MORPHO-AGRONOMIC CHARACTERIZATION OF *Varronia curassavica* GERMPLASM CONSERVATED "*EX SITU*"

CARACTERIZAÇÃO MORFOAGRONÔMICA DE GERMOPLASMA DE Varronia curassavica *CONSERVADO "EX SITU"*

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ABSTRACT: *Varronia curassavica* Jacq. is a medicinal and aromatic plant native to Brazil. The essential oil of this species is valued by the pharmaceutical industry due to its bioactive substances containing anti-inflammatory properties. This study aimed to morpho-agronomically characterize 27 accessions of the collection of *V. curassavica* of the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe. The experiment consisted of a randomized block design with three replications. The morphological characterization occurred in the field, by evaluating the variables plant height; canopy width; canopy shape; stem diameter; stem color; leaf blades width, length, and length/width ratio; leaves, petals, and sepals color. The agronomic characterization was performed using the essential oils extracted from dried leaves by hydrodistillation in a Clevenger apparatus. Leaves dry matter yield per plant and essential oil yield and content were also evaluated. The accessions showed great variation for leaves color, with different shades of green, which allowed separating them into dark green leaf and light green leaf plants. Plant height values ranged from 101.33 cm (VCUR-801) to 345.33 cm (VCUR-701). The clustering analysis of the traits revealed seven distinct groups. The accessions VCUR-103 and VCUR-001 were the most divergent, whereas the accessions VCUR-401 and VCUR-404 were the most similar. The morpho-agronomic characterization of *V. curassavica* accessions provides a correct description of the species by pointing out perspectives for genetic improvement, besides optimizing the conservation process.

KEYWORDS: Cordiaceae. Medicinal plant. Aromatic plant. Essential oil. Domestication. Genetic breeding

INTRODUCTION

Brazil is rich in plant biodiversity (SOUZA et al., 2010). However, in recent years, its biodiversity has undergone accelerated destruction, mainly affecting the natural vegetation. This fact is due to agricultural expansion, fires, logging, extractivism, and uncontrolled urban growth. All these changes have posed a great threat to several plant species in the country (OLIVEIRA, 2010).

An alternative for the maintenance and conservation of endangered species is the formation of collections in Active Germplasm Banks, which holds base collections for the conservation of a broad plant genetic variability, enabling biodiversity maintenance (SILVA et al., 2012).

Varronia curassavica Jacq. (ex *Cordia verbenacea* DC.)] is a medicinal and aromatic plant native to Brazil, belonging to the Cordiaceae family (GASPARINO; BARROS, 2009). It occurs from Central America to southern Brazil (LORENZI; MATOS, 2008) in a wide range of habitats, such as beaches, restinga, forests, and cerrado (WANDERLEY et al., 2002). *V. curassavica* has stood out both in folk medicine and in the pharmaceutical industry, mainly due to the anti-inflammatory substances present in its essential oil (PASSOS et al., 2007; PARISSOTO et al., 2012; PIMENTEL et al., 2012).

The effectiveness of *V. curassavica* is recognized by the National Sanitary Surveillance Agency (ANVISA). The plant is included in the List of the Unified Health System (SUS) and the National List of Medicinal Plants of Interest to the Unified Health System (RENISUS) (BRASIL, 2011). Due to its therapeutic properties, several studies have been developed aimed at the selection

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of superior accession for its agronomic aspects and chemical composition (VAZ et al., 2006).

Studies have proved several biological activities of the essential oil of *V. curassavica*, such as inhibition of gram-positive bacteria (CARVALHO JR. et al., 2004; MECCIA et al., 2009), fungistatic activity against *Candida albicans* (PINHO et al., 2012), anti-bacterial action against *Staphylococcus aureus* and *Escherichia coli* (RODRIGUES et al., 2012), antifungal activity against the plant pathogenic fungi *Oidium eucalypti* (SILVA et al., 2014) and *Lasiodiplodia theobromae* (NIZIO et al., 2015), and antiprotozoal activity against *Ichthyophthirius multifiliis* (NIZIO et al., 2018).

In 2012, a *V. curassavica* collection was implanted in the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe, containing accessions from the states of Sergipe and São Paulo, aiming to conserve the genetic variability of the species. An Active Germplasm Bank provides information on molecular, morphological, and agronomic variability. Moreover, it allows the knowledge about the diversity and instability of the essential oil chemical composition of the conserved accessions and their biological activities, consequently enhancing the exploitation of the species' genetic resources.

