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Apple Scab Resistant Cultivars Cultivated in Bucharest area - Fruits Characterization

Preda L.F., Butcaru Ana Cornelia*, Mihai C.A., Stănică F.

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59, Bv. Mărăști, Romania

*Corresponding author. Email: anabutcaru@gmail.com

Abstract Apple scab (*Venturia inaequalis*) is one of the most important pathogens for apples, the specific treatment being required. Every year, new resistant apple scab varieties are released by breeders that need to be tested in specific growing conditions. This study aims to present the fruit quality evaluation through sensorial analyses of more than 25 apple scab resistant cultivars in the Bucharest area. The apple cultivars were tested including size, color, attractiveness, firmness, pulp juiciness and color, taste and flavor. The analysis like weight, total soluble solids, firmness were determined and correlated with the sensorial analyses parameters. The results highlighted the necessity of multiannual data in evaluation, the technology applied and climatic factors being strongly correlated with the fruit quality. From the apple scab resistant cultivars, most of the highly appreciated ones had Golden delicious between genitors. Several cultivars can be promoted for large production, due to their fruit quality evaluation.

Key words

firmness, *Malus domestica*, pulp juiciness, pulp color, taste

Apple has been present for many years in mankind's history. With its large plasticity, it is one of the most cultivated fruit species both in the northern as in the southern hemisphere. "An apple per day keeps the doctor away" express mostly the fruit nutraceutical properties. Even if other fruits have, perhaps, a larger quantity of some biochemical compounds, apple is a complete and complex fruit.

In the last 25 years in the world, apple production almost doubled according to much lower harvesting areas, Asia being the biggest producer with 58.5% followed by Europe with 23.5%. Romania had the same trend for apple harvesting areas and production, the orchard surfaces lowered but the production doubled [37] technologies and new cultivars released with higher production potential are important causes [19, 14, 1, 18, 13, 12, 5, 4, 9].

Breeding programs had common objectives with other fruit species like increasing production potential together with pest and disease resistance, improving adaptability to various climate and soil conditions, continuously improving fruit quality [5].

For apple, specific breeding objectives were scab and mildew resistant cultivars, high fruit quality (similar to Jonathan and Golden delicious), spur type fruiting and identify resistance molecular markers. At the same time, other breeding lines were pest resistance cultivars, columnar type trees and genotypes with genetic pest and disease resistance.

In the breeding process, multiple methods were used but the general basis was to start or combine the best potential available genitors using also intra-clonal selection of somatic mutants, natural or artificial induced [5].

Apple scab (*Venturia inaequalis*) resistant cultivars are the objective of one of the largest and successful breeding programs. Through Vf gene included in the new genome, new scab resistant cultivars were released.

Apple scab (*Venturia inaequalis*) is one of the most important pathogens for apples, the specific treatment being required. One of the important challenges for apple growers is to obtain high-quality fruits respecting the rules regarding the pesticide limits, which are continuously changing due to the consumers' requests.

One of the most used evaluation methods for fruits is the sensorial analysis, using different attributes to be tested and evaluated, according to the fruit species [25].

The importance of international collaboration was highlighted through different programs and international databases for apple breeding with specific information on molecular markers (SSR), biochemical analysis for different genotypes fruits and also observation through sensorial analysis [4].

The sensorial evaluation proved to be an important selection tool in apple breeding. The preferences for some fruit attributes changed from year to year, like juiciness, aroma or sweetness [15].

For apple (*Malus domestica* Borkh.) fruits, quality standards were designed and improved continuously. Fruit size was an important attribute [6], changing in time with the consumer's preferences and style. Fruit color, firmness, pulp juiciness and color, taste and aroma completed the panel [16,17].

Every year, new resistant apple scab cultivars are released by breeders that need to be tested in specific growing conditions [21, 3].
This study aims to present the fruit quality evaluation through sensorial analyses of more than 25 apple scab resistant cultivars, from which 10 being Romanian creations, cultivated in the Bucharest area.

