http://journal.unoeste.br/index.php/ca/index
DOI: 10.5747/ca.2021.v17.n5.a460
ISSN on-line 1809-8215

Colloquium Agrariae

Submetido: 20/04/2021 Revisado: 26/07/2021 Aceito: 09/09/2021

Quality of the pirenic and apirenic fruits of surinam cherry tree accesses (*Eugenia uniflora*)

Kelli Pirola, Marcelo Dotto, Américo Wagner Júnior, Darcieli Aparecida Cassol

Universidade Tecnológica Federal do Paraná – UTFPR, PR. Centro Universitário do Vale do Ribeita – UNISEP, SP. E-mail: kelli_pirola1@hotmail.com

Abstract
Surinam cherry is a native fruit tree with market potential. However, the pulp yield can be impaired by the size of the fruit seed. At UTFPR there is a genotype which produces seedless fruits, that can intensify the use of this species in orchards, and it is important to analyze the quality of the produced fruit. The aim of this study was to determine the quality of fruits from pirenic and apirenic accessions of Surinam cherry (*Eugenia uniflora*). In 2012, 2013 and 2015, 40 ripe fruits were collected from 23 Surinam cherry accessions, including an apirenic genotype one. The fruits were taken to the laboratory and analyzed regarding total fruit and seed weight, equatorial fruit and seed diameter, and total soluble solids content (SST). The twenty-third access presented physical characteristics that stood out from the other accesses, but, a larger size of the seed is an undesirable factor, once with industrialization it diminishes the use and yield of the pulp. Access 19, corresponding to the apirenic cherry tree, presented a smaller diameter and seed weight, which is a desirable feature. This genotype also has the physicochemical characteristics considered appropriate for processing or fresh market.
Keywords: seedless fruit; fruit mass; *Myrtaceae*.

Qualidade dos frutos pirênicos e apirênico de acessos de pitangueira (*Eugenia uniflora*)

Resumo
A pitangueira é fruteira nativa com potencial de mercado. Contudo, o rendimento de polpa pode ficar prejudicado pelo tamanho da semente do fruto. Na UTFPR tem-se um genótipo que produz frutos sem sementes que pode potencializar o uso desta espécie em pomares, sendo importante analisar a qualidade de seu fruto produzido. O objetivo deste estudo foi determinar a qualidade dos frutos de acessos pirênicos e apirênico de pitangueira (*E. uniflora*). Nos anos de 2012, 2013 e 2015, foram coletados 40 frutos maduros de 23 acessos de pitangueira, incluindo-se um genótipo apirênico. Os frutos foram levados ao laboratório e analisadas quanto ao peso total do fruto e da semente, diâmetro equatorial do fruto e semente, teor de sólidos solúveis totais (SST). O acesso 23 apresentou características físicas que se destacam dos demais acessos, porém, o maior tamanho da semente é fator indesejável, pois com a industrialização diminui-se o aproveitamento e rendimento da polpa. O acesso 19, correspondente à pitanga apirênica apresentou o menor diâmetro e peso da semente, sendo esta característica desejável. Este genótipo também apresentou as características físico-químicos considerados adequados para o processamento ou mercado in natura.
Palavras-chave: Fruto sem semente. Massa do fruto. Myrtaceae.

Introduction

Brazil has stood out in recent years as a major producer in the fruit industry, having exported a considerable volume production annually (KIST *et al.*, 2021; ABRAFRUTAS, 2021). However, the Brazilian native fruit trees, which have potential, are still little explored by the domestic and foreign market, even with the possibility to supply for fresh consumption, and the alimentary, cosmetics and pharmaceutical

industries (REIS; SCHMIELE, 2019).

Currently, with the increasing search for natural products and the growing use of antioxidant compounds in preventive therapies for diseases, in which free radicals are involved, natural products such as vitamins and flavonoids have deserved special attention (CHANG *et al.*, 2016).

Therefore, native fruit trees have been drawing attention by producers and consumers, once studies have shown that some have antioxidant action, such as *Psidium guajava* (guava) (MELO *et al.*, 2008a), *Eugenia dysenterica* (cagaita) (ROESLER *et al.*, 2007), *E. uniflora* (Surinam cherry) (ASSIS *et al.*, 2009; MELO *et al.*, 2008b), *E. pyriformis Camb.* (uvaia), *E. involucrata DC.* (Wild cherry) and *Plinia* sp., Berg (jaboticaba fruit) (WAGNER JÚNIOR *et al.*, 2017), all belonging to the *Myrtaceae* family.

The fruits produced by the Surinam cherry are rich in vitamins A and C (BEZERRA *et al.*, 2000; LORENZI, 2002) and in antioxidant substances, such as essential oils, which can be extracted from leaves and other parts of the plant (MARIN *et al.*, 2004).

However, to develop this economic potential, it is needed research, especially regarding genetic improvement and vegetative propagation, so that productive cultivars can be launched and maintained, enabling standardized orchards, with little variation in fruit quality (GOMES *et al.*, 2007).

In Brazil, until nowadays, only one commercial cultivar for Surinam cherry has been launched, named 'Tropicana', which has as its main advantages the high production - 20.8 kg of fruits year^{-1} (ten years average), average weight of the fruit varying from 3 to 4.5 g, reddish pulp, SST of 9.0°Brix and SST/Acidity ratio of 4.1 (IPA, 2000).

