Physicochemical characterization of watermelon accessions from traditional agriculture with resistance to Fusarium wilt[1]

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ABSTRACT

Watermelon has great importance due to its nutritional properties. The aim of this work was to study accessions classified as resistant to fusariosis. Twelve accessions and two cultivars, Sugar Baby and Charleston Gray (controls), were characterized for watermelon fruit quality descriptors. The experiment was conducted in Petrolina-PE, over two production cycles in a randomized complete block design, with three repetitions and five plants per plot. Two fruits per plot were sampled for characterization. Ten quantitative and seven qualitative descriptors were evaluated. For the qualitative traits, dissimilarity measures were determined by a matrix of Euclidean distance. At the second harvest, most accessions had higher organic acid and vitamin C content in the pulp and higher soluble solids (°Brix) content. The accessions were divided into four groups according to the Tocher method. There is variability among the evaluated accessions, and the accessions BGH-Univasf 40, BGH-Univasf 169, and BGH-Univasf 177 are potential sources for use in watermelon breeding programs. Accessions BGH-UNIVASF 76, BGH-UNIVASF 128, and BGH-UNIVASF 185 (*Citrullus lanatus* var. *citroides*) performed well in terms of total production, fruit mass, and vitamin C content.

Keywords: *Citrullus lanatus*; *Fusarium oxysporum* f. sp *niveum*; germplasm; plant breeding.

INTRODUCTION

The watermelon (*Citrullus lanatus* (Thunb.) Matsum. & Nakai), belonging to the cucurbit family (Cucurbitaceae) and originating in tropical regions of Equatorial Africa, is considered one of the most important vegetables produced and marketed worldwide (FAOSTAT, 2021). In Northeastern Brazil, watermelon can be grown year-round, both under irrigated conditions, as in the Vale do Submédio São Francisco, and in arid regions, where it is grown during the rainy season, often in mixed cultivation with other species (Embrapa, 2010a). The fruits of watermelon are used for both human and animal consumption, and due to their sweet and refreshing taste, they are especially appreciated in summer (Ramirez et al., 2021). In 2019, the area under watermelon in Brazil was 91, 922 ha, with a production of 2.14 Mt (FAOSTAT, 2021).

One of the factors limiting the development of watermelon is the presence of pests and diseases during the cultivation cycle, which affect production and cause losses. Diseases affecting watermelon cultivation include those caused by root pathogens such as Fusarium wilt, which is caused by the fungus *Fusarium oxysporum* f. sp. n*iveum* (Fon). This pathogen attacks the plant at different stages and causes severe damage with symptoms such as chlorosis, necrosis, vascular system browning, and finally wilting, and

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death of the plant (Rahman et al., 2021). Various aspects, including economic and environmental factors, make it difficult to control Fusarium wilt in growing areas, so it is important to obtain genetically resistant material, which is the most efficient control measure (Zhang *et al.,* 2015, Costa *et al*., 2018).

For the development of new resistant cultivars against Fusarium wilt, it is important to ensure the quality of these materials demanded by consumers. This factor will determine the success of the new cultivar, whether in the field to ensure production or in marketing to ensure consumer acceptance. Therefore, it is important to characterize materials that express resistance to diseases, either for use as parent in crosses (Prakash *et al.,* 2016) or for direct use by the farmers. This is an essential activity that will provide information on potential genotypes conserved in germplasm banks or even landraces, important sources of genetic variability, especially for vegetables.

The aim of this study was to evaluate the physicochemical quality of watermelon accessions from the germplasm bank of the Universidade Federal do Vale do São Francisco (BGH-Univasf) phenotypically classified with resistance to Fusarium wilt.

MATERIAL AND METHODS

Experiments were carried out in the agricultural production area of the Campus de Ciências Agrárias (CCA) from Universidade Federal do Vale do São Francisco, in Petrolina-PE (latitude 9°19’10’’ S; longitude 40°33’39’’ W; average altitude of 376 m). The region’s climate is classified as semi-arid tropical, type BSh, according to the Köppen classification, with sparse and irregular precipitations. Two production cycles were evaluated, the first between the months of April to August 2016 and the second between October 2016 to January 2017. During cycle 1 the average monthly temperature data for the period varied from 24.39 ºC to 26.57 ºC and the average monthly relative humidity varied between 51.01 to 56.84%. For the second cycle, the temperatures were higher, varying from 26.57 to 28.96 ºC, and the average relative humidity in the period ranged from 42.02 to 59.30% (Figure 1).

