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Maintaining Quality of Fruits and Vegetables
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An Overview on Postharvest Sector in Jordan

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Jordan

Introduction

Jordan has a very significant comparative advantage in the production and export of high value horticultural commodities during the off-season period, due to its location, unique climatic conditions, and proximity to traditional markets (Arab Gulf-States, Syria, Lebanon and Iraq) and EU eastern and western markets as compared to many other countries. Western Europe is the world's largest importing region for fresh fruit and vegetables, and Jordan initiated research to define market opportunities in Europe since 1991.

Jordan produces a wide range of horticultural crop almost year around. The Jordan valley which consider as a natural big green house make Jordan a good fresh fruit producer in winter season that could be exported to Europe. Jordan also produces horticultural crops in summer time at the high land areas to be exported to the Gulf-States where it's almost impossible to produce there under a very hot weather. Jordan is more than self-sufficient in most vegetables crops and self-sufficient in a few fruit crops.

Although Jordan have witnessed a tremendous change horizontally and vertically on fresh fruit and vegetables production during the last four decades, the post harvest sector has remained relatively unchanged, with high post harvest losses percentage, inefficient marketing systems, weak research and development capacity, and improper policies, infrastructure and information exchange. Such constraints within the post harvest sector have drawn the attention of the concerned agencies dealing with horticultural crops either from the public sector or from the private sector.

Post Harvest Losses

The range of post harvest losses in fruit and vegetables is estimated to be 5-20% in developed countries, and 20-50% in developed countries depending on the commodity. To reduce these losses percentages we must understand the biological and environmental factors involved in fruits deterioration, then use the post harvest technology procedures which will maintain quality and delay deterioration.

In Jordan, the post harvest sector is highly influenced by the marketing system. The marketing system of fresh horticultural crops suffers from different problems or constrains that limit the development of this sector. These problems and constrains affect either directly or indirectly the post harvest losses of horticultural commodities. Marketing problems and constrains can be divided in to subgroup in Jordan as follows:

Post harvest losses in Jordan are within the range of losses of many developing countries. Several studies had been conducted to estimate the losses for some important crops. The results revealed that the losses are high. The post harvest percentage losses were (19, 22, 23, and 18%) for tomatoes, squash, sweet pepper and eggplant, respectively. More investigation is required to determine the size of the problem in Jordan.

The post harvest losses causes in Jordan

1- Improper harvesting stage of maturity (immature, over ripe)

2- Improper postharvest handling practices in the marketing chain (field, wholesale markets, packing house of export firms, cold storages, transportation means, retailers and consumers).

3 - Improper packing (overfilling and over staking).

4- Improper package (poor material and design).

5- Absence of pre-cooling.

6 - Improper loading and unloading.

7- Absence of sorting any fruit not marketable from the field.

8- Water loss.

9- Poor temperature and relative humidity management.

10- Losses due to physiological, mechanical and pathological disorder.

11- Exposing the product to an appropriate conditions (light, temperature, relative humidity, rain, winds, ethylene).

12- In adequate transport means.

Infrastructures required for healthy marketing sector in Jordan

1- Efficient wholesale markets.

2- Packing house with grading machines

3- Efficient exporting firms.

4- Cold storages.

5- Apropraite ripening rooms.

6- Transportation means.

7- Pre-cooling units.

8- Package factories.

9- Marketing services

Export firms

There are two kinds of export firms in Jordan, depending on the targeted market. First kind is the export firms for the traditional markets (Arab Gulf-States, Syria, Lebanon and Iraq), and the second kind is the export firms to eastern and western Europe countries.

Traditional export firms

There are 40 export firms to the traditional markets.

All of them are owned by private sector

Export firms to Europe

There are 18 export firms to Europe .

Cold sorage fcilities

There are 60 cold storages facilities distributed in Jordan, with a storage capacity of 85000 ton.

Ripening rooms

There are 73 ripening room facilities,58 of them in Amman while the rest distributed in the cities of Jordan.

Transportation means

In Jordan, Mini-trucks, trucks, refrigerated trucks and airplanes are used to move fresh horticultural crops from shipping point to the destination markets. The major portion of exported crops is transported by refrigerated trucks mainly to the Arab Gulf-States, Syria, Lebanon, Iraq and Eastern Europe countries.

