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Effect of some agricultural treatments on fruits storage quality of two tomato hybrids cultivated in gypsum soil

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Abstract

The research was conducted at horticulture laboratory. The fruits were stored in cold storages of Food and Dairy Department, College of Agriculture, Tikrit University, Iraq during the agricultural season 2010, to study the effect of treatments (calcium chloride 150 mg.l^{-1} + urea 0.05% + calcium chloride and gamax extract $cm^3.l^{-1}$ and biofertil EM1 4 ml.l^{-1}) on fruit storage characteristic of tomato hybrids Jinan and Hassan. The fruits were harvested when they reached a ripening stage and filled in corky boxes within 10 kg capacity and stored in cold storage on 4°C for four weeks, then the laboratory measurements were done at three times (at fruits harvested, after two weeks of storage and after four weeks). The CRD was used with three replication for each treatment with 5 kg fruits and then the results were compared by using LSD test at the 5% probability level. The results showed that the biofertile and chloride and gamax treatment had less level of weight missing of fruit (16.89, 14.47 and 11.86 %) respectively, while the chloride, urea + chloride calcium had the highest fruits hardness at the end of storage. gamax treatments, calcium chloride, urea + calcium chloride, decreased the fruits respiration rate, whereas the urea and gamax reserved high vitamin contents, urea treatment + $CaCl_2$ reserved high content of juice lycopene. Hassan hybrid reserved the least weight loss up fruits 6.92% and highest acidity, while Jinan reserved the least respiration rate with 7.87 mg CO_2 . $kg^{-1}.hr^{-1}$. Fruits storage period affected the increasing weight loss and decreased the total acidity and fruits hardness and high fruit respiration rate at the storage end.

Keywords: Tomato, Agricultural treatments, Storage, Quality, Gypsum soil.

Introduction

Tomato (*Lycopersicon esculentum* MILL), which belongs to the family Solanaceae, is considered the most common vegetable crops in the world for its economic importance and the possibility of being processed and stored. The production of tomato in Iraq was about 802,386 tons for the year 2008, according to Central Bureau of Statistics and Information Technology, Ministry of Planning, Iraq (2009). Tomato has high value as food, where each 100 g of fruits contains 93.5 g water, 0.22 calories, 1.1 g protein, 0.2 g fiber, 0.23 mg vitamin C, 900 units worldwide of vitamin A and 0.06 mg vitamin B1 (Bose and Som, 1986). Tomatoes are sensitive to the trading and marketing and perishable after harvest where the proportion of damage may reach to 20% and exceeds to 42% in developing countries (Pantastico and Bautista, 1976).

To reduce the rate of spoilage in stored fruits, agricultural treatments that provide macro and micro nutrients essential have been used for plant growth, as the lack of any of them leads to defects in growth and production. Some of these elements are found in the soil with good quantities but the ready for the plant is hardly compatible with the needs of natural growth of the plant, as some nutrients in some lands face many factors that determine the movement and readiness for the benefit of plant growth. Plants in these lands, in many cases when fertilizers are added, do not respond to the soil because of the continuing decline in the readiness of the plant (Abduul, 1986). Therefore, leaf feeding by spraying vegetative parts of plants with diluted salt solutions of nutrients for number of times was one of the important and successful methods to meet the lack of nutrients and micro nutrients and to some extent the major nutrients (Al-Muharib, 2008). Hall (1977) found that the level of calcium has an effect on the absorption of other elements,

especially magnesium. Ringey and Wills (1981) stated that there is a strong negative relationship between the content of the fruits of calcium in tomato and the physiological age where calcium content in the fruit decreased as the maturity advanced. Al-Dulaimi (1984) administrated calcium concentration 1% and nitrogen level 60 g $N.m^{2-1}$on tomatoes, found an increased in the amount of marketable production, and the calcium increased the hardness of fruits at harvest time and after storage , also the natural tomato contains about twice what the fruits infected with stink of flower edge blossom end rot (BER) of calcium contain.

Robert (1995) studied the effect of different levels of nitrogen fertilizer (0.0, 40, 60 and 100 kg $N.ha^{-1}$) on tomato and found that the increase in fruit weight and size was at the rate of fertilization 40 kg $N.ha^{-1}$.

Marck (1996) showed a significant increase in the length and fruit diameter of tomato due the increasing levels of nitrogen fertilization when using 0.0, 50 ,100 kg $N.ha^{-1}$ with the rates of 5.2 and 4.2 cm respectively. Teruo *et al.* (1996) showed that the yield of tomato in Japan will increased when adding solutions of calcium and the calcium has a primary role in the infection of BER and its addition in the form of calcium nitrate or calcium chloride may reduce the occurrence of this phenomenon, but when calcium was added in the form of nitrate, it increased the sum total of the plant production. Taylor *et al.* (2002) in a study in Florida on tomatoes by using calcium in the form of calcium nitrate, thiosulfate calcium, calcium chloride and sulphide of calcium to determined their impact on the occurrence of BER and the production of the plant, they found that tomatoes treated with nitrates of calcium were reduced by disease BER as compared with plants that have been treated with other forms of calcium, and the production was more in the treatments to which the calcium nitrate and calcium chloride had been added as compared to the treatment of thiosulfate calcium, and plants that had to add calcium nitrate contained highest concentrations of calcium in the leaves and fruits.

