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COMPARISON OF FRUIT QUALITY ATTRIBUTES OF SOME FIG (*FICUS CARICA* L.) GENOTYPES FROM THE SOUTH-WEST REGION OF ROMANIA

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Abstract

The study aims to make a comparison between fourteen fig genotypes, grown in the South-West region of Romania, that have fruits with different quality traits and to assess which of these genotypes have elevated potential and represent valuable biological material for future propagation. Biometrical variables (weight, length, and width) were measured for the first and the main crop, stalk length and ostiole diameter were also measured. Visual observations were done and the fruits were characterized using the fig characterization given by IPGRI (The International Plant Genetic Resources Institute), 2003. The fruit weight had values between 67 g in SV2 and 11 g (S1), the fruit length varied between 5.6 cm (SV2) and 2.6 cm (S1) and the width of the fruits was between 2.81 cm (C1) and 4.68 cm (SV2) genotype. The total soluble solids/TSS (sugar) and the titratable acidity (TA) of the fruits were also assessed, the sugar content recording values of 17.41% Brix for IJ1 genotype and 27.83% Brix for C3 genotype.

Key words*: Ficus carica L., genotype, fruit quality, sugar content, titratable acidity, fruit size.*

INTRODUCTION

Fig (*Ficus carica* L.) is one of the ancient fruits known to mankind which also finds its mention in the Bible. It is reported to be under cultivation from 3000-2000 BC in the eastern Mediterranean region (Fig, 2016). Fruits are consumed fresh as well as in the dried form. Fresh figs are delicious and nutritious as they are rich in calorie, protein, calcium and iron. Fig has nutritive index of 11, as against 9 for apple and 6 for raisin (Mazmanyan V., 2022). The bulk of the fruit (about 80%) is consumed in the dried form (Fig, 2016). The fruit is also credited with laxative and medicinal properties and is being applied on boils and for other skin infections (Mazmanyan V., 2022). Studying the fruit quality of different fig cultivars in order to select and preserve valuable biological material represents the a big part of the work of many authors (Holia, 2018; Zhang et al. 2020; Pereira et al., 2017; Trad et al., 2014; Polat et al., 2017, 2008; Çalişkan and Polat, 2012, 2008; Saddoud et al., 2008 etc.).

The productivity and popularity of fig trees in the South-West region of Romania has increased in the last years due to the climate changes that have created a favourable environment for growing figs and harvesting high quality fruits with minimum of maintenance required, creating an opportunity for researchers to expand their studies on *Ficus carica* L. in this region, as well as giving a more precise and complex cultivar characterization to farmers and growers.

In the climatic conditions of Romania, when planted in the right environmental conditions, fig trees produce two crops every year, this fact giving big yields to farmers who grow figs for commercial purposes.

The study aims to make a comparison between fourteen fig genotypes, grown in the South-West region of Romania, that have fruits with different quality traits and to assess which of these genotypes have elevated potential and represent valuable biological material for future propagation. This research could offer to growers a scientific based characterization of the fig varieties in the area.

MATERIALS AND METHODS

The study was conducted in the South-West region of Romania, during the year 2020. The

genotypes were collected from Svinița village (44°32′11″N 22°05′15″E), location well known for the mild and favourable climate and numerous fig trees, and Orșova town (44°43′ 31″N 22°23′46″E) which is 48 km away from Svinița.

A total of fourteen genotypes were included in the study, four collected from Svinița (S1, SV1, SV2, SM1) and the other ten (C1, C2, C3, M0, M2, F1, F2, F3, L1 and IJ1) from different parts of Orșova town (Figures 1-6).

Figure 1. S1 genotype

Figure 2. SV1 genotype

From each genotype, 30 fruits were randomly selected from the fig trees. Pomological characteristics were determined for each genotype. The biometrical aspects (weight, length, width) were measured for both crops, first and main crop, for every genotype. Fruit characteristics such as external appearance and internal quality aspects such as sugar content and titratable acidity were recorded only for the main crop, the reason being that this is the crop which represents higher commercial value.

Figure 3. SM1 genotype

Figure 4. SV2 genotype

Figure 5. IJ1 genotype

Figure 6. F3 genotype

Fruit weight was measured with a precise kitchen scale. The ostiole width was measured with a manual clipper, as well as the fruit width, fruit length and fruit stalk. The sugar content was determined with a digital ATAGO refractometer (ATAGO Co., Tokyo, Japan). The titratable acidity (expressed as % citric acid) was determined by titrating with 0,1*N* NAOH, and using phenolphthalein as an indicator, up to an end point.

The fruit index was calculated by dividing the width by the length. The fruit shape, the petiole length, the shape of stalk, the osteole width, the fruit skin cracks, the fruit skin colour and the fruit flesh colour, were determined based on the fig descriptor developed by IPGRI and CIHEAM, 2003.