Pre-coling uits fcilities

Pre-cooling is removal of field heat from the fruits as soon as possible after harvest. This technology leads to a reduction in plant or plant part the following:

1- Respiration rate.
2-Water loss.
3-Ethylene production.
4-Pathogen infection.
5-Delaying ripening and senescence

In Jordan, the pre-cooling concept still limited for small-scale growers and unknown for many shippers (mainly shippers of traditional markets).

Packing and pckages fctories

Polystyrene. Plastic, carton and wooden boxes are used in Jordan for both local and export markets. Eight polystyrene factories located at different locations producing packages with several dimensions with a processing capacity to manufacture between 50,000 to 500,000 boxes a day. There are four factories producing more than 7 million of plastic boxes of different sizes annually. Four factories processing carton boxes. There are 20 manufacturing workshops for wooden boxes with different sizes and styles are operating in Jordan.

Vision for an active and an efficient marketing system for Jordan

1-An independent governmental umbrella involved only with marketing of fresh horticultural crops, and strongly co operate with private sector.

2-Qualified staff for both private and public sectors in the methods of production and marketing to insure high quality product.

3-Orientation the production in accordance with market demand.

4-Adequate infrastructure and marketing services.

5-Data base and market information intelligence.

6-Budjet financing agency for pre and postharvest technology required.

7-Strict and efficient legislations.

8-Anefficient exporting firms.

9-An active quality control system

10-Straight for wards training programs for growers on production (cultural practices) techniques and proper postharvest handling practices.

Post-harvest Losses of Tomatoes and Eggplants Produced for Local Market in Jordan

Introduction

Jordan produces a wide variety of horticultural crops around the year. Such an advantage is created by the combination of climate, soil, and topography of growing areas, namely the Jordan valley and the Uplands.

Tomato and eggplant are considered as fleshy fruit vegetables, although differ in their physiological characteristics from postharvest point of view. Tomato fruit, harvested mature, is a typical climacteric fruit, undergoes different metabolic changes associated with ripening in coordination with a climacteric rise in respiration, which marks the transition stage in the fruit development between maturation and senescence [2] . When harvested at the mature green stage, the fruit continues to develop and ripen similar to having been left on the plant [3, p 24]. On the other hand, eggplant, harvested immature, is a non-climacteric fruit that does not undergo the metabolic changes exhibited by tomatoes.

The objectives of this study were: to assess postharvest losses in tomatoes and eggplants grown in open fields in the Jordan Valley and the Uplands; to identify causes of these losses; and to propose means for reduction of postharvest losses.

Materials and Methods

Plant Materials: Tomato (Solanum lycopersicom L. cv. "GS12") and eggplant (Solanum melongena cv. "Black Beauty") fruits grown in the open field in the Jordan Valley (North and mid-valley) and in the Uplands (Al-Mafraq area) were subjected to this postharvest loss study. This study was carried out during October to July in the Jordan Valley (the minimum and maximum air temperatures were between 12.1 and 36.3℃), and during March to December in the Uplands (the minimum and maximum air temperatures were between 2.6 and 34.4℃) in 1999. Fruit samples of tomatoes and eggplants packed in polystyrene (Styrofoam) boxes (46 x 26 x 12 cm, holding 7-9 kg) were examined for postharvest losses at different levels (farm, transport, wholesale and retail markets) of the marketing chain. Fruits were handled traditionally as described below under postharvest practices for tomatoes and eggplants in Jordan.

Determination of postharvest losses: For each sample, ten boxes were taken at random at the study site. After weighing the contents of each box, unmarketable fruit (diseased, injured, immature green, very soft over mature, bruised, crushed, blemished etc.) were isolated, weighed (and returned into their box), and their percentage was calculated from the total weight of the box. The fact that postharvest losses are cumulative (i.e. increasing with the progression of postharvest handling) was taken into consideration in order to come up with the actual loss percentage at a given level. At the farm level, the percentage reported was the actual percentage of loss, since no preceding levels exist. Each of the reported percentages thereafter, was the result of subtracting the preceding percentage(s) from the newly obtained loss value for a given level. For example: the obtained loss at the transportation level was 11.6 – 6.0 (loss at the farm level) = 5.6 (actual loss at the transport level reported in Table 1).