Material and Method

Description of the study site and experimental design
The tested apple fruits were harvested from the Experimental field of the Faculty of Horticulture in Bucharest, located in the North part of the town. They were kept in the cold storage until they were analyzed.
Biological material
In the Experimental orchard of the Faculty of Horticulture within the University of Agronomic Sciences and Veterinary Medicine of Bucharest, more than 25 apple scab resistant varieties are cultivated and monitored (Table 1). Most of the trees are grafted of M9 rootstock, planted at 3.5 x 1.0 m and led as Vertical Axe. Integrated technology is applied, where the soil is maintained covered with a mixture of perennial grasses on the inter-row and clean with herbicide on the row. Drip irrigation is installed. Three cultivars sensitive to apple scab were maintained as control.

Table 1. Scab resistant apple cultivars

Cultivar	Genitors	Fruit color (ground/over)	Fruit size	References
Ariwa	Golden Delicious × A 849-5	green-yellow/ orange	medium	[4, 20]
Aura	Prima x BN 33/39	green-yellow/ orange	Big	[5, 4, 31]
Bistrițean	Starkrimson x Prima	green - yellow/ red	medium	[5, 4, 31]
Ciprian	Prima x Starkrimson	green/ dark red	medium	[5, 4, 8, 31]
Dalinette	cross of X4598 x X3174	yellow - green/ dark red	medium	[9, 36]
Dalinred	cross of X4598 x X3174	yellow - green/ red	medium - big	[4, 39]
Enterprise	COOP 30= Starking delicious, Giant limb, Golden delicious, Rome beauty, *Malus floribunda* 821	green - yellow/ orange	medium - big	[4, 38, 7]
Florina	*M.floribunda* 821, Rome Beauty, Golden Delicious, Starking Simpson'S Giant Limb, Jonathan	yellow/ red	medium - big	[4, 8, 9, 31, 18, 7, 13, 20]
Fuji kiku 8	Sport of Fuji (Red Delicious x Ralls Janet)	green - yellow/ red	medium	[4, 41]
Generos	(Parmain d'or x M. Kaido) x (Jonathan x Frumos de Voinești)	green - yellow/ orange	big	[5, 4, 8, 9, 31, 18, 13, 7]
Golden orange	Golden Delicious × PRI 1956-6	light green/ orange	medium-big	[4, 20, 7]
Goldrush	COOP 17 x Golden delicious	light green/ orange	medium-big	[4, 20, 7]
Goldstar	Rubín × Vanda (Jolana × Lord Lambourne)	green - yellow/ orange	big	[27, 7]
Iris	Prima (seeds irradiation)	yellow/ red	medium-big	[5, 4]
Jonafree	PRI 855-102 x NJ 31	green-yellow/ red	medium	[4, 41]
Jonaprim	Prima x Jonathan	green - yellow/ red	medium	[5, 4, 31]
Luna	Topaz x Golden delicious	green - yellow/ yellow	medium-big	[4, 39]
Opal	Golden Delicious x Topaz	yellow/-	medium - big	[39, 41]
Orion	Golden Delicious x Otava	yellow/-	big	Patent US PP 19,276 P3
Rajka	Šhampion × ÚEB 1200/1(Katka) (Jolana x Rubin)	yellow/ red	medium-big	[41, 27, 7]
Rebra	Florina x Idared	green - yellow/ pink	medium-big	[5, 4, 31]
Red devil	Discovery x Kent	dark red	medium	[41]
Redix	Goldspur x Prima (free pollination)	green - yellow/ red	medium-big	[5, 4, 31]
Remar	Prima (free pollination, seed irradiation)	/red and yellow - orange at peduncle	big	[32]
Remo	James Grieve x Clone BX 44,14	green - yellow/ dark red	medium	[4, 8, 9, 40, 7]
Rene	James Grieve x Clone BX 44,14	green - yellow/ red	big	[35]
Remus	Complex hybrid F4	light green/ red	medium	[4, 31, 7]
Rubinola	Prima x Rubin	yellow/red	medium-big	[20, 7]
Sirius	Golden Delicious x Topaz	yellow	big	Patent US PP18,541 P2
Starkprim	Prima x Starkrimson = 2000	green - yellow/ red	big	[5, 4, 31]
Topaz	Rubin x Vanda	green - yellow/ red	medium	[4, 39, 7]

Biochemical analyses
The basic analyses like average weight, size, total soluble solids, dry matter and firmness were calculated and correlated with the sensorial analysis parameters.
Total soluble solids were determined for each genotype, with a refractive device Kruss DR301-95 (% Brix) [34, 29, 26].

