

## RESEARCHES ON THE INFLUENCE OF SOIL AND CLIMATE CONDITIONS IN THE ROMANIAN PLAIN AND TECHNOLOGICAL CHAINS ON THE CAPACITY TO MAINTAIN THE APPLES QUALITY-CASE STUDY

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### *Abstract*

*The success of fruit storage in storehouses is conditioned and depends largely on the environment factors, on applied technology and storage conditions. The better the optimal factors are known on which the growth and formation of the fruit depends, when and how to manipulate and transport the fruit, the more secure the premise for the success for the good preservation of fruit is. It is absolutely necessary to know the main factors that must be taken into account in order to bring into storehouse only fruit corresponding to this purpose. The experiments were organized in comparative variants in the case of apples based on 6 homologated varieties of apple (Florina, Generos, Golden Delicious, Idared, Jonathan and Redix) present in the current assortment in Moara Domneasca farm and in Romania. After 120 days of storage, determinations were made concerning: evolution of the soluble dry matter content; evolution of some components; organoleptic appraisal (appearance, firmness, taste). The results showed that, after storage, the dry matter content, the titratable acidity, the total sugar content and the vitamin C content recorded an increased or decreased evolution depending on variety, compared to the initial content.*

**Key words:** *evolution, solids content, storage, titratable acidity, varieties*

### INTRODUCTION

In Romania, the apple tree crop has very favorable soil and climate conditions for obtaining high quality production[4].

The current variety of apple in our country comprises varieties, divided into three groups, namely: summer varieties, autumn varieties and winter varieties.

Once with Romania's integration into the European Union, product quality requirements were aligned with European standards, on the one hand to facilitate trade, but also to raise living standards to the same standards[12].

In order to achieve superior quality, in addition to the technological processes applied in the orchard, the fruits must be used according to an appropriate technology, which allows the quality to be maintained at the highest rates, from harvesting to delivery to the consumer[3]. Competition in internal and foreign markets determines producers and re-evaluers to

improve both the crop systems and the flow of apple fruit[9].

That is why there are permanent concerns in the modernization of the material base and the appropriate technologies regarding the use of apples in the fresh state[7].

Preserving fruit in the best conditions, for as long as possible and with the lowest quantitative and qualitative depreciation, can be done by taking into account a whole complex of factors [1].

The factors influencing preservation can be divided into several groups, namely: the group of factors contributing to the formation and growth of fruit in plantations; group of factors and conditions of harvesting, handling and transport of fruit; group of environment factors of fruit storage [2].

The success of fruit storage in storehouses is conditioned and depends to a large extent on the factors belonging to the first two groups. The better what are the optimal factors are known on which the growth and formation of

the fruit depends, when and how to manipulate and transport the fruit, the more secure the premises for the successful preservation of the fruit [10].

It is absolutely necessary to know the main factors that must be taken into account in order to introduce into the storage only fruit corresponding to this purpose [5].

The nutritional value of fruits and vegetables is mainly due to their richness in minerals and vitamins, low molecular weight carbohydrates, dyes [6].

The main quality characteristics of fruits and vegetables determine their qualitative value [8].

Determinations made as well as the analysis of the obtained results aimed at following the behaviour of some apple varieties to the action of the technological factors used and the evolution of some chemical components during the maintaining period [11]. The researches aimed to establish the capacity to preserve the fresh fruit quality of the existing varieties in the variety grown at Moara Domneasca, on the preluvosoil type soil.

## MATERIALS AND METHODS

The apples introduced into experiment were represented by 6 homologated varieties of apple (Florina, Generos, Golden Delicious, Idared, Jonathan and Redix) present in the current assortment in Romania and in intensive orchard from Moara Domneasca Farm. The fruits belong 2016 fruitage and were harvesting at commercial maturity. The analyses were