The harvest period was determined for the main crop.

The data regarding the biometrical aspects was statistically processed using variance analysis, as the experiment control being used the experience average.

RESULTS AND DISCUSSIONS

The results regarding the biometrical aspects of the fruits for the both crops (first and main), in the year 2020, are presented in Tables 1-6. The weight and the fruit size (expressed by width and length) of the majority of genotypes, varied from one crop to another; the fruits in the main crop being slightly smaller compared to the first crop. The external and some internal fruit characteristics (TSS, TA, colour of the pulp) are presented in Tables 7 and 8. It is shown that the genotypes have different coloured skin and pulp, also some present crack on the skin surface, or medium to very large ostiole width (Table 8.). The fruit shape, the length of the petiole, the shape of the stalk and the harvest period, are presented in Table 7. The sugar and the titratable acidity are shown in Table 8.

Table 1. Fruit weight values (first crop), year 2020

Genotype	Fruit weight (g)	Relative value (%)	Difference to control	Significance
C1	25.00	67.65	-11.95	000
C2	26.20	70.90	-10.75	000
C3	29.10	78.75	-7.85	00
M0	50.57	136.84	13.61	XXX
M2	24.73	66.93	-12.22	000
S1	19.07	51.60	-17.89	000
SV1	26.13	70.72	-10.82	000
SV2	60.70	164.26	23.75	XXX
SM1	60.03	162.46	23.08	XXX
F1	13.27	35.90	-23.69	000
F2	60.33	163.26	23.38	XXX
F3	34.9	94.44	-2.05	-
L1	47.23	127.81	10.28	XXX
IJ1	40.13	108.60	3.18	-
Average	36.95	100.00	0.00	Control
LD5% = 5.55 g		LD1% = 7.50 g		LD0.1% = 9.99 g

In the first crop the fruit weight of the studied genotypes, had values between 13.27 g (F1) and 60.72 g (SV2) g with an experience average of 36.95 g (Table 1). Six genotypes have exceeded the mean value, five of them being very significant positive compared to the control (SV2, SM1, F2, M0 and L1) and one was not statistically assured (IJ1). Eight of the genotypes recorded values under the experience average, being very significant negative, other significant negative (C3), while F3 genotype was not statistically assured.

Table 2. Fruit weight (main crop), year 2020

Genotype	Fruit weight (g)	Relative value (%)	Difference to control	Significance
C1	21.63	76.51	-6.64	00
C2	20.70	73.21	-7.57	00
C3	22.27	78.76	-6.01	0
M0	40.37	142.77	12.09	XXX
M2	19.97	70.62	-8.31	00
S1	12.97	45.86	-15.31	000
SV1	21.83	77.22	-6.44	00
SV2	47.70	168.71	19.43	XXX
SM1	41.47	146.66	13.19	XXX
F1	10.80	38.20	-17.47	000
F2	39.3	139.00	11.02	XXX
F3	30.86	109.17	2.59	-
L1	34.96	123.673	6.69	XX
IJ1	31.03	109.76	2.76	-
Average	28.27	100.00	0.00	Control
LD5% = 4.83 g		LD1% = 6.352 g		LD0.1% = 8.69 g

For the main crop the fruits weighted between 10.80 g (F1), being very significant negative and 47.40 g (SM1), being very significant positive compared to the control, with an experience average of 28.27 g (Table 2). Higher values compared to the experience average were also recorded in M0, SV2, F2 genotypes, all being very significant positive and in L1 being distinct significant positive. Lower values compared to the average were recorder for S1 genotype being very significant negative, others, C1, C2, M2, SV1 were distinct significant negative, while F3 and IJ1 were not statistically assured. Similar weight values were also recorded by Çalişkan and Polat (2012), in their research about some Turkish fig genotypes, the figs' weight values varying between 22.8-57.5 g. Koyunku et al. (2004, 1998, 1998) recorded fruit weights between 23-84 g, 9.00-38.37 g and 11.35- 58.00 g. In the first crop, the fruit width measured between 4.68 cm (SV2) and 2.81 cm (C1), with an experience average of 3.81 cm (Table 3).