Dry matter was determined by oven drying for 24 hours at 105°C using a UN110 Memmert oven, a method used also by [23, 30, 11, 10, 24, 33, 2].

Firmness was determined with a digital penetrometer TR Turoni 53205, the results being calculated in kg f/cm^2.

Researches were conducted in 2017 (winter, I) and 2018 (autumn, II and winter, III), evaluating the quality of fruits. The apple cultivars were tested with different types of consumers by gender and age including size, color, attractiveness, firmness, pulp juiciness and color, taste and flavor.

The analyses were conducted in the Research Center for Studies of Food Quality and Agricultural Products, University of Agronomic Studies and Veterinary Medicine of Bucharest.

Statistical analysis

Data statistical analysis was performed with Excel (MS Office) and Quattro programs. For correlation between two data sets Excel statistical functions with a significance level $p < 0.05$ were used [28].

Results and Discussions

For some of the cultivars, 2018 was a better year than 2017 regarding the appreciation of fruits. Enterprise, Florina, Galaxy, Luna, Red Elstar and Sirius cultivars received higher notes in the 2018 winter than in 2017. But, Ariwa, Generos, Goldrush and Topaz cultivars were highly appreciated in 2017 than in winter 2018 (Table 2, Figure 2).

Some of the cultivars were tested both in autumn (October) and winter (December) of 2018. With a single exception, all of them were significative more appreciated in wintertime (Dalinette, Gala king, Generos, Iris and Remar cultivars). Redix cultivar had the highest appreciation from the three testing sessions in autumn, highlighting his maturity time for this period.

At the first winter testing, Ariwa, Goldrush and Jonafree cultivars received the highest scores, followed by Opal and Topaz cultivars and then by Mela and Generos cultivars.

At the second winter testing, Fuji kiku (a new cultivar introduced in the panel) was the most appreciated apple scab cultivar. It was followed by Florina and Enterprise cultivars, Galaxy, Goldstar and Remar cultivars and after by Luna, Dalinette and Ariwa cultivars.

At the autumn testing, Gala king and Dalinette cultivars were the first options followed by Generos and Galaxy.

For the evaluation, the type of the fruit color was not a delimitation; orange, red and yellow over colored fruits were randomly noted.

It was noticed Golden delicious genitor in most of the highest quoted cultivars.