However, it is insufficient to have only a single commercial cultivar if all the existing diversity in the country is being analyzed. Thus, it is important to characterize the physical and sensorial fruit qualities of the different Surinam cherry genotypes, especially those in which they can be more attractive to the market, such as seedless fruit producers, since, normally, most Surinam cherry fruits is formed by 66% of pulp and 34% of seed (FRANZON, 2004). This is disadvantageous in commercial production, once the pulp yield is low, turning it into a highly desirable characteristic for the Surinam cherry trees.

Apirenic fruits are desired by the market that processes them, since the presence of seeds makes their usage and handling difficult. For a plant to be considered apirenic, it must be able to produce either seedless fruits, or with traces of seeds or even with seeds reduced in number and size (VAROQUAUX *et al.*, 2000). As it is the Surinam cherry case under study, and until then, there were no reports in the scientific literature for the *Eugenia* genus.

This study aims to determine the physical and sensorial fruit quality from Surinam cherry (*E. uniflora*) pirenics and one apirenic accessions.

Material and Methods

In 2012 (October 18th) and 2013 (October 28th) 40 ripe fruits were collected from 23 accessions of Surinam cherry trees from the Native Fruits Collection of the Federal Technological University of Paraná - Dois Vizinhos Campus area. In 2015 (October 6), accesses nine and ten were not evaluated for not having production. This year, access 23, producer of fruits with black epidermis was included. The accessions came from seeds collected from eight mother plants from Honório Serpa on 10/30/2004.

After harvesting, the fruits were taken to the Laboratory of Plant Physiology, where they were analyzed for total fruit and seed mass, fruit equatorial diameter and seed, mass and pulp percentage, and total soluble solids content (SST).

The mass of the fruit and seed (g) was performed with the aid of an analytical balance, obtaining first the value of the fruit and then the seeds, when the pulp was removed. From the difference, the pulp mass value was obtained and the pulp percentage was calculated. The evaluations of the fruit equatorial diameters and seed were determined with the aid of a digital caliper. SST was measured with a digital refractometer (RTD-45), by average obtained from 10 fruits.

A completely randomized design was used, with each access consisting of a treatment, with four replications, and 10 fruits per experimental unit.

The data were submitted to the Lilliefors normality test, and they were not transformed. Subsequently, the averages were submitted to variance analysis and the Scott-Knott test (α = 0.05). All analysis were performed using the ASSISTAT® computer application (SILVA;

AZEVEDO, 2009). Pearson's correlation analysis was performed between fruit weight and SST data during the years evaluated.

Accumulated precipitation, and maximum and minimum temperatures were obtained from data recorded from the INMET meteorological station installed at UTFPR – Dois Vizinhos Campus (8th Meteorological district – DISME), located approximately 500 meters from the experiment.

Results

The variability among genotypes has always been the target of studies among them and different species in order to know and explore them in genetic improvement and conservation programs (OHASHI *et al.*, 2010).

Among the accesses evaluated in this study, there were different responses in the averages of all variables (Tables 1, 2 and 3). Such behaviors are important in genetic improvement programs, as they constitute material for use by the improver.

Table 1. Fruit and seed mass, fruit and seed diameter, total soluble solids (SST) and mass and pulp percentage of 22 accessions of Surinam cherry (*E. uniflora*) from the UTFPR Native Fruit Collection, collected in 2012.

Access	Fruit mass (mg)	Fruit diameter (mm)	Seed mass (mg)	Seed diameter (mm)	SST (°Brix)	Pulp mass (mg)	% Pulp
1	22.18 b*	15.44 b	8.80 a	10.18 a	12.67 c	13.38 c	60.35 d
2	12.27 f	12.85 e	3.20 d	6.66 b	7.85 e	9.07 e	73.81 b
3	16.22 e	13.68 d	6.32 b	9.44 a	17.40 a	9.90 d	60.98 d
4	25.52 a	16.48 a	8.40 a	10.72 a	9.07 e	17.12 a	67.17 c
5	12.76 f	11.94 f	5.57 c	11.98 a	15.22 b	7.19 e	56.23 e
6	14.27e	12.72 e	5.74 c	8.60 b	11.25 d	8.53 e	59.67 d
7	16.63 e	13.46 d	5.28 c	8.35 b	15.10 b	11.35 d	68.25 c
8	13.37 f	12.30 e	5.05 c	8.46 b	15.02 b	8.33 e	62.29 d
9	11.42 f	11.18 g	3.81 d	7.39 b	15.77 b	7.60 e	66.69 c
10	18.00 d	13.68 d	5.22 c	8.11 b	13.02 c	12.76 c	70.83 b
11	20.40 c	15.20 b	5.56 c	8.38 b	9.45 e	14.83 b	72.73 b
12	15.50 e	13.79 d	3.83 d	7.93 b	12.97 c	11.67 d	75.27 b
13	12.15 f	12.06 f	4.06 d	8.01 b	7.77 e	8.08 e	66.61 c
14	20.63 c	15.41 b	5.89 c	8.36 b	7.65 e	14.74 b	71.26 b
15	16.78 e	14.05 d	6.21 b	9.03 b	11.95 d	10.57 d	62.97 d
16	22.98 b	16.57 a	6.98 b	10.12 a	10.85 d	16.00 a	69.61 c
17	20.50 c	15.74 b	6.46 b	9.25 a	10.15 d	14.03 c	68.50 c
18[1]	12.19 f	12.94 e	4.35 d	8.52 b	10.80 d	7.84 e	64.27 d
19[2]	11.07 f	12.64 e	0.29 e	1.01 c	10.77 d	10.79 d	97.49 a
20	20.62 c	15.58 b	5.44 c	9.34 a	8.65 e	15.18 b	73.70 b
21	15.83 e	14.28 c	4.03 d	8.45 b	8.97 e	11.80 d	74.48 b
22	16.76 e	14.60 c	5.14 c	9.32 a	16.30 a	11.62 d	69.22 c
CV(%)	8.41	3.16	11.73	16.43	9.39	9.35	3.89

*Averages grouped with different lowercase letters in the same column differ by the Scott-Knott test (α = 0.05).