Besides the germplasm maintenance, the Active Germplasm Bank also provides the characterization of conserved accessions. Thus, all information regarding the morphological and agronomic traits, besides providing an "identity" for each accession, may be useful in the genotype selection process to compose breeding programs for this species (GOEDERT, 2007). Characterization is an essential activity in germplasm collections management and consists of describing, identifying, and differentiating accessions of the same species (BURLE; OLIVEIRA, 2010).

Morphological and agronomic characterization is the starting point for the knowledge of a plant species, especially when the objective is the selection of accessions of interest both for cultivation and for use in breeding programs (BLANK et al., 2017; OLIVEIRA et al., 2018). Therefore, this study aimed to morpho-agronomically characterize 27 *V. curassavica* accessions of the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe.

MATERIAL AND METHODS

The *Varronia curassavica* Jacq. (ex *Cordia verbenacea* DC.) collection from the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe is implemented in the Research Farm "Campus Rural da UFS," located in the municipality of São Cristóvão, Sergipe, Brazil (lat. 11°00'S, long. 37°12'W). The collection contains accessions, obtained by vegetative propagation, from different locations in the states of Sergipe and São Paulo (Table 1).

The experiment consisted of a randomized blocks design with three replications. Each plot consisted of one plant, spaced at 2.0 m between plants and 3.0 m between rows. Fertilization was carried out every three months, using 5 L of bovine manure per plant. Monthly weeding was also performed.

The morphological and agronomic characterization of 27 *V. curassavica* accessions was carried out in June 2015.

The morphological characterization of the plants kept in the *V. curassavica* collection of the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe was performed based on Blank et al. (2004). The following variables were evaluated: plant height (cm); canopy width (cm); stem diameter at 10 cm from the ground (cm); leaf blade length and width (mean of four fully expanded leaves randomly sampled from each plant), and leaf blade length/width ratio. Canopy width was measured by the mean between the smallest and the largest diameter. Qualitative evaluations were also performed for canopy shape (rounded, goblet, or irregular); stem, leaf vein, petals, and sepals color. The leaf area index was measured in four leaves per plant, using the LICOR leaf area meter, model LI-3 100C. Leaf color was determined by scanning four leaves collected from each plant on an HP 1005 MPF scanner. Colors were analyzed in R (red), G (green), and B (blue) patterns, using the color picker tool of Paint software for Windows. Six color measurements were performed on each side of the leaves (abaxial and adaxial). The mean of the color measurements for each side of each leaf formed the means for each plant. These means were used to transform the RGB color system into hexadecimal code, using the online software Webcalc, which represents the color pattern of the leaves of each plant. Sepals and petals colors were determined shortly after blooming, and stem color was determined visually.

The agronomic characterization was performed by analyzing the leaves dry matter and the essential oil content and yield. Leaves were collected and then weighed on an electronic scale. Afterward, they were dried in a forced-air circulation oven at 40 ºC ± 1 ºC for five days. After drying, the material was weighed to determine the dry matter.

The essential oil was extracted by hydrodistillation in a modified Clevenger apparatus for 140 minutes, coupled to a 3000 mL round bottom flask. For each accession, samples of 50 g of dry leaves were used for two liters of distilled water in triplicate.

The essential oil content and yield were calculated for each accession, following the equations:

Content (%, v/m) = (Volume of essential oil extracted from the sample/leaves dry matter) x 100

Essential oil yield (mL/plant) = (content% x total plant dry matter)

Table 1. Accession code, origin, and geographic information of 27 *V. curassavica* accessions from the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe (UFS) (BRITO et al., 2016).