Table 2. Sensorial evaluation of scab resistant apple genotypes fruits

Cultivar	Session	Fruit size	Fruit color	Attractiveness	Pulp firmness	Pulp juiciness	Pulp color	Taste	Aroma	Total
Ariwa	I	63.77±17.15	72.46±16.37	91.30±14.97	85.22±17.29	78.26±21.58	85.51±19.66	68.12±23.52	86.96±19.43	78.26±12.05
	III	83.33±23.57	83.33±23.57	72.00±27.00	90.00±14.14	83.33±28.33	83.33±28.33	53.33±32.20	67.50±31.29	75.00±17.43
Aura	II	94.67±12.47	73.33±23.57	56.80±20.56	68.80±17.40	76.00±20.46	74.67±22.11	55.33±22.93	62.00±22.96	68.00±13.95
Bistritean	II	87.50±16.48	77.78±21.23	71.67±22.00	50.00±21.26	75.00±17.72	73.61±19.61	52.78±18.82	54.17±22.92	65.10±12.49
Ciprian	III	85.19±24.22	81.48±29.40	77.78±27.28	57.78±27.28	70.37±26.06	88.89±23.57	61.11±28.87	58.33±25.00	70.49±20.56
Dalinette	II	77.78±24.34	84.13±22.65	67.62±21.43	88.57±13.52	90.48±18.69	68.25±22.30	61.11±21.94	63.10±25.76	73.81±13.02
	III	72.22±23.57	90.74±19.15	74.44±19.17	78.89±23.24	75.93±22.30	85.19±17.04	70.37±19.43	70.83±21.44	76.39±13.94
Dalinred	III	85.71±17.12	83.33±25.32	70.00±24.49	75.71±23.77	73.81±29.75	83.33±28.50	63.10±32.80	71.43±27.49	74.11±17.65
Enterprise	I	92.75±14.06	84.06±24.35	91.30±20.64	86.09±16.44	76.81±23.43	76.81±23.43	63.77±26.90	71.01±32.26	79.01±14.18
	III	91.67±15.43	87.50±24.80	85.00±17.73	85.00±20.70	83.33±25.20	95.83±11.79	83.33±17.82	71.88±20.86	84.77±13.82
Florina	I	72.46±12.92	84.06±17.03	97.10±9.60	66.09±20.39	62.32±23.15	79.71±21.88	63.04±20.69	82.61±22.18	73.91±12.16
	III	100.00±0.00	97.78±8.61	92.00±16.56	77.33±23.74	77.78±27.22	93.33±18.69	77.78±28.64	80.00±25.35	85.63±16.78
Fuji kiku	III	97.22±9.62	100.00±0.00	93.33±9.85	93.33±9.85	91.67±15.08	97.22±9.62	83.33±17.41	81.25±21.65	91.15±7.40
Gala King*	II	76.81±23.43	86.96±16.63	80.00±22.56	68.70±15.76	79.71±19.43	82.61±24.35	70.29±15.86	77.17±23.73	76.63±12.24
	III	93.33±14.05	90.00±22.50	90.00±14.14	66.00±25.03	76.67±22.50	90.00±16.10	83.33±15.71	80.00±19.72	82.81±10.65
Galaxy*	I	68.12±21.27	66.67±20.10	76.81±29.19	53.04±15.50	75.36±22.96	75.36±22.96	57.25±25.04	73.91±24.53	66.12±13.30
	II	65.28±25.02	76.81±27.40	66.67±24.08	67.50±21.11	81.94±19.61	81.94±21.93	65.28±21.38	69.79±24.43	70.31±15.14
	III	92.31±14.62	94.87±12.52	87.69±22.42	81.54±12.81	82.05±22.01	92.31±19.97	70.51±29.78	73.08±27.88	82.69±13.78
Generos	I	92.75±14.06	72.46±21.68	94.20±16.37	55.65±19.96	72.46±25.92	86.96±21.88	68.12±21.27	84.06±22.18	75.71±11.55
	II	85.33±19.44	70.67±24.19	55.20±20.23	70.40±20.10	78.67±18.95	77.33±26.74	68.67±16.19	77.00±23.85	71.38±12.09
	III	94.87±18.49	92.31±19.97	78.46±25.12	67.69±22.42	71.79±22.96	82.05±29.24	58.97±27.74	59.62±29.82	73.32±20.12
Goldstar	III	100.00±0.00	97.62±8.91	84.29±16.04	71.43±20.33	80.95±21.54	88.10±21.11	76.19±23.31	76.79±26.79	82.59±13.63
Goldrush	I	60.87±21.68	71.01±23.15	89.86±18.63	88.70±13.25	79.71±21.88	78.26±23.80	74.64±17.31	84.06±19.77	78.71±11.08
	III	66.67±27.22	70.00±24.60	56.00±26.33	88.00±13.98	83.33±17.57	93.33±14.05	61.67±24.91	67.50±23.72	71.88±16.20
Golden orange	III	95.24±12.60	90.48±25.20	77.14±21.38	40.00±16.33	52.38±26.23	80.95±26.23	50.00±21.52	50.00±25.00	63.84±13.48
Iris	II	82.05±16.95	82.05±16.95	69.23±20.58	55.38±18.16	62.82±25.52	75.64±20.13	48.72±18.21	54.81±24.51	63.82±11.70
	III	91.67±19.25	85.42±20.97	70.00±24.22	66.25±22.77	75.00±25.82	77.08±23.47	62.50±26.18	70.31±24.53	72.66±14.09
Jonafree	I	97.10±9.60	88.41±21.58	97.10±13.90	66.96±22.25	69.57±17.15	76.81±21.17	69.57±16.40	82.61±19.77	78.86±8.96
Jonaprim	II	66.67±21.52	76.00±20.46	58.40±17.24	53.60±21.39	68.00±22.53	69.33±23.41	54.00±16.16	62.00±17.85	61.63±11.61
Luna	I	49.28±19.77	69.57±22.28	85.51±22.08	64.35±19.03	78.26±23.80	78.26±23.80	62.32±20.24	69.57±22.28	68.52±11.40
	III	80.56±26.43	86.11±17.16	76.67±18.75	85.00±12.43	77.78±25.95	91.67±20.72	65.28±28.83	64.58±29.11	77.08±17.24
Mela	I	60.87±12.92	78.26±21.58	91.30±18.03	68.70±15.76	73.91±22.38	84.06±22.18	66.67±18.12	91.30±14.97	75.26±8.98
Opal	I	78.26±19.09	84.06±24.35	95.65±15.26	66.96±15.50	72.46±21.68	81.16±24.26	65.22±19.41	85.51±22.08	76.46±13.18

