Scientific Papers. Series B, Horticulture. Vol. LXV, No. 1, 2021
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

IMPACT OF THE IRRIGATION OF THE APRICOT TREES ON THE ORGANOLEPTIC FRUITS QUALITY

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Abstract

The research purpose was to establish the most efficient/suitable strategy for apricot irrigation, in order to obtain high fruits quality, with great aspect, firmness and taste. The apricot trees of 'Orizont' Romanian cultivar were irrigated in three variants: fully irrigated - FI (V_1 = non hydric stress) according to the irrigation needs (100% of ET), low irrigation LI (V_2 = partial hydric stress) irrigated with half of water the amount (50% of ETc) and non-irrigated trees, representing the control NI (V_3 = hydric stress). After the harvest, the fruits were stored in different storage options: at 20-22ºC (room temperature), 10-12°C (refrigerant conditions) and at 3-5ºC (cold storage), with and without modified atmosphere for different periods of time. At the harvest moment and after that, a couple of determinations were made, as concern the organoleptic quality of the fruits (aspect, firmness and taste). The results revealed that the organoleptic quality of the apricots at the time of the harvest and its evolution during storage, varied according to the irrigation schedule. Thus, the highest values of the organoleptic parameters were obtained at the non-irrigated variant, followed by the low irrigated variant.

Key words: *aspect, Prunus armeniaca, firmness, irrigation, storage, taste.*

INTRODUCTION

Lately, the Romanian consumers increasingly prefer to consume fruits of Romanian cultivars. At the same time, their demands for the quality of the purchased products have increased, determining the producers to reconsider not only the fruits quantity of, but also their quality. The sensory quality is the one that promotes the goods, because it is the first one with which the consumer meets.

The apricot (*Prunus armeniaca* L.) is a thermophile fruit tree species, highly appreciated in Romania, but its favorability area is relatively restricted in our country due to the climate. It gets suitable growing conditions in the region of Dobrogea where the winter temperatures are not too low, and, also, proper soil conditions (mainly fertile black soil, called chernozem). As regard the water shortage that can be solved by applying irrigation measures (Septar, 2017).

Nowadays, in the global warming up context, in arid and semi-arid regions, the irrigation is necessary for fruit trees growing, but the optimal irrigation application requires large amounts of water. Thus, water saving is a major objective. An alternative, is the irrigation with low amount of water (Fereres & Soriano, 2007; Hoffman, 1990) which requires a moderate reduction of water amount during the critical stages of trees development, while keeping on a satisfactory quantity and quality of fruit production. Low irrigation leads to water saving without short-term yields loss (Naor, 2006), while the entire fruit yield can be reduced due the long-term cumulative effects on trees (Intrigliolo & Castel, 2005).

Perez-Pastor (2007) studied the effect of different irrigation strategies on the fruit quality of apricot at the harvesting time and during the storage at 1°C and found that low irrigation was demonstrated to be commercially favorable for maintaining fruit quality, saving, at the

same time, considerable amounts of water. The apricot fruits are an excellent source of nutrients and they are appreciated for their special flavor. However, high rates of ripening and susceptibility to mechanical injury and diseases, limit their shelf life. Being a climacteric fruit, the ethylene can regulate the ripening of apricot fruits. The application of different pre and post-harvest treatments, such as harvesting at optimum maturity, maintenance of cold chain, selection of proper packaging and storage atmospheres, determines/influences the post-harvest behavior of fruits (Muzzaffar et al., 2018).

For delaying the ripening and maintaining the quality of harvested fruits, quick cooling and low-temperature storage are recommended (Alexe, 2012; Moise, 2018). However, if apricots are kept at low temperatures for longer periods, chilling injury occurs in the fruits, which is manifested in the form of various symptoms. Therefore, postharvest technology of apricots aims to reduce fruit losses, as well as optimizing their quality through the postharvest chain.

The objective of this study was to evaluate the effect of the irrigation schedule on the sensory quality of 'Orizont' apricots at harvesting time and at 7, 15, respectively 30 days after the harvest, in different storage conditions.

MATERIALS AND METHODS

The research was carried out in years 2017 and 2018 at the Research and Development Institute for Processing and Marketing of the Horticultural Products "Horting" Bucharest and at the University of Agronomic Sciences and Veterinary Medicine of Bucharest on the Romanian apricot cultivar 'Orizont' (Figures 1 and 2), cultivated in experimental plots at the Constanța Fruit Growing Research and Development Station.

Figure 1. 'Orizont' apricots on orchard

Figure 2. Detail of 'Orizont' apricot fruit

A two-level factorial experience was organized setting the irrigation schedule and the post-harvest storage conditions.