Accession code	Origin (municipality, state, country)	Voucher of UFS herbarium	Georeferenced data
VCUR-001	Donated by Centro Multidisciplinar de Pesquisas Químicas, Biológicas e Agrícolas da Universidade Estadual de Campinas, Campinas, Estado de São Paulo, Brasil	30.913	-
VCUR-002	Ubatuba, São Paulo, Brasil	36.095	23°32’18.0”S; 45°03’73.4”W
VCUR-003	Ilha Comprida, São Paulo, Brasil	36.096	25°02’44.0”S; 47°53’17.0”W
VCUR-004	Mongaguá, São Paulo, Brasil	36.097	24°08’00.0”S; 46°42’54.0”W
VCUR-005	Ilha Comprida, São Paulo, Brasil	36.098	24°43’08.0”S; 47°30’36.0”W
VCUR-101	Graccho Cardoso, Sergipe, Brasil	35.763	10°14’48.5”S; 37°12’52.8”W
VCUR-102	Graccho Cardoso, Sergipe, Brasil	35.759	10°14’47.6”S; 37°12’52.8”W
VCUR-103	Graccho Cardoso, Sergipe, Brasil	36.099	10°14’47.9”S; 37°12’52.2”W
VCUR-104	Graccho Cardoso, Sergipe, Brasil	36.100	10°14’46.1”S; 37°12’52.8”W
VCUR-105	Graccho Cardoso, Sergipe, Brasil	36.101	10°14’46.4”S; 37°13’26.6”W
VCUR-201	Tobias Barreto, Sergipe, Brasil	33.470	11°03’54.2”S; 38°03’21.1”W
VCUR-202	Tobias Barreto, Sergipe, Brasil	33.471	11°04’10.1”S; 38°04’03.4”W
VCUR-301	São Cristóvão, Sergipe, Brasil	36.102	10°54’26.3”S; 37°11’53.1”W
VCUR-302	São Cristóvão, Sergipe, Brasil	36.205	10°54’59.7”S; 37°11’16.3”W
VCUR-303	São Cristóvão, Sergipe, Brasil	36.208	10°54’48.5”S; 37°11’50.3”W
VCUR-401	Japaratuba, Sergipe, Brasil	36.227	10°38’05.4”S; 36°55’10.5”W
VCUR-402	Japaratuba, Sergipe, Brasil	36.103	10°37’59.9”S; 36°55’16.1”W
VCUR-403	Japaratuba, Sergipe, Brasil	36.104	10°37’39.0”S; 36°55’25.8”W
VCUR-404	Japaratuba, Sergipe, Brasil	36.105	10°37’37.8”S; 36°56’00.0”W
VCUR-501	Tomar do Geru, Sergipe, Brasil	36.106	11°21’12.0”S; 37°50’59.0”W
VCUR-502	Tomar do Geru, Sergipe, Brasil	36.107	11°19’17.1”S; 37°52’02.4”W
VCUR-503	Tomar do Geru, Sergipe, Brasil	36.239	11°19’05.2”S; 37°52’17.5”W
VCUR-504	Tomar do Geru, Sergipe, Brasil	36.108	11°19’01.7”S; 37°52’25.0”W
VCUR-505	Tomar do Geru, Sergipe, Brasil	36.109	11°19’04.0”S; 37°51’51.8”W
VCUR-601	Itabi, Sergipe, Brasil	30.914	10°09’24.9”S; 37°08’27.0”W
VCUR-701	Cedro de São João, Sergipe, Brasil	36.110	10°18’06.9”S; 36°53’27.7”W
VCUR-801	Itabaiana, Sergipe, Brasil	36.111	10°50’27.6”S; 37°12’49.3”W

The quantitative data of the morpho-agronomic characterization were subject to analysis of variance (ANOVA), and the means were compared by the Scott-Knott test ($p \leq 0.05$) with the aid of the statistical package Sisvar, version 5.6 (FERREIRA, 2011). From the morphological and agronomic characterization data, two multivariate analyses were performed, cluster analysis and principal component analysis (PCA), using the Statistica software. Subsequently, a dissimilarity matrix was constructed based on the morpho-agronomic characteristics of each accession, according to their Euclidean distances. The dissimilarity matrix was simplified with dendrograms, using the Ward's clustering method.

Due to the differences of the units of the morpho-agronomic traits, data were standardized according to (REGAZZI, 2000), using the formula:

$$Z_{ij} = \frac{X_{ij} - \bar{X}_j}{S(X_j)}$$

Where:

Z_{ij} = is the standardized value of observation i in variable j

X_{ij} = is the original value of observation i in variable j

X_j = is the mean of the variable j

$S(X_j)$ = is the standard deviation of variable j

RESULTS AND DISCUSSION

V. curassavica accessions presented phenotypic variability for the evaluated traits. Accessions presented great uniformity for sepals and petals colors. However, some variations were identified for stem color, canopy shape, and leaf color (two shades of green) (Table 2).

Table 2. Stem, veins, sepals, and petals color and canopy shape of 27 *V. curassavica* accessions of the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe.