Twelve watermelon accessions were evaluated, nine of which were *C. lanatus* var. *lanatus* and three of forage watermelon (*C. lanatus* var. *citroides*) collected in areas of traditional agricultural producers, which were previously evaluated and classified as resistant to Fusarium Wilt (Costa *et al*, 2021). In addition to the accessions, the commercial cultivars Sugar Baby susceptible to all races of Fon and Charleston Gray resistant to race 0 of Fon were used as control. In both cycles, a randomized block design with 14 treatments and three repetitions was used, with a spacing of 0.80 x 3.00 meters, with the plot consisting of five plants. Seeds of the 14 watermelon genotypes were placed to germinate in plastic trays containing commercial substrate for vegetables, after germination, when the seedlings had two definite fully developed leaves, they were transplanted to the field, located in the experimental sector of CCA - Univasf. The management of culture in the field was carried out with adequate fertigation and phytosanitary activities. For the characterization, two fruits were sampled per plot.

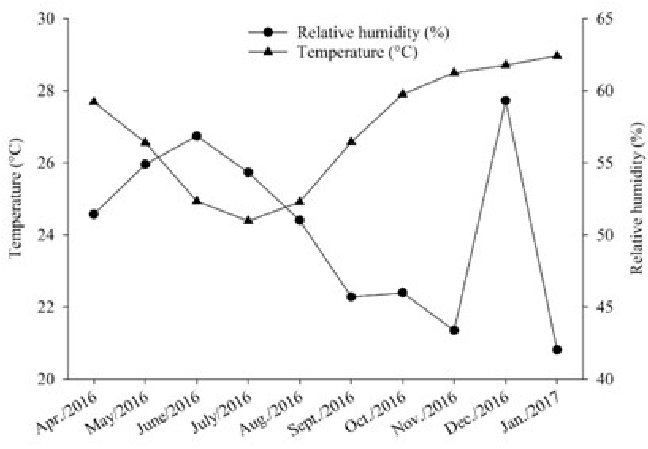

Figure 1: Monthly average temperature (°C) and average relative humidity (%) data recorded in cycle 1 between the months of April and August 2016 and the second cycle October and January 2016.

Fruits were harvested when they reached maturity, characterized by the drying of the tendril located in the peduncle of the fruit itself and by the change in the color of the fruit's peel in the region that remains in contact with the soil (Embrapa, 2010b). After harvesting, the total fruit production per plot (TFP) and the mass of the first fruit developed per plot was obtained by weighing all the fruits produced by the same plant and the first developed fruit of each plant, respectively. For the other variables, two fruits were randomly selected per plot for characterization using eight quantitative descriptors: transversal diameter (TD) (cm), longitudinal diameter (LD) (cm), fruit shape index (FSI), soluble solids content (SS) (°Brix), titratable acidity (TA) (%), pH, vitamin C content (VC) (mg/100mL), SS/AT (ratio). For qualitative data were used: shape of the longitudinal section (SLS), epidermis color (EC), epidermis color intensity (ECI), stripes presence (SP), stripe type (ST), stripe color intensity (SCI) and stripe width (SW).

Transverse diameter and longitudinal diameter measurements were obtained from measuring the fruit with a tape measure. The fruit shape index was calculated using the TD/LD ratio, and the fruits were classified as long when they presented values for the ratio below 0.5, oval when 0.5 and 0.79 were observed, and spherical with values between 0.80 to 1.00, according to Silva *et al.* (2006).

Content of soluble solids (SS) was performed in a digital refractometer (Hanna ® scale from 0 to 85 °Brix), from the aliquot extracted in the central region of the fruit, from which samples of the pulp were also taken, stored in plastic bags identified and packed in polystyrene boxes carrying out the other post-harvest analyzes. In the laboratory, the watermelon pulps were processed in a blender to obtain the homogeneous juice, subsequently transferred to 45 mL Falcon tubes. The pH was measured with pH meter calibrated with pH 4 and 7 buffers solutions. Measurements were done in duplicate. Titratable acidity was determined by titration, according to the methodology proposed by the Adolfo Lutz Institute (2008), which is based on the titration with sodium hydroxide (0.01 M) until the turning point with the phenolphthalein indicator (1%). The ratio was obtained by the SS / TA ratio. Levels of vitamin C were determined according to Baccan *et al.* (2001).