made to a sample of 15 uniform fruits from each variety. They were stored in the freezing cells of the specialized storehouse within Moara Domneasca. The technology used consisted in the application of a number of 12 phytosanitary treatments. With 3 of these treatments, Terra-Sorb® Complex foliar fertilizers at a dose of 1 l / ha. This is a bio-stimulator for foliar applications with a high content of free amino acids obtained by enzymatic hydrolysis, the only method to keep their completeness and, implicitly, their effectiveness. The Terra-Sorb Complex contains amino acids, nitrogen, boron, magnesium and other microelements to ensure a rapid resumption of vegetation to de-spring and to maximize the formation of productivity elements and the resistance of crops to stress factors. The product helps to better pollination and fructification and to better plant nutrition through nutrient content. In the autumn of 2015, the scarification work was carried out, followed by the disc-bearing work. In the spring, 200 kg of complex fertilizers of type N: P: K 15:15:15 were incorporated in a disc work. The climate regime is characterized by very hot summers and relatively cold winters with snow storm periods. During the year 2016, the recorded precipitations were 811.6 mm, the largest quantities being recorded during the months of May, June and August, exceeding the monthly multiannual averages (Table 1). Also, the annual average of temperatures was higher compared to the multi-annual average of 1981-2010.

Table 1. Temperatures and precipitations recorded during the year 2016

Month		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Rainfall
2016	P mm	62.6	35.6	67.8	64.6	71.0	114.8	4.2	88.8	83.2	164.2	51.8	3.0	811.6
	T °C	-5.6	3.2	7.6	14.3	15.9	22.4	24.2	23.1	18.9	9.7	5.3	-2.1	10.7
Average	P mm	33.6	31.6	38.3	51.3	66.5	84.5	77.8	64.7	55.0	43.5	41.5	44.8	633.1
	T °C	-2.1	-1.0	3.5	9.3	14.9	18.3	20.2	19.7	14.8	9.6	3.8	-0.8	9.8

Source: Stefanesti-Ilfov Weather Station

The experiments were organized in comparative variants in the apples based on the mentioned varieties, with 3 repetitions in each variant. The fruits were placed for storing in plastic pots for vegetables and fruit. The fruit storage duration was 120 days. During storage

the daily control of the thermo-hydric factors in the refrigeration room was performed to ensure that the optimal conditions for maintaining the quality are observed (temperature 0 ... 4 degrees Celsius and UR 90-95%) were observed. Determinations were

made on harvesting and at the end of the maintenance period. Determinations related to contents in soluble dry matter were made, to the evolution of some chemical components (titratable acidity, total sugar, C vitamin), to aspect, firmness, taste.

The determination of the soluble dry matter content was performed by the refractometric method, using the ABBE mass refractometer, with the expression of the results in percentage. The determination of chemical components (titratable acidity, total sugar and vitamin C) was performed by standardized laboratory methods, their evolution being evidenced by comparing the initial results with the data obtained at the end of the retention period. The titratable acidity was determined by the titrimetric method with results expressed in g malic acid/100g. The product, the sugar content was determined by the Bertrand method with the expression of the results in percent and the vitamin C by spectrophotometric method with the expression of the results in mg. acid ascorbic/100g of the product. The fruit firmness was performed with manual penetrometer type Effe -gi with large piston with the diameter of 11 mm, to a number of 25 fruits per variant, each fruit being penetrated in 4 points in the equatorial area, after the removal of skin in the penetration areas.

After 120 days of storage, determinations were made regarding the evolution of the soluble dry matter content, at the evolution of some components, at the organoleptic assessment (appearance, firmness, taste).

## RESULTS AND DISCUSSIONS

The initial soluble solids content SSC of the apples tested varied between 10.48-14.33% depending on the variety, with an average of 12.65% (Table 2). During storage, the apples showed increases of 1.88-69,85% or 3.42% decrease soluble content depending on the variant, the overall experience was an average increase of 17.15%. The highest increases in

SSC were recorded for Jonathan, followed by Generos (+ 32.94%). At the end of storage, the SSC of the apple was between 12.70-17.80% depending on the variety, with an average of 14.82%. The highest content was determined for Jonathan, followed by Generos (15.90%). The lowest SSC was recorded in the Idared variety with a value below 13%.