1 Pirenic Surinam cherry used in other works compared to apirenic.

2 Access to the apirenic Surinam cherry.

Table 2. Fruit and seed mass, fruit and seed diameter, total soluble solids (SST) and mass and pulp percentage of 22 accessions of Surinam cherry (*E. uniflora*) from the UTFPR Native Fruit Collection, collected in 2013.

Access	Fruit mass (mg)	Fruit diameter (mm)	Seed mass (mg)	Seed diameter (mm)	SST (°Brix)	Pulp mass (mg)	% Pulp
1	6.81 e*	13.25 d	2.05 d	7.49 e	12.92 b	4.75 h	69.62 c
2	19.15b	17.73 a	5.73 b	10.42 b	15.92 a	13.42 d	69.97 c
3	22.25 a	15.67 b	7.31 a	10.02 b	16.87 a	14.94 c	67.28 c
4	18.80b	18.81 a	4.99 c	10.98 a	10.22 d	13.81 c	73.55 c
5	19.39b	15.34 c	6.97 a	10.13 b	12.40 c	12.42 d	63.93d
6	20.45b	15.21 c	6.22 b	9.70 c	11.95 c	14.23 c	69.60 c
7	19.46b	14.64 c	6.32 b	9.53 c	10.75 c	13.14 d	67.44 c
8	11.69d	12.41 e	4.78 c	8.71 d	13.07 b	6.91 g	59.01 e
9	19.88b	14.96 c	5.67 b	8.99 d	13.62 b	14.20 c	71.41 c
10	23.10 a	15.04 c	4.46 c	8.72 d	10.25 d	18.64 a	80.64b
11	23.52 a	16.33 b	5.30 c	9.46 c	9.17 d	18.22 a	77.45b
12	19.46b	15.04 c	4.65 c	8.71 d	10.45 d	14.80 c	76.09b
13	19.40b	14.54 c	4.34 c	8.56 d	8.07 e	15.06 c	77.58b
14	22.49 a	18.15 a	5.02 c	9.65 c	9.47 d	17.47 a	77.70b
15	13.16d	13.94 d	4.69 c	9.06 d	11.42 c	8.46 f	63.86d
16	13.37d	16.13 b	3.77 c	9.77 c	11.85 c	9.59 f	71.84 c
17	20.67b	16.25 b	4.76 c	9.24 d	11.67 c	15.90 b	77.02b
18[1]	16.03 c	13.82 d	4.90 c	8.91 d	11.57 c	11.12 e	69.37 c
19[2]	12.19d	13.52 d	0.28 e	0.51 f	11.47 c	11.91 d	97.74 a
20	17.17b	16.24 b	4.62 c	10.34 b	7.40 e	12.55 d	73.06 c
21	19.32b	16.33 b	5.39 c	10.11 b	9.95 d	13.92 c	71.93 c
22	13.58d	12.79 e	4.84 c	8.84 d	12.02 c	8.74 f	64.27d
C.V (%)	9.08	4.24	12.51	5.09	7.12	10.17	4.27

* Averages grouped with different lowercase letters in the same column differ by the Scott-Knott test (α = 0.05).

1 Pirenic Surinam cherry used in other works compared to apirenic.

2 Access to the apirenic Surinam cherry.

Table 3. Fruit and seed mass, fruit and seed diameter, total soluble solids (SST) and mass and pulp percentage of 21 accessions of Surinam cherry (*E. uniflora*), from the UTFPR Native Fruit Collection, collected in 2015.

Access	Fruit mass (mg)	Fruit diameter (mm)	Seed mass (mg)	Seed diameter (mm)	SST (°Brix)	Pulp mass (mg)	% Pulp
1	17.50d*	17.27 b	5.59 b	9.79 b	11.82 c	11.90 c	67.80 d
2	16.28 d	15.69 c	4.52 c	9.14 c	14.47 a	11.75 c	72.27 c
3	13.44 e	14.59 d	3.59 d	8.90 c	11.90 c	9.85 d	73.31 c
4	20.85 b	17.69 b	4.90 c	9.85 b	9.57 d	15.95 b	76.52 b
5	12.57 e	14.24 d	3.93 c	9.11 c	13.30 b	8.64 d	68.42 d
6	11.42 e	13.75 d	3.00 d	8.39 d	9.47 d	8.41 d	73.68 c
7	10.63 e	13.08 e	2.52 e	7.68 e	10.90 c	8.11 d	76.23 b
8	8.66 f	12.23 f	3.35 d	8.62 d	6.40 e	5.31 e	61.14 e
11	15.57 d	15.87 c	3.34 d	8.18 d	9.02 d	12.24 c	78.57 b
12	11.79 e	14.28 d	2.33 e	7.49 e	10.77 c	9.47 d	80.14 b
13	10.90 e	13.33 e	2.36 e	7.80 e	9.25 d	8.54 d	78.31 b
14	16.92 d	16.52 c	3.22 d	7.36 e	11.35 c	13.70 b	80.95 b
15	7.66 f	12.06 f	2.43 e	7.20 e	11.40 c	5.23 e	68.43 d
16	10.92 e	14.31 d	2.31 e	7.91 e	10.75 c	8.60 d	78.79 b
17	16.92 d	16.37 c	4.25 c	9.70 b	10.10 d	12.67 c	74.69 b
18[1]	9.22 f	13.35 e	2.97 d	8.14 d	7.52 e	6.25 e	67.56 d
19[2]	14.57 d	15.44 c	0.54 f	2.68 f	11.87 c	14.03 b	96.45 a
20	15.82 d	15.54 c	4.35 c	9.01 c	10.80 c	11.47 c	72.25 c
21	18.35 c	16.23 c	4.10 c	8.43 d	11.17 c	14.25 b	77.60 b
22	10.01 f	14.00 d	3.03 d	8.55 d	10.05 d	6.97 e	69.63 d
23[3]	28.12 a	20.52 a	6.88 a	11.04 a	12.60 b	21.23 a	75.61 b
C.V (%)	11.56	5.23	17.54	7.28	9.24	13.28	4.43