Cultivar	Session	Fruit size	Fruit color	Attractiveness	Pulp firmness	Pulp juiciness	Pulp color	Taste	Aroma	Total
Orion	III	91.11±15.26	91.11±15.26	73.33±20.93	65.33±23.26	80.00±24.56	71.11±27.79	52.22±26.63	56.67±25.82	69.79±10.93
Rajka	I	86.96±16.63	79.71±21.88	92.75±17.28	47.83±22.35	66.67±26.59	82.61±24.35	57.97±29.25	72.46±25.92	70.01±14.97
Rebra	II	86.67±16.67	73.33±19.25	58.40±19.08	58.40±17.24	68.00±22.53	77.33±20.91	53.33±17.35	60.00±22.82	64.38±11.05
Red devil	I	94.20±12.92	86.96±21.88	94.20±16.37	47.83±24.67	71.01±20.85	85.51±19.66	57.97±24.03	76.81±23.43	72.86±12.45
Red Elstar*	I	63.77±13.90	69.57±17.15	85.51±16.90	51.30±18.90	78.26±21.58	75.36±20.64	63.04±16.63	88.41±19.09	69.57±7.62
	II	81.82±22.37	68.18±21.77	50.91±16.01	60.91±23.48	80.30±24.47	77.27±21.54	55.30±15.76	59.09±19.74	64.06±11.68
	III	80.39±16.91	84.31±20.81	68.24±22.43	65.88±23.20	80.39±23.74	94.12±13.10	65.69±22.42	69.12±25.81	73.71±13.89
Redix	I	69.57±17.15	78.26±23.80	92.75±17.28	55.65±19.96	55.07±23.80	62.32±20.85	46.38±21.29	65.22±25.58	62.97±14.49
	II	75.36±22.96	94.20±12.92	77.39±20.27	62.61±20.27	71.01±18.27	72.73±22.15	57.97±20.64	60.87±23.63	69.43±11.50
	III	80.95±21.54	88.10±21.11	74.29±25.33	48.57±24.45	59.52±19.30	59.52±23.31	50.00±22.65	57.14±26.73	62.72±16.24
Remar	II	80.95±19.92	92.06±14.55	79.05±18.41	64.76±17.78	66.67±18.26	71.43±21.82	49.21±17.06	54.76±23.21	67.71±9.65
	III	100.00±0.00	93.33±14.05	88.00±10.33	82.00±14.76	80.00±17.21	90.00±22.50	63.33±25.82	72.50±24.86	81.56±10.04
Remo	II	61.90±21.82	73.02±20.05	59.05±20.47	60.00±24.49	73.02±24.99	66.67±23.57	53.17±21.49	63.10±25.76	62.20±15.05
Remus	I	86.96±19.43	75.36±20.64	91.30±20.64	45.22±20.20	55.07±19.09	66.67±26.59	46.38±24.08	69.57±26.43	63.42±14.43
Rene	II	57.33±22.61	66.67±21.52	52.00±15.28	58.33±19.08	73.33±21.52	81.33±19.44	58.00±17.43	69.00±18.09	62.88±10.91
Rubinola	III	92.59±14.70	96.30±11.11	91.11±10.54	62.22±21.08	62.96±30.93	88.89±23.57	57.41±30.17	63.89±25.34	74.65±11.21
Sirius	I	60.87±16.37	62.32±18.27	73.91±24.53	47.83±18.82	85.51±16.90	73.91±19.99	40.58±21.22	62.32±27.16	59.97±12.81
	III	92.31±19.97	89.74±21.01	76.92±24.28	60.00±27.08	76.92±25.04	76.92±28.50	53.85±29.78	59.62±28.02	70.43±15.02
Starkprim	II	77.78±18.82	76.39±18.33	61.67±21.20	59.17±19.98	75.00±22.52	81.94±24.04	56.94±19.61	64.58±22.01	66.80±11.17
Topaz	I	69.57±17.15	88.41±19.09	94.20±12.92	61.74±18.00	79.71±24.08	78.26±25.84	70.29±20.07	86.96±24.08	76.61±10.95
	III	86.11±17.16	80.56±26.43	66.67±27.41	56.67±23.87	77.78±25.95	86.11±26.43	73.61±24.06	79.17±23.44	73.96±16.50

