STUDY THE STORABILITY OF FRUITS OF SOME CUCUMBER HYBRIDS (*CUCUMIS SATIVUS* L.) GROWN IN UNHEATED PLASTIC HOUSES /

دراسة القابلية الخزنية لثمار بعض هجن الخيار المزروعة في البيوت البلاستيكية غير المدفأة

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Keywords: *cucumber hybirds, training methods, storage, decay percentage, total soluble solids*

ABSTRACT

The experiment was conducted during the winter season 2016-2017 in Siddakheel district, Dhi Qar province, south of Iraq in order to study the storage ability of fruits of four cucumber hybirds (Sayf F1, Silyon Rz F1, Baraa 138F1 *and Rami F1) planted in unheated plastic house. Experiment was carried out as factorial experiment for the possible combination of three factors (four cucumber hybrids, two training methods and four storage periods) by using C.R.D. design with three replicated and the differences of means were compared by using the least significant difference (L.S.D) test at the probability level of 0.05. Fruits were packed in perforated polyethylene bags (16 hole with a diameter of 5 mm per bag and weighed 2 kg per bag), then stored at 13°C for four weeks. Results indicated that Silyon RZ F1hybrid fruits recorded the highest percentage of total soluble solids, with no significant difference with Baraa 138 F1 and with significant difference with the rest hybrids. Silyon RZ F1 hybrid fruits recorded the lowest percentage of weight loss and the lowest percentage of decay with no significant difference with Baraa 138 F1 hybrid fruits. The statistical analysis showed no significant differences between the two methods of training in all studied properties. The percentage of decay and weight loss increased while the percentage of total soluble solids decreased by increasing the storage period. Interactions between studied factors were significant in their effect on the studied parameters. The highest percentage of weight loss was in fruits of Silyon RZ F1 plants grown on one stem while the highest total soluble solids were in the fruits of Baraa 138 F1 plants grown on one stem after four weeks of storage.*

REZUMAT

أجريت التجربة خلال الموسم الزراعي الشتوي 2016-2017 في احد البيوت البلاستيكية غير المدفأة في قضاء سيد دخيل محافظة ذي قار *بهدف تقييم هجن الخيار (Sayf F1, Silyon Rz F1, Baraa 138F1 and Rami F1) المزروعة بالبيوت البلاستيكية من ناحية القابلية الخزنية للثمار. عبئت الثمار في أكياس من البولي أثيلين مثقبة (16 ثقباً قطر الثقب 5 ملم) حيث وضع 2 كغم من الثمار في الكيس الواحد ثم خزنت على درجة حرارة 13 م^0 في حاضنة مبردة لمدة أربعة أسابيع .نفذت كتجربة عاملية لثلاثة عوامل هي عبارة عن التوافيق الممكنة بين أربعة هجن من الخيار وثلاث مكررات وقورنت المتوسطات باستخدام اختبار أقل فرق معنوي (CRD)وطريقتي تربية وأربعة فترات خزن باستخدام التصميم العشوائي الكامل في تحقيق اعلى نسبة للمواد الصلبة الذائبة الكلية وبفارق غير Silyon RZ F1اظهرت النتائج تفوق ثمار الهجين تحت مستوى معنوية 0.05 . LSD اقل نسبة معنوية للفقد بالوزن وبفارق غير Silyon RZ F1 ومعنوي على بقية الهجن كما حققت ثمار الهجين Baraa 138 F1معنوي عن الهجين اقل نسبة مئوية للفقد بالوزن واقل نسبة مئوية Silyon RZ F1 ومعنوي على بقية الهجن حققت ثمار الهجين Baraa 138 F1معنوي عن ثمار الهجين .ولم يظهر التحليل الاحصائي وجود فروق معنوية بين طريقتي التربية في التاثير في Baraa 138 F1 للتلف وبفارق غير معنوي عن ثمار الهجين الصفات المدروسة كما ازدادت النسبة المئوية للتلف والفقد بالوزن في حين انخفضت النسبة المئوية للمواد الصلبة الذائبة الكلية كلما زادت مدة الخزن Silyonوكانت التداخلات بين العوامل معنوية في تاثيرها في مؤشرات الدراسة اذ نجد ان اعلى نسبة مئوية للفقد باالوزن كانت في ثمار نباتات الهجين المرباة على ساق واحدة Baraa 138 F1 المرباة على ساق واحدة في حين كانت اعلى نسبة للمواد الصلبة الذائبة الكلية في ثمار نباتات الهجين RZ F1 بعد أربعة أسابيع من الخزن.*