Table 2. Evolution of soluble solids content during apples storage

Variety	Soluble solids content (SSC) (%)		
	Initial storage	After storage	Difference (%)
Jonathan	10.48	17.80	+69.85
Generos	11.96	15.90	+32.94
Idared	13.15	12.70	-3.42
Florina	14.33	14.60	+1.88
Redix	13.50	13.90	+2.96
Golden delicious	12.46	14.00	+12.36
<b>Average</b>	<b>12.65</b>	<b>14.82</b>	<b>+17.15</b>

Source: Own calculation.

The results on the dynamics of some chemical components during the apple storage are shown in Table 2. Initial values were recorded, immediately after harvesting and values measured after maintaining.

The data in Table 3 show the following: In apples, the initial titratable acidity content was 0.37-0.73% depending on the variety, with an average of 0.52%. Fruit with the highest acidity belonged to Jonathan variety (0.73%), and the lowest Redix variety followed by Golden delicious (0.40%).

During storage, both increases of 5.40-20.69% and decreases of 29.27-54.79% in the initial acidity content occurred, depending on the variant, the overall tendency was decreasing on an average by 23.08%.

After storage, the apple acidity was 0.27-0.70% depending on the variant, with an average of 0.40% variants. Fruits with the highest acidity belonged to Idared variety, followed by Florina variety (0.41%). The lowest acidity was determined in Golden delicious variety, followed by Generos variety (0.29%).

The initial total sugar content was at apples of 8.32-11.60% depending on the variety, with an average of 10.12%.

Table 3. Evolution of some chemical components at the harvest moment and after the apples storage

Variety	Titrable acidity (%)			Total sugar content (%)			Vitamin C (mg/100g)		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
Jonathan	0.73	0.33	-54.79	8.39	7.47	-10.97	8.10	8.80	+8.64
Generos	0.41	0.29	-29.27	8.32	7.53	-9.50	9.97	9.26	-7.12
Idared	0.58	0.70	+20.69	10.95	8.87	-19.00	10.04	9.78	-2.59
Florina	0.63	0.41	-34.92	11.38	9.22	-18.98	11.00	10.67	-3.00
Redix	0.37	0.39	+5.40	11.60	8.90	-23.28	10.30	9.70	-5.83
Golden delicious	0.40	0.27	-32.5	10.05	11.51	+14.53	8.72	9.09	+4.24
<b>Average</b>	<b>0.52</b>	<b>0.40</b>	<b>-23.08</b>	<b>10.12</b>	<b>8.92</b>	<b>-11.86</b>	<b>9.69</b>	<b>9.55</b>	<b>-1.44</b>

Source: Own calculation

The variants with the highest sugar content were Redix variety, Florina variety (11.38%) and Idared variety (10.95%), and the lowest, Generos variety followed by Jonathan variety (8.39%). During the storage, both increase of 14.53% and decrease of 9.50-23.28% of the total sugar content, depending on the variation, took place during the storage period, with the overall trend of decrease on an average by 11.86%.

After storage, the total apple sugar content was 7.47-11.51% depending on the variant, with an average of 8.92% variants. Fruits with the highest total sugar content belonged to Golden delicious variety, followed by Florina variety (9.22%) and Jonathan variety (7.47%) and Generos variety, 53%). The initial vitamin C content was in apples of 8.10-11.00 mg / 100g depending on the variety, with an average of 9.69 mg / 100g. The variants with the highest vitamin C content were Florina variety (11.00 mg/ 100g) and Redix variety (10.30 mg/100g), and the lowest Jonathan variety (8.10 mg/100g), followed by Golden delicious variety (8,72mg/100g) and Generos variety (9.97mg/100g), so values below 10 mg/100g. During storage, both increases by 4.24-8.64% and decreases by 2.59-7.12% in vitamin C occurred, depending on the variant, the overall tendency was decreasing on an average by 1.44%. After storage, the apple vitamin C content was 8.80-10.67 mg/100g depending on the variant, with an average of 9.55 mg / 100g variants. Fruits with the highest content of vitamin C belonged to Florina variety followed by Idared variety (9.78 mg/100g), and the lowest Jonathan variety (8.80 mg/100g) followed by Golden delicious variety (9.09 mg/100g). For the organoleptic assessment, tastings were conducted using the tasting sheets comprising a total of 3 assessment

criteria (appearance, texture, taste). The assessment was made using 100 points scale. Each of the three assessment criteria have different weight in the general scoring, depending on their importance (Table 4) This "aspect" is 15%, "firmness" is 35% and "taste" is 50%. Depending on the achieved score, 5 quality classes differentiate, according to table 4. The evolution of the organoleptic characteristics of apples (appearance, firmness, taste) after preservation are presented in table 5.