	Color				
Accessions	**Stem**	**Veins**	**Sepals**	**Petals**	**Canopy shape**
VCUR-001	Brown	Green	Olive green	White	Irregular
VCUR-002	Brown	Light green	Olive green	White	Irregular
VCUR-003	Brown	Green	Olive green	White	Rounded
VCUR-004	Brown	Green	Olive green	White	Rounded
VCUR-005	Brown	Green	Olive green	White	Rounded
VCUR-101	Brown	Green	Olive green	White	Rounded
VCUR-102	Brown	Green	Olive green	White	Rounded
VCUR-103	Brown	Green	Olive green	White	Rounded
VCUR-104	Brown	Green	Olive green	White	Rounded
VCUR-105	Brown	Light green	Olive green	White	Irregular
VCUR-201	Gray	Green	Olive green	White	Rounded
VCUR-202	Gray	Light green	Olive green	White	Irregular
VCUR-301	Brown	Light green	Olive green	White	Irregular
VCUR-302	Brown	Green	Olive green	White	Irregular
VCUR-303	Brown	Light green	Olive green	White	Irregular
VCUR-401	Brown	Green	Olive green	White	Rounded
VCUR-402	Brown	Green	Olive green	White	Rounded
VCUR-403	Brown	Light green	Olive green	White	Irregular
VCUR-404	Brown	Green	Olive green	White	Rounded
VCUR-501	Brown	Green	Olive green	White	Irregular
VCUR-502	Brown	Light green	Olive green	White	Irregular
VCUR-503	Brown	Light green	Olive green	White	Irregular
VCUR-504	Brown	Green	Olive green	White	Rounded
VCUR-505	Brown	Green	Olive green	White	Rounded
VCUR-601	Brown	Green	Olive green	White	Rounded
VCUR-701	Brown	Light green	Olive green	White	Irregular
VCUR-801	Brown	Green	Olive green	White	Rounded

A great variation was observed between the accessions for leaf color due to their different shades of green, which allowed separating them into dark green leaf and light green leaf plants (Table 3).

Considering the adaxial side, the accessions VCUR-002, VCUR-003, VCUR-004, VCUR-401, and VCUR-404 stood out for their dark green leaves, whereas the accessions VCUR-701, VCUR-303, and VCUR-105 stood out for their light green leaves. The RGB color blending indicates the specific color of the leaves sampled from the *V. curassavica* collection. The variation of the percentage of green determines the greenish shade of the leaves. A higher percentage of red in the three-color blend expresses a lighter shade of green, whereas a higher percentage of blue indicates a darker shade of green. In general, the accessions had a lighter shade of green on the abaxial side of the leaves.

All the quantitative parameters evaluated showed significant differences (Table 4). Considering the variables leaf length (LL) and leaf width (LW), the accessions VCUR-103 (10.88 and 3.66 cm), VCUR-301 (10.07 and 3.71 cm), VCUR-

302 (10.13 and 3.13 cm), VCUR-402 (11.47 and 4.44 cm), VCUR-503 (9.98 and 3.42 cm), VCUR-505 (10.68 and 3.28 cm), VCUR-601 (12.09 and 3.98 cm), and VCUR-801 (10.28 and 3.38 cm) stood out for having the highest means for both traits. The other accessions showed a mean leaf length of 9.04 cm and a mean leaf width of 2.88 cm. For the length/width ratio (L/W), the accessions VCUR-002 and VCUR-005 stood out with 3.98 and 3.66, respectively. The other accessions had a mean of 3.09.

For leaf area (LA), the accessions VCUR-402 and VCUR-601 revealed the highest means, with 144.38 and 117.48 mm², respectively, differing significantly from the others. Concomitantly, they were clustered with accessions that had the highest means for leaf length and width.

The accession VCUR-202 had the widest canopy width (CW), with 291.67 cm. The mean of the other accessions was 125.55cm. Such result is possibly due to the irregular canopy shape of this material. The accession VCUR-202 also had higher means for plant height (PH) and stem diameter (SD); conversely, this accession showed lower values for the other variables analyzed. The accessions VCUR-701 (345.33 and 19.33cm), VCUR-202 (295.00 and 18.33 cm), VCUR-201 (236.67 and 16.00 cm), and VCUR-001 (250.00 and 14.00 cm) had, simultaneously, the highest means for plant height (PH) and stem diameter (SD), respectively. The other accessions showed a mean of 9.04 cm of PH and 2.88 cm of SD.

Table 3. Leaf-blade color (adaxial and abaxial side) of 27 *V. curassavica* accessions, based on the RGB (Red, Green, and Blue) pattern and hexadecimal codes.

