^{-1}$. The flowering management treatments without foliar application (B_1 and B_3) had significant increase in the percentage of the calcium in leaves (3.39% and 3.30%) respectively, compared with the foliar application by Biozyme (B_2 and B_4) which gave 3.18 and 3.21 respectively. The growing media (C) were significantly affected in the percentage of calcium in the leaves, the highest percentage was 3.37% in the plants when grown in the local media (C_4). While the lowest percentage (3.09%) founded in the plants of standard media (C_1). The plants when growth in the standard media (C_1) had significant increasing in the total chlorophyll (330.02 mg.$100g^{-1}$ fresh weight), leaves area (2.13m^2.$plant^{-1}$), fruits number (55.24 fruit.$plant^{-1}$) and house production (9.63 ton.$house^{-1}$). The plants were grown in the media C_2 exceeded the growing media C_3 and C_4 in the leaves area, number of the fruits and house production (9.10 ton), however, the fruits were produced from using the medium C_3 had significant increases in TSS% at 5.77%, while the lowest for medium C_1 (5.68%).

Table 5- A Effect of growth media, nutrient solution and flowering management on the some vegetative growth parameters and cucumber production by soilless culture

Field Experiment Factors	%Ca in the leaves	leaves area m^2.plant.$^{-1}$	Total chlorophyll (mg.100g fresh w).	number of fruits fruit.$plant^{-1}$	plastic house productivity ton(504m^2)	%TSS in the fruit	fruit firmness (kg/cm^2)
A1	**3.40**	**1.89**	**275.92**	**48.31**	**8.19**	**5.81**	**9.27**
A2	**3.14**	**1.98**	**302.97**	**54.24**	**9.46**	**5.60**	**8.88**
LSD	**0.062**	**0.074**	**26.094**	**3.558**	**0.194**	**0.132**	**NS**
B1	**3.39**	**1.81**	**283.11**	**49.31**	**8.38**	**5.79**	**9.09**
B2	**3.18**	**2.05**	**316.29**	**52.27**	**8.96**	**5.96**	**8.97**
B3	**3.30**	**1.80**	**256.47**	**50.05**	**8.69**	**6.04**	**9.16**
B4	**3.21**	**2.07**	**301.92**	**53.48**	**8.26**	**5.42**	**9.06**
LSD	**0.090**	**0.039**	**10.072**	**1.066**	**0.090**	**0.056**	**NS**
C1	**3.09**	**2.13**	**330.02**	**55.24**	**9.63**	**5.68**	**8.90**
C2	**3.31**	**2.08**	**278.24**	**52.98**	**9.10**	**5.69**	**9.41**
C3	**3.31**	**1.77**	**264.52**	**48.49**	**8.23**	**5.77**	**9.13**
C4	**3.37**	**1.75**	**285.02**	**48.39**	**8.34**	**5.69**	**8.84**
LSD	**0.090**	**0.039**	**10.072**	**1.066**	**0.090**	**0.056**	**NS**

Results of the field experiment treatments combination (ABC) showed significant effects in all the experiment of characteristics (Table 5b), The treatment $A_1B_3C_4$ had a superior percentage of calcium in the leaves (4.11%) in comparison with other treatments, while the lowest percentage was 2.75% of the treatment plants $A_2B_4C_1$. The treatment combination $A_2B_2C_1$ was superior produced the highest leaves area (2.55 m 2), total chlorophyll in the leaves (356.49 mg), fruits number per plant (62.75 fruit) and plastic house production (10.84 tons), while the combination treatment $A_1B_1C_4$ produced the lowest number of the fruits.plant^{-1} (41.63 fruits) but the lowest production was 6.95 tons.house$^{-1)}$ founded in $A_1B_1C_3$. The results showed that the combination treatment $A_2B_3C_2$ and $A_2B_1C_1$ had no significant differences in comparison to the superior combination treatment ($A_2B_2C_1$) in production (10.69 tons. house^{-1}) and (10.67tons.house^{-1}) respectively. combination treatment plants $A_1B_3C_1$ had highest percentage of total soluble solids in fresh fruits

Table 5 - b.