INTRODUCTION

Cucumber (Cucumis sativus L.) is an important vegetable crop in Iraq and the world cultivated in the fields during the spring and summer seasons *(Bacci et al., 2006).*

Cucumber fruits are distinguished by their high content of water, which constitutes about 95% of the fresh weight of the fruit *(Al-Khuza'i, 2006).* Each 100 grams of fruit contains 12 calories, 0.6 grams of protein, 0.1 grams of fat, 2.2 grams of carbohydrates, 0.06 grams of vitamin A, 0.03 grams of vitamin B1, 0.02 grams of vitamin B2, 12 mg of Ca, 15 mg of magnesium, 0.3 Iron Mg, 24 mg Phosphorous 0.3 g Niacin *(Papadopoulos, 2003).*

The process of storing fruits is one of the important processes that researchers looked at, because of its great importance in preserving the fruits from damage and keeping them healthy and with a high nutritional value for the longest possible period during storage. In general, storage is one of the means used to try to extend the storage life of fresh fruits and thus extend the period of supply in the local markets taken into consideration, the short period of display of these fruits in the markets. As it is well known, the cold storage is important in reducing the vital activities of fruits, especially the respiration process and the production of ethylene.

It also works to limit the growth of pathogens (*Al-Ani,1985; Shihikov,1988).* Regulating the supply of cucumber fruits in the market and increasing the duration of their presentation in its fresh condition and with high quality of consumption requires improving the storage ability of the crop if it is taken into consideration the weak storability of the fruits due to their high water content, which leads to attack by fungi in addition to weight loss. On the other hand, cucumber fruits are sensitive for chilling injury when stored at temperatures below 10 °C, which is the formation of pitting and decomposition of fruit tissue and the appearance of water spots (*Desouki et al., 2001).*

The water content of the fruits is the most important reservoir quality, as losing water from the fruits leads to a decrease in the turgor pressure of fruit cells and then caused fruits wilting. Weight loss occurs either as a result of the loss of the water content by evaporation from the surface of the fruits or as a result of the loss of stored food as a result of consumption by the respiration process or both and after harvesting, there is a big problem of water loss because reaching it to the extent that leads to wilting and wrinkling and shrinking the fruit caused large loss in the marketing value of the fruits *(Shirokvo 1988; Taain, 2005, 2011).*

Pragathi (2014) mentioned when evaluating several hybrids of cucumber plants grown in greenhouses which were Don, Encounter-963, Indam-swadish -43, Kareena, Maharaja, Silyon, Multi-star, and Sedona. that Don hybrid significantly superior to the rest in storability and qualitative characteristics of fruits.

The present study aims to evaluate the storage behavior of fruits of cucumber hybrids *(Sayff, Silyon RZ, Baraa 138, Rami)* planted in greenhouses and the effect of the training method on their storage behavior.

MATERIALS AND METHODS

The experiment was conducted during winter agricultural season 2016-2017 in one of the orchards of the district of Sayyid Dakhil, Dhi Qar Governorate, south of Iraq in one of the greenhouses of 50 x 9 m dimensions and an area of 450 m 2 with the aim of studying the effect of the storage behavior of some cucumber hybrids (Sayff, Silyon RZ, Baraa 138, Rami) and the effect of two methods of training (one stem, two stems) of cucumber plants on the storage behavior of fruits.

The soil with clay mixture textures are prepared by plowing, softening, leveling , dividing into four lines with a length of 48 m with 1.8 m distance between them and adding the triple super phosphate fertilizer (45% P2O5) at a rate of 2.5 kg. Line-1 and sterilized with the systemic pesticide 5g by 4.6 gm2-. Seeds were planted on 1/10/2016 directly and on both sides of the line, with a distance of 40 cm.

All agricultural service operations followed in the production of the crop inside the greenhouses were carried (Bashir, 1990). Training of cucumber plants with (one stem, two stems) was carried out.