Dawood *et al.* (2001) studied several varieties of tomato in the province of Diyala, Iraq (Daual Royal, RS 2786, Narita, Speedy, Parts 113185 with hybrid GS 12 for comparison), results showed that Daual Royal, RS 2786, Narita and Speedy were superiority over the others in the early production at 6.24, 5.81, 6.31 and 6.85 $tons.acre^{-1}$, respectively as compared with the hybrid GS 12, which produced 4.71 $tons.acre^{-1}$, and the sum total were 17.81, 17.44, 18.47 and 18.46 $tons.acre^{-1}$ respectively as compared with the hybrid GS 12, which was 13.954 $tons.acre^{-1}$. The average fruit weight were 172 177, 198.5 and 174 g respectively as compared with the hybrid GS 12, which was 131 g. Loewn (2003) compared 36 varieties of tomatoes, results showed that the character of absorbed materials has excelled in the category N 1980 and reached 4.93% and was the lowest in the category FG 99-44 which gave 3.5%.

Nowadays seaweed extracts, which consists of weeds, algae and marine plants, are used in a wide range and they are a source of natural growth and nutrients and the most species that are produced commercially is one of the seaweed *Ascophyllum nodosum*. The extract algamix has been used in this study, which is a natural source of many big and small nutrients such as N, Ca, Mn, Zn, Mg (Al-Allaaf, 2009; Suhail, 2013).

In addition, the extract works to an increase in the process of photosynthesis by increasing the chlorophyll content of leaves. O'Dell (2003) confirmed that extracts of seaweed contains nutrients necessary for plants as major nutrients (N, P and K) and micronutrients (Mg, B, Zn, Mo, Fe and Cu) as well as plant hormones such as auxins, gibberellins and cytokinines. These hormones lead to increase the efficiency photosynthesis in addition to the fact that extracts of seaweed work to protect the plant from stress such as cold, drought, old age, by supporting and strengthening the tissues of plant cells.

When estimating the chemical content of 26 species of seaweed, Rizvi (2003) showed that it contained N, followed by Ca and small amounts of Co and Cu. Van-staden and Crouch (1993) found that tomato plant treated with seaweed *Ecklonia maxima* extract by spraying it on the shoot led to fruit ripening in speed and increased the wet weight of the sum to 17% while the final production increased by 15%. Also, spraying tomato plant several times (4 and 7) with concentration (28 and 24 $oz.lker^{-1}$) respectively, with seaweed *Ascophyllum nodosum* extract led to a significant increase in the marketable production (Csizinszky, 1994).

O'Dell (2003) proposed that extracts of sea herbs Norway and Nova Scotia, which contain a high proportion of cytokinin and humic acid and other plant hormones, increased the plants

efficiency of the process of photosynthesis and give resistance against the environmental stresses.

Eris *et al.* (2004) studied the effect of seaweed extract of *Ascophyllum nodosum* on peppers (Class: California Wonder) by spraying in five stages of growth, they noted a significant increased in soluble solids (TSS) and chlorophyll content in fruits and a significant increased in the production of fruits and 10 days earlier in production, with a significant increased in the length of the fruit diameter as increased the concentration of sea extract.

Al-Bayati (2010) used four sea plant extracts (marmarine, algaren, L-24 soluamine and alga 600) by sprayed them on potato with concentrations (1.5 and 3) ml. l^{-1} (1.5 and 3) ml. l^{-1}, (1 and 2) ml. l^{-1} and (1 and 2) g.l^{-1}, respectively, which sprayed three times, first at 45 days after planting, the second was after a month of the first spray and the third after a month of the second spray. results showed that there was a significant increased in the qualities of production for marketing and in the average tuber weight for both seasons.

The enriched bio-EM1 is an abbreviation of the term effective micro-organisms, which is a normal product having a consistent set of beneficial micro-organisms and has an active and effective role in improving soil fertility. It is also a safety product from a health point where the microorganisms in it is not modified genetically and does not contain pesticides or harmful chemicals. EM1 is composed of more than of 60 species of living organisms beneficial and which includes several groups of microorganisms, also it contains photo synthetic bacteria that have the ability to grow under different environmental conditions, producing different materials such as amino acids, sugars that promote the growth of plants and lactic acid bacteria which has a strong inhibiting effect that resists the growth of some fungal disease. It also helps to reduce the degree of interaction (pH) in the surrounding medium which helps dissolve nutrients and being absorbed by the plant (Higa, 2006). Wididana and Higa (1994) added enriched bio-EM1 at several levels (0.1, 0.5 and 1%) from one to two weeks, results revealed increased in the proportion of plants chlorophyll of tomato, onion, garlic and water melon.