Qualitative descriptors were evaluated based on seven attributes related to the fruits listed by UPOV (2005), as shown in Table 1. Characterization was made through a scale of notes for each variable, with modifications for type of range, intensity of the band color and band width, to which a note was added corresponding to the absence of the characteristic.

Data were initially tested for homogeneity of variances using the Bartlett test and for normality of residues using the Shapiro-Wilk test. The pH, vitamin C, soluble solids and SS/AT ratio data were transformed by the equation , , and , to verify the assumptions of ANOVA. Subsequently, individual analyzes were carried out, as well as the joint analysis of the two cycles. The averages were grouped using the Scott-Knott test at 5% significance to compare the performance of each access used, based on the significance of the F test.

The qualitative traits were subjected to the analysis of genetic diversity, with evaluation of the frequency of each of the categories among the variables and obtaining the dissimilarity matrix by the Euclidean distance. Using Tocher's optimization method, accesses were then grouped.

Statistical analysis was performed using the statistical programs GENES (Cruz *et al.,* 2013), R Core Team (2010) and SISVAR (Ferreira, 2011).

RESULTS AND DISCUSSION

Genotype × environment interaction was significant for six quantitative descriptors evaluated among the 12 accessions and the two commercial cultivars. In accession performance studies, it is desirable that the traits assessed remain stable across environments so that observed variability can be attributed to the genetic component. Ramalho *et al.* (2012) reported that quantitative traits are often controlled by multiple genes, so environmental influence to be expected.

Variability in the physicochemical parameters assessed was observed among the 12 accessions studied. In this way, future studies can identify accessions that can be used directly by farmers or included in breeding programs to be used as parents in crosses. Thus, there is a time gain in the stages of association of disease resistance previously evaluated (Costa et al., 2021) with the traits of agronomic interest.

The variables pH, titratable acidity, transverse diameter, and fruit shape did not show significant value for the genotype × environment interaction (Table S1). For these characters, the analysis was based on the average of the environments. In general, experimental precision based on the coefficient of variation, was within the usual range for field experiments, with values ranging from 3.77 (pH) to 27.57% (total production) (Table S1). The lowest amplitudes were observed for pH, indicating greater homogeneity of the character among the genotypes studied.

Table 1: Scales of grades of qualitative descriptors used in the evaluation of the fruits of watermelon accessions

Descriptor*	Class	Scale of grades
Shape of the longitudinal section	Circular	1
	Wide elliptical	2
	Medium elliptical	3
	Narrow elliptical	4
Skin color	Yellow	1
	Very light green	2
	Very light green to light green	3
	Light green	4
	Light to medium green	5
	Medium green	6
	Medium to dark green	7
	Dark green	8
	Dark to very dark green	9
	Very dark green	10
Skin color Intensity	Very weak	1
	Weak	2
	Medium	3
	Strong	4
	Very strong	5
Stripes	Absent	0
	Present	1
Stripe Type	Only one color	1
	One color and veins	2
	One color, veins and marbled	3
	One color and marbled	4
	Two colors, veins and marbled	5
	Only veins	6
Stripe Color Intensity	Absent	0
	Very weak	1
	Weak	2
	Medium	3
	Strong	4
	Very strong	5
Stripe Width	Absent	0
	Very narrow	1
	Narrow	3
	Medium	5
	Wide	7
	Very wide	9

Adapted: UPOV (2005)

This variable grouped the accessions into three groups of average values, ranging from 4.79 for BGH-Univasf 128 to 5.62 for 'Sugar Baby', as shown in Table 2, with values corresponding to those observed in the literature for this crop, around 5.34 (Barros *et al.,* 2012).