* Averages with different lowercase letters in the same column differ by the Scott-Knott test (α = 0.05).

1 Pirenic Surinam cherry used in other works compared to apirenic.

2 Access to the apirenic pitanga.

3 Black surinam cherry pirenic access.

Variations in fruit mass and size reveal the potential of the fruit species for selection and genetic improvement (FENNER, 1993), a fact which was observed in the present work with the Surinam cherry. Such behavior is desired so that the selection of these natural hybrids is possible, and it should also be associated, in addition to physical characterization, the chemistry of the fruits produced by the accessions so that they can try to meet the industry or natural consumption.

The results obtained in 2012 allowed the formation of 6, 7, 5, 3 and 5 groups regarding the analysis of mass and fruit diameter, mass and seed diameter, and total soluble solids, respectively (Table 1). This year, accession 4 was the only one present in the group with greater weight along with accession 16 for the fruit diameter. Such superiority response with accessions 4 and 16 was maintained by the group formed with the highest pulp mass, a fact that was not maintained with the same yield (%), as the group with the highest average was composed by accession 19 (Table 1).

The fact that this access did not have seed or that it was virtually rudimentar interfered in two characteristics - allowed higher pulp yield, but was among the accessions in the group with the lowest fruit weight. The fruit is usually sold by its weight, but as this access has a different characteristic, that is, seedless, which reduces its weight, it is important to add value at the time of sale, so that there is no economic loss to the producer and to motivate its usage in the orchard. Such value-adding factor could be based on the clear exposure that it is a seedless fruit, as already occurs with the grape, which obtains a higher market value for this product and better acceptance by buyers (FELDBERG *et al.*, 2008). However, for the industrialization usage it is very important.

In the 4th accession, as described above, was also present in the group with the highest average for seed diameter and, along with accession 1. Regarding seed weight, the group with the highest averages were also formed by accessions 4 and 1, together with 3, 5, 16, 17 and 22 (Table 1).

This demonstrates that not always larger Surinam cherry tree fruits also tend to have larger seeds, due to the comparative results among the diameters of the fruit and seed. This characteristic must be well observed if the fruit is destined for industrialization, as it affects the pulp yield. However, due to the visual aspect when buying fresh fruit, those with a larger diameter can be interesting.

The consumer is considered the most important element of any company or business, as it plays a crucial role in the products and the quality of what one wants to acquire (RASEIRA, 2000). Attributes such as fruit size are references that the consumer takes into account when choosing the product (FRUTIFATOS, 2002; TREVISAN *et al.*, 2006).

As for the content of total soluble solids, the group with the highest average had two accessions, these being 3 (17.40°Brix) and 22 (16.30°Brix) and the group with the lowest average was composed of seven accessions (2, 4, 11, 13, 14, 20 and 21) whose values were between 7.65 to 9.07°Brix.

The values obtained with the upper group for SST were higher than those found by Bezerra *et al.* (2004), who, while studying the behavior of Surinam cherry tree selections from the Pernambuco Agricultural Research Corporation – IPA, originated through sexual propagation, found fruits with SST from 9.0 to 13.4°Brix. After clonal evaluation, the IPA-2.2 access was launched as the first commercial Brazilian cultivar, named 'Tropicana', which presents as main advantages the high yield - 20.8 kg of fruits per year^{-1} (a ten-year average), average fruit weight ranging from 3 to 4.5 g, reddish pulp, SST of 9.0°Brix and SST/Acidity ratio of 4.1 (IPA, 2000).

By comparing the description of this Tropicana cultivar with the apirenic Surinam cherry (access 19), it was found that the characteristics described for the latter were superior in mass and SST in the years of analysis (Tables 1, 2 and 3), reinforcing its potential.

Another important point is that access 19 was not among those grouped as having the lowest SST (Tables 1, 2 and 3), serving virtually for dual purposes, that is, for processing or for in natura market, as in the latter case, it may even arouse the interest to export the fruit. Such feature of the rudimentary seed or its absence, may be interesting for the market for children, as large seeds can create choking risks.