Materials and Methods

The study was conducted at the Research Laboratories in the Department of Horticulture and Landscaping and cold stores at the Department of Food Science and Bio-Technologies, College of Agriculture, University of Tikrit, Iraq during the season of 2010, to study the effect of some agricultural factors in storage qualities of hybrids tomato (Jinan, Hassan). The tomato seeds of Jinan and Hassan hybrids were planted in cork dishes in the greenhouse of the Department of Horticulture and Landscape in January 17th 2010. The field soil has been prepared and the process of transplanting was done on 17/3. That was done on terraces of 3 m length and the distance between the terrace and the other 1.50 m, on both sides of the terrace. The distance between one seedling and the other was 30 cm and two terraces per experimental unit were used. Thus, each experimental unit contained 36 plants. The treatments were distributed randomly with three replicates. Service operations and other agricultural operations were performed as recommended (Matloob *et al.*, 1989) and plants were treated after 14 days of transplanting in the permanent place with the following treatments, as follows:

1.Control treatment without spray (T0).
2.Spraying calcium chloride, 150 mg.l^{-1} at the beginning of the fruit set and were repeated every 14 days by 4 times (T1).
3.Spraying urea with the concentration of 0.05% and spraying urea fertilizer every 15 days between each spray and the other up to the stage of fruit ripening (T2).
4.Spraying 0.05% urea + spray calcium chloride, 150 mg.l^{-1} every 15 days up to the stage of fruit ripening (T3).
5.Spraying paper gamax fertilizer 3 ml.l^{-1} every 15 days up to the stage of fruit ripening (T4).
6.Adding vital vertilizer-EM1 4 cm^3.l^{-1} in the soil two weeks after transplanting and were to be repeated every week until fruit ripening (T5).

Fruits of tomato hybrid plants have been reaped manually after they reached to the stage of full maturity. The damaged fruits were excluded and then the remaining corps was washed. Initial measurements of the studied characteristics have been made and fruits have been filled in cork boxes, and stored in the mechanically cold warehouse at a temperature (4^{o}C) for 4 weeks. In the analysis of the results a complete randomized design (CRD) has been used with factorial experiment by three replicates per treatment and the weight of 5 kg of fruit per duplicate. Averages

were compared using LSD test at the 5% probability level of probability and the statistical software was used (SAS, 2001) in analyzing the results and taking the initial laboratory measurements at the beginning of storage and after two and four weeks of cold storage. The qualitative studies included.

1- The percentage of weight loss: The percentage of weight loss has been calculated, according to the following equation: -

$$= \frac{\text{weigh of fruits loss}}{\text{total weight}} \times 100$$

2- Estimation of hardness: a pressure tester has been used and reading was $kg.cm^{2\ -1}$. A metal drill diameter of 1 cm has been used to read the hardness of fruits.

3- Percentage of total soluble solids was measured in the fruit juice-by using hand refractometer

4- The respiration speed was calculated using the fruits closed system as stated in (Al-Ani, 1985) and estimated according to the following equation: -

The molecular weight of CO_2 = 12 +16 × 2 = 44

Number of CO_2 milligrams resulting from respiration = the number of equivalent weights of the interacting base × 22. Equivalent weight of CO2 = 44 divided by 2 = 22.

mg CO_2 = NO. of equivalent of NaOH reacting × 22

5- Percentage of total acidity: was calculated by extracting a particular amount of fruit juice with sodium hydroxide (0.1N). Phenolphthalein was used on the grounds that citric acid is the predominant acid according to (Ranganna, 1977).

6- Vitamin C content has been estimated by extracting a particular amount of fruit juice with the pigment 2-6-diclorophenolindopheols as stated by (Ranganna, 1977).

7- Estimation of the lycopene pigment: was estimated according to Delia (2001) by taking (1 g) of the sample to be crushed with 10 ml of petroleum ether, then filtered and measured in a spectrophotometer at wavelength 470 nm. Applying the equation we get the amount of pigment lycopene (mg. g^{-1} fresh weight).

Where, A = absorbance of sample at wavelength at 450 nm, Y = the volume of ethanol used.

Results and Discussion

1 - Percentage of weight loss:

Agricultural treatments led to significant effects in the percentage of weight loss in the two hybrids of tomatoes, Jinan and Hassan which were stored for 15 and 30 days (Table 1). The lowest weight loss was in fruits treated with urea stored for 15 days reached 3.83%, in which the proportion of weight loss decreased to 8.81% compared to the control. With fruits stored for 30 days, agricultural treatments resulted in significant weight loss where treatments of vital fertilizer and calcium chloride were marked by weight loss (11.86 and 14.47%) respectively compared to the control treatment in which the percentage of weight increased to 29.21%.

Storage period led to significant loss in the proportion of weight loss, where the ratio of weight loss was 4.95 % after 15 days of refrigerated storage, and the percentage loss in weight increased to 18.43% after 30 days of cold storage.

Tomato hybrids significantly affected in the percentage rate of weight loss of fruit stored for 30 days, where tomato hybrid Hassan kept on the lowest rate of weight loss of 6.92% while the percentage of weight loss increased significantly in tomato hybrid Jinan to 8.66%.