The titratable acidity in cycle 2 was higher than in cycle 1, with a higher content of organic acids in the pulp observed in the accessions of the species *Citrullus lanatus* var. *lanatus*: BGH-Univasf 40, BGH-Univasf 174, BGH-Univasf 177, BGH-Univasf 210, BGH-Univasf 321 and 'Charleston Gray', with values of 1.13, 1.27, 1.17, 1.37, 1.32 and 1.25%, respectively (Figure 2A). Similar results were found by Lima Neto *et al.* (2010) in the evaluation of fruit quality of watermelon cultivars under the conditions of hot and dry climate of Mossoró, RN, conditions like those of the present work. According to Barros *et al.* (2012), acidity is an important characteristic related to fruit flavor, since low values tend to make the flavor pleasant. Carlos *et al.* (2002) reported the tendency for total titratable acidity to increase with the growth process of the fruit until its complete physiological development and then to decrease through the ripening process. Thus, the analysis of titratable acidity values obtained in the present study suggests that the fruits were harvested relatively ripe, which emphasizes the need to correlate the other ripeness indices and to make evaluations of unripe fruits.

Accessions BGH-Univasf 116 and 'Charleston Gray' had superior performance for soluble solids content in the second cycle, while BGH-UNIVASF 169 showed a decrease in content compared to the first cycle (Figure 2B). The content of soluble solids varied from 2.51 to 8.94 °Brix among the evaluated genotypes, as expected, the accessions of forage watermelon obtaining the lowest values. For commercial cultivars, soluble solids content was consistent with literature data. Leão *et al.* (2007) evaluated soluble solids content in eight watermelon cultivars, including 'Charleston Gray', which obtained lower values for this variable than in the present study. In the case of 'Sugar Baby', Ramos *et al.* (2009) evaluated the effect of planting density on the performance and fruit quality parameters of the cultivar. These authors obtained a value of 7.19 °Brix, which was lower than the value observed for this cultivar in the present study, whose average from cycles were 8.94 °Brix.

Soluble solids content is a characteristic that is strongly influenced by environmental conditions. Sandlin et al. (2012) reported that soluble solids content in watermelon is considered a polygenic character influenced by genetic and environmental factors, with watermelon being sensitive to temperature and moisture fluctuations during its developmental stage (Figure 1). According to the climate data, there

Table 2: Variables with no significant genotype × environment interaction for quantitative characterization of fruits from 12 watermelon accessions and two commercial cultivars

Accessions	pH[3]		Fruit shape index (TD/LD ration)[3]	
BGH-UNIVASF 40[1]	5.34	a	0.95	a
BGH-UNIVASF 76[2]	4.91	c	0.6	b
BGH-UNIVASF 116[1]	5.46	a	0.46	c
BGH-UNIVASF 128[2]	4.79	c	0.52	c
BGH-UNIVASF 169[1]	5.25	a	0.46	c
BGH-UNIVASF 174[1]	5.09	b	1.01	a
BGH-UNIVASF 177[1]	5.39	a	0.57	c
BGH-UNIVASF 185[2]	4.86	c	0.52	c
BGH-UNIVASF 210[1]	5.19	b	0.56	c
BGH-UNIVASF 321[1]	5.16	b	0.64	b
BGH-UNIVASF 395[1]	5.12	b	0.67	b
BGH-UNIVASF 398[1]	5.42	a	0.71	b
'Sugar Baby'	5.62	a	0.91	a
'Charleston Gray'	5.38	a	0.54	c
CV (%)	3.77		15.01	

[1]Accessions of the species Citrullus lanatus var. lanatus
[2]Accessions of the species Citrullus lanatus var. citroides
[3]Dimensionless value
Means followed by the same lowercase belong to the same grouping according to the Scott-Knott test at 5% probability