Table 1. Percentages of postharvest losses of tomatoes and eggplants at four levels of postharvest handling in both growing areas

	Average loss %			
	Uplands		Jordan valley	
Postharvest handling	Eggplant	Tomato	Eggplant	Tomato
Farms	7.2	5.6	7.8	6.0
Transport	4.6	4.1	6.2	5.6
Wholesale market	1.8	1.1	2.1	1.5
Retail stores	5.4	6.3	1.9	2.7
Total loss	19.4	18.0	16.2	17.3

1. Represents the average of 90 boxes.
2. Means within the column followed by the same letter are not significantly different at $P<0.05$ levels by the LSD method.

Table 2. Color variation of harvested tomato fruit at the farm level.

Farm	Color stage1 (%)						
	G	B	T	P	LR	R	DR
J. V.[2]							
1st	4.3[3]	2.1	1.5	24.9	12.4	50.1	3.1
2nd	3.5	43.2	33.0	13.4	2.5	3.0	1.6
3rd	4.5	40.1	23.8	18.5	3.0	2.8	7.1
Up.[2]							
1st	2.1	40.1	28.1	21.1	1.4	3.2	3.3
2nd	3.7	4.1	2.8	10.4	27.1	41.7	1.7
3rd	3.2	2.9	5.1	21.4	18.8	45	3.9

1. G (green), B (breaker), T (turning), P (pink), LR (light red), R (red), DR (dark red).
2. J.V. (Jordan Valley) and Up. (Uplands).
3. Each value represents the average of 90 boxes.

Table 3. Decay and defect percentages of tomato fruit at the farm level.

Farm	Decay %			Defect %		
	Harvest frequency					
	3rd	2nd	1st	3rd	2nd	1st
J. V.[1]						
1st	3.6[3]	5.9	4.0	27.3	31.3	30.3
2nd	31.3	30.3	31.3	4.8	5.1	3.8
3rd	5.3	3.1	3.9	42.1	42.2	38.3
Up.[1]						
1st	30.3	27.3	23.8	6.3	4.3	5.0
2nd	6.4	5.2	6.0	41.0	37.8	48.8
3rd	3.3	4.3	3.1	33.8	42.3	41.8

1. J.V. (Jordan Valley) and Up. (Uplands).
2. Each value represents the average of 90 boxes

Table 4. Proportions of the different causes of postharvest losses of tomatoes and eggplants from the total loss at four levels of postharvest handling tested for both growing areas.

	Direct causes of postharvest loss (%)			
	Growing area	Diseases Disorder	Deffect	Mechanical damage
Jordan Valley				
Tomato	37.5	16.0	24.0	22.5
Eggplant	43.6	20.5	16.4	19.5
Uplands				
Tomato	27.3	22.3	17.4	33.0
Eggplant	39.8	16.5	22.1	21.6

1.Each value represents the average of 360 boxes.

Postharvest Losses of Tomato Fruits (*Lycopersicon esculentum* Mill.) and Grapes (*Vitis vinifera* L.) in Jordan, August 2000

Introduction

The environment and conditions exist in Jordan to produce large volume of high quality crops. All impedances to proper postharvest handling techniques are managerial and not physiological in nature due to lack of resources or infrastructure.

Generally, postharvest handling systems of tomatoes and grapes in Jordan can be summarized as follows:

*** Tomatoes for the local market:**

Harvest in buckets, wooden or Polystyrene boxes

▼

Sorting & Packing

▼

Loading & Transport

▼ ▼

◄Wholesale markets Exporters warehouse

▼

Repacking

▼

▼

*** Tomatoes for export to the Gulf States:**

Harvest in buckets, wooden or Polystyrene boxes

▼

Packing in Polystyrene boxes

▼

Loading & Transport

▼

Wholesale markets

▼

Retail Markets

Loading in refrigerated trucks

Shipping to destination markets

* Grapes Handling System

Harvest in field boxes ►Trimming and Primary Sorting► Packing ► Transport ►

►Cold Storage │►wholesale markets ► Retail Markets

│► Packing House ►Sorting, Grading & Re-packing ► Precooling │ ↓

►Shipping to destination markets

Objectives

The objective of the current study was to evaluate five common postharvest steps in the handling of tomatoes and grapes in order to estimate the postharvest losses and determine the causes of these losses.