field experiment combinations	%Ca in cucumber leaves	leaves area m^2. plant^{-1}	Total chloro-phyll in the leaf mlg.100g^{-1}wet weight	fruits number.plant^{-1}	plastic house production (504m^2).ton^{-1}	%TSS in fresh fruits	fruit firmness kg/cm^2
$A_1B_1C_1$	3.00	1.98	283.41	49.71	8.66	5.85	8.5
$A_1B_1C_2$	3.79	1.81	263.05	49.17	8.87	5.85	10.00
$A_1B_1C_3$	3.79	1.56	250.98	43.59	6.95	5.85	8.50
$A_1B_1C_4$	3.24	1.57	261.28	41.63	7.00	5.60	9.50
$A_1B_2C_1$	3.22	2.14	345.52	48.88	8.71	5.85	10.00
$A_1B_2C_2$	3.57	2.02	261.29	53.59	9.16	5.60	8.50
$A_1B_2C_3$	3.23	1.92	274.60	48.55	7.71	5.10	9.25
$A_1B_2C_4$	3.13	1.69	319.40	43.63	7.12	5.67	9.00
$A_1B_3C_1$	3.47	1.96	331.22	50.25	8.71	6.77	10.00
$A_1B_3C_2$	3.11	1.81	233.60	46.38	7.81	6.10	10.50
$A_1B_3C_3$	3.17	1.61	212.56	43.46	7.22	6.35	8.00
$A_1B_3C_4$	4.11	1.60	219.34	44.38	7.52	6.32	9.25
$A_1B_4C_1$	3.13	2.43	317.64	58.34	10.06	5.35	8.50
$A_1B_4C_2$	3.51	2.22	303.37	52.30	9.23	5.35	10.25
$A_1B_4C_3$	3.30	1.97	245.89	47.00	8.03	5.60	10.25
$A_1B_4C_4$	3.55	1.87	291.65	52.13	9.20	5.85	8.50
$A_2B_1C_1$	3.16	2.27	326.06	59.96	10.67	5.60	10.00
$A_2B_1C_2$	3.50	1.89	254.99	47.29	7.94	5.85	9.50
$A_2B_1C_3$	3.29	1.68	323.84	50.67	8.79	5.85	9.50
$A_2B_1C_4$	3.27	1.77	301.26	52.42	9.17	5.85	7.50
$A_2B_2C_1$	2.88	2.55	356.49	62.75	10.84	5.60	8.25
$A_2B_2C_2$	3.24	2.22	313 94	54.46	9.87	5.60	9.00
$A_2B_2C_3$	3.10	1.83	313.87	53.88	9.49	5.60	9.00
$A_2B_2C_4$	3.10	1.91	345.22	52.42	8.80	5.60	9.00
$A_2B_3C_1$	3.06	1.73	342.44	54.46	9.65	5.52	8.25
$A_2B_3C_2$	2.78	2.26	266.65	59.42	10.69	5.60	8.50
$A_2B_3C_3$	3.37	1.69	220.96	50.46	8.73	6.35	9.50
$A_2B_3C_4$	3.29	1.76	225.00	51.58	9.21	5.35	8.25
$A_2B_4C_1$	2.75	1.99	337.39	57.58	9.71	5.35	8.25
$A_2B_4C_2$	2.95	1.32	329.00	61.21	10.26	5.35	9.00
$A_2B_4C_3$	3.25	1.87	273.43	50.34	8.90	5.10	9.25
$A_2B_4C_4$	3.27	1.87	316.98	48.96	8.65	5.43	8.50
LSD 0.05	0.254	0.109	28.487	3.014	0.255	0.159	1.600