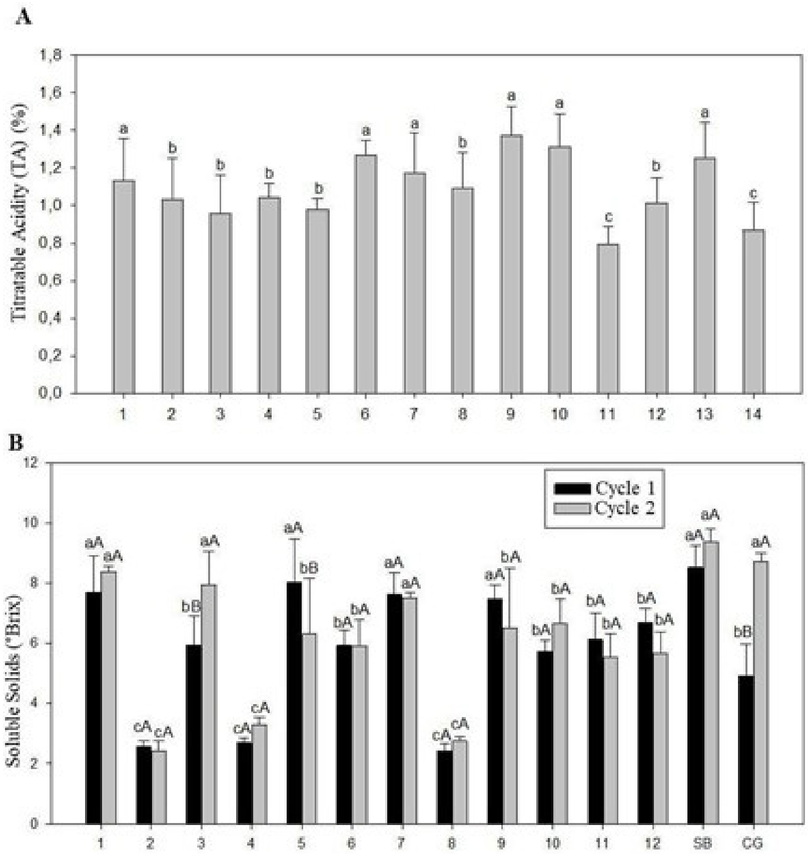

Figure 2: Average of 12 watermelon accessions plus Sugar Baby (SB) and Charleston Gray (CG) cultivars in two production cycles for: A) Titratable acidity (%) based on the general average of the cycles and B) Soluble solids (ºBrix). Means followed by the same uppercase letter (between cycles) and lowercase letter (between genotypes) belong to the same group according to the Scott-Knott test at 5% probability. 1 - BGH-UNIVASF 40; 2 - BGH-UNIVASF 76; 3 - BGH-UNIVASF 116; 4 - BGH-UNIVASF 128; 5 - BGH-UNIVASF 169; 6 - BGH-UNIVASF 174; 7 - BGH-UNIVASF 177; 8 - BGH-UNIVASF 185; 9 - BGH-UNIVASF 210; 10 - BGH-UNIVASF 321; 11 - BGH-UNIVASF 395; and 12 - BGH-UNIVASF 398.

was an increase in temperature and a decrease in humidity during the second cycle compared to the first cycle. These conditions should be more favorable for the development of watermelon fruits with higher organoleptic quality.

Fruit flavor can be better evaluated using the SS/AT ratio, which is considered more representative than isolated measurements of sugar and acidity (Lima Neto *et al.,* 2010). The accessions BGH-Univasf 40 and 'Charleston Gray' obtained lower values in the first cycle (Table 3). By cycle, these two treatments were classified in the group with the highest value for SS/AT. This fact results from the low contents of organic acids obtained in the representative fruits of each treatment.

The vitamin C content ranged from 11.41 to 17.22 mg ascorbic acid 100 mL^{-1} of juice. In the genotype × environment interaction, cycle 2 was superior to cycle 1 for most treatments, except for BGH-UNIVASF 210 and BGH-UNIVASF 321, which had a reduction in the second cycle as seen in Figure 3-A. During the second cycle, the highest temperatures were observed (Figure 1). The combination of high light intensity and high temperatures are optimal conditions for development of watermelon fruits (Wehner, 2008). The accession BGH-UNIVASF 128, of the species *Citrullus lanatus* var. *citroides* had better mean values than the commercial cultivars in both experimental periods. The other var. *citroides* accessions, BGH-UNIVASF 76 and 128, also grouped with BGH-UNIVASF 128 in the second cycle with the highest of vitamin C contents.

Commercial cultivars were grouped with the lowest average values for vitamin C synthesis, but still reached higher values than those reported by Lima Neto *et al.* (2010) in Mossoró - RN of 7.64 and 6.97 mg 100g pulp^{-1} for 'Charleston Gray' and 'Sugar Baby', respectively (Figure 3-A). The Brazilian Food Composition Table – TACO

Table 3: Variables with significant genotype × environment interaction for quantitative characterization of fruits from 12 watermelon accessions and two commercial cultivars