Interference between the treatments and the duration of storage resulted in a significant effect, where the lowest percentage of weight loss of 3.83% in the treatment of urea interference and duration of storage 15 days while the percentage of weight loss increased in the interference of control stored for 30 days to 29.21%,

Interference between the hybrid and the duration of storage resulted a significant effect where less significant proportion of weight loss was 4.23% in Hassan hybrids after 15 days of storage and the highest percentage of weight loss of 20.31% in the Jinan hybrids after 30 days of storage. The interference of treatments with hybrids was also significant, where the lowest weight loss in the treatment of vital fertilizer with Hassan hybrid 3.39% and the highest weight loss was 16.81% in Hassan hybrid interference with the control treatment .

Interference between hybrid and the duration of storage was also significant. The lowest weight loss was 3.09% in the interference of hybrid Jinan with control treatment for the period of storage 15 days. The percentage of weight loss increased in the interference of hybrid Hassan in the control treatment and storage 30 days to 45.11%.

Treatments led to reduction of the proportion of weight loss. This may be due to the role of minerals especially calcium, in destroying the cell wall in particular especially the central plate and reducing the rate of respiration of fruits (Table 3),

Table (1): The Impact of agricultural treatments and the duration of storage to the percentage of weight loss of tomato hybrids Jinan and Hassan.

Variety (V)	Treatments (T)	Storage duration(day (D)			Treatment effect (T)
		D0	D15	D30	
D x T	T0	0.00	4.21	29.21	11.33
	T1	0.00	4.40	14.47	6.29
	T2	0.00	3.83	17.25	7.02
	T3	0.00	5.56	20.88	8.81
	T4	0.00	6.11	16.89	7.66
	T5	0.00	5.61	11.86	5.82
Storage duration effect (D)		0.00	4.95	18.43	
					Variety effect (V)
D x V	V1	0.00	5.67	20.31	8.66
	V2	0.00	4.23	16.54	6.92
					V x T
V1	T0	0.00	3.09	13.31	5.46
	T1	0.00	4.41	17.58	7.33
	T2	0.00	3.53	26.04	9.85
	T3	0.00	7.10	22.30	9.89
	T4	0.00	8.35	25.48	11.27
	T5	0.00	7.57	17.19	8.25
V2	T0	0.00	5.32	45.11	16.81
	T1	0.00	4.39	11.37	5.25
	T2	0.00	4.14	8.46	4.20
	T3	0.00	4.02	19.47	7.83
	T4	0.00	3.88	8.30	4.06
	T5	0.00	3.66	6.53	3.39

LSD 5%

V	D	T	T × V	T × D	V × D	T × D × V
0.63	0.77	1.09	1.55	1.90	1.09	2.69

that resulted in reducing the consumption of food that is involved in respiration calcium also activates enzymes responsible for the formation of galacturonic acid which is a unit of the building protopectin materials that are related to calcium and increase the hardness of the cell wall (Faust and Shear, 1972 and McGuire and Colman, 1986 and Al-Ani, 1985). Weight loss increased as the duration of storage increased, this may be also due to the increase of the loss of humidity past from the stored fruit and the continuation of vital activities that occur in the fruits including respiration and transpiration.

2 - Hardness:

Table (2) shows the results of the impact of treatments and the storage duration on the Jinan and Hassan hardness fruits stored for 30 days. Treatments of calcium chloride and the treatment of urea + calcium chloride are characterized by giving the highest hardness of the fruit (5.52 and 5.46) $kg.cm^{2\ -1}$ respectively, but they did not reach level significance. The lowest hardness of the fruit was 4.63 $kg.cm^{2\ -1}$ in fertilizer vital treatment fruits. The results showed that the period of storage had an impact on the hardness of the fruits. The hardness decreased with the progress of storage where the hardness at the beginning of storage was (5.36) kg / cm^2 and decreased at the end of storage, which lasted for 30 days to 4.77 $kg.cm^{2\ -1}$. The Table shows that the storage of tomato hybrids Jinan and Hassan did not show significant differences between them in the character of hardness of the fruits stored for 30 days. The results of Table (2) show that the interference between treatments and the duration of storage, and interference between the tomato hybrids and the duration of storage, and interference between the hybrid and treatments

Table (2): The impact of agricultural treatments and the duration of storage in the hardness of tomato hybrids Jinan and Hassan.

Variety (V)	Treatments (T)	Storage duration days (D)			Treatment effect
		D0	D15	D30	(T)
D x T	T0	5.21	4.76	4.27	4.75
	T1	6.31	5.09	5.18	5.52
	T2	5.22	5.62	4.79	5.21
	T3	5.60	5.40	5.38	5.46
	T4	4.93	5.30	4.67	4.96
	T5	4.90	4.65	4.34	4.63
Storage duration effect (D)		5.36	5.14	4.77	
					Variety effect (V)
D x V	V1	5.73	5.12	4.65	5.17
	V2	4.99	5.15	4.89	5.01
					V x T
V1	T0	4.88	4.65	3.63	4.39
	T1	6.13	4.87	5.28	5.43
	T2	6.02	5.52	4.43	5.32
	T3	5.6	5.4	5.43	5.48
	T4	5.98	5.03	4.70	5.24
	T5	5.77	5.27	4.4	5.14
V2	T0	5.54	4.87	4.9	5.10
	T1	6.48	5.3	5.07	5.62
	T2	4.42	5.72	5.15	5.09
	T3	5.6	5.4	5.32	5.44
	T4	3.87	5.57	4.63	4.69
	T5	4.03	4.03	4.27	4.11