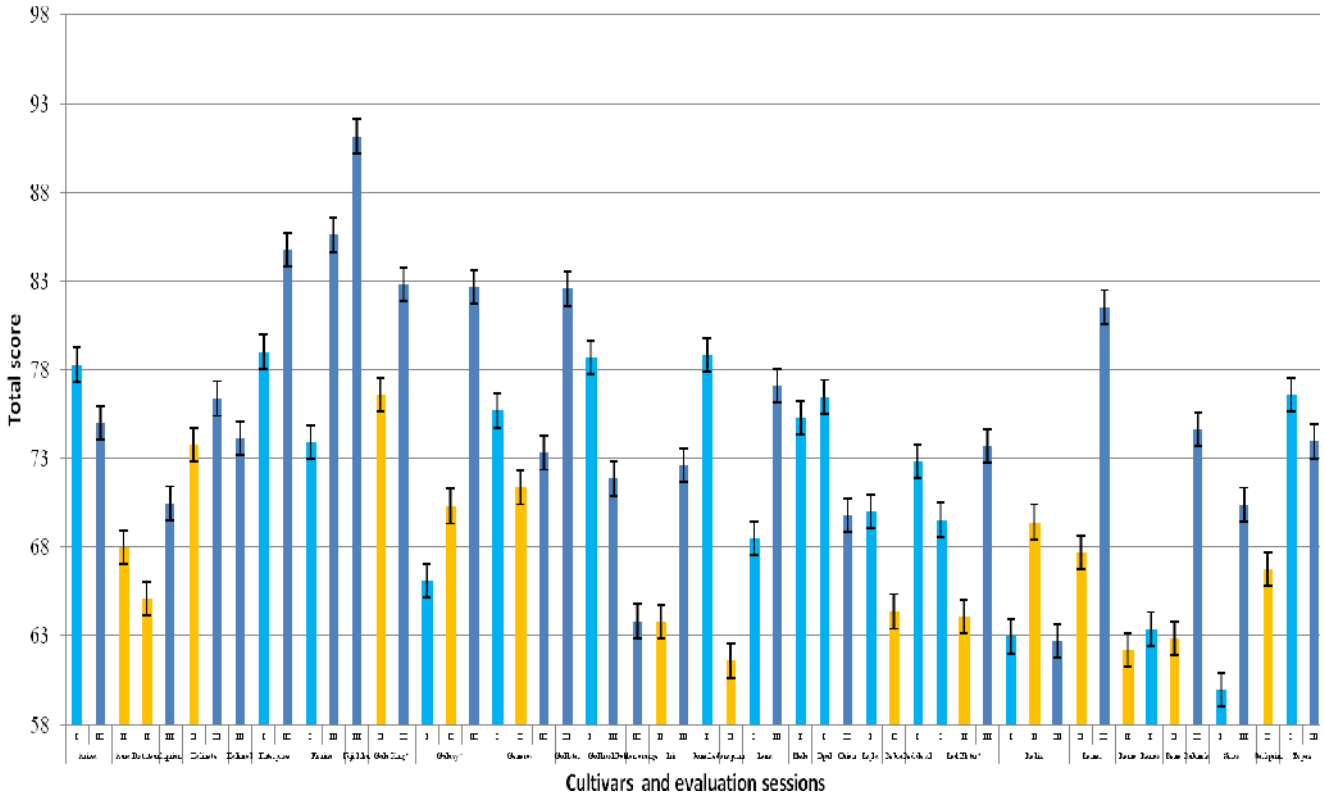

Figure 2. Overall sensorial evaluation of apple scab resistant cultivars fruits

Apple attributes were compared with the fruit parameters calculated through laboratory analysis (Table 3). For the weight, some of the cultivars had values under the cultivar potential (*) and others over (**).