The results found allow us to verify that the access with the highest fruit weight (4) was among those with the lowest SST (Table 1), a characteristic that should be well analyzed in the next production cycles together, as if the fruit is offered to the in natura market, this attracts by its visual aspect, but it can compromise the return of the purchase due to the flavor it presents. When proceeding with correlation analysis to prove possible interference between one variable on another, values of r = -23.36* were obtained in 2012, 2013 and 2015; -0.132 ns and 35.95**, respectively. This demonstrates that even in years when r was significant at 5 and 1% (2012 and 2015, respectively) its value was low.

In 2013, for the same variables evaluated (fruit weight and diameter, seed weight and diameter, and total soluble solids content), there was a reduction in the number of groups formed for the physical characteristics related to the fruit (Table 2), when compared to the previous year (Table 1). Fruit weight formed five groups, with the highest averages being that formed by accessions 3, 10, 11 and 14, whose averages were between 22.25 to 25.52 mg. The minor group only consisted of access 1 (6.81 mg) (Table 2).

For the fruits diameter, five groups were also formed. The one with the highest averages were constituted by the accessions 2, 4 and 14 (17.73 to 18.81 mm), repeating only the latter as the group with the highest weight. On the other hand, the group with the smallest diameter was formed by accessions 8 and 22 (12.41 and 12.79, respectively), also different from that constituted by weight (Table 2).

As for seed weight in 2013, five groups were formed, with accessions 3 and 5 composing the one with the highest average (7.31 and 6.97 mg, respectively) and the 19 as the lowest (0.28 mg), which was already expected.

Those seeds diameter allowed the formation of six groups, with access 4 grouped in the highest value (10.98 mm) and accesses 19 and 1 of the smallest (0.51 and 7.49 mm, respectively) (Table 2).

Accession 19 (seedless Surinam cherry, or when seeds are present they are rudimentary) in

the productive cycles confirmed the smaller diameter and the smaller weight of the seed. There was also repetition for access 4 for the seed diameter, which had the highest average, a fact that, if related to pulp yield, can compromise it for the industrial market.

As for the total soluble solids in 2013, there was the formation of five groups, with the highest average being formed by accessions 2 (15.92°Brix) and 3 (16.87°Brix) and the lowest by 13 (8, 07°Brix) and 20 (7.40°Brix) (Table 2).

Accessions 13 and 20 during the two years (Tables 1 and 2), repeated the lowest values of soluble solids content. Thus, if there is interest in the commercialization of those fruits, one should seek to serve markets that do not have a preference for sweeter fruits, as is the case with the industry, for the fruit processing. On the other hand, access 3 (Tables 1 and 2) had the highest soluble solids content in both years of evaluation, which is interesting for the *in natura* market.

The qualitative characteristics of the fruits, involving physical and chemical properties, are relevant factors in the purchase decision (SOARES *et al.*, 2010). First, the consumer buys the product by its appearance, but it only returns to consume it if the sensory characteristic gives him satisfaction, a fact virtually associated with SST.

For pulp mass, the group with the highest average was composed of three accessions, 10, 11 and 14, and the group with the lowest average also composed by 3 accesses - 15, 16 and 22. As for the pulp percentage, access 19, corresponding to apirenic, repeated the highest average (97.74%) (Table 2), which had already occurred in the previous year (Table 1).

In 2015, no analysis were performed on the accessions 9 and 10 fruits, because they did not presented fruit set. Therefore, access 23 was included characterized by producing black Surinam cherry. This access (23) was the one with the highest weights and diameters of fruits and seeds (Table 3). Access 19 maintained the same behavior as the analysis performed for seed weight and diameter in 2012 and 2013, (Tables 1 and 2, respectively) in 2015 (Table 3), a fact that really proves the apirenic characteristic.

This access 19 was not in the group with the lowest mean for fruit weight and diameter, which makes it possible to favor its pulp yield, as observed during all evaluation years (Tables 1, 2 and 3), in which it can be useful for its processing, because of the seed presence it makes the usage and handling difficult (SHIFRISS; EIDELMAN, 1986).

As for fruit weight and diameter in 2015, the smallest group for the first was formed by accessions 22, 18, 15 and 8, and for the second with accessions 15 and 8 (Table 3), thus proving the relationship of both variables in the accesses that repeated the lowest values.

Variations were observed in the averages analyzed among years (Tables 1, 2 and 3). This may be related to the fact that these accessions do not undergo through any management process, especially thinning, which allows for alternating production, within one year producing a greater number of fruits with smaller weight and diameter, and in another smaller number of fruits, and as a consequence enabling greater weights and diameters.

Alternation is one of the common problems for most fruit trees, with a tendency for them to produce excessive harvest in the current year, followed by scarce production in the following year (MONSELISE; GOLDSCHMIDT, 1982), causing, in years of excessive production, very small size fruits, which often are not sold and can cause, in some cases, breakage of the plants' branches (COGGINS; HIELD, 1968).