Fruits were harvested before they reached to maturation stage in the early morning and packed in perforated polyethylene bags (16 hole with a diameter of 5 mm per bag weighed 2 kg per bag), then stored at 13°C for four weeks.

The decay and weight loss was calculated as a percentages, Vitamin C (mg / 100 g) determined according to A.O.A.C. (1992). Total soluble solids determined by using hand refractometer and the results were corrected to 20 ºC. Experiment was carried out as factorial experiment consisting of three factors: Four cucumber hybrids (*Sayf F1, Silyon Rz F1, Baraa 138F1 and Rami F1)*, two methods of training of cucumber plants (one stem, two stems) and four storage periods, using Complete Rondomize Design (CRD) with 3 replicates.

The results were statistically analyzed using the statistical program Genstat. The mean differences were compared by using the least significant difference (L.S.D) test at the probability level of 0.05 (*Al-Rawi and Khalf Allah 1980).*

RESULTS

Decay percentage. The results of Table 1 indicated to the effect of the hybrid, the method of training, storage periods and the interaction between them on the decay percentage of fruits stored at 13°C. The results showed that the lowest percentage of decay (0.84%) was in the fruits of the hybrid Silyon RZ F1 with no significant difference from the fruits of the hybrid Barra 138 F1 and significant from the rest of the hybrids .while, the highest percentage of decay (1.38%), recorded in the fruits of the hybrid Rami F1with no significant difference from the fruits of the hybrid Sayff F1. It appeared from the same table that there are no significant differences between the two methods of training on their effect on the decay percentage of fruits, while the effect of the storage period was significant, noting that the percentage of decay increased with increasing the storage period until it reached (2.92%) after four weeks of storage.

The interaction between the hybrids and training methods was significant, as the lowest decay percentage was in the fruits of the Silyon RZ F1 hybrid plants grown on one stem, which amounted to (2.603%), while the highest percentage of decay(1.39%) was in the fruits of Rami F1 hybrid plants. grown on two stems. As for the interaction between hybrids and the storage period was significant, it was noted that the highest percentage of decay was in the fruits of the Rami F1 hybrid after four weeks of storage, which amounted to (3.65%). Fruits of hybrids had no decay up to the third week of storage. As for the interaction between the training methods and the storage period, it was also significant, the highest percentage of decay was in the fruits of plants grown on two stems after four weeks of storage, which amounted to (2.94%). In regard to triple interaction. The highest percentage of decay was in the fruits of Rami F1 hybrid plants planted on two stems after four weeks of storage, which amounted to (3.67%).

The fruits are exposed during the process of packing and storage to the damage, which takes several forms according to its causes. It may be the result of mechanical disorders to the fruits during packing and storage, such as bruises caused by the pressure of the fruits of each other inside the package.

The damage is caused as a result of the progress of fruits ripening, and also due to injuries with pathogens such as bacteria, fungi and yeast (Dementeva and Vegonski , 1988 , Taain 2011, 2014). It should be noted that the hybrids did not know the damage except at the beginning of the third week of storage at a temperature of 13 ° C. It is also noted that the fruits of the hybrids under study differed in their percentage of decay at the end of the storage period and this may be due to the genetic differences between them.Thus, Silyon RZ F1 and BARAA 138 F1 hybrids showed a significant decrease in the percentage of decay compared with the Rami F1 and Sayff F1 hybrids.

Table 1

The effect of hybrids, the training methods, the storage periods and the interaction among them in the percentage of decay of the cucumber fruits stored at 13 ° C.

Hybrids	Training methods	Storage periods(weeks)				Hybrids= Training methods
		1	2	3	4	
BARAA 138 F1	One stem	0	0	1.33	2.36	0.92
	Two stems	0	0	1.29	2.31	0.90
Sayff F1	One stem	0	0	1.76	3.55	1.32
	Two stems	0	0	1.81	3.61	1.35
Silyon RZ F1	One stem	0	0	1.24	2.12	0.84
	Two stems	0	0	1.21	2.17	0.85
Rami F1	One stem	0	0	1.83	3.63	1.36
	Two stems	0	0	1.92	3.67	1.39
						Means of hybrid
Hybrids + storage period	BARAA 138 F1	0	0	1.31	2.33	0.91
	Sayff F1	0	0	1.78	3.58	1.34
	Silyon RZ F1	0	0	1.22	2.14	0.84
	Rami F1	0	0	1.87	3.65	1.38
						Means of training method
Training Methods+ Storage periods	One stem	0	0	1.54	2.91	1.11
	Two stems	0	0	1.55	2.94	1.12
Means of storage periods		0	0	1.54	2.92	

hybrids	Training methods	storage periods	Hybrids=Training methods	Hybrids + storage periods	Training Methods+ Storage periods	Triple interaction
0.41	0.07	0.86	0.49	0.97	0.11	1.22