Table 3. Fruit parameters analyzed in the laboratory

Cultivar	Session	Weight (g)	Firmness (kg f/cm^2)		TSS (%Brix)	
Ariwa	III	122.29	6.19	±0.69	11.96	±0.54
Aura	II	143.00*	6.14	±0.46	11.69	±0.52
Bistritean	II	233.40**	5.76	±0.60	9.73	±0.49
Ciprian	III	126.67	3.67	±0.51	11.74	±0.80
Dalinette	II	145.40	7.89	±0.39	10.46	±0.42
	III	135.39	6.21	±0.49	11.64	±0.92
Dalinred	III	120.56*	6.28	±0.55	13.38	±0.85
Enterprise	III	162.69	5.55	±0.69	13.78	±1.20
Florina	III	141.92*	4.45	±0.59	13.08	±0.61
Fuji Kiku	III	244.00**	6.17	±0.90	13.98	±0.76
Gala King	II	160.60	6.90	±0.51	10.41	±0.59
	III	163.44	4.45	±0.75	12.44	±1.72
Galaxy	II	140.40	7.05	±0.40	10.34	±0.56
	III	118.82	5.34	±0.34	12.42	±0.81
Generos	II	126.00*	5.90	±0.45	10.86	±0.58
	III	162.81*	3.68	±0.40	11.16	±1.30
Goldstar	III	149.18*	3.93	±0.43	13.18	±0.86
Goldrush	III	102.81*	7.67	±0.92	11.78	±0.72
Golden orange	III	147.78	3.34	±0.46	11.08	±2.26
Iris	II	156.80	5.30	±0.50	11.04	±0.49
	III	143.85	4.09	±0.43	12.02	±0.88
Luna	III	104.29*	5.52	±0.62	12.14	±0.68
Jonaprim	II	112.80*	5.73	±0.42	13.51	±0.46
Orion	III	161.82*	3.27	±0.48	10.52	±0.86
Rebra	II	122.80*	5.28	±0.34	10.21	±0.43
Red Elstar	II	144.00	4.88	±0.41	10.09	±0.41
	III	120.00	3.59	±0.48	12.08	±0.85
Redix	II	104.00*	5.38	±0.49	10.31	±0.58
	III	121.11*	3.77	±0.37	11.40	±1.05
Remar	III	148.96*	4.16	±0.31	11.75	±1.48
Remo	II	127.40*	5.39	±0.42	11.69	±0.40
Rene	II	98.00*	4.94	±0.42	10.18	±0.49
Rubinola	III	165.29	3.71	±0.56	14.32	±1.16
Sirius	III	145.94*	3.61	±0.36	11.74	±1.74
Starkprim	II	146.60*	4.57	±0.40	11.00	±0.53
Topaz	III	126.05*	4.39	±0.64	11.72	±0.42

*the value is under the cultivar potential according to literature cited
**the value is over the cultivar potential according to literature cited

Significant correlations were observed and calculated. An important correlation was confirmed between the evaluated and determined firmness [22]. Fruit attractiveness was very strongly correlated with the fruit color. The size was also important for attractiveness. Significant correlations were between taste and aroma (Table 4). In both panels (II and III), appreciation of the fruit size was not correlated with determined weight, consumers preferences being randomly (bigger fruits were not the most preferred ones regarding the evaluation of the fruit size). Also, in both 2018 evaluations, the sweetness wasn't an attribute highly correlated with taste.