Table 3. Fruit width (first crop), year 2020

Genotype	Fruit width (cm)	Relative value (%)	Difference to control	Significance
C1	2.81	73.91	-0.99	000
C2	2.91	76.53	-0.89	000
C3	3.71	97.46	-0.10	-
M0	4.46	117.25	0.66	XX
M2	2.87	75.31	-0.94	000
S1	3.38	88.88	-0.42	0
SV1	3.69	96.94	-0.12	-
SV2	4.68	122.85	0.87	XXX
SM1	4.66	122.42	0.85	XXX
F1	2.84	74.69	-0.96	000
F2	4.60	121.01	0.80	XXX
F3	4.08	107.35	0.28	-
L1	4.43	116.46	0.62	XX
IJ1	4.26	111.90	0.45	X
Average	3.81	100.00	0.00	Control
LD5% = 0.39 cm		LD1% = 0.53 cm	LD0.1% = 0.71 cm	

The highest width values were recorded in SV2 genotype, followed by SM1, all being very significant positive compared to the experience average. M0 and L1 were distinct significant positive, while IJ1 was significant positive. C1, C2, M2 and F1, recorded the lowest values (2.81 cm, 2.91 cm, 2.87 cm and 2.84 cm), all four being very significant negative followed by S1 genotype with a significant negative value. C3, SV1 and F3, were not statistically assured.

For the main crop, seven genotypes exceeded the experience average (3.47 cm), M0, SV2, SM1 were very significant positive, L1- distinct significant positive, while F2, F3 and IJ1 were significant positive. Five genotypes recorded the lowest width values - M2, C2, C1, F1 and S1, all being very significant negative. C3 and SV1 genotypes were not statistically assured (Table 4).

Table 4. Fruit width (main crop), year 2020

Genotype	Fruit width (cm)	Relative value (%)	Difference to control	Significance
C1	2.67	77.02	-0.80	000
C2	2.58	74.33	-0.89	000
C3	3.39	97.69	-0.08	-
M0	4.30	124.04	0.83	XXX
M2	2.49	71.92	-0.97	000
S1	2.90	83.56	-0.57	000
SV1	3.34	96.44	-0.12	-
SV2	4.43	127.88	0.97	XXX
SM1	4.26	122.79	0.79	XXX
F1	2.73	78.85	-0.73	000
F2	3.85	111.25	0.39	X
F3	3.8	109.61	0.33	X
L1	4.02	116.05	0.55	XX
IJ1	3.86	111.34	0.39	X
Average	3.47	100.00	0.00	Control
LD5% = 0.31 cm		LD1% = 0.41 cm	LD0.1% = 0.55 cm	

The fruit length for the first crop, varied between 5.21 cm (F2) and 2.82 cm (F1), with an experience average of 3.87 cm (Table 5).

Table 5. Fruit length (first crop), year 2020

Genotype	Fruit length (cm)	Relative value (%)	Difference to control	Significance
C1	2.94	76.06	-0.93	00
C2	2.96	76.40	-0.91	00
C3	3.00	77.52	-0.87	00
M0	4.75	122.65	0.88	XX
M2	2.59	66.84	-1.28	000
S1	3.03	78.29	-0.84	00
SV1	3.96	102.24	0.09	-
SV2	4.96	128.25	1.09	XXX
SM1	4.96	128.08	1.09	XXX
F1	2.82	72.78	-1.05	000
F2	5.21	134.79	1.34	XXX
F3	4.32	111.80	0.45	-
L1	4.45	114.98	0.58	X
IJ1	4.32	111.71	0.45	-
Average	3.87	100.00	0.00	Control
LD5% = 0.52 cm		LD1% = 0.71 cm	LD0.1% = 0.94 cm	

Five genotypes exceeded the experience average - SV2, SM1 and F2 being very significant positive, M0 - distinct significant positive and L1 - significant positive. The lowest values were recorded by M2 (2.59 cm) and F1 (2.82 cm) being very significant negative, followed by C1, C2, C3 and S1 with significant negative values. SV1, F3 and IJ1 genotypes were not statistically assured. The main crop fruits, had length values between 2.35 cm (C2) and 5.05 cm (SV2), with an experience average of 3.50 cm (Table 6). Six of the studied genotypes had length values that exceed the experience average, M0, SV2, SM1 and F3 all being

very significant positive, while L1 and IJ1 were distinct significant positive. Other six genotypes had lower values that the experience average, C1, C2, C3, M2 and F1, being all very significant negative, S1 - distinct significant negative, while SV1 and F2 were not statistically assured. Similar results were obtained by Ali Koyuncu et al. (2004, 1998, 1998), recording values of 36-56 mm, 24.48-43.60 mm and 3.10-5.25 cm (fruit width) and 30-56 mm, 22.00-39.80 mm and 2.20-6.20 cm (fruit length).