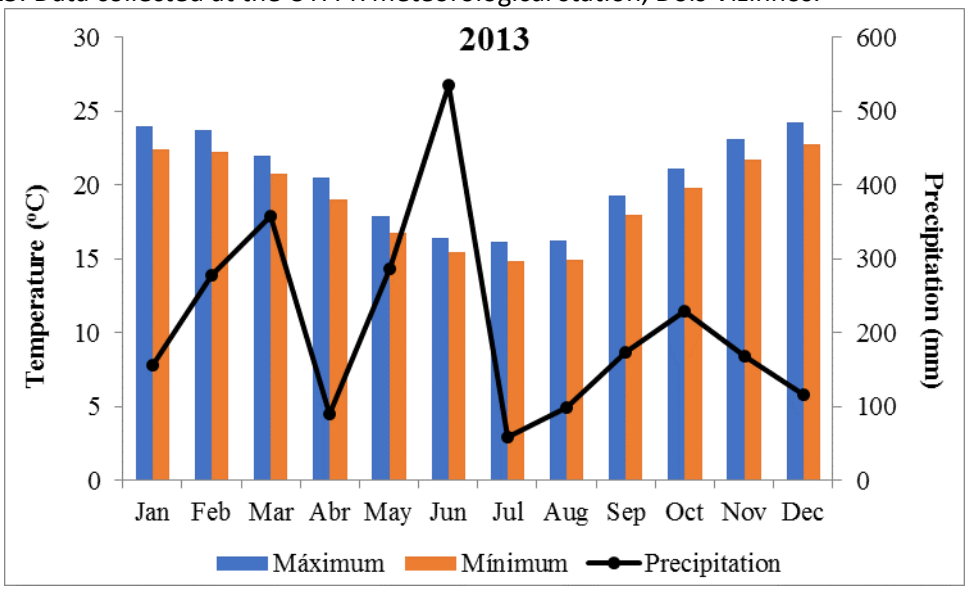
Regarding the soluble solids content, in the 2015 analysis, there was the formation of five groups, with access 2 alone making up the group with the highest average, and 18 and 8 as the lowest average, with values of these three being 14, 47°Brix, 7.52°Brix and 6.40°Brix, respectively (Table 3).

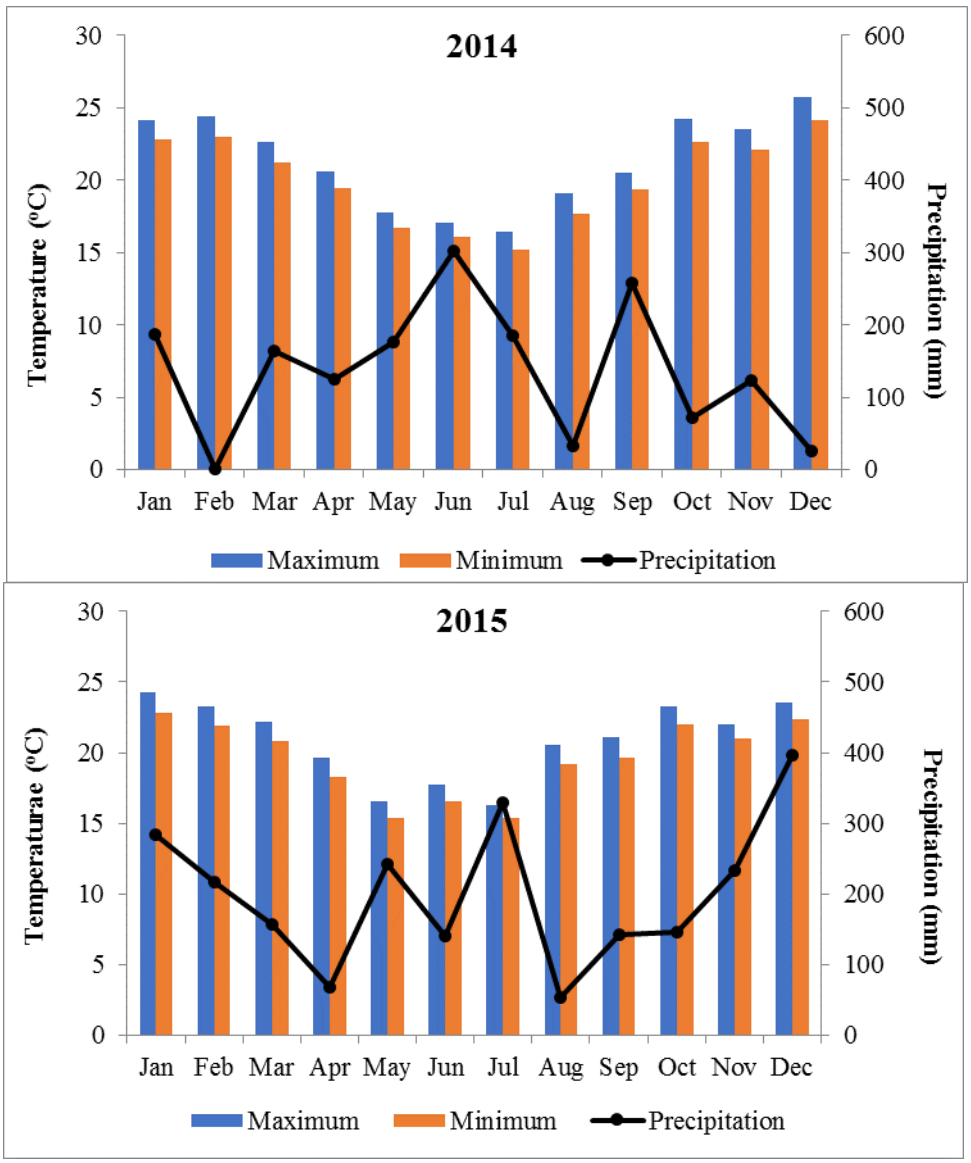
What is noteworthy is the fact that access 2 in 2012 (Table 1) was among those with the lowest total soluble solids, and in other years (2013 and 2015) it was higher (Tables 2 and 3). This reinforces the hypothesis that the lack of plant management influences the flavor or the fact that weather conditions have also changed over the years (Figure 1), interfering with the fruit quality.

