EVALUAREA CALITĂŢII FRUCTELOR LA UNELE SOIURI DE CĂPŞUN (*FRAGARIA X ANANASSA* L. DUCH.)

THE EVALUATION OF FRUITS QUALITY IN SOME STRAWBERRY CULTIVARS (*FRAGARIA X ANANASSA* L. DUCH.)

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Abstract

The major factors influencing the strawberries quality are the genotype, culture technology, climatic conditions and harvest time. In Romania consumers like strawberry fruits especially picked in May to June season, in that period having better appearance, nutritional and organoleptic qualities, superior to those that ripen in summer and autumn. In 2012-2014 period at RIFG Pitesti was organized an experiment with seven strawberry cultivars to compare the quality of fruits, some cultivars being already in the commercial culture. The results showed significant differences between cultivars regarding the following quality parameters: the color of the fruits, determined by chroma (C*) recorded values ranging between 23.52 (Magic) and 32.92 (Premial) and the hue angle (hº), values between 21.74 (Clery) and 26.95 (Magic); fruit size determined by the size index registered values between 34.28 (Coral) and 39.2 (Record), average fruit weight ranging from 13.63 g at Coral cultivar and 25.02 g at Record cultivar. At the same time fruit firmness revealed the highest values for Alba (2.98 kgf/cm2) and Clery cultivars (2.78 kgf/cm2); The Coral cultivar noted the strongest aroma and the highest soluble solids content (10.33% Brix).

Cuvinte cheie: culoare, greutatea fructului, fermitate, conţinutul în substanţă uscată
Keywords: color**,** fruit weight, firmness, soluble solids content

1. Introduction

Strawberries (*Fragaria x ananassa*) are among the first fruits consumed in Romania during the year, being appreciated for their flavor and special nutritional qualities. Strawberry fruit quality is defined by several characteristics and is influenced by genetic factors, pedoclimatic factors (Maltoni et al., 2009, Temocico et al., 2008) and culture technology (Anttonen et al., 2006).

The color, texture, flavor and balance between sweetness and acidity were identified as key parameters for evaluating the quality of strawberry fruits (McGuire, 1992, Shamaila et al., 1992). In the selection of the fruit, the consumer is influenced by the color and texture and the taste is defined by the flavor, sugar content and acidity (Wozniak et al., 1997, Voca et al., 2008).

The genotype is very important in determining the nutritional and organoleptic qualities of the fruit (Moshiur et al., 2015, Atkinson et al., 2006). The aim of this study was to evaluate the influence of the cultivars on the quality of strawberry fruits.

2. Material and methods

The research was conducted in 2012-2014 period, in an experimental plot of the Research Institute for Fruit Growing Pitesti, in a monofactorial trial with seven graduations (cultivars): Alba, Clery, Coral, Magic, Premial, Queen Elisa and Record. The experience was organized in randomized blocks with three repetitions (eight plants per each repetition). The planting distance was 0.25 m distance in the row and 0.90 m distance between rows.

Strawberry fruits were harvested at commercial maturity and fruits samples were analyzed immediately after picking. The optimum moment for harvesting strawberries was considered when the entire surface was red (Voca et al., 2008).

Average fruit weight was determined by weighing 20 fruits per sample using HL-400 digital balance.

Fruit firmness of each fruit was determined for each sample with a penetrometer Bareiss HPE II Fff nondestructive test, with a measuring surface of 0.50 cm^2.

Soluble solids content was determined with digital refractometer PR Series.

External fruit color was determined with a colorimeter Konica Minolta CR 400, based on system Huntel L*, a*, b* on both sides of the fruit (L* corresponds to brightness, a* and b* chromaticity coordinates from green to red and from blue to yellow, respectively). Chroma index was determined by

the formula C = $(a^{*2} + b^{*2})^{1/2}$ and hue angle of the formula hº = arctangent (b*/a*), where 0º= red-purple, 90º= yellow, 180º= bluish-green and 270º =blue (McGuire, 1992).

Index size was calculated with the formula: (large diameter + height + small diameter)/ 3, recommended by Botu and Botu, 1997.

Statistical processing of data was conducted using analysis of variance and the test for determining the significance of differences between the variants was multiple range test DUNCAN, for a probability of error ≤0.05.

3. Results and discussions

Fruit skin color

Colorimetric characteristics of the fruit is of great importance because influences the consumer priority in choosing the fruits. Generally, there are preferred the fruits with a bright light red color.