Table 4. Classification of fruit after scoring

Quality classes	Points
Very good	80-100
Good	60-79
Acceptable	40-59
Mediocre	20-39
Not adequate	0-19

Source: The National Research\_Development Institute for Food Resources.

In terms of appearance, the apples were scored 9.00-15.00 points depending on the variant, with an average of 11.83 points. The Idared variety scored the highest score (14.57 points) of all the experimental variants, followed by Florina variety and Redix variety with 13.19 points and 12.23 points respectively. Variants Golden delicious got the lowest score on this indicator (9.00 points). At the end of the storage period, the apples firmness was evaluated with a score of 22.00 to 31.00 points, averaging 26.00 points. The Florina variety was best appreciated, scoring 30 points, followed by Idared variety with 31 points. The lowest score was recorded by Golden delicious variety (20 points), followed by Generos variety with 22.00 points. In terms of taste, the rating score ranged between 37.00 and 50.00 points, depending on the variant, with an average of 43.24 points. Among the studied varieties, the highest score was the Jonathan

variety, 50 points, and the lowest Generos variety with 37.00 points.

In terms of taste, only half of the variants in the research exceeded the score average, 43.24, these being Jonathan variety, Golden delicious variety and Idared variety.

The total score (look + firmness + taste) ranged between 69.61 and 89.80 points, depending on the variant, with an average of 81.08 points.

Table 5. Organoleptic appreciation of apples after storage

Variety	Organoleptic appreciation – score				Rating
	Appearance	Firmness kgf/cm <sup>2</sup>	Taste	Total	
Jonathan	11.47	27.00	50.00	88.47	Very good
Generos	10.61	22.00	37.00	69.61	Good
Idared	14.50	31.00	44.30	89.80	Very good
Florina	13.19	30.00	42.56	85.75	Very good
Redix	12.23	26.00	40.00	78.23	Good
Golden delicious	9.00	20.00	45.60	74.60	Good
<b>Average</b>	<b>11.83</b>	<b>26.00</b>	<b>43.24</b>	<b>81.08</b>	-

Source: Own calculation.

On the first place was Idared variety followed by Jonathan variety with 88.47 points and rating “very good”. The last place was the Generos variety with 69.61 points and rating “good”. The Golden delicious variety (74.60) achieved rating “good”.

## CONCLUSIONS

The highest content in SSC, immediately after harvesting, was recorded in Florina variety, 14.33%. It recorded an insignificant increase in the SSC content of only 1.88%, although it was a lower increase of the studied variants.

The lowest SSC content belonged to Jonathan variety, 10.48%, which at the end of the storage period recorded the highest increase in SSC value, 69.85%.

In general, after depositing in the conditions presented, there was an increase in the SSC content of all varieties taken in the study, the average value of the increase being of 17.15%. In terms of titratable acid content, both increases and decreases occurred. Increases were seen in Redix and Idared varieties (5.40%, respectively 20.69%).

The other varieties had significant declines with values contained between 20.69 and

54.79%. In general, varieties with a low titratable acidity content recorded an increase during storage, except for Golden delicious variety where acidity decreased after storage.

The sugar content recorded the storage period, in most cases, a decrease compared to the value recorded immediately after harvesting. The decreases averaged 11.86%. The exception was made by Golden delicious variety, with an increase in sugar content of 14.53%. In terms of vitamin C content, varieties with a low initial content (Jonathan and Golden delicious) recorded an increase after the storage period ranging between 4.24% and 8.64%. In the other varieties analyzed, there was a slight decrease of the vitamin C content, its average was 1.44%.

Total score (look + firmness + taste) ranged between 69.61 and 89.80 points, depending on variety. On the first place was Idared variety. The last place was Generos variety with 69.61 points.

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