Results and Discussion

1. Tomaotes

Color:

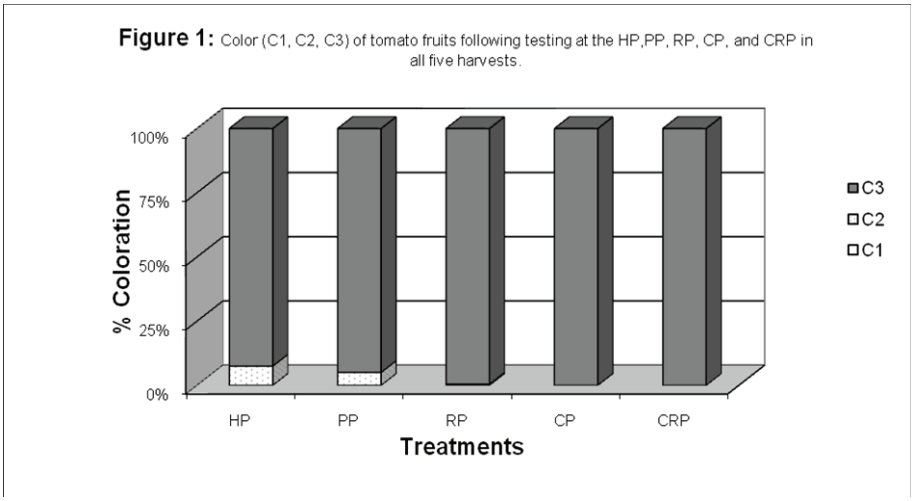

Figure 1: Color (C1, C2, C3) of tomato fruits following testing at the HP,PP, RP, CP, and CRP in all five harvests.

Firmness

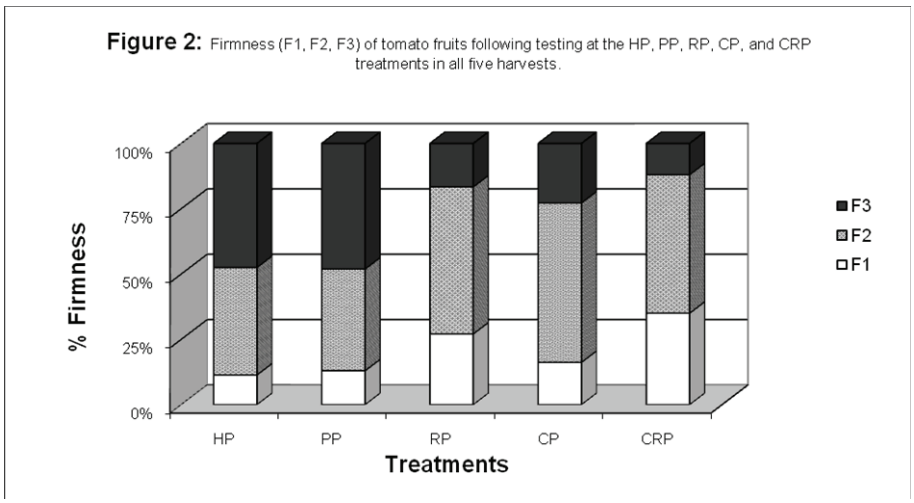

Figure 2: Firmness (F1, F2, F3) of tomato fruits following testing at the HP, PP, RP, CP, and CRP treatments in all five harvests.

Calyx Freshness

Table 3. Calyx Freshness 1,2 of tomato fruits following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP), in all five harvests.

Harv. ► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	85.87[3]a[4]	88.3a	72.0a	82.0a	76.3a
PP	83.66a	82.7a	76.3a	83.0a	81.7b
RP	47.0b	57.0b	50.7b	56.7b	34.0c
CP	61.3c	69.4c	63.0c	69.7c	66.3d
CRP	42.3b	30.6b	39.3d	37.0d	33.6c

1. Calyx freshness was rated as (1 = dry & brown), 2 = Partially green), and (3 = Green & fresh), the average of the three values was taken out of 3 which then were converted to percentages (3 considered as 100%).
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent fresher calyx.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

Decay

Table 4. Decay1, 2 incidence in tomato fruits following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in all five harvests.