Weight loss percentage. Date presented in table 2 showed the effect of the hybrid, the method of training, storage periods and the interaction among them on the percentage of weight loss of fruits stored at 13°C. It is clear that the lowest percentage of weight loss (2.623%) was in the fruits of the hybrid Silyon RZ F1 with no significant difference from the fruits of the hybrid Barra 138 F1 and significant from the rest of the hybrids. As for the highest percentage of weight loss (4.073%), it was recorded in the fruits of the hybrid Rami F1, with no insignificant difference from the fruits of the hybrid Sayff F1. The same table showed that there were no significant differences between the two methods of training. The results indicate that the lowest percentage of weight loss increased with the continuation of storage period reached to 7.437%mg 100 g^{-1} after four weeks of storage.

In regard to Binary interaction between hybrids and training methods, there were significant differences between factorial treatments, the lowest percentage of weight loss was in the fruits of the Silyon RZ F1 hybrid plants with one stem, which amounted to (2.603%), while the highest percentage of weight loss was in the fruits of hybrid plants Rami F1 with two stems (4.093%). As for the interaction between hybrids and the storage periods, it is clear that the highest percentage of weight loss was in the fruits of the Rami F1 hybrid after four weeks of storage, which amounted to (8.929%). It should be noted that the fruits of hybrids had no loss in weight until the end of the first week of storage. The results of the same table also indicated to the significance of the interaction between the training methods and the storage periods, as it is noticed that the highest percentage of weight loss was in the fruits of plants with one stem after four weeks of storage, which amounted to (7.457%). In regard to triple interaction, the highest percentage of weight loss was in the fruits of the Rami F1 hybrid plants with one stem after four weeks of storage, which amounted to 8.981%.

The increment in the percentage of weight loss by increasing the storage period is due to the decrease in the weight of the fruits as the storage period progresses as a result of the loss in the water content of the fruits with the continuation of the storage period as well as the consumption of food stored in the fruit as a result of the respiration process *(Taain ,2005, Taain et al., 2017).*

Table 2

The effect of hybrids, the training methods, the storage periods and the interaction among them in the percentage of weight loss of the cucumber fruits stored at 13 ° C.

Hybrids	Training methods	Storage periods(weeks)				Hybrids= Training methods
		1	2	3	4	
BARAA 138 F1	One stem	0	1.121	3.652	6.555	2.832
	Two stems	0	1.133	3.945	6.543	2.905
Sayff F1	One stem	0	1.265	5.671	8.111	3.761
	Two stems	0	1.281	5.888	8.133	3.825
Silyon RZ F1	One stem	0	1.111	3.121	6.181	2.603
	Two stems	0	1.125	3.333	6.116	2.643
Rami F1	One stem	0	1.271	5.961	8.981	4.053
	Two stems	0	1.285	6.211	8.877	4.093
						Means of hybrid
Hybrids + storage period	BARAA 138 F1	0	1.127	3.798	6.549	2.868
	Sayff F1	0	1.273	5.779	8.122	3.793
	Silyon RZ F1	0	1.118	3.227	6.148	2.623
	Rami F1	0	1.278	6.086	8.929	4.073
						Means of training method
Training Methods+ Storage periods	One stem	0	1.192	4.601	7.457	3.312
	Two stems	0	1.206	4.844	7.417	3.366
Means of storage periods		0	1.199	4.722	7.437	

hybrids	Training methods	storage periods	Hybrids= Training methods	Hybrids + storage periods	Training Methods+ Storage periods	Triple interaction
0.877	0.235	1.165	1.115	1.563	1.862	2.366

Percentage of total soluble solids (T.S.S). Table 3 showed the effect of the hybrids, the training methods, the storage periods and the interaction among them on total soluble solids percentage of cucumber fruits.