Table 6. Fruit length (main crop), year 2020

Genotype	Fruit length (cm)	Relative value (%)	Difference to control	Significance
C1	2.60	74.38	-0.90	000
C2	2.35	67.24	-1.15	000
C3	2.42	69.05	-1.08	000
M0	4.63	132.38	1.13	XXX
M2	2.38	67.90	-1.12	000
S1	2.76	78.86	-0.74	00
SV1	3.36	96.00	-0.14	-
SV2	5.05	144.38	1.55	XXX
SM1	4.34	124.00	0.84	XXX
F1	2.66	76.00	-0.84	000
F2	3.83	109.61	0.33	-
F3	4.32	123.42	0.82	XXX
L1	4.27	122	0.77	XX
IJ1	4.10	117.238	0.60	XX
Average	3.50	100.00	0.00	Control
LD5% = 0.45 cm		LD1% = 0.60 cm	LD0.1% = 0.80 cm	

Table 7. External fruit characteristics for the studied genotypes and the harvest period, in 2020 (main crop)

Genotype	Fruit width/length (index)	Fruit shape	Petiole length	Shape of stalk	Harvest period
C1	1.02	Globose	Short	Short and thick	August-September
C2	1.09	Globose	Short	Short and thick	August-September
C3	1.40	Oblate	Short	Short and thick	August-September
M0	0.92	Globose	Short	Short and thick	August-September
M2	1.04	Globose	Short	Short and thick	August-September
S1	1.05	Globose	Short	Short and thick	August-September
SV1	0.99	Globose	Short	Short and thick	August-September
SV2	0.87	Oblong	Short	Short and thick	August-September
SM1	0.98	Globose	Short	Short and thick	August-September
F1	1.02	Globose	Short	Short and thick	August-September
F2	1.00	Globose	Short	Short and thick	August-September
F3	0.89	Oblong	Long	Long and slender	August-September
L1	0.94	Globose	Short	Short and thick	August-September
IJ1	0.89	Oblong	Short	Short and thick	August-September

The fruit shape index had values between 0.97 (SV2) and 1.40 (C3). The fruit shape was globose, oblate and oblong (Table 7). Similar result were recorded by Polat and Çalişkan (2008). The petiole length was short for the most genotypes with the exception of F3 with a long petiole. The shape of the stalk was short and thick, with one exception (F3) of long and slender. The harvest period for the main crop in the studied genotypes is long (41-60 days), harvesting the fruits in August-September for all genotypes.

Table 8. External and internal fruit characteristics for the studied fig genotypes, year 2020 (main crop)

Geno-type	Osteole width	Fruit skin cracks	Fruit skin colour	Fruit flesh colour	TTS %	TA citric acid %
C1	Medium	None	Purple	Pink	27.70	0.22
C2	Medium	None	Purple	Pink	25.26	0.16
C3	Medium	None	Purple	Pink	28.90	0.16
M0	Large	Scarce longitudinal cracks	Brown	Amber	21.20	0.20
M2	Medium	None	Purple	Pink	26.54	0.18
S1	Medium	None	Purple	Pink	24.33	0.21
SV1	Medium	None	Purple	Pink	21.63	0.28
SV2	Large	Scarce longitudinal cracks	Brown	Amber	25.75	0.13
SM1	Very Large	Scarce longitudinal cracks	Brown	Amber	25.33	0.23
F1	Medium	None	Purple	Pink	27.70	0.21
F2	Large	Scarce longitudinal cracks	Yellow green	Amber	24.20	0.26
F3	Large	Scarce longitudinal cracks	Yellow green	Pink	21.1	0.29
L1	Large	Scarce longitudinal cracks	Brown	Amber	22.3	0.21
IJ1	Very Large	Scarce longitudinal cracks	Brown	Amber	18.15	0.27

The ostiole width was of medium size for C1, C2, C3, M2, S1, SV1 and F1 genotype, large for M0 and SV2 genotype and very large for SM1 genotype (Table 8). The fruit skin colour was purple, brown and yellow green with scarce longitudinal cracks or no cracks at all (Table 8). The flesh colour was pink for some genotypes and amber for others (Table 8.)

The total soluble solids content recorded values between 18.15 % (IJ1) and 28.90% (C3) and the titratable acidity between 0.13% (SV2) and 0.29% (F3). Similar values of TSS were recorded in some fig cultivars from Tunisia, the lowest being 16.53% and the highest 34 % and 36.54% (Aljane et al., 2009). Koyunku et al. (2004, 1998, 1998) recorded TTS contents ranging from 12 to 21.3%, 11.9-24.30% and 16.6-20.0%. Polat and Çalişkan (2008), recorder values of the titrable acidity ranging between 0.20 and 0.38% and TTS between 22.7 and 27.2%.

CONCLUSIONS

The South-West region of Romania has a high potential for fig cultivation, the results of the

study showing that the studied genotypes give good quality fruits. Regarding the external appearance of the fruits in the studied fig genotypes, the size, shape and colour varied. The purple, smaller sized fruits (C1, C2, C3, F1, S1, M2, SV1) are more suitable for eating fresh and are more resistant to transportation, and storing, whereas bigger sized fruits (M0, L1, F2, F3, SM1, SV2, IJ1), are mostly used processed in jams and for making alcoholic drinks. They are easily perishable and do not perform well when transported.

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