Harv. ► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	3.8[3]a[4]	3.8a	5.6a.b	3.6a	8.5a.b
PP	2.9a	3.8a	3.9a	4.7a	6.8a
RP	6.6a	9.3b	9.5b.c	11.0b	13.3b
CP	7.8a	10.8b	12.5c	10.2b	11a.b
CRP	29.1b	23.7c	28.9d	37.4c	26.0c

1. Decay was determined by the number of decayed fruits, converted to percentages from the total number of the fruits in each box (considered as 100%).
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent more decayed fruits.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

Defects

Table 5. Defects1, 2 occurrence in tomato fruits following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in all five harvests.

Harv. ► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	47.7[3]a[4]	61.7a.b	51.9a	53.2a	53.3a
PP	42.5a	51.5a	50.0a	59.5a.b	67.8a.b
RP	69.0b	69.4b.c	66.2b	67.8b	67.8b
CP	59.5b.c	62.3a.b	66.2b	62.9b.c	62.9b.c
CRP	72.5b	81.2c	85.9c	81.5c	80.5c

1. Defects were determined by the number of defected fruits, converted to percentages from the total number of the fruits in each box (considered as 100%).
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent more defected fruits.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

Cleanliness

Table 6. Cleanliness1, 2 of tomato fruits following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in all five harvests

Harv. ► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	71.3[3]a[4]	64.0a	67.3a	67.0a	63.6a
PP	72.0a	72.0a	71.0a	51.0a	65.3a
RP	56.7b	73.3a	72.0a	69.3a	71.7a
CP	72.0a	76.3	73.7a	71.7a	78.3b
CRP	69.7a	78.3a	73.7a	64.0a	66.4a

1. Cleanliness was determined using a scale of 1= dirty, 2= skin clean but calyx is dirty, and 3= completer clean.
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent more clean.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

General Appearance (GA)

Table 7. General Appearance1, 2 of tomato fruits following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in the five harvests.

Harv. ► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	76[3]a.b[4]	76.7a	77.0a	75.7a.c	72.7a.c
PP	81.0b	74.3a.b	79.0a	77.3a	76.0a
RP	73.3a.b	68.7b	73.0a	68.4b	68.3b.c
CP	69a.c	70.7a.b	72.0a	70.0c	69.3c
CRP	60.7c	61c	59.0b	55.7d	63.0b

1. General appearance was determined by 1= poor, 2= good, and 3= excellent.
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent better general appearance.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

2. Grapes

Table 8. Total Soluble Solids (TSS) 1,2 of grapes following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in the five harvests.

Harv.► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	15.2[3]a[4]	15.7a	16.0a	16.3a	16.6a
PP	15.1a	15.5a	16.0a	16.8a	16.7a
RP	15.5a	16.2a	16.8a	16.9a	17.3a
CP	15.2a	15.8a	16.3a	16.5a	16.6a
CRP	15.5a	16.0a	16.2a	16.4a	16.6a

1. TSS was determined for each cluster by refractometer.
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent more TSS content.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

Abscission (shattering)

Table 9. Abscission (Shattering) of grape berries1,2 following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in the five harvest.

Harv. ► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	10.83a4	10.2a	11.5a	15.3a.b	13.9a
PP	9.3a	9.7a	14.7a	11.7a	12.2a
RP	16.6b	15.2b	23.3b.c	15.2a.b	17.4a
CP	16.4b	12.8a.b	18.5a.b.c	17.6b.c	12.4a
CRP	18.4b	15.2b	25.8c	20.9c	16.9a

1. Shattering was determined by the number of missing berries from each cluster.
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent more shattering percentages.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

Firmness

Table 10. Firmness1, 2 determination in grapes following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in the five harvests.

Harv. ► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	93.3[3]a[4]	96.0a	98.7a	96.0a	95.7a
PP	96.0b	96.3b	99.3b	97.7b	98.0b
RP	63.7c	61.3c	62.9c	55.0c	60.3c
CP	69.7d	76.7d	69.7d	65.d	68.6d
CRP	58.3e	49.7e	46.7e	51.7e	45.7e

1. Firmness was determined for each cluster using a scale of 1=soft, 2=firm, and 3= very firm.
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent firmer berries.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

Stem Freshness

Table 11. Stem Freshness1,2 of grapes following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in the five harvests.