LSD 5%

V	D	T	T × V	T × D	V × D	T × D ×V
N.S	N.S	N.S	N.S	N.S	N.S	N.S

and interference between the treatments, the duration of storage and hybrid did not reach the level of significance. The reason of storage effect in reducing the hardness of fruits could be due to prolong storage. The prolong storage lead to increased in respiratory rate, which activates the vital activities within the cells of fruits and separates the protopectin links between cells causing decreased force cohesion (Westwood, 1978) where protopectin has a role in the composition of walls of cell particularly central plate which is the binder. As the maturity progresses, the protopectin material dissolved in water increases due to the decomposition of polygalacturonic acid and the formation of galacturonic acid dissolved in water (Al-Ani, 1985).

3 - Total soluble solids

The results shown in Table (3) indicate the lack of significant effects of treatments in the proportion of total soluble solids in tomato stored for 30 days. There are no significant effects of the hybrids and the duration of storage in this character. Also, there are no significant differences in the percentage of dissolved solids as a result of interference between treatments and the duration of storage, interference of hybrid and the duration of storage, interference between the treatments and the hybrid and the interference between the treatments and the duration of storage and hybrid, as shown in Table (3).

4 - Respiration rate of fruits:

From the results of this study, it is noted that the treatments affected the respiration speed of tomato hybrids Jinan and Hassan. It is found from

Table (3): The impact of agricultural treatments and the duration of storage in the proportion of total soluble solids in fruits of tomato hybrids Jinan and Hassan.

Variety (V)	Treatments (T)	Storage duration(day (D)			Treatment effect (T)
		D0	D15	D30	
D x T	T0	4.62	4.47	4.28	4.46
	T1	4.07	4.78	4.12	4.32
	T2	4.65	4.92	4.88	4.82
	T3	4.90	4.25	4.58	4.58
	T4	3.77	4.48	3.97	4.07
	T5	4.66	4.69	4.17	4.50
Storage duration effect (D)		4.44	4.60	4.33	
					Variety effect (V)
D x V	V1	4.47	4.46	4.44	4.45
	V2	4.42	4.73	4.22	4.46
					V x T
V1	T0	4.66	3.93	4.63	4.41
	T1	3.66	4.86	3.23	3.92
	T2	4.00	4.50	5.66	4.72
	T3	5.50	4.53	5.23	5.09
	T4	4.33	4.23	3.60	4.05
	T5	4.66	4.73	4.30	4.56
V2	T0	4.58	5.00	3.93	4.50
	T1	4.48	4.70	5.00	4.73
	T2	5.30	5.33	4.10	4.91
	T3	4.30	3.96	3.93	4.06
	T4	3.21	4.72	4.33	4.09
	T5	4.65	4.65	4.03	4.44
LSD 5%					
V	D	T	T × V	T × D	V × D	T × D × V
N.S	N.S	N.S	N.S	N.S	N.S	N.S

the Table (4), Figure (1) that the treatment of gamax, kloredalcalseyoum treatment and the treatment of urea + calcium chloride affected significantly in reducing the rate of respiration to 9.01, 9.80 and 9.85 mg $CO_2.kg^{-1}.hur^{-1}$, respectively, as compared with the control treatment where the rate of respiration of fruits increased to 10.10 mg $CO_2.kg^{-1}.hur^{-1}$. Also, the treatment of gamax led to a significant reduction in the fruits rate of respiration of fruits compared to the treatment of vital fertilizer where speed of the respiration of the fruit increased to 10.39 mg $CO_2.kg^{-1}.hur^{-1}$. The cause of the low rate of respiration of fruits in the treatments of calcium and gamax might be due to their work of maintaining the cell wall and preventing the decomposition of membranes, cytoplasm, alandoblazem and almetukondria (Hopfinger and Poovaiah, 1978), which reducing the production of ethylene, low respiration and delaying aging (Chien *et al.*, 1993).

Storage of fruits led to significant reduction in the rate of respiration of fruits after 15 days of storage to 9.30 mg $CO_2.kg^{-1}.hur^{-1}$ where the rate of respiration of fruits at the beginning of storage was 9.669 mg $CO_2.kg^{-1}.hur^{-1}$ and then increased after 30 days of storage to 10.68 mg $CO_2.kg^{-1}.hur^{-1}$.