Accessions	SS/TA ratio[3]		Total production (kg)	
	Cycle 1	**Cycle 2**	**Cycle 1**	**Cycle 2**
BGH-UNIVASF 40[1]	6.12 aB	8.62 aA	7.65 cA	14.66 bA
BGH-UNIVASF 76[2]	2.61 cA	2.49 dA	41.57 aA	16.98 aB
BGH-UNIVASF 116[1]	6.75 aA	8.10 aA	7.48 cA	11.73 bA
BGH-UNIVASF 128[2]	2.73 cA	3.00 dA	25.31 bA	17.75 aB
BGH-UNIVASF 169[1]	7.94 aA	6.62 bA	20.66 bA	20.09 aA
BGH-UNIVASF 174[1]	4.88 bA	4.49 cA	7.42 cA	11.46 bA
BGH-UNIVASF 177[1]	6.84 aA	6.40 bA	16.77 bA	12.75 bA
BGH-UNIVASF 185[2]	2.35 cA	2.47 dA	46.16 aA	23.59 aB
BGH-UNIVASF 210[1]	5.75 aA	4.51 cA	14.65 bA	17.84 aA
BGH-UNIVASF 321[1]	4.76 bA	4.79 cA	8.65 cA	7.72 bA
BGH-UNIVASF 395[1]	8.43 aA	6.48 bA	11.95 cA	13.05 bA
BGH-UNIVASF 398[1]	7.11 aA	5.35 cA	18.57 bA	14.17 bA
'Sugar Baby'	7.39 aA	7.27 bA	9.15 cA	5.67 bA
'Charleston Gray'	6.63 aB	9.20 aA	5.99 cA	11.66 bA
CV (%)	21.58		27.57	

[1]Accessions of the species Citrullus lanatus var. lanatus
[2]Accessions of the species Citrullus lanatus var. citroides
[3]Dimensionless value
Means followed by the same uppercase letter in the row and lowercase in the column belong to the same grouping according to the Scott-Knott test at 5% probability.

(Universidade Estadual de Campinas, 2006) is one of the most important Brazilian references on food composition. The values obtained in the present study were higher than those taken as a reference for watermelon in this table (6.1 mg 100g pulp^{-1}). Vitamin C is considered an important component of human nutrition, mainly because human cannot synthesize this element themselves and therefore must obtain it from food. In this sense, vitamin C can be used as a quality index because it is a characteristic that is strongly influenced by factors such as climatic conditions, cultural practices and ripeness in addition to genetic differences (Lee & Kader, 2000; Toscano et al., 2019).

The accession BGH-UNIVASF 185, of the species *Citrullus lanatus* var. *citroides*, was superior to the other treatments in terms of variable fruit mass in cycle 1 with an average value of 11.35 kg (Figure 3-B). This potential was maintained in the second cycle, however, in cycle 2, 'Charleston Gray, BGH -UNIVASF 76, and BGH-UNIVASF 128 grouped together with BGH-UNIVASF 185, all accessions also belonged to *Citrullus lanatus* var. *citroides*. It is also worth mentioning the observed amplitude between BGH-UNIVASF 185 accession with the highest mass (11.35 kg) and BGH-UNIVASF 321 with the lowest mass (2.50 kg), showing the variability of the material under the test conditions. Accessions with small fruits (below four kilograms), such as BGH-UNIVASF 321, BGH-UNIVASF 395 and BGH-UNIVASF398, are promising. Recently, fruit size has become an important characteristic for breeders as consumers increasingly prefer smaller fruits (Ngwepe et al., 2019).

Fruits obtained in cycle 2 were larger than in cycle 1 in terms of longitudinal diameter (LD), with values ranging from 19.37 cm (BGH-Univasf 174) to 41.68 cm (BGH-Univasf 116). For transverse diameter (TD), four groups were formed, with BGH-UNIVASF 76 (21.06 cm) and BGH-Univasf 185 (21.70 cm) having the highest average values. Regarding the fruit shape index (FSI), 64.3% of the accessions were classified in the oval fruit category, as they had a TD/LD ratio between 0.5 and 0.79, a result that included accessions such as BGH-UNIVASF 76, BGH-UNIVASF 128, BGH-UNIVASF 177, BGH-UNIVASF 185, and 'Charleston Gray'. It has been reported in the literature fruits considered oval or spherical have a greater portion of edible pulp, and it is more advantageous in terms of storage, as it can be easily placed in boxes (Silva *et al.,* 2006). In the accessions BGH-UNIVASF 40, BGH-UNIVASF 174