Harv.► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	94[3]a[4]	97.0a	99.3a	98.3a	99.7a
PP	98.7b	93.3b	99.3a	98.3a	100b
RP	52.3c	47.0c	45.3b	38.9b	49.0c
CP	72.0d	77.4d	80.7c	73.0c	80.3d
CRP	50.3e	39.0e	39.0d	41.0d	42.0e

1. Stem freshness was determined for each cluster using a rating scale of 1= dry, 2= partially dry, and 3= fresh and green.
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent better stem freshness.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

Decay

Table 12. Decay incidence1, 2 in grapes following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in the five harvests.

Harv. ► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	2.0[3]a.b[4]	1.8a.b	1.5a	1.8a	1.4a
PP	1.3a	1.0a	1.9a	1.8a	1.5a.b
RP	3.0b.c	1.7a.b	2.6a	2.0a	2.8b
CP	3.3b.c	1.8a.b	2.8a	2.3a	2.0a.b
CRP	3.7c	2.2b	5.0b	3.8b	2.8b

1. Decay occurrence was determined by the number of decayed berries.
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent more decayed berries.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

Defects

Table 13. Defect occurence1, 2 in grapes following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in the five harvests in the five harvests.

Harv. ► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	45.4[3]a[4]	34.4a	35.7a.b	39.7a.b	34.9a
PP	31.8a.b	20.3c	21.2b	21.2b	19.2b
RP	28.5b	30.4a.b	36.8a.b	36.8a.b	30.7a.b
CP	34.3a.b	23.2b.c	38.3a.b	38.3a.b	29.0a.b
CRP	37.4a.b	27a.b.c	45.6a	45.6a	38.4a

1. Defects were determined by the number of defected berries.
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent more defected fruits.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

Cleanliness

Table 14. Cleanilness1,2 of grapes following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in the five harvests.

Harv. ► Treat.▼	1st H	2nd H	3rd H	4th H	5th H
HP	79.0[3]a.b[4]	84.7a	78.3b	82.0a.b	87.3a
PP	86.0a	81.7a.b	87.5a	85.3a	89.7a
RP	69.4c	69.4c	78.4b	71.2c	71.0b
CP	75.3b.c	79.0a.b.c	81.0a.b	74b.c	84.3a
CRP	68.3c	73.7b.c	62.3c	65.4c	59.2c

1. Cleanliness was determined using a scale of 1= dirty, 2= skin clean, but stem dirty, and 3= complete clean.
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent more clean clusters.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

General Appearance

Table 15. General Appearance1,2 of grapes following testing at the Harvest Point (HP), Packing Point (PP), Room temperature Point (RP), Cold storage Point (CP), and Cold storage + Room temperature Point (CRP) in the five harvests.

Harv. ► **Treat.▼**	**1st H**	**2nd H**	**3rd H**	**4th H**	**5th H**
HP	57[3]a[4]	70b	67a.b	68.7a	71.3a
PP	58.7a	77.3a	68.3a	71.7a	74.7a
RP	50a	54c	58.3b.c	51c	54.7b
CP	58.7a	68.7b	68.7a	59.3b	68.7a
CRP	53.7a	56.3c	52b.c	51c	49.3b

1. General appearance was determined using a scale of 1= poor, 2= good, and 3= excellent.
2. Means are the average of ten separate samples (10 boxes of fruits).
3. Higher values represent more fruits with better general appearance.
4. Values within columns followed by the same letter are not significantly different at the 0.05 level by the LSD method.

Postharvest Losses

Estimation of postharvest losses for tomatoes and grapes

Table 16. Estimated postharvest losses in tomatoes and grapes in the five treatments.

Treatment	% Losses in tomatoes		% Losses in grapes	
	The Assumed Lower Range	The Maximum Possible Range	The Assumed Lower Range	The Maximum Possible Range
HP	14.0	24.4	25.8	33.2
PP	13.1	22.5	23.4	29.1
RP	16.7	29.7	39.0	46.4
CP	15.7	29.8	29.3	35.2
CRP	25.0	40.2	40.3	47.5
Average loss	16.9	29.3	31.6	38.3

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