The experimental variants were:

-V_1: non hydric stress - the irrigation regime consisted of a fully irrigated (FI) treatment according to the irrigation needs (100% of ETc = ETo x Kc, Penman-Monteith method);

-V_2: partial hydric stress (LI) - low irrigation variant; the trees received just half of the water amount provided at V_1 (50% of ETc);

-V_3: hydric stress - the trees were non-irrigated (NI), representing the control variant

After harvest, the fruits were stored in different storage conditions: at 20-22ºC (room temperature), 10-12°C (refrigeration) and at 3-5ºC (cold storage), with and without modified atmosphere, for different periods of time.

The experimental plots consisted of three rows of apricot tress, with the central row containing three trees for measurements and observations. Plant available soil water capacity was measured using Watermark resistance blocks which were installed at four levels of depth: 20 cm, 40 cm, 60 cm and 80 cm, at 150 cm distance from the trunk, with two repetitions for each tree.

Relating the fruit organoleptic evaluation, seven persons observed, tasted and evaluated the organoleptic quality (aspect, firmness, taste) of the apricot fruits.

In order to determine the post-harvest factors involved in promoting the organoleptic quality, the apricot fruits were stored under different technological conditions, as follows:

- room temperature: warm conditions (T = 24-27°C, RH = 69-71%), for 7 days;
- fridge storage: refrigerant conditions (T = 10-12°C, RH = 75-78%), for 15 days;
- cold storage: low temperature conditions (T = 3-5°C, RH = 82-86%), for 30 days;
- cold + modified atmosphere (MA) storage, in airtight packages: the composition of the atmosphere inside was modified, be reducing the amount of O_2 and increasing the amount of CO_2 - storage in modified atmosphere - MA (T= 3-5°C, RH = 92-96%), for 30 and 45 days;

After storage, the fruits were re-examined in order to establish the effect of the technologic measures, especially as regard the irrigation schedule and the storage conditions on the post-harvest quality and apricot fruits shelf life.

The oorganoleptic quality assessment was done by performing a sensory testing which represents a method of fruit assessing using a grading scale from 1 to 100. Tasting sheets had three evaluation criteria (aspect, texture, taste). Each criteria of evaluation had a different. percentage in the general scoring, according to their importance: aspect - 15%, firmness - 35% and taste - 50%. Depending on the score, five quality classes were defined, as follows:

Grading scale	**Score**
Very Good	80-100
Good	60-79
Satisfactory	40-59
Unsatisfactory	20-39

RESULTS AND DISCUSSIONS

The results of the organoleptic quality (Table 1) reveal the fact that at the harvesting time, at all irrigation variants, the apricot fruits obtained "very good" grade. Notable is the close range of the variants.

Table 1. The organoleptic evaluation of apricots at the harvesting time

Criteria for assessment	Variant		
	V_1	V_2	V_3
Aspect	12.60	12.40	11.40
Firmness	28.00	28.60	29,00
Taste	42.00	44.00	46.00
Total	82.60	85.00	86.40
Grading scale	very good	very good	very good

The variant V_3 (non irrigated trees – control variant) got the highest score (86.40), due to the higher values of taste and firmness, while V_1 (non-stressed - fully irrigated) got the lowest score (82.60).
The results of sensory analysis of the apricot fruits stored in warm conditions for seven days are presented in Table 2.

Table 2. The organoleptic evaluation of apricot fruits after room temperature storage for 7 days

Criteria for assessment	Variant		
	V_1	V_2	V_3
Aspect	10.20	10.80	11.40
Firmness	23.80	23.80	25.20
Taste	36.00	36.00	38.00
Total	70.00	70.60	74.60
Grading scale	good	good	good

It can be noticed that the total score decreased to all irrigation variants, due mainly to the taste depreciation, so it got only "good" grade.
Also, during warm storage, the apricot fruits rapidly lost their firmness due to the fast ripening. Thus, V_3 (non-irrigated - the control variant) obtained the highest score (74.60).
After 15 days of fridge storage (T = 10-12°C), the organoleptic properties of the apricot fruits remained in good parameters only at V_3 which received "very good" grade (Table 3).

Table 3. The organoleptic evaluation of apricots after fridge storage for 15 days

Criteria for assessment	Variant		
	V_1	V_2	V_3
Aspect	11.40	12.00	13.40
Firmness	25.40	24.60	27.80
Taste	34.00	38.00	40.00
Total	70.80	74.60	81.20
Grading scale	good	good	very good

V_1 and V2 (partial hydric stress) obtained "good" grade, with 70.80 and, respectively, 74.60 score.
After the cold storage (T = 3-5°C) for 30 days, the apricots of V2 and V3 maintained their commercial aspect and good firmness and obtained a high score and "very good" grade (Table 4).