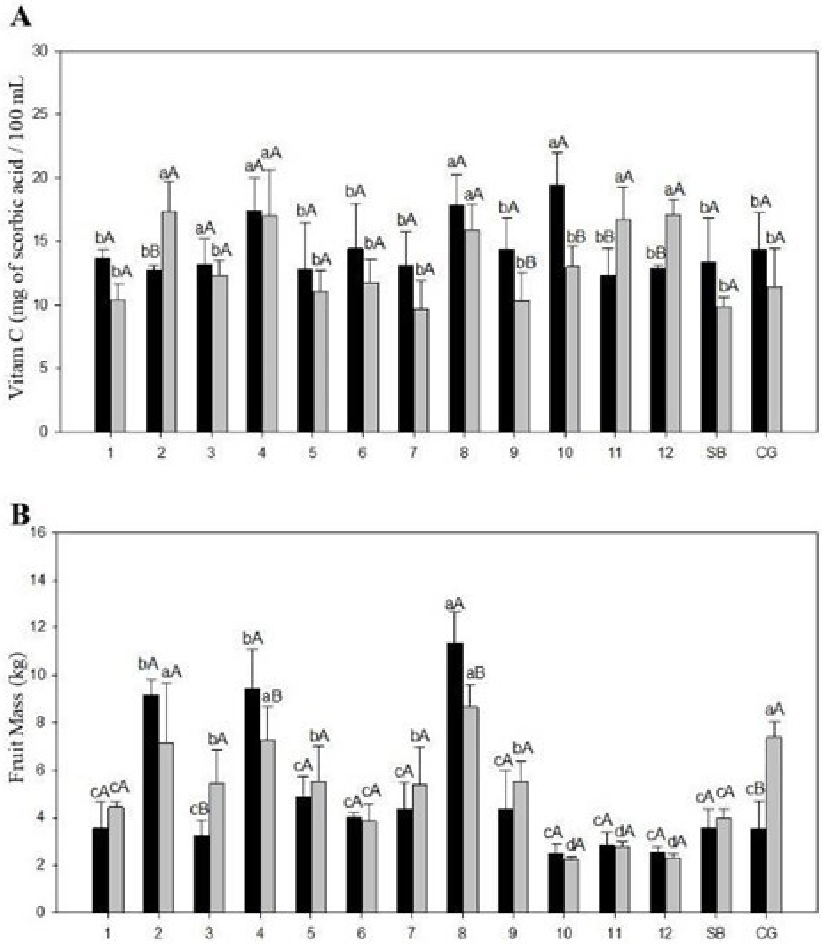

Figure 3: Average of 12 watermelon accessions plus Sugar Baby (SB) and Charleston Gray (CG) cultivars in two production cycles for: A) Vitamin C (ascorbic acid mg / 100 mL) and B) Fruit Mass (kg). Means followed by the same uppercase letter (between cycles) and lowercase letter (between genotypes) belong to the same group according to the Scott-Knott test at 5% probability. Description of accessions: 1 - BGH-UNIVASF 40; 2 - BGH-UNIVASF 76; 3 - BGH-UNIVASF 116; 4 - BGH-UNIVASF 128; 5 - BGH-UNIVASF 169; 6 - BGH-UNIVASF 174; 7 - BGH-UNIVASF 177; 8 - BGH-UNIVASF 185; 9 - BGH-UNIVASF 210; 10 - BGH-UNIVASF 321; 11 - BGH-UNIVASF 395; and 12 - BGH-UNIVASF 398.

and ‘Sugar Baby’, round fruits were observed, which are classified as spherical, since TD/LD ratio closest to 1.0 (Table 2). In this context, associating the content of soluble solids and fruit size, the accessions BGH-UNIVASF 40 and BGH-UNIVASF 177 are a good source as they are grouped with the highest average values for both variables.

Environmental effects with significant interaction can be observed in production per plot, with three of the evaluated treatments performing better in the first cycle compared to the second cycle (Table 3). Only the accessions BGH-UNIVASF 76 and BGH-UNIVASF 185, both from the species *C. lanatus* var. *citroides*, were grouped among accessions with the highest average values in both cycles, indicating a productive capacity to be exploited with potential for animal feed. Silva *et al.* (2009) reported the advantages of using watermelon in animal feed, because it is drought tolerance and easy to grow. ‘Sugar Baby’ achieved the lowest overall production, 7.41 kg, allocated with ‘Charleston Gray’ in the group with the lowest averages. In general, these results demonstrate the potential of these accessions as genetic resources for use in breeding programs.