It was observed in Figure 1 that the accumulated precipitation occurred differently among the periods that preceded the harvest in the three years, when the demand for water is greater for cell elongation and division - processes that determine the size of the fruits. In 2012, the harvest was carried out on October 18, 2012, with an accumulation of precipitation close to 200 mm in September. In 2013, the harvest was on October 28, having in September values

greater than 200 mm of accumulated precipitation, and in 2015 the harvest took place on October 6, whose accumulated precipitation in September was less than 200 mm (Figure 1). To avoid this type of natural dependence on meteorological factors, the use of orchards irrigation should be adopted, a fact that was observed in the present work.

Figure 1. Monthly averages of maximum and minimum temperatures (°C) and precipitation (mm) in 2013, 2014 and 2015. Data collected at the UTFPR meteorological station, Dois Vizinhos.





This proves what was described by Danner *et al.* (2010), about the importance of analyzing the characteristics of the fruits for four or five consecutive productive cycles, so that it can support the selection of superior genotypes and serve as descriptors of possible cultivars, with this number of measurements considered adequate to predict the real value of individuals, with reliability higher than 80% in all characters, indicating that these characters can be used in the phenotypic selection of superior genotypes in Surinam cherry.

Therefore, it can be proven that access 23, despite being analyzed in a single year, proved to be promising for future analysis, in other production cycles.

It can be stated, in general, that the SST of the fruits evaluated with pirenic and apirenic cherry trees in these years of collection varied between 10 and 12 ^{o}Brix (Tables 8, 9 and 10). This range of analysis is within the values considered to be adequate for the species, as verified by the IPA (2007), which highlights that the Ministry of Agriculture, Livestock and Supply (BRASIL, 2009), through Normative Instruction No. 136, of 31 March 1999, which establishes the following standard values regarding the physical-chemical characteristics of the Surinam cherry pulp industrialization: total soluble solids of 6 °Brix (minimum); total acidity of 0.92% citric acid (minimum); 9.5 g/100 g total natural sugars (maximum); pH between 2.5 and 3.4; red-colored pulp; own flavor and aroma.

Conclusions

The access related to the apirenic Surinam cherry tree confirmed the qualities of its fruit for pulp yield, which can mainly serve the industrial market, however, it can also be used for dual purposes. Accessions 2 and 3 stood out in two cycles as having the highest SST, and may be interesting for natural consumption.

References

ABRAFRUTAS. **Associação brasileira dos produtores exportadores de frutas e derivados:** dados estatísticos. Brasília: ABRAFRUTAS, 2021. Disponível em: https://abrafrutas.org/dados-estatisticos. Acesso em: 26 jul. 2021.

ASSIS, S.A.; VELLOSA, J.C.R.; BRUNETTI, I.L.; KHALIL, N.M.; LEITE, K.M.S.C.; MARTINS, A.B.G.; OLIVEIRA, O.M.M.F. Antioxidant activity, ascorbic acid and total phenol of exotic fruits occurring in Brazil. **International Journal of Food Sciences and Nutrition,** v. 60, n. 5, p. 439-448, 2009. https://doi.org/10.1080/09637480701780641

BEZERRA, J. E. F.; SILVA JUNIOR, J. F.; LEDERMAN, I. E. **Pitanga (*Eugenia uniflora* L.)**. Jaboticabal: FUNEP, 2000. (Série Frutas Nativas; 1)

BEZERRA, J. E. F.; LEDERMAN, I. E.; SILVA JUNIOR, J .F.; ALVES, M. A. Comportamento da pitangueira (*Eugenia uniflora* L.) sob irrigação na região do Vale do Rio Moxotó, Pernambuco. **Revista Brasileira de Fruticultura**, v.26, n.1, p.177-179, 2004. https://doi.org/10.1590/S0100-29452004000100047

BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. **Regras para análise de sementes.** Brasília: Mapa/ACS, 2009.

CHANG, S. K.; ALASALVAR, C.; SHAHIDI, F. Review fo dried fruits: Phytochemicals, antioxidante efficacies and health benefits. **Journal of Functional Foods,** v. 21, p. 113-132, 2016. https://doi.org/10.1016/j.jff.2015.11.034

COGGINS, C. W.; HIELD, H. Z. **Plant growth regulators.** *In*: REUTHER, W.; BATCHELOR, L. D.; WEBBER, H. J. (Eds). The citrus industry. Riverside: University of California, 1968. v. 2, p. 371-386.

DANNER, M. A.; RASEIRA, M. C.; SASSO, S, A. Z.; CITADIN, I.; SCARIOT, S. Repetibilidade de caracteres de fruto em araçazeiro e pitangueira. **Ciência Rural**, v. 40, n. 10, 2010. https://doi.org/10.1590/S0103-84782010005000163

FELDBERG, N. P; DA MOTA, R.V.; SIMÕES, W.L.; LIMA, W.; REGINA, M. A. Viabilidade da utilização de descartes de produção de uvas sem sementes para elaboração de passas. **Revista Brasileira de Fruticultura**, v. 30, n. 3, p. 846-849, 2008. https://doi.org/10.1590/S0100-29452008000300050

FENNER, M. **Seed ecology**. London: Chapman & Hall, 1993.

FRANZON, R. C. Caracterização de mirtáceas nativas do Sul do Brasil. 2004. 102f. Dissertação (Mestrado) –Universidade Federal de Pelotas, Pelotas, 2004.

FRUTIFATOS. **Informação para a fruticultura irrigada**. Brasília, 2002. v.2, n.2, 64p.