Table 4. The organoleptic evaluation of apricots fruits after cold storage for 30 days

Criteria for assessment	Variant		
	V_1	V_2	V_3
Aspect	9.00	12.60	13.40
Firmness	26.40	27.20	29.40
Taste	38.00	40.40	41.00
Total	73.40	80.20	83.80
Grading scale	good	very good	very good

V3, with 83.80 score is again in on top. V1, with 73.40 score obtained "good" grade.
After storage under conditions of modified atmosphere (T = 3-5°C) for 30 days, the apricot fruits continued to maintain their firmness and pleasant aspect, but their taste slightly decreased and finally it obtained the grade "very good", for all variants, with score at the lower limit of this quality class (Table 5).

Table 5. The organoleptic evaluation of apricots fruits after cold+ M.A. storage for 30 days

Criteria for assessment	Variant		
	V1	V2	V3
Aspect	12.20	12.60	12.80
Firmness	28.60	28.00	29.40
Taste	39.20	40.40	40.20
Total	80.00	81.00	82.40
Grading scale	very good	very good	very good

After storage under conditions of modified atmosphere for 45 days, although the apricot fruits maintained their commercial aspect, they lost their firmness and decreased the quality of their taste. For this reason, V_2 and V_3 obtained "good" grade, while V_1 with 38.80-42.00 score obtained "satisfactory" grade (Table 6).

Table 6. The organoleptic evaluation of apricots fruits after cold+ M.A. storage for 45 days

Criteria for assessment	Variant		
	V1	V2	V3
Aspect	12.00	12.00	12.80
Firmness	18.80	19.20	20.00
Taste	8.00	10.60	9.20
Total	38.80	41.80	42.00
Grading scale	satisfactory	good	good

In fact, in this case, the irrigation schedule had not an important influence on the sensory quality. The only factor with direct impact on the organoleptic quality of the apricot fruits was the storage time and its characteristics. In some cases, the apricots stored in MA conditions displayed certain physiological impairments, manifested through deterioration of the pulp around the stone. This reveals the fact that the period in which the fruits had the capacity to maintain their quality was overdue, meaning that the storage time in an atmosphere enriched with carbon dioxide was too long.

Following the evolution of the sensory quality during storage using different technological methods of each irrigation variant (Table 7), it is found that there are differences between the variants in terms of score and grade obtained.

Table 7. The grades obtained by the apricot fruits at the harvesting time and after storage

Moment of determination	Grading scale Variant		
	V_1	**V_2**	**V_3**
At harvest	very good	very good	very good
After warm storage	good	good	good
After fridge storage	good	good	very good
After cold storage	good	very good	very good
After MA storage-30 days	very good	very good	very good
After MA storage-45 days	unsatisfactory	satifactory	satisfactory

Although at the harvesting time, all fruits obtained a high score and "very good" grade, later their evolution was different.

Thus, the fruits of V_1 received less than 80 score and the "good" grade at room temperature, fridge and cold storage and less than 40 score and "unsatisfactory" grade at modified atmosphere storage for 45 days (Figure 3).

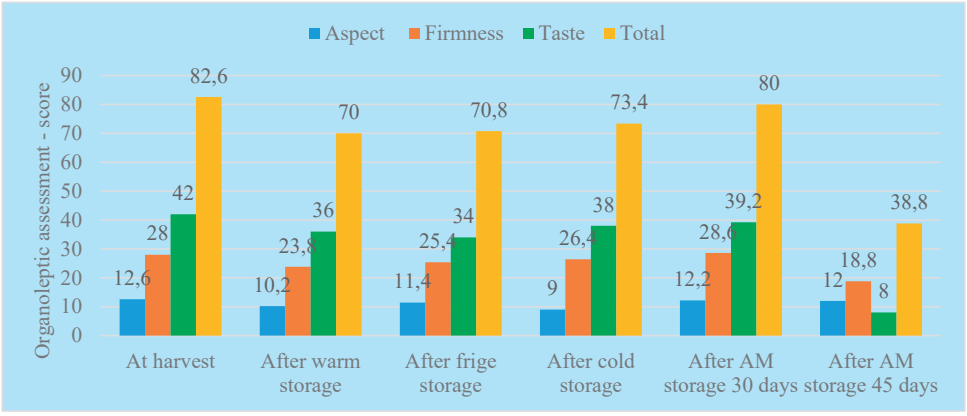

Figure 3. Organoleptic evaluation of V_1 apricot fruits at harvesting time and after storage, using different technological conditions

The fruits of V_2 obtained a higher score, compared to V_1, receiving the "very good" grade at cold storage without and with modified atmosphere for 30 days, "good" grade for room temperature and fridge storage and "satisfactory" grade at modified atmosphere storage for 45 days (Figure 4).