Table 4. Correlation between evaluated attributes and fruit parameters analyzed in the laboratory

Parameters		Session	The correlation coefficient (R)	Regression equation
Fruit firmness (laboratory)	Evaluated firmness	II	0.76	y = 0.074x + 1.127
		III	0.77	y = 0.0682x – 0.1638
Fruit color	Fruit attractiveness	II	0.93	y = 1.0938x – 21.158
		III	0.86	y = 1.2045x – 28.669
Fruit size	Fruit attractiveness	III	0.75	y = 0.8233x + 5.2313
Taste	Aroma	II	0.92	y = 1.0221x + 4.8219
		III	0.87	y = 0.6986x + 22.604
Fruit size	Weight	II	0.48	
		III	0.6	
Fruit attractiveness	Weight	II	0.39	
		III	0.62	
Taste	TSS (%)	II	-0.23	
		III	0.59	

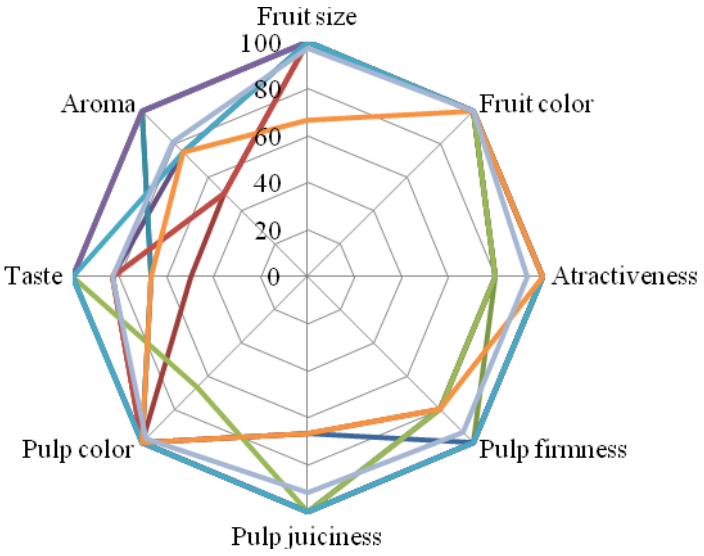

Figure 2. Fuji kiku sensorial evaluation attributes

Figure 3. Florina cultivar sensorial evaluation attributes (winter 2017 and winter 2018)

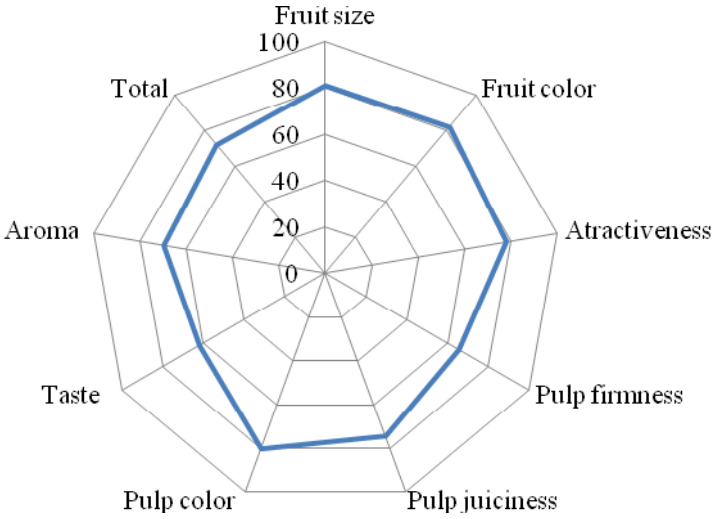

Figure 4. Overall evaluation attributes of apple scab resistant cultivars (2017-2018)

Conclusions

Apple scab resistant cultivars have high importance, especially for integrated and organic agriculture. They are tested by breeders respectively researchers according to specific locations, their quality parameters being correlated. The results highlighted the necessity of multiannual data, the technology applied and climatic factors being strongly correlated with the fruit quality. In the conducted research, some of the cultivars had a very good appreciation in one year different from the other. From the apple scab resistant cultivars, most of the highly appreciated ones had Golden delicious between genitors. There weren't significant correlations between fruit size and weight and also between taste and total soluble solids. Attractiveness was strongly correlated with fruit color and size. The overall cultivars appreciation stated that several apple scab resistant cultivars can be proposed to be introduced in large orchards for production, due to their fruit quality evaluation.

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