Leaf-blade										
	Adaxial					**Abaxial**				
Accession	**R**	**G**	**B**	**Color**	**Code**	**R**	**G**	**B**	**Color**	**Code**
VCUR-001	63	100	16		#3F6410	117	142	65		#758E41
VCUR-002	39	68	16		#274410	103	124	62		#677C3E
VCUR-003	45	72	27		#2D481B	98	120	57		#627839
VCUR-004	44	70	28		#2C461C	102	135	60		#66873C
VCUR-005	49	75	27		#314B1B	98	127	58		#627F3A
VCUR-101	55	91	11		#375B0B	108	131	53		#6C8335
VCUR-102	49	80	19		#315013	101	122	58		#657A3A
VCUR-103	51	90	13		#335A0D	99	144	51		#639033
VCUR-104	53	92	11		#355C0B	113	136	62		#71883E
VCUR-105	61	97	12		#3D610C	119	138	66		#778A42
VCUR-201	51	88	14		#33580E	105	128	58		#69803A
VCUR-202	53	89	14		#35590E	110	131	59		#6E833B
VCUR-301	51	85	19		#335513	109	130	57		#6D8239
VCUR-302	44	80	13		#2C500D	106	126	58		#6A7E3A
VCUR-303	64	104	11		#40680B	116	140	60		#748C3C
VCUR-401	39	72	15		#27480F	99	119	55		#637737
VCUR-402	46	85	11		#2E550B	99	127	53		#637F35
VCUR-403	53	85	14		#35550E	115	130	66		#738242
VCUR-404	44	76	16		#2C4C10	101	121	55		#657937
VCUR-501	57	92	15		#395C0F	112	132	57		#708439
VCUR-502	54	86	23		#365617	108	130	60		#6C823C
VCUR-503	55	90	18		#375A12	111	133	62		#6F853E
VCUR-504	48	80	18		#305012	109	129	62		#6D813E
VCUR-505	49	78	21		#314E15	105	124	58		#697C3A
VCUR-601	50	88	11		#32580B	105	130	56		#698238
VCUR-701	60	99	15		#3C630F	113	135	60		#71873C
VCUR-801	38	74	11		#264A0B	97	123	55		#617B37

The accession VCUR-105 stood out with the highest essential oil content among the 27 accessions evaluated, with 3.20%, proving to be a promising accession to be used in breeding programs aimed at increasing essential oil production. For the essential oil yield, the accessions VCUR-505, VCUR-504, VCUR-101, VCUR-303, and VCUR-002 stood out with means ranging from 9.19 to 11.71 mL/plant. The accessions VCUR-601, VCUR-505, VCUR-504, VCUR-502, VCUR-402, VCUR-301, VCUR-303, and VCUR-002 had the highest value for dry matter, with means ranging from 470.46 g to 755.90 g (Table 5).

Results obtained with the hierarchical cluster analysis revealed high phenotypic variability among *V. curassavica* accessions. Seven groups were formed: group 1 (VCUR-103, VCUR-402, and VCUR-601); group 2 (VCUR-401, VCUR-404, VCUR-801, and VCUR-302); group 3 (VCUR-005, VCUR-004, and VCUR-003); group 4 (VCUR-701 and VCUR-202); group 5 (VCUR-002, VCUR-505, VCUR-504, VCUR-502, and VCUR-301); group 6 (VCUR-101, VCUR-501, VCUR-102, and VCUR-201); and group 7 (VCUR-105, VCUR-104, VCUR-503, VCUR-403, VCUR-303, and VCUR-001). The differences observed between the accessions for the morphological traits may be due to their genetic origin. The accessions VCUR-103 and VCUR-001 were the most divergent, being the former from the municipality of Graccho Cardoso-SE, and the latter, from the state of São Paulo. Conversely, the lowest divergence was detected between the accessions VCUR-401 and VCUR-404, both from Japaratuba-SE (Figure 1). No duplicate accessions were observed. The phenotypic traits showed high variability; however, studies developed with the same accessions detected low to intermediate genetic diversity (BRITO et al., 2016). In a study carried out with plants of natural populations of *V. curassavica* of the state of Sergipe revealed a high chemical diversity of the essential oil (NIZIO et al., 2015). That work studied traits influenced by the environment, which indicates that this species has phenotypic plasticity, attributed mainly to different responses to environment x genotypes interactions.

Table 2. Stem, veins, sepals, and petals color and canopy shape of 27 *V. curassavica* accessions of the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe.