GOMES, G. C.; RODRIGUES, W. F.; GOMES, F. R. C.; BARBIERI, R. L.; GARRASTAZU, M. C. **Conservação de frutíferas nativas: localização, fenologia e reprodução.** Pelotas: Embrapa Clima Temperado, 2007. (Documentos; 183).

IPA. **Pitanga cultivar tropicana.** 2000. 4p. (Fôlder).

KIST, B. B.; CARVALHO, C.; BELING, R. R. **Anuário brasileiro de Horti&Fruti.** Santa Cruz do Sul: Gazeta Santa Cruz, 2021. 104 p.

LORENZI, H. **Árvores do Brasil:** manual de identificação e cultivo de plantas arbóreas do Brasil. 2. ed. Nova Odessa: Instituto Plantarum, 2002. v. 2.

MARIN, R.; PIZZOLI, G.; LIMBERGER, R.; APEL, M.; ZUANAZZI, J. A. S.; HENRIQUES, A. T. Propriedades nutracêuticas de algumas espécies frutíferas nativas do sul do Brasil. *In*: RASEIRA, M. C. B.; ANTUNES, L. E. C.; TREVISAN, R.; GONÇALVES, E. D. **Espécies frutíferas nativas do sul do Brasil.** Pelotas: Embrapa Clima Temperado, 2004. p.107-122. (Documentos; 129)

MELO, E. A.; MACIEL, M. I. S.; LIMA, V. L. A. G.; NASCIMENTO, R. J. Capacidade antioxidante de frutas. **Revista Brasileira de Ciências Farmacêuticas,** v.44, n.2, 2008a. https://doi.org/10.1590/S1516-93322008000200005

MELO, E. A.; MACIEL, M. I. S.; LIMA, V. L. A. G.; ARAÚJO, C. R. Teor de fenólicos totais e capacidade antioxidante de polpas congeladas de frutas. **Alimentos e Nutrição**, v. 19, n. 1, p. 67-72, 2008b.

MONSELISE, S. P.; GOLDSCHMIDT, E. E. Alternate bearing in fruit trees: a review. **Horticultural Reviews,** v.4, p.128–173, 1982. https://doi.org/10.1007/978-1-349-06519-6_5

OHASHI, S. T.; YARED, J. A. G., FARIAS NETO, J. T. Variabilidade entre procedências de paricá Schizolobium parahyba var amazonicum (Huber ex Ducke) Barneby plantadas no município de Colares – Pará. **Acta Amazônica,** v. 40, n. 1, p. 81–88, 2010. https://doi.org/10.1590/S0044-59672010000100011

RASEIRA, M. C. B.; SIMONETTO, P. R.; GRELLMAN, E; NAKASU, B. H. **Lançamento de cultivares de pessegueiro, ano 2000**. Embrapa Clima Temperado, 2000.

REIS, A. F.; SCHMIELE, M. Características e potencialidades dos frutos do cerrado na indústria de alimentos. **Brazilian Jornal of Technology**, v.22, e2017150, 2019. https://doi.org/10.1590/1981-6723.15017

ROESLER, R.; MALTA, L. G.; CARRASCO, L. C.; HOLANDA, R. B.; SOUSA, A. S.; PASTORE, G. M. Atividade antioxidante de frutas do cerrado. **Ciência e Tecnologia de Alimentos,** v. 27, n. 1, p. 53-60, 2007. https://doi.org/10.1590/S0101-20612007000100010

SHIFRISS, C.; EIDELMAN, E. An approach to parthenocarpy in peppers. **Hort Science**, v. 21, n. 6, p. 1458-1459, 1986.

SILVA, F. A. S.; AZEVEDO, C. A. V. Principal Components Analysis in the Software Assistat-Statistical Attendance**.** *In*: WORLD CONGRESS ON COMPUTERS IN AGRICULTURE, 7. **Anais [...].** Reno-NV-USA: American Society of Agricultural and Biological Engineers, 2009

SOARES, I. A. A.; FREITAS, F. C. L.; NEGREIROS, M. Z.; FREIRE, G. M.; AROUCHA, E. M. M.; GRANGEIRO, L. C.; LOPES, W. A. R.; DOMBROSKI, J. L. D. Interferência das plantas daninhas sobre a produtividade e qualidade de cenoura. **Planta Daninha**, v.28, p.247-254, 2010. https://doi.org/10.1590/S0100-83582010000200003

TREVISAN, R.; TREPTOW, R. O.; GONÇALVES, E. D.; ANTUNES, L. E. C.; HERTER, F. G. Atributos de qualidade considerados pelo consumidor de Pelotas/RS na compra do pêssego in natura. **Current Agricultural Science and Technology,** v. 12, n. 3, p. 371-374, 2006.

VAROQUAUX, F.; BLANVILLAIN, R.; DELSENY, M.; GALLOIS, P. Less is better: new approaches for seedless fruit production. **Trends in Biotechnology**, v. 18, p. 233–242. 2000. https://doi.org/10.1016/S0167-7799(00)01448-7

WAGNER JÚNIOR, A.; PALADINI, M. V.; DANNER, M. A.; MOURA, G. C.; GUOLLO, K.; NUNES, I. B. Aspects of the sensorial quality and nutraceuticals of *Plinia cauliflora* fruits. **Acta Scientiarum Agronomy**, v. 39, n.4, p. 475-485, 2017. https://doi.org/10.4025/actasciagron.v39i4.35420