The results of the color parameters showed statistically significant differences between the average values over the three years of study, and between the same cultivar and different years of study. The average values of the brightness-darkness fruit index from the whole experimentation period were classified into two homogeneous classes of statistical significance and varied between 26.10 units at cultivar Clery and 30.88 units at cultivar Premial (fig. 1). The cultivar Premial had significantly higher values (30.88) than cultivars Clery and Queen Elisa (26.10 and 27.02 respectively). Studying the interaction between variety and year of study, it was noted that yearly differences between cultivars regarding the brightness index of the fruits decline until they disappeared in 2014.

The average values of the chroma index of the fruit were also classified into two statistically homogeneous classes, if we interpret the average of 2012 – 2014 period: cultivar Premial recorded significantly higher values (31.92) versus all other cultivars, except cultivar Coral which has intermediate values between the two homogeneous groups (fig. 2). The interactions of the study year and the effect of the cultivars on the chroma index of the fruit were generally weak, only remarking 2014, when the highest values were obtained by Coral cultivar (29.86) instead of Premial (23.92).

The average value of hue angle index of the fruits in the experimentation period, varied between 21.74 units at Clery cultivar and 26.95 units at Magic cultivar (fig. 3). The Magic cultivar had significantly higher values compared with Clery, Premial, Queen Elisa and Record cultivars. Intermediate values were registered by Alba and Coral cultivars. In the third year of study, analysis the hue angle divided the cultivars into three statistically homogeneous classes. Brightness was significantly positively correlated with five of the studied indicators, four indicators of fruit color (a *, b *, C *, hº) and one indicator of the fruit size (index size). Also, the chroma index was significantly positively correlated with three color indexes (L *, a *, b *), and the hue angle only with two indexes of fruit color (L * and b *).

Average fruit weight

The average fruit weight is a characteristic that expresses the fruit size, having high commercial importance, especially when fruits are used for fresh consumption. Statistical evaluation of the average fruit weight during the study, divided the seven cultivars into four homogeneous classes of statistical significance. The highest value was recorded by Record cultivar (25.02 g) and the lowest by Coral cv. (13.63 g, fig. 4). The cultivar Record was significantly differentiated from all other studied cultivars. The average fruit weight was significantly and positively correlated with two fruit quality indices (index size r = 0.588***, firmness r = 0.365*) and negatively with % Brix (r = 0.513**, tab. 1).

Fruit size index

The size of the fruit expressed in index of size has recorded during the study period average values ranging between 34.28 at Coral cultivar and 39.2 at Record cv. (Fig. 5). The cultivar Record was significantly different by all other cultivars through the high values of the index size, excepting Clery cultivar. The dominance of Record cultivar over the other cultivars in terms of size index was strong in the first year of study, nonexistent in 2013 and relatively low in 2014. In statistical terms of the size index values, in 2012 cultivars were classified into three statistically homogeneous classes, in 2013 in one class and in 2014 in two classes. The fruit size index was significantly negatively correlated with the brightness of fruits (r = - 0.316°, Tab. 1) and with the percentage of soluble solids expressed in Brix degrees (r = - 0.314° C) and very significantly positive with the average fruit weight (r = 0.588***).

Fruit firmness

The firmness is an important feature for the cultivars with fruits for fresh consumption, being an indicator that can significantly influence the harvesting, packaging, transport and storage life of the fruits. The Alba cultivar has recorded the highest values of the fruit firmness, on average, during the study period (2.98 kgf cm^{-2}), showing a significant increase by 13.07% to 10.72%, compared to cultivars: Premial, Magic and Coral (Fig. 6). The cultivars Clery, Queen Elisa and Record registered intermediate values of the fruit firmness.

Total soluble solids

The statistical analysis of the recorded values of the content in total soluble solids of the fruits from different cultivars highlighted large differences in statistical terms. The Coral cultivar fruits recorded the highest value (10.33 % Brix) being the sweetest, with a significant increase of 15.77% up to 10.80% compared to all other studied cultivars (fig. 7). The lowest value was recorded by Alba cultivar (6.55% Brix). Regarding the interaction between the year of study and the effect of cultivars on the total soluble solids content of the fruits, the Coral cultivar highly exceeded all other varieties only in the second year of study, while in the other two years the values are very close to those of Premial and Queen Elisa cultivars.