(6.77%) in comparison with lowest percentage (5.10%) in fruits of treatments combination $A_1B_2C_3$ and $A_2B_4C_3$, while the plants fruits of the treatment $A_1B_3C_2$ produces highest fruits firmness (10.5 kg/cm^2), while the lowest value 7.5kg/cm^2 showed in $A_2B_1C_4$. From the previous Table 5-A shows that the independent effected of the treatment, to the plants were nutrition by the commercial solution (A_2) had significant superior in total chlorophyll in the leaves, could be due to increases in phosphorus concentration and potassium in this solution, which caused to increase in the produces energy compounds and increased the process of the amino acids synthesis, carbon representation. The presence of magnesium within the clavicle compounds (Table 3) had contributed to the prevent of sedimentation reactions of the phosphorus and magnesium and thus increase their availability for the plant, especially that magnesium as well as nitrogen enters in structure of the chlorophyll molecule and then increase the concentration in the leaves thus increasing the

representation and bio-building process which reflected a positive increase to the leaves area and the amount of food processed and thus increases number of the fruits and increase the productivity. The reason for the increasing in the percentage of total soluble solids for the fruits were fed by standard solution as well as the plants which did not sprayed by the growth promoter (biozyme), may be due to the fact that the commercial solution had higher levels of phosphorus and potassium as well as the compounds formulas of micro nutrients which contributed to increasing the availability and vegetative growth and the number of the fruits and caused competition for food synthesis then the reduction of TSS%. The foliar application by the biozyme which containing natural growth had contributed to this increase in the growth activity at the expense of the share for the fruits which produced by the plant. The results showed that plants growth in the growing media C_3 produced fresh fruits containing the highest percentage of TSS% in the fruits, while the lowest of the fruits produced from plants grown in the standard media C_1, This may be caused by more activity of the organic matter in the growing media, the media C_3 had the highest percentage from the organic matter (Table 1), while the standard media C_1 produced the lowest percentage from the organic matter, because it was contains the perlite substrate at rate 50% from the total volume. The organic matter has an important effect in the processing of plant nutrition in quantities that increase the concentration of the food produced in fruits. The field treatments $A_2B_2C_1$, $A_2B_3C_2$ and $A_2B_1C_1$ respectively produced highest values in the productivity of the plastic house, it is observed that these treatments were highest content in phosphorus and potassium as well as the clavicle formula of the elements of Mg, Fe, Cu and Zn, thus contributed, to increase the availability of these nutrients and increase the growth and the production. In addition, these treatments had superior growth media in porosity and buffering for the water and nutrients, This increased the development of the root system and could be increase their efficiency in absorbing nutrients. The two highest treatments in productivity included a flowering management method based on removal of lateral branches from the main stem and spray by the biozyme extract. This had contributed to the competition of the vegetative reducing on the stage food synthesis providing more for the fruiting process, as well as foliar application that provided the plant with additional nutrients and natural growth catalysts which have contributed to increase plant efficiency in the growth and the production.

Effect of the field experiment combinations (ABC) and storage conditions on the cucumber fruits quality.

Percentage of fruits weight loss after storage

Table 6 shows significant effects of ABC on the percentage of the fruits weight loss after the store for a week due to the independent effect of the field experiment combinations (ABC).Lowest weight reduced 1.35% in fruits of the treatment combinations ($A_1B_1C_4$) , while the highest percentage of the fruits weight lost was 3.35% from the experiment yield under all combinations ($A_2B_4C_1$). The independent effect of the packing and storage conditions was significant in the fruits weight loss after the storage. The lowest percentage was 1.90% in the fruits which were packed inside non-perforated bags and storage under 7°C (S_4), while the highest percentage of fruits weight loss was 2.68% when packing with perforated bags and storage under 25°C (S_1). The packing by the perforated bags (S_1 and S_2) was significantly affected in fruits weight loss increasing in comparison with non-perforated bags (S_3 and S_4), reducing of the storage temperature to 7°C (S_2 and S_4) was significant effected in reduced of fruits weight loss in comparison with a storage under temperature 25°C (S_1 and S_3). The interaction between the field experiment combinations (ABC) and the storage conditions (S) had significantly effected in percentage of fruits weight loss after the storage, the lowest weight loss was 1.00% for the treatment (S_4 -$A_2B_1C_4$), while the highest was 4.14% for the treatment (S_1-$A_2B_4C_1$).

Table 6. Effect of the field experiment combinations and methods of storage in the percentage of cucumber fruits weight loss after the storage.