Accessions	LL (cm)		LW (cm)		L/W (cm)		LA (cm)		CW (cm)		PH (cm)		SD (cm)	
VCUR001	9.55	b	2.81	b	3.41	b	65.96	c	185.00	c	250.00	b	14.00	b
VCUR002	11.37	a	2.88	b	3.98	a	84.14	c	138.67	d	208.33	c	13.33	b
VCUR003	8.63	b	2.84	b	3.09	c	62.90	c	52.67	f	149.00	c	6.33	c
VCUR004	8.03	b	2.66	b	3.04	c	51.49	d	53.33	f	141.67	c	5.67	c
VCUR005	6.76	b	1.85	b	3.66	a	37.17	d	66.00	f	165.00	c	7.33	c
VCUR101	9.57	b	2.94	b	3.25	b	74.95	c	108.33	d	181.67	c	9.33	c
VCUR102	8.64	b	2.55	b	3.46	b	48.87	d	113.33	d	188.33	c	11.00	c
VCUR103	10.88	a	3.66	a	2.99	c	96.40	b	136.67	d	176.00	c	12.67	b
VCUR104	9.13	b	3.12	a	2.95	c	71.62	c	96.67	e	145.00	c	9.00	c
VCUR105	11.33	a	3.68	a	3.10	c	97.89	b	82.33	e	105.33	c	8.33	c
VCUR201	6.93	b	2.20	b	3.15	c	34.85	d	183.33	c	236.67	b	16.00	a
VCUR202	8.73	b	2.60	b	3.38	b	54.25	d	291.67	a	295.00	a	18.33	a
VCUR301	10.07	a	3.71	a	2.73	c	91.09	b	138.33	d	144.67	c	11.33	c
VCUR302	10.13	a	3.13	a	3.27	b	76.77	c	126.67	d	167.33	c	8.00	c
VCUR303	9.33	b	2.95	b	3.30	b	66.73	c	135.33	d	155.33	c	10.33	c
VCUR401	9.61	b	3.42	a	2.84	c	79.71	c	112.67	d	174.00	c	11.33	c
VCUR402	11.47	a	4.44	a	2.61	c	144.38	a	143.33	d	186.67	c	13.33	b
VCUR403	9.13	b	3.21	a	2.96	c	74.90	c	127.33	d	143.33	c	8.67	c
VCUR404	9.43	b	3.27	a	2.91	c	74.65	c	118.33	d	176.67	c	9.67	c
VCUR501	8.41	b	2.73	b	3.12	c	52.90	d	101.67	e	148.33	c	9.00	c
VCUR502	9.59	b	3.11	a	3.15	c	72.82	c	159.33	d	170.00	c	12.33	b
VCUR503	9.98	a	3.42	a	2.99	c	80.29	c	107.67	d	138.00	c	8.67	c
VCUR504	9.19	b	3.23	a	2.88	c	73.41	c	163.33	d	188.33	c	11.00	c
VCUR505	10.68	a	3.28	a	3.29	b	85.66	c	151.00	d	153.67	c	10.67	c
VCUR601	12.09	a	3.98	a	3.09	c	117.48	a	132.67	d	150.00	c	12.33	b
VCUR701	8.35	b	2.59	b	3.22	b	50.84	d	231.67	b	345.33	a	19.33	a
VCUR801	10.28	a	3.38	a	3.10	c	82.86	c	98.67	e	101.33	c	6.33	c
CV (%)	11.54		14.89		8.18		22.92		20.11		22.91		28.18	

Values followed by the same letter in the column did not statistically differ from each other by the Scott-Knott test (P <0.05%).

Variations for morphological and agronomic traits were observed among genotypes of *Ocimum* sp. (BLANK et al., 2004), among accessions of *Lippia alba* (CAMÊLO et al., 2011), and among sweet-potato (*Ipomoea batatas*) accessions, indicating phenotypic variability (ALVES et al., 2017).

The knowledge of the morpho-agronomic traits evaluated in germplasm collections allows better use of the species under conservation. The information generated in the characterization of the material also collaborated with the optimization of germplasm banks by eliminating accession duplication and reducing maintenance costs (BLANK, 2013).

Variability is important both for germplasm conservation and for use in breeding programs, as it increases the possibilities of the selection of materials that have promising and desirable attributes for the industry and the consumer market (CARVALHO et al., 2014).

Table 5. Dry matter and essential oil content and yield of 27 *V. curassavica* accessions from the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe.