4. Conclusions

Record cultivar recorded the highest value of average fruit weight (25.02 g) and respectively the size index (39.20) versus other studied cultivars.

Alba cultivar recorded the highest value of fruit firmness (2.98 kgf cm^{-2}) followed by Clery, Queen Elisa and Record cultivars (2.78, 2.69 and respectively 2.69 kgf cm^{-2}).

The Coral cultivar noted the highest value of the fruit total soluble solids content (10.33% Brix).

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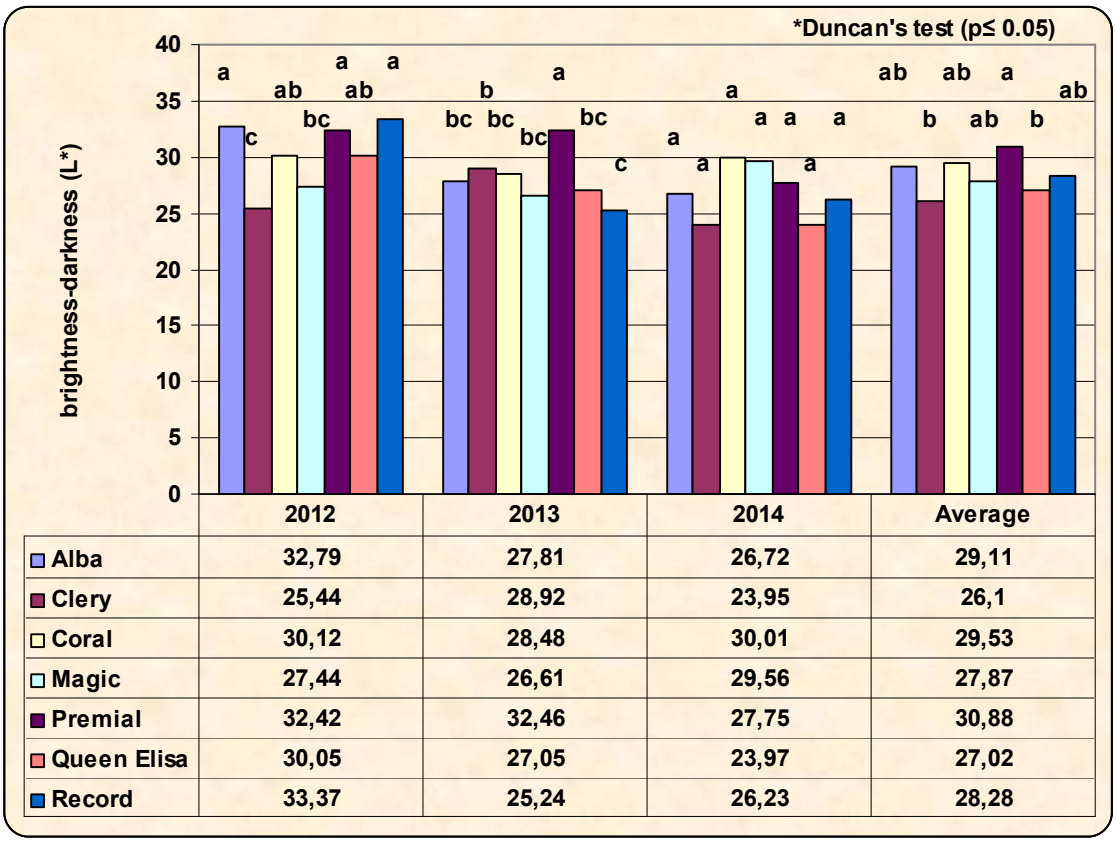
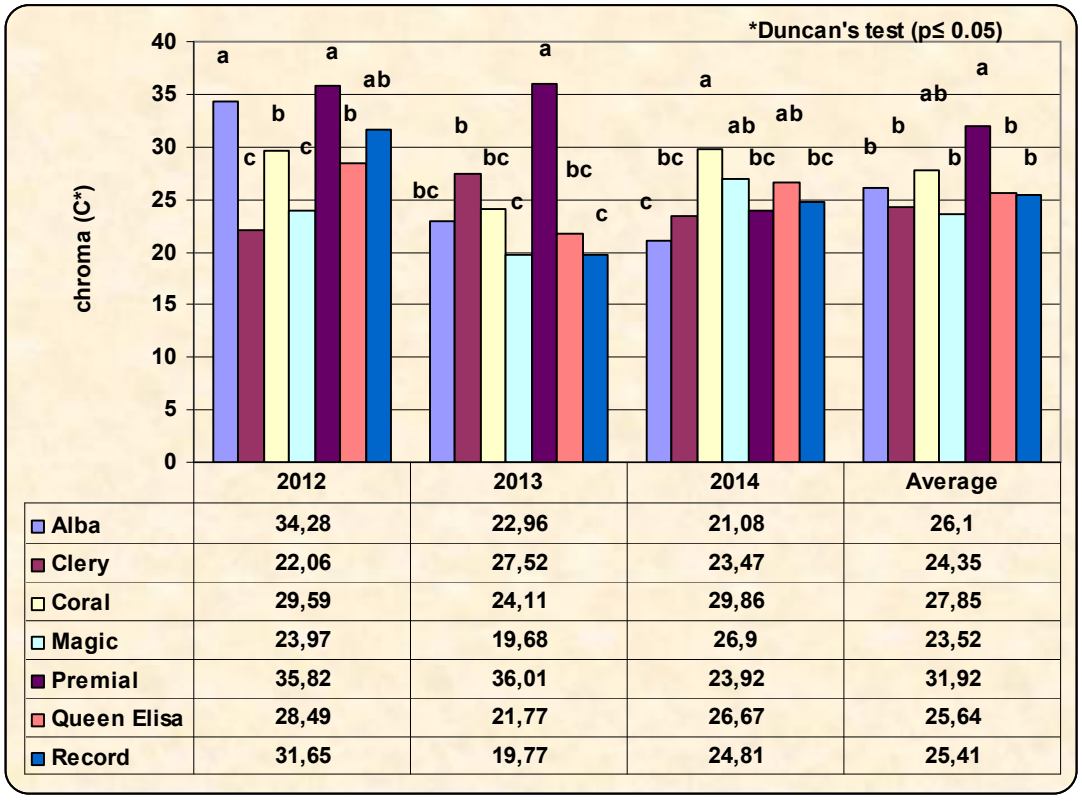
Tables and Figures