Field experiment combinations	Methods of packing and storage (s)				Average of field experiment
(ABC)	S1	S2	S3	S4	combinations
A1B1C1	2.00	1.91	1.90	1.90	1.93
A1B1C2	2.11	1.67	1.26	1.19	1.56
A1B1C3	2.08	1.79	1.76	1.35	1.75
A1B1C4	1.61	1.00	1.44	1.35	1.35
A1B2C1	2.29	2.05	2.19	1.72	2.06
A1B2C2	2.70	2.26	2.60	2.17	2.43
A1B2C3	3.11	2.65	2.65	2.56	2.74
A1B2C4	2.69	2.00	1.67	1.89	2.14
A1B3C1	2.17	2.10	2.00	2.09	2.09
A1B3C2	2.17	2.26	2.11	2.03	2.14
A1B3C3	2.00	1.56	1.66	1.06	1.57
A1B3C4	2.26	1.78	2.05	2.00	2.02
A1B4C1	3.26	3.24	2.70	2.26	2.87
A1B4C2	2.35	1.72	2.75	1.75	2.14
A1B4C3	3.01	2.31	2.00	2.00	2.33
A1B4C4	2.61	2.38	2.20	2.40	2.40
A2B1C1	2.79	2.50	2.79	2.26	2.59
A2B1C2	2.84	1.72	2.10	1.55	2.05
A2B1C3	2.56	2.08	2.00	1.19	1.96
A2B1C4	2.88	1.13	2.17	1.00	1.80
A2B2C1	2.35	2.35	2.30	2.30	2.33
A2B2C2	3.13	3.17	2.13	2.04	2.62
A2B2C3	3.78	3.25	2.00	1.41	2.61
A2B2C4	2.84	2.64	2.42	2.28	2.55
A2B3C1	2.86	2.25	2.29	2.19	2.40
A2B3C2	2.80	2.00	2.19	2.10	2.27
A2B3C3	2.03	2.06	2.08	2.00	2.04
A2B3C4	2.50	2.00	2.22	2.18	2.23
A2B4C1	4.14	3.83	3.18	2.25	3.35
A2B4C2	3.11	2.14	2.11	2.11	2.37
A2B4C3	4.03	3.52	2.50	2.00	3.26
A2B4C4	2.63	2.24	2.28	2.18	2.33
LSD 0.05			0.089		0.051
Average methods of packing and storage (S).	2.68	2.27	2.19	1.90	
LSD 0.05			0.023		

S_1 = a storage by perforated bags under 25°C. S_2 = a storage by perforated bags + under 7°C
S_3 = a storage by non-perforated bags under 25°C. S_4 = a storage by non-perforated bags under 7°C

Percentage of total soluble solids after the storage

The results in Table 7 shows a independent significant effects for the field experiment combinations (ABC) on the percentage of the total soluble solids in the fruits after storage, the highest percentage was 5.79 in the fruits of experimental combinations ($A_2B_1C_2$) in comparison with lowest percentage was (4.85%) in the fruits of the field experiment combinations ($A_1B_4C_1$). The results showed that packing and storage conditions had significant effects on TSS% in fruits cucumbers after storage; the highest percentage was 5.51% at the storage treatment S2 and the lowest percentage in the storage treatment S4 (4.97%). Interaction between the field experiment combinations and storage

conditions (S-ABC) had significant effects on the percentage of total soluble solids of the fruits after the storage. The highest ratio was 6.10% in the treatments S_2-$A_1B_3C_3$ and S_2-$A_2B_1C_2$ in comparison with the lowest ratio (4.35%) in the fruits of storage treatment S_4 for many field treatments and S_1-$A_2B_1C_1$. The fruits weight loss effected by the field conditions, and increased in the percentage of fruits weight loss after a storage appeared in the field treatments that were characterized by rapid growth requirements regardless of the storage conditions. The commercial solution has a high level of nutrients, especially the concentration of the potassium and phosphorus (Table 3), this increased the efficiency of the plant in the process of composition of vehicles in quantities appropriate to increase the speed of vegetative growth. The method of flower management which included spraying of natural growth hormones and nutrients accelerated the rate of the number of total fruits and then increased the rate of competition for developing fruits on processed food and as a result, there was a small amount of material obtained by the fruits. The lowest percentage of weight loss from the fruits at the storage for a week with non-perforated bags under 7°C at 1.90%, This reduction in weight loss may be due to the lowest loss of water from the fruits in this case of storage (S_4). This result is consistent with the findings of Moalemiyan and Ramaswamy (12) as the refrigerated storage by using the packing bags was the best in reducing of weight loss.