Accession	Essential oil content (%)		Essential oil yield (mL/planta)		Leaf dry matter per plant (g)	
VCUR001	0.98	d	4.61	c	345.23	b
VCUR002	1.45	c	10.93	a	755.90	a
VCUR003	2.20	b	2.97	c	138.87	b
VCUR004	1.60	c	1.22	c	78.13	b
VCUR005	1.52	c	6.78	b	164.07	b
VCUR101	2.51	b	9.43	a	375.60	b
VCUR102	2.33	b	8.88	b	377.73	b
VCUR103	1.17	d	4.72	c	400.73	b
VCUR104	1.78	c	6.54	b	384.53	b
VCUR105	3.20	a	6.59	b	213.03	b
VCUR201	1.93	b	5.38	c	279.47	b
VCUR202	1.90	b	5.13	c	271.23	b
VCUR301	1.63	c	8.29	b	506.43	a
VCUR302	1.16	d	3.13	c	277.23	b
VCUR303	1.32	d	9.20	a	465.70	a
VCUR401	1.31	d	4.14	c	354.67	b
VCUR402	0.85	d	4.20	c	489.87	a
VCUR403	1.60	c	3.11	c	188.40	b
VCUR404	1.16	d	3.22	c	281.17	b
VCUR501	2.12	b	3.36	c	157.43	b
VCUR502	1.53	c	8.03	b	523.30	a
VCUR503	1.20	d	2.70	c	235.03	b
VCUR504	1.52	c	11.72	a	800.83	a
VCUR505	1.75	c	11.29	a	648.80	a
VCUR601	1.04	d	4.91	c	470.47	a
VCUR701	1.32	d	3.43	c	226.73	b
VCUR801	1.20	d	1.30	c	105.47	b
CV (%)	14.44		40.26		52.39	

Values followed by the same letter in the column did not statistically differ from each other by the Scott-Knott test (P <0.05%).

The principal component analysis with two principal components explained 53.52% of the total variation (Figure 2). The first principal component represented 29.40% of the total variation and was positively related to the variables R (AB) (r = 0.86); G (AB) (r = 0.91); R (AD) (r = 0.83); and G (AD) (r = 0.72). The second principal component represented 24.11% of the total variation and was negatively related to LL (r = -0.85), LW (r = -0.97), and LA (r = -0.94).

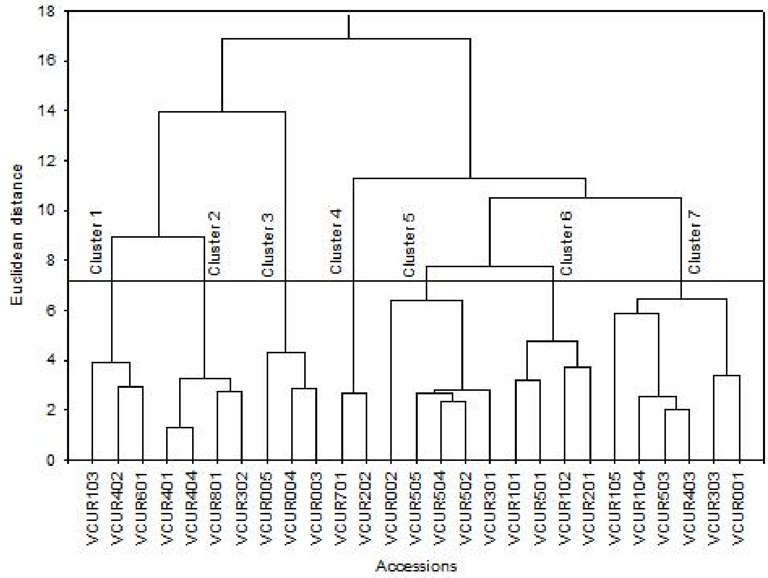

Figure 1. A two-dimensional dendrogram representing the similarity between 27 *V. curassavica* accessions, obtained by the Ward's method, based on the Euclidean distance of the morpho-agronomic traits. São Cristóvão-SE.