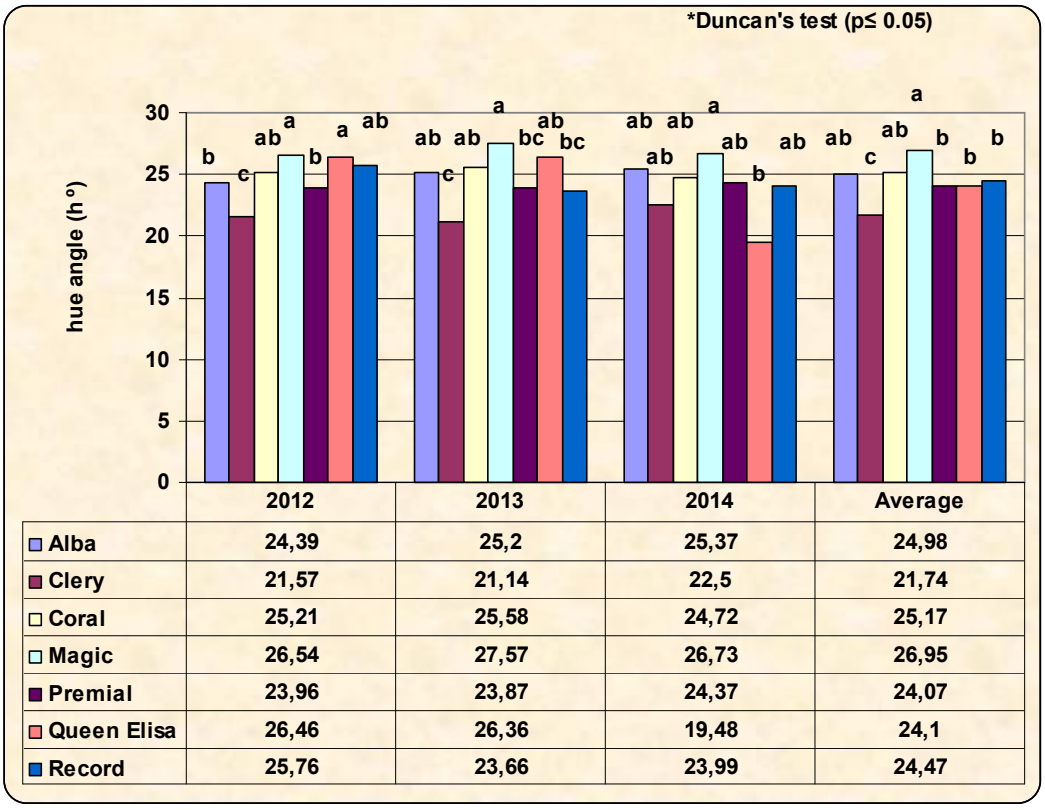
	2012	2013	2014	Average
Alba	32,79	27,81	26,72	29,11
Clery	25,44	28,92	23,95	26,1
Coral	30,12	28,48	30,01	29,53
Magic	27,44	26,61	29,56	27,87
Premial	32,42	32,46	27,75	30,88
Queen Elisa	30,05	27,05	23,97	27,02
Record	33,37	25,24	26,23	28,28