Table 7. Effect of the field experiment combinations and methods of storage in the percentage of total soluble solid of cucumber fruits after the store

Field experiment combinations	Methods of packing and storage (s)				Average of field experiment
(ABC)	S1	S2	S3	S4	combinations
A1B1C1	5.35	5.35	4.60	5.35	5.16
A1B1C2	5.35	5.35	5.35	5.35	5.35
A1B1C3	5.35	5.10	4.85	4.85	5.04
A1B1C4	5.35	5.10	5.35	5.35	5.29
A1B2C1	5.10	5.85	4.85	5.10	5.23
A1B2C2	5.60	5.10	5.35	5.85	5.48
A1B2C3	5.60	5.10	5.10	5.85	5.41
A1B2C4	5.35	5.60	5.35	5.85	5.54
A1B3C1	5.35	5.35	5.10	5.35	5.29
A1B3C2	5.85	5.85	5.60	4.85	5.54
A1B3C3	5.35	6.10	5.35	4.85	5.41
A1B3C4	5.35	5.85	5.35	5.35	5.48
A1B4C1	5.35	5.10	4.60	4.35	4.85
A1B4C2	5.60	5.10	5.35	4.85	5.23
A1B4C3	5.43	5.35	5.10	5.35	5.31
A1B4C4	5.35	5.85	4.85	4.35	4.91
A2B1C1	4.35	5.85	5.10	4.35	4.91
A2B1C2	5.85	6.10	5.85	5.35	5.79
A2B1C3	5.35	5.60	5.35	4.35	5.16
A2B1C4	5.85	5.85	5.60	4.85	5.54
A2B2C1	5.10	5.60	5.10	4.35	5.06
A2B2C2	5.35	5.35	4.85	4.85	5.10
A2B2C3	5.35	5.60	5.60	4.85	5.35
A2B2C4	5.85	5.35	5.35	4.85	5.35
A2B3C1	5.10	5.35	5.35	4.35	5.04
A2B3C2	5.35	5.60	5.10	4.35	5.10
A2B3C3	5.35	5.35	5.35	4.85	5.23
A2B3C4	5.35	5.35	5.35	4.35	5.10
A2B4C1	5.00	5.60	5.60	5.85	5.51
A2B4C2	5.35	5.35	5.60	4.35	5.16
A2B4C3	5.60	5.35	5.10	5.35	5.35
A2B4C4	5.60	5.85	4.85	4.85	5.29
LSD 0.05			0.269		0.156
Average methods of packing and storage (S).	5.39	5.51	5.23	4.97	
LSD 0.05			0.166		

S_1 = a storage by perforated bags under 25°C. S_2 = a storage by perforated bags + under 7°C
S_3 = a storage by non-perforated bags under 25°C. S_4 = a storage by non-perforated bags under 7°C

There is a possibility to dispense standard salts in the preparation of nutrition solutions for the large farms and rely on ready and specialized combinations for each crop due to its availability. The standard growth media (C1) and the media of the sawdust (C2), produced superior plants in the quantity of the yield, while the straw-containing media and compost such as corn (C3) and (C4) produced superior plants in the specific qualities of the fruits. Using of the fertigation technique for nutrition the plants by the nutrient solutions, which is the easiest in the carrying out and it does not need much experience in preparing of solutions. which are less expensive and flexible to suit any number of plants that can be planted within the system capacity. Using of sawdust after water soaking for two weeks as a partial component of the growth media, because it has a high physical properties, low cost and its available. sawdust results in producing plants with high competitive and productive. packaging with perforated bags and storage 7 to 10 ° C was the best in prolonging shelf life.

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