Figure (1) shows fruits respiration of tomato hybrid during storage when tomato hybrid Jinan continues to rise in the rate of respiration with the progress of storage. Whereas the rate of breathing of the fruits of the hybrid Hassan decreased after 15 days of storage then fruit breath speed headed to rise until the end of the storage. The Table shows that hybrid tomato has a significant effect in the rate of respiration of fruits. Tomato hybrid Jinan is marked by a significant reduction in the

rate of respiration of fruits to 7.87 mg $CO_2.kg^{-1}.hur^{-1}$ as compared to the speed of respiration of tomato hybrid Hassan which rises to 11.90 mg $CO_2.kg^{-1}.hur^{-1}$. The impact of interference between the treatments and the duration of storage is significant as gamax treatment, after 15 days of storage, gave the lowest speed of respiration 7.21 mg $CO_2.kg^{-1}.hur^{-1}$, while the treatment of the vital fertilizer at the beginning of the storage gave a higher rate of breathing 12.23 mg $CO_2.kg^{-1}.hur^{-1}$.

As the Figure shows, there are significant effects as a result of interferences between the fruits of tomato hybrid and duration of storage, where the lowest speed of respiration in the fruits of hybrid Jinan at the beginning of storage is 6.52 mg $CO_2.kg^{-1}.hur^{-1}$ and the highest rate of respiration in the fruits of hybrid Hassan at the beginning of storage is 12.85 mg $CO_2.kg^{-1}.hur^{-1}$.

Also, there are significant interferences as a result of treatments with tomato hybrid as well as significant interference between the treatments and tomato hybrid and duration of storage, as shown in Table (4).

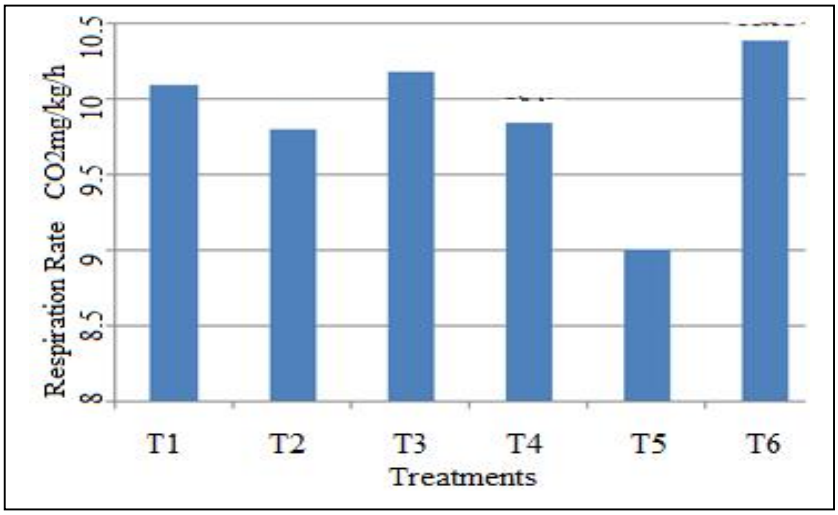

Figure (1): The impact of treatments on the respiration rate of tomato hybrid.

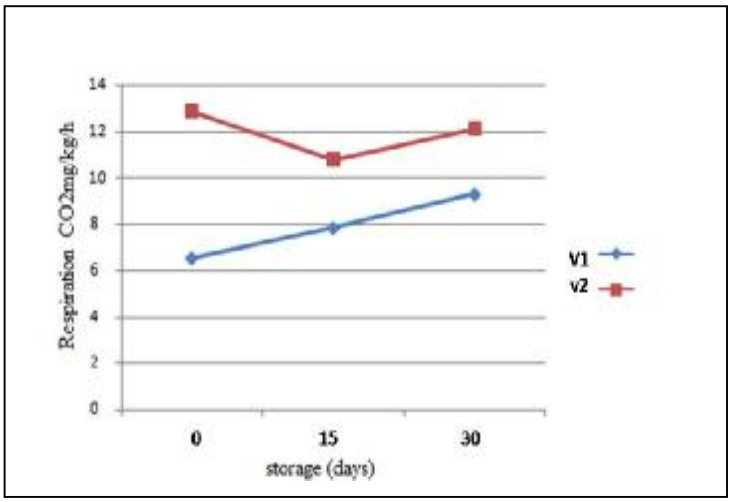

Figure (2): The impact of storage time on the respiration rate of tomato hybrid Jinan V1 and V2 Hassan.

Table (4) The impact of agricultural treatments and the duration of storage in the rate of respiration of tomato hybrids to Jinan and tomato Hassan.

Variety (V)	Treatments (T)	Storage duration(day (D)			Treatment effect (T)
		D0	D15	D30	
D x T	T0	9.38	9.95	10.96	10.10
	T1	6.74	10.95	11.71	9.80
	T2	8.86	11.41	10.31	10.19
	T3	11.30	7.73	10.53	9.85
	T4	9.63	7.21	10.20	9.01
	T5	12.23	8.53	10.40	10.39
Storage duration effect (D)		9.69	9.30	10.68	
					Variety effect (V)
D x V	V1	6.52	7.82	9.28	7.87
	V2	12.85	10.78	12.09	11.90
					V x T
V1	T0	6.05	9.33	8.80	8.06
	T1	6.25	8.83	11.12	8.73
	T2	6.53	8.53	9.34	8.13
	T3	5.89	7.06	8.08	7.01
	T4	8.21	6.07	9.30	7.86
	T5	6.21	7.09	9.04	7.45
V2	T0	12.71	10.57	13.12	12.13
	T1	7.23	13.07	12.29	10.86
	T2	11.18	14.29	11.28	12.25
	T3	16.71	8.40	12.97	12.69
	T4	11.05	8.35	11.09	10.16
	T5	18.24	9.97	11.76	13.32