Fig. 1. The effect of the cultivar in the brightness-darkness fruit index



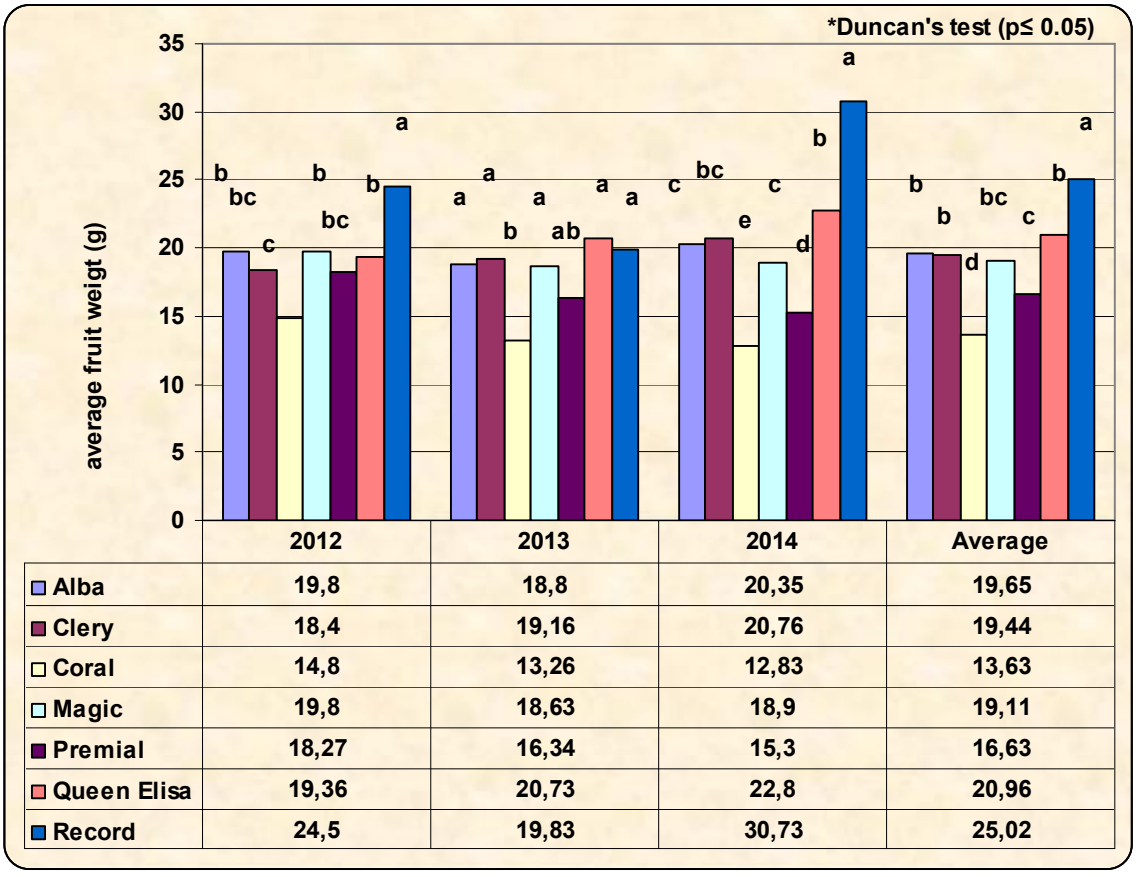
	2012	2013	2014	Average
Alba	34,28	22,96	21,08	26,1
Clery	22,06	27,52	23,47	24,35
Coral	29,59	24,11	29,86	27,85
Magic	23,97	19,68	26,9	23,52
Premial	35,82	36,01	23,92	31,92
Queen Elisa	28,49	21,77	26,67	25,64
Record	31,65	19,77	24,81	25,41