Using Tocher’s optimization method, the evaluated treatments were divided into four groups, two of which were composed of unique components, one with accession BGH-UNIVASF 40 in another with cultivar ‘Sugar Baby, as shown in Table 4. The evaluation of attributes related to the external appearance of the fruits is necessary because the commercialization conditions of vegetables in general are strongly influenced by the visual attraction to the consumer (Vilela *et al.,* 2000). Fruit characterization provides infor-

Table 4: Grouping performed according to the Tocher Method, based on the dissimilarity matrix obtained by the Euclidean distance for qualitative variables1 of twelve accessions and two commercial cultivars

Group	Treatment	Qualitative descriptors *						
		SLS	SC	SCI	SP	ST	SCI	SW
I	BGH-UNIVASF 40	2	2	4	1	1	4	5
II	'Sugar Baby'	2	2	5	1	0	2	1
	BGH-UNIVASF 128	3	2	3	1	0	0	0
	BGH-UNIVASF 395	3	2	3	1	0	1	0
III	'Charleston Gray'	3	2	3	1	1	2	1
	BGH-UNIVASF 185	4	2	3	1	0	0	0
	BGH-UNIVASF 76	3	2	3	1	0	0	1
	BGH-UNIVASF 116	3	2	4	1	1	4	3
	BGH-UNIVASF 321	3	2	3	1	1	4	5
	BGH-UNIVASF 169	3	2	3	1	1	4	7
IV	BGH-UNIVASF 174	2	2	2	1	2	5	7
	BGH-UNIVASF 177	3	2	2	1	2	4	5
	BGH-UNIVASF 210	3	2	2	1	1	4	5
	BGH-UNIVASF 398	3	2	2	1	1	3	1

[1]Quantitative descriptors used: shape of the longitudinal section (SLS), skin color (SC), skin color intensity (SCI), stripes presence (SP), stripe type (ST), stripe color intensity (SCI) and stripe width (SW).

mation on accessions and allows genetic diversity analyzes to be conducted, which in turn help identify parents with potential use for hybridization in breeding programs and define groups with a greater or lesser degree of similarity (Cruz *et al.,* 2014).

Characteristics of commercial interest for watermelon, such as fruit shape, weight, external and internal color, and stripe pattern, are important aspects for the commercial success of the crop due to strong market demand (Mashilo et al., 2022). Fruit longitudinal cut shape varied little among accessions, and it was classified as broadly elliptical for groups I and II and as mid-elliptical for most accessions in groups III and IV. Skin color was homogeneous in all groups, with fruits classified based on their light green color, with the greatest intensity attributed to 'Sugar Baby'.

Regarding the stripe pattern, group I, which was composed only of the accession BGH-UNIVASF 40 (Table 4), differed from the others, as the fruits were evaluated with the highest score for the description of this characteristic. The accessions BGH-UNIVASF 128, BGH-UNIVASF 395, BGH-UNIVASF 185 and BGH-UNIVASF 76 showed a fruit pattern similar to that of 'Charleston Gray', with light green outer tones, stripes (when present), in unique colors and the presence of veins, the color being of low intensity.

Among the evaluated accessions that show resistance to fusariosis, according to a preliminary evaluation, they are alternatives for use both in breeding programs and for direct use by farmers. In this way, it is possible to obtain an improvement in agronomic performance to obtain material that has good agronomic performance both in organoleptic and production terms.

CONCLUSION

Twelve characterized accessions show variability in the physicochemical analysis studied. Among the evaluated accessions, BGH-UNIVASF 40, BGH-UNIVASF 169, and BGH-UNIVASF 177 can be highlighted, as they are phenotypically resistant to fusariosis and present a good performance for the main evaluated characteristics of commercial interest, representing possible sources for watermelon breeding.

The accessions BGH-UNIVASF 76, BGH-UNIVASF 128, and BGH-UNIVASF 185 (*Citrullus lanatus* var. *citroides)* showed good performed in total production, fruit mass and vitamin C content.

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