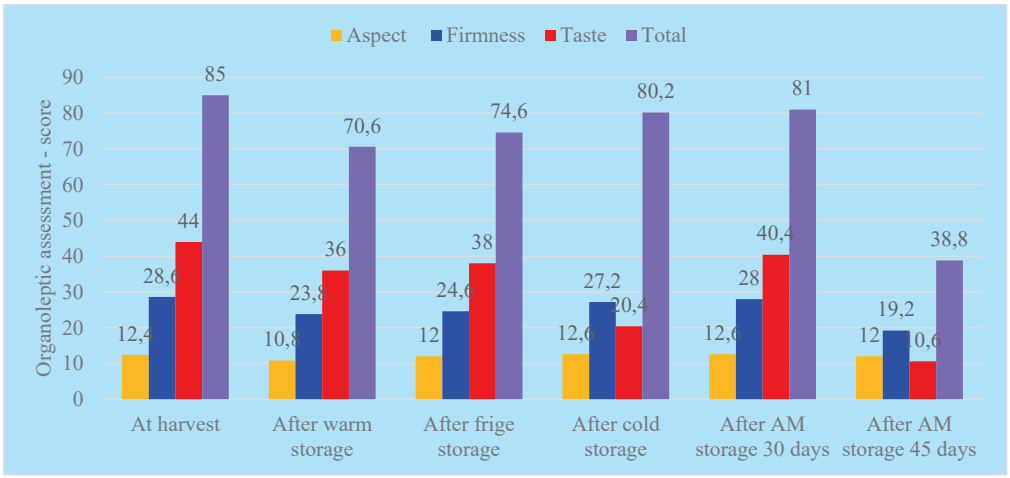

Figure 4. Organoleptic evaluation of apricots from V2 at harvesting time and after storage, using different technological conditions

The highest score was received by the V_3 apricot fruits, including all technological storage options. V3 has got "good" grade at room temperature storage for 7 days, "satisfactory" at modified atmosphere storage for 45 days and "very good" for keeping them in the other technological conditions (Figure 5).

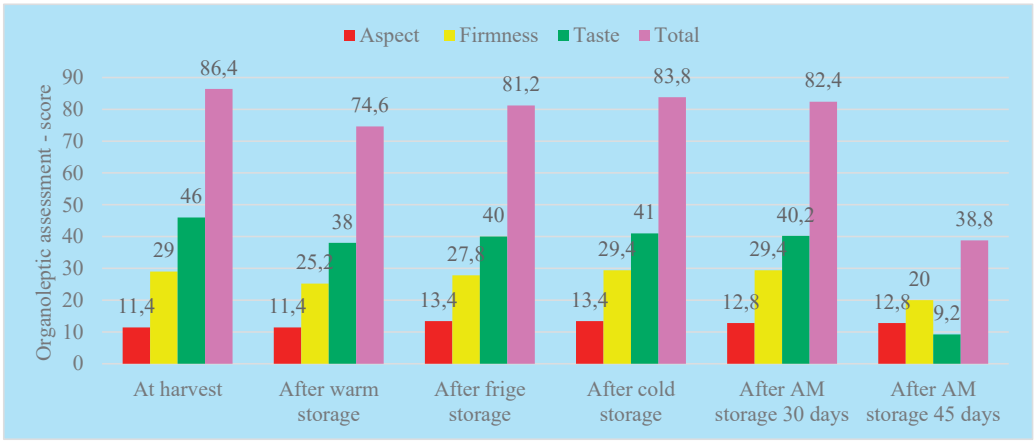

Figure 5. Organoleptic evaluation of V_3 apricots fruits at harvesting time and after storage, using different technological conditions

CONCLUSIONS

The 'Orizont' apricot cultivar is appreciated for the organoleptic characteristics of its fruits. This fact is clearly shown in the obtained score (the highest from all three variants) at the moment of harvest and at further determinations.

For getting best fruit sensory values, the apricot trees do not need extra water amount supplied by full or partial irrigation. This aspect is reflected in the results obtained at non irrigated

trees where a real hydric stress existed. The intermediary values were obtained at low irrigated trees where a partial hydric stress existed.

The evolution of the sensory quality of apricot fruits during storage depends on irrigation schedule and storage environmental conditions, especially the temperature and gaseous composition.

The fruits harvested from the apricot trees irrigated with large amount of water (V_1 = non-stressed - fully irrigated) lost easier their organoleptic quality.

The best method to promote the organoleptic quality is the storage at cold + modified atmosphere (T = 3-5°C), taking into account the storage period and the score obtained at the end of it.

A low irrigation schedule represents a trade advantage by promoting the sensory quality and shelf life of the apricot fruits and by saving considerable amounts of water, as well.

As regard the global warming up process, a huge challenge for plant cultivation is represented by water shortages but a solution, not only in arid or semi - arid areas, is the wise irrigation schedule by supplying lower amounts of water and using species and cultivars resistant to the hydric stress.

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