Fig. 2. The effect of the cultivar in the chroma index



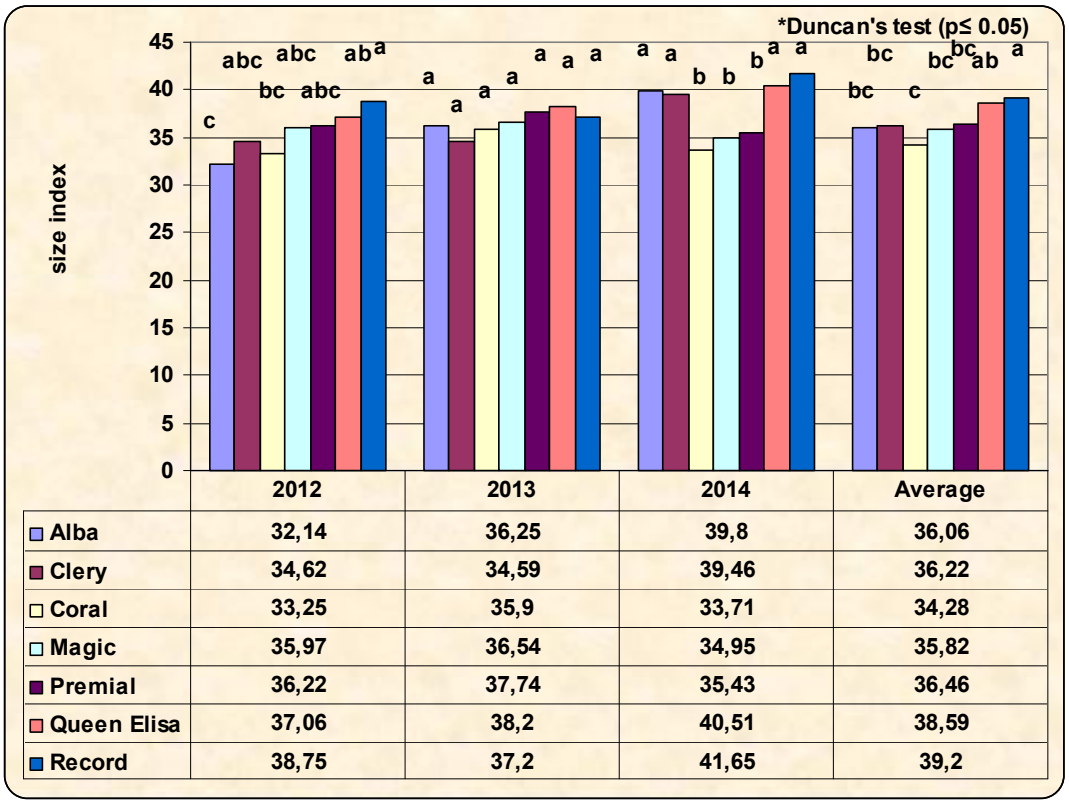
	2012	2013	2014	Average
Alba	24,39	25,2	25,37	24,98
Clery	21,57	21,14	22,5	21,74
Coral	25,21	25,58	24,72	25,17
Magic	26,54	27,57	26,73	26,95
Premial	23,96	23,87	24,37	24,07
Queen Elisa	26,46	26,36	19,48	24,1
Record	25,76	23,66	23,99	24,47