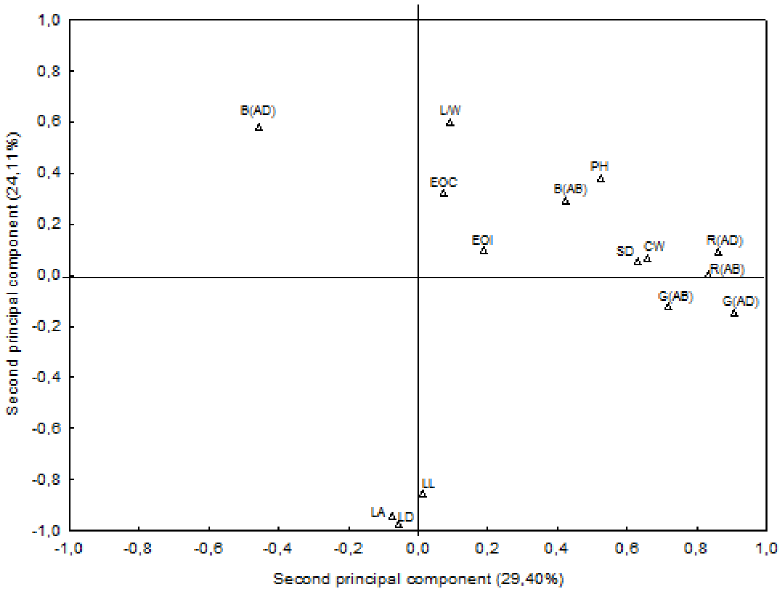

Figure 2. Graphical dispersion of 15 morpho-agronomic traits of the 27 *Varronia curassavica* accessions in relation to the two principal components by the principal component analysis (PCA) of the *V. curassavica* collection of the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe.
São Cristóvão-SE. Variables: Leaf Length (LL), Leaf Width (LW), Leaf Length/width ratio (L/W), Leaf Area (LA), Canopy Width (CW), Plant Height (PH), stem diameter at 10 cm from the ground (SD), Essential Oil Content (EOC), Essential Oil Yield (EOY), and leaf color as RGB – R (Red), G (Green), B (Blue), where: R(AD), G(AD), B(AD), R(AB), G(AB), and B(AB) refer to the colors of the adaxial and abaxial sides of leaves.

CONCLUSION

The results confirm the existence of phenotypic variability among *V. curassavica* accessions of the Active Germplasm Bank of Medicinal and Aromatic Plants of the Federal University of Sergipe. The information obtained in the present study assists the establishment of strategies to improve the species conservation and allows the exchange, extension, and availability of materials for breeding programs. The preserved accessions, by means of genetic breeding programs, may generate superior cultivars adapted to specific environments and with favorable traits, such as high yield of essential oils rich in the desired compounds.

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RESUMO: *Varronia curassavica* Jacq. é uma planta medicinal e aromática nativa do Brasil. O óleo essencial desta espécie é utilizado pela indústria farmacêutica por conter substâncias bioativas com propriedades anti-inflamatórias. Objetivou-se caracterizar morfoagronomicamente 27 acessos da coleção de *V. curassavica* do Banco Ativo de Germoplasma de Plantas Medicinais e Aromáticas da Universidade Federal de Sergipe. O delineamento experimental foi em blocos casualizados com três repetições. A caracterização morfológica foi realizada em campo, por meio da avaliação da altura da planta; largura da copa; formato da copa; diâmetro do caule a 10 cm do solo; cor do caule; largura, comprimento e relação comprimento/largura das lâminas foliares; e cor das folhas, pétalas e sépalas. A caracterização agronômica foi realizada a partir dos óleos essenciais extraídos de folhas secas por hidrodestilação em aparelho Clevenger. Foi avaliado o rendimento de massa seca das folhas por planta e o teor e rendimento do óleo essencial. Grande variação foi observada entre os acessos para a coloração das folhas, as quais apresentaram diferentes tonalidades de verde, sendo possível separá-las entre plantas com folhas verde-escuro e plantas com folhas verde-claro. Para a variável altura de planta, os valores variaram de 101,33 cm (VCUR-801) a 345,33 cm (VCUR-701). Sete grupos distintos foram formados na análise de agrupamento realizada a partir dos caracteres avaliados. Os acessos VCUR-103 e VCUR-001 foram os que se mostraram mais divergentes, enquanto que os mais semelhantes foram os acessos VCUR-401 e VCUR-404. A caracterização morfoagronômica dos acessos de erva-baleeira permitirá a realização de uma correta descrição da espécie, apontando perspectivas para o melhoramento genético, além de possibilitar a otimização do processo de conservação.

PALAVRAS-CHAVE: Cordiaceae. Planta medicinal. Planta aromática. Óleo essencial. Domesticação. Melhoramento genético.

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