It is noted from the table that the highest percentage of total soluble solids (3.405%) was in the fruits of the Silyon RZ F1 hybrid with no significant difference from the fruits of the hybrid BARAA 138 F1 and with significant differences compared to the rest of the hybrids, while the lowest percentage of total soluble solids (3.132%) was in the fruits of the Rami F1 hybrid.

The same table showed that there were no significant differences between the two training methods of cucumber plants in affecting the total soluble solids percentage of fruits. As for the effect of the storage period, it is observed that the fruit content of total total soluble solids decreased with the continuation of storage period. This may be due to its consumption by respiration, and this result is consistent with Choi et al. (2015) for Baegdadagi cucumber fruits.

The table also showed a significant difference between the hybrids and training methods, as the fruits of the hybrid BARAA 138 F1 with the training method on one stem recorded the highest percentage of total soluble solids (3.621%), while the lowest percentage of total soluble solids was in the fruits of the hybrid Silyon RZF1 and Rami F1 F1 with the training method on two stems that amounted to (2.968%).

As for interaction between the hybrids and the storage periods, it was significant, as the fruits of the hybrid BARAA 138 F1 excelled in recording the highest percentage of total soluble solids after a week of storage amounted to (4.340%), while the lowest percentage of the total soluble solids (2.527%) was in the fruits of the hybrid BARAA 138 F1 after four weeks of storage.

The results of the same table indicated to the interaction between the training methods and the storage period, the highest percentage of total soluble solids was in the fruitsof hybrids with the training method on one stem after a week of storage, which was recorded (4.034%), while the lowest percentage of the soluble solids recorded by the fruit of hybrids of two stems training method for four weeks storage period, which amounted to (2.530%), In regard to triple interaction, the BARAA 138 F1 hybrid plants with one stem for a week storage period gave the highest percentage of total soluble solids amounted to (5.147%), while the lowest percentage was in the fruits of the Rami F1 hybrid with one stem for three weeks of storage, which amounted to (2.250%).

Table 3

The effect of hybrids, the training methods, the storage periods and the interaction among them in the percentage of total soluble solids of the cucumber fruits stored at 13 ° C.

Hybrids	Training methods	Storage periods(weeks)				Hybrids= Training methods
		1	2	3	4	
BARAA 138 F1	One stem	5.147	3.690	3.017	2.630	3.621
	Two stems	3.533	2.533	3.993	2.423	3.121
Sayff F1	One stem	3.733	3.340	3.220	3.293	3.402
	Two stems	3.397	3.500	3.477	2.573	3.237
Silyon RZ F1	One stem	3.327	3.717	3.120	3.430	3.398
	Two stems	3.610	3.670	3.497	2.873	2.968
Rami F1	One stem	3.927	3.150	2.930	3.200	3.302
	Two stems	3.633	2.860	3.107	2.250	2.968
						Means of hybrid
Hybrids + storage period	BARAA 138 F1	4.340	3.112	3.505	2.527	3.371
	Sayff F1	3.565	3.420	3.348	2.933	3.317
	Silyon RZ F1	3.468	3.693	3.308	3.152	3.405
	Rami F1	3.780	3.005	3.018	2.725	3.132
						Means of training method
Training Methods+ Storage periods	One stem	4.034	3.474	3.072	3.138	3.431
	Two stems	3.543	3.141	3.518	2.530	3.184
Means of storage periods		3.789	3.308	3.295	2.834	

hybrids	Training methods	storage periods	Hybrids=Training methods	Hybrids + storage periods	Training Methods+ Storage periods	Triple interaction
0.03754	0.2225	0.04335	0.07508	0.07508	0.06502	0.13005

CONCLUSIONS

In conclusion, the results obtained in the present work clearly indicated that cucumber hybrids (Sayf F1, Silyon Rz F1, Baraa 138F1 and Rami F1) can be stored for four weeks at 13°C . Silyon RZ F1 hybrid fruits recorded the lowest percentage of weight loss and the lowest percentage of decay with no significant difference with Baraa 138 F1 hybrid fruits, while Silyon RZ F1hybrid fruits recorded the highest percentage of total soluble solids, with no significant difference with Baraa 138 F1.

Results also showed no significant differences between the two methods of training (one stem, two stems) in studied parameters.

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