Fig. 3. The effect of the cultivar in the hue angle index



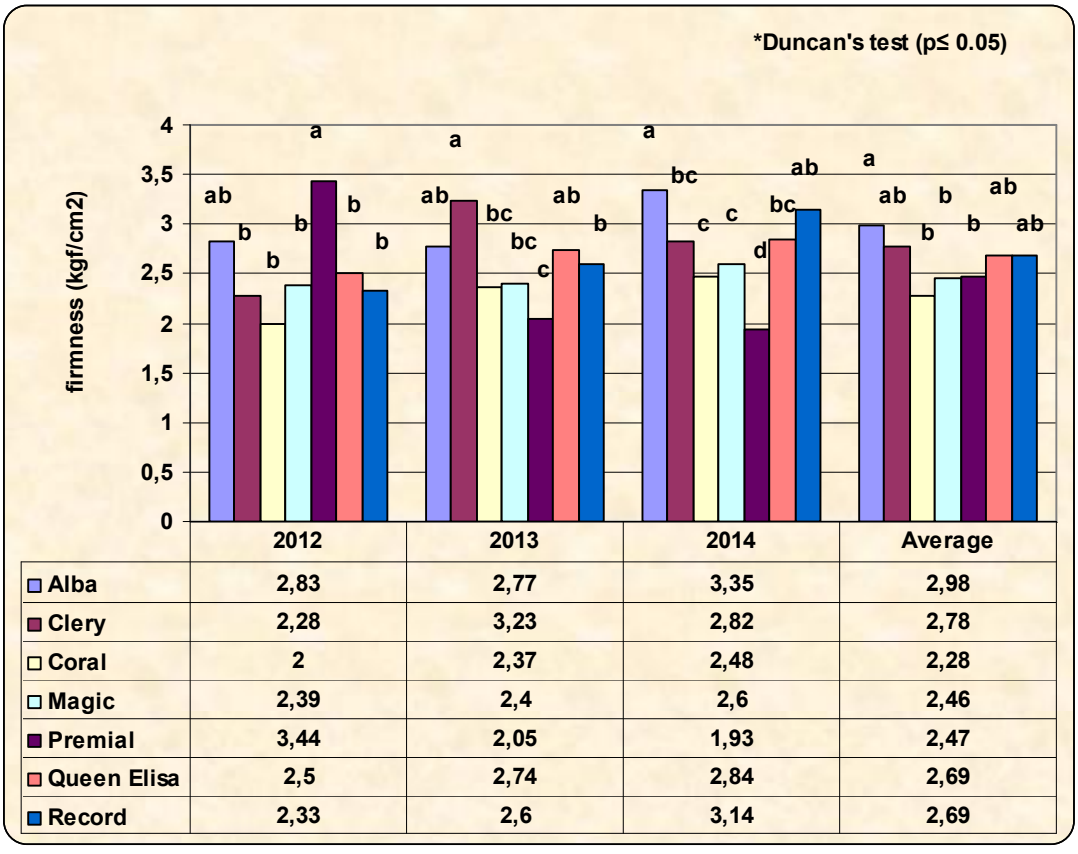
	2012	2013	2014	Average
Alba	19,8	18,8	20,35	19,65
Clery	18,4	19,16	20,76	19,44
Coral	14,8	13,26	12,83	13,63
Magic	19,8	18,63	18,9	19,11
Premial	18,27	16,34	15,3	16,63
Queen Elisa	19,36	20,73	22,8	20,96
Record	24,5	19,83	30,73	25,02