LSD 5%

V	D	T	T × V	T × D	V × D	T × D × V
0.76	0.94	1.33	1.88	2.30	1.33	3.26

5- Influence in the percentage of total acidity:

The results of Table (5) showed that the treatments have no significant effect in the proportion of total acidity, as the treatments of urea and vital fertilizer are characterized by highest acidity (0.69 and 0.65)%, followed by the impact of the treatment of urea + Kloredalcalseyoum and the treatment of calcium chloride and less acidity in the treatment comparison (0.61)%. Fruit storage led to a significant reduction in the proportion of total acidity where it was 0.78% at the beginning of storage and decreased to 0.50% at the end of storage. Tomato hybrid affected significantly in the rate of the proportion of total acidity. Hassan hybrid was characterized by highest acidity amounted to 0.68%, which significantly exceeded the proportion of total acidity in the fruits of Jinan hybrids which pH decreased to 0.59%. The results of statistical analysis refer to the presence of significant effects in the proportion of total acidity as a result of interferences between treatments and the storage duration, as the treatment of vital fertilizer at the beginning of storage is characterized by the highest acidity (0.85)% and the lowest percentage of acidity in the juice the fruits of the treatment of urea + kloredalcalseyoum at the end of storage is 0.44%. Also interference between the tomato hybrid and the duration of storage show significant interference. Tomato hybrid Hassan at the beginning of storage has the highest acidity (0.83)% and the lowest in the acidity of the juice of tomato hybrid Jinan after 30 days of cold storage

Table (5): The impact of agricultural treatments and the duration of storage in the proportion of total acidity in the fruit of tomato hybrids Jinan and Hassan.

Variety (V)	Treatments	Storage duration days (D)			Treatment effect
	(T)	D0	D15	D30	(T)
D x T	T0	0.77	0.58	0.48	0.61
	T1	0.74	0.69	0.47	0.63
	T2	0.75	0.67	0.67	0.69
	T3	0.80	0.68	0.44	0.64
	T4	0.77	0.60	0.46	0.61
	T5	0.85	0.60	0.51	0.65
Storage duration effect (D)		0.78	0.63	0.50	
					Variety effect (V)
D x V	V1	0.73	0.58	0.47	0.59
	V2	0.83	0.69	0.54	0.68
					V x T
V1	T0	0.74	0.55	0.45	0.58
	T1	0.69	0.58	0.45	0.57
	T2	0.73	0.56	0.63	0.64
	T3	0.70	0.61	0.42	0.58
	T4	0.77	0.58	0.45	0.60
	T5	0.73	0.59	0.39	0.57
V2	T0	0.79	0.60	0.51	0.63
	T1	0.79	0.79	0.48	0.69
	T2	0.77	0.77	0.70	0.75
	T3	0.90	0.74	0.45	0.70
	T4	0.77	0.61	0.46	0.61
	T5	0.96	0.60	0.63	0.73

LSD 5%

V	D	T	T ×V	T ×D	V ×D	T ×D ×V
0.07	0.08	N.S	0.17	0.21	0.12	0.29

is 0.47% Interferences between treatments and the hybrid and between the treatments and hybrid and the duration of storage show significant interferences as shown in Table (5). The reason for the low percentage of acidity with theoverall progress of storage might be due to the consumption of organic acids in the process of respiration (Table 5) and that citric acid is destroyed during storage as a result of Climacteric rise as well as the continuation of transpiration (Table 1) increases the process of respiration, which increases the consumption of organic acids because of the oxidative stress (Daoud, 1984).

6. Fruit content of vit. C (mg.100g^{-1})

Results from Table (6) show that the treatments have significant effect in vitamin C content of fruits where fruits content of vitamin C increases as a result of treatments. All treatments surpass significantly the control treatment in vitamin C juice content of treatments of extract gamax and urea + kloredalcalseyoum are characterized by the highest content of vitamin C (17.96 and 17.83 and 17.72 mg.100g^{-1}), respectively, which surpass significantly the vitamin C content of the fruits in the treatment of the comparison, which contained a lower content (14.93 mg.100g^{-1}) tomato hybrids Hassan and Jinan do not show significant differences in their content of vitamin C. As for the impact of storage in the content of the fruits of this vitamin, the results indicated in the same table refer to decrease in the content of the fruits of vitamin C significantly when storage prolonged, where the content of the fruits of vitamin C at the beginning of storage was (18.50) mg.100g^{-1}juice and dropped at the end of the storage to 15.95 mg.100g^{-1}juice, while the effect of interference between the treatments and the duration of storage, interference between the hybrid and the

Table (6): The impact of agricultural treatments and the duration of storage in the vitamin C content in fruits of tomato hybrids Jinan and Hassan.