Fig. 4. The effect of the cultivar in the average fruit weight



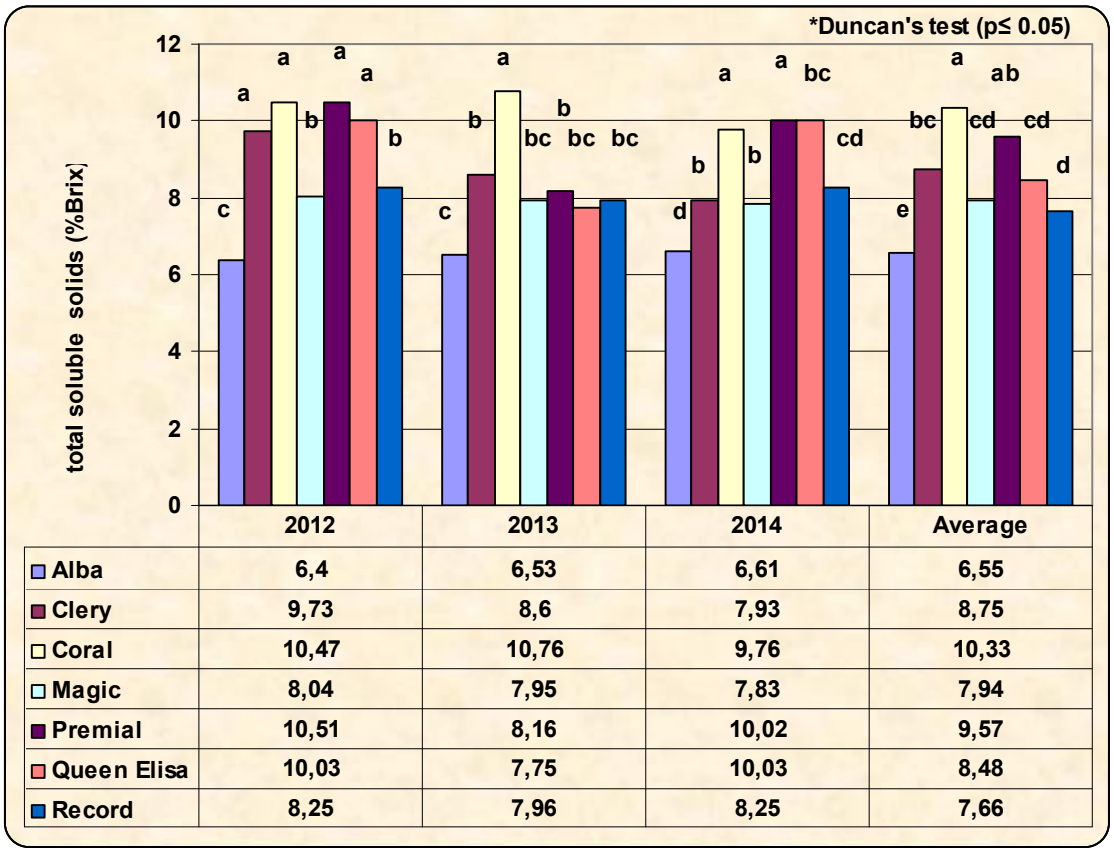
	2012	2013	2014	Average
Alba	32,14	36,25	39,8	36,06
Clery	34,62	34,59	39,46	36,22
Coral	33,25	35,9	33,71	34,28
Magic	35,97	36,54	34,95	35,82
Premial	36,22	37,74	35,43	36,46
Queen Elisa	37,06	38,2	40,51	38,59
Record	38,75	37,2	41,65	39,2

Fig. 5. The effect of the cultivar in the fruit size index



	2012	2013	2014	Average
Alba	2,83	2,77	3,35	2,98
Clery	2,28	3,23	2,82	2,78
Coral	2	2,37	2,48	2,28
Magic	2,39	2,4	2,6	2,46
Premial	3,44	2,05	1,93	2,47
Queen Elisa	2,5	2,74	2,84	2,69
Record	2,33	2,6	3,14	2,69

Fig. 6. The effect of the cultivar in the fruit firmness



	2012	2013	2014	Average
Alba	6,4	6,53	6,61	6,55
Clery	9,73	8,6	7,93	8,75
Coral	10,47	10,76	9,76	10,33
Magic	8,04	7,95	7,83	7,94
Premial	10,51	8,16	10,02	9,57
Queen Elisa	10,03	7,75	10,03	8,48
Record	8,25	7,96	8,25	7,66

Fig. 7. The effect of the cultivar in the total soluble solids

Table 1. Correlations between fruit quality indicators (simple Pearson correlation coefficient - r)

The studied character	L* (brightness-darkness)	a* (green-red)	b* (blue-yellow)	C* (Chroma index)	Hue angle (redness)	Fruit size index	Fruit firmness (kgf/cm2)	Fruit weight (g)	Soluble solid (% Brix)
L*(brightness-darkness)	1	,758(**)	,938(**)	,809(**)	,443(**)	-,316(*)	-,066	-,168	,222
a*(green-red)	,758(**)	1	,854(**)	,995(**)	-,141	-,220	,061	-,093	,213
b* (blue-yellow)	,938(**)	,854(**)	1	,901(**)	,386(**)	-,244	-,051	-,114	,207
C* (Chroma index)	,809(**)	,995(**)	,901(**)	1	-,045	-,227	,042	-,096	,215
Hue angle (redness)	,443(**)	-,141	,386(**)	-,045	1	-,080	-,209	-,112	,025
Fruit size index	-,316(*)	-,220	-,244	-,227	-,080	1	,207	,588(**)	-,293(*)
Fruit firmness (kgf/cm2)	-,066	,061	-,051	,042	-,209	,207	1	,365(**)	-,314(*)
Fruit weight (g)	-,168	-,093	-,114	-,096	-,112	,588(***)	,365(**)	1	-,513(**)
Soluble solid (% Brix)	,222	,213	,207	,215	,025	-,293(*)	-,314(*)	-,513(**)	1