Variety (V)	Treatments (T)	Storage duration days (D)			Treatment effect (T)
		D0	D15	D30	
D x T	T0	14.00	16.30	14.50	14.93
	T1	19.00	15.25	14.65	16.30
	T2	21.50	16.50	15.88	17.96
	T3	19.25	16.75	17.15	17.72
	T4	20.00	16.00	17.50	17.83
	T5	17.25	16.75	16.00	16.67
Storage duration effect (D)		18.50	16.26	15.95	
					Variety effect (V)
D x V	V1	18.50	16.27	15.91	16.89
	V2	18.50	16.25	15.98	16.91
					V x T
V1	T0	13.00	17.60	15.00	15.20
	T1	15.00	15.00	14.50	14.83
	T2	23.00	15.50	14.75	17.75
	T3	20.00	17.50	17.20	18.23
	T4	18.50	16.00	16.00	16.83
	T5	21.50	16.00	18.00	18.50
V2	T0	15.00	15.00	14.00	14.67
	T1	23.00	15.50	14.80	17.77
	T2	20.00	17.50	17.00	18.17
	T3	18.50	16.00	17.10	17.20
	T4	21.50	16.00	19.00	18.83
	T5	13.00	17.50	14.00	14.83

LSD 5%

V	D	T	T × V	T × D	V × D	T × D × V
N.S	0.94	1.32	1.88	2.30	1.32	3.25

duration of storage, interference between the treatments and the Hybrid and the interference between the treatments, the hybrid and the duration of storage all have significant impacts, as shown in Table (6).

The reason that the fruits of treatments retain high rates of vitamin C might be due to the containment of these treatments on elements such as calcium, which has a role in reducing the speed of respiration of fruits and the lack of oxidative stress. Thus, it maintained the integrity of cell membranes reducing permeability and reducing the access of oxygen through the membrane into the cells and the oxidation of ascorbic acid .The decrease in the content of fruits with vitamin C with prolonging the duration of storage could be due to oxidation of vitamin C by the enzyme oxidase and ascorase (Picchioni *et al.*,1995; Barreiro *et al.*, 2003).

7 - Lycopene Pigment (mg.100g^{-1}):

Table (7) shows that the treatments have significant effect to the content of the fruits of pigment lycopene which the treatment of urea + Kloredalcalseyoum has exceeded the treatment comparison to the highest content of the pigment (5.850) mg / 100 g whereas the content of the fruits of the treatment comparison of the pigment is (5.262) mg.100g^{-1} and the treatment of urea is characterized by the content of the pigment (5.511) mg.100g^{-1}, and less content of pigment lycopene is in the fruits of the treatment of calcium. The cause of the low content of pigment lycopene in the treatment of calcium is due to the role of calcium in the delay of ripening by reducing the speed of respiration and the production of ethylene, the decomposition of chlorophyll and the appearance of pigment lycopene (Al-Ani, 1985).

Table (7): The impact of agricultural treatments and the duration of storage in the content of the fruits of the pigment lycopene tomato hybrids Jinan and Hassan.

Variety (V)	Treatments (T)	Storage duration days (D)			Treatment effect (T)
		D0	D15	D30	
D x T	T0	5.846	4.981	4.959	5.262
	T1	4.899	4.462	5.043	4.801
	T2	4.984	5.094	6.454	5.511
	T3	5.480	5.464	6.606	5.850
	T4	5.761	4.909	4.957	5.209
	T5	6.219	5.072	4.704	5.332
Storage duration effect (D)		5.531	4.997	5.454	
					Variety effect (V)
D x V	V1	5.5314	4.9942	5.4536	5.326
	V2	5.531	5.000	5.454	5.329
					V x T
V1	T0	5.780	5.383	4.586	5.249
	T1	5.913	4.577	5.333	5.274
	T2	3.881	4.333	4.762	4.326
	T3	6.090	5.855	8.139	6.695
	T4	4.855	5.064	5.072	4.997
	T5	6.670	4.754	4.829	5.417
V2	T0	5.913	4.580	5.333	5.275
	T1	3.884	4.348	4.754	4.329
	T2	6.087	5.855	8.145	6.696
	T3	4.870	5.072	5.072	5.005
	T4	6.667	4.754	4.841	5.420
	T5	5.768	5.391	4.580	5.246

LSD 5%

V	D	T	T × V	T × D	V × D	T × D ×V
N.S	NS	0.443	1.879	2.302	1.329	3.255

Hybrid of tomato does not have a significant effect on the content of pigment lycopene. Besides, the storage duration does not have a clear impact on the concentration of the pigment as a result of these disparate effects of treatments on the concentration of the pigment at the storage of the fruits.

The effect of interference between the treatments and the duration of storage is significant as the highest concentration of the pigment is (6.606) mg.100g^{-1} in the interference treatment urea + calcium chloride after 30 days of storage and the lowest concentration of 4.462 mg.100g^{-1} the treatment of calcium chloride after 15 days of storage. Also, the other interferences are significant between the hybrid and the duration of storage; interference between the treatments and hybrid and the interference between the treatments and the duration of storage and Hybrid, as shown in Table (7).

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