Journal of Biotechnology and Biodiversity

journal homepage: *https://sistemas.uft.edu.br/periodicos/index.php/JBB/index*

Relevance of leaf morphology and biometrics: a study with species of *Aphelandra* R. Br. *(Acanthaceae)*

Livia Zottele[a], *Elisa Mitsuko Aoyama*[a], *Alexandre Indriunas*[a]

[a] Centro Universitário Norte do Espírito Santo, Brasil
[b] Universidade Federal do Rio do Janeiro, Brasil

[*] Autor correspondente (aleindri@gmail.com)

INFO

Keyworks
blade
leaf structure
variegation

ABSTRACT

Morphological characteristics, as well as biometrics, govern the description of species. However, systematical comparative analyzes of these aspects between taxa are scarce. The aim of the work was to evaluate the relevance of these characteristics in species of *Aphelandra*. Leaves of *A. longiflora*, *A. harleyi*, *A. espirito-santensis*, *A. nitida*, A. *sinclairiana* and *A. squarosa* were collected and analyzed for morphologic patterns: phyllotaxis, texture, leaf blade form, symmetry, apex, base, margin, venation and coloring pattern; and for biometric parameters: total length, length and width of the leaf blade, length and diameter of the petiole. We calculated mean and standard deviations. Among the relevant morphological patterns are the shape of the blade, apex and base, and the biometric data showed differences. As conclusion, this analysis proposal proves to be an instrument of accuracy and detail for descriptions.

RESUMO

Palavras-chaves
estrutura foliar
limbo
variegação

Relevância da morfologia e biometria foliar: um estudo com espécies de Aphelandra *R. Br. (Acanthaceae).* Características morfológicas, assim como biométricas, regem a descrição de espécies. Mas, análises comparativas sistemáticas desses aspectos entre táxons são escassas. O objetivo desse trabalho foi avaliar a relevância dessas características em espécies de *Aphelandra*. Foram coletadas folhas de *A. longiflora*, *A. harleyi*, *A. espirito-santensis*, *A. nitida*, *A. sinclairiana* e *A. squarosa* e analisados quanto a morfologia: a filotaxia, textura, forma do limbo, simetria, ápice, base, margem, venação e padrão de coloração; e como parâmetros biométricos: comprimento total, comprimento e largura do limbo e comprimento e diâmetro do pecíolo; foram utilizados a média e o desvio padrão. Dentre os padrões morfológicos relevantes encontram-se a forma do limbo, ápice e base e, os dados biométricos apresentaram diferenças. Conclui-se que essa proposta de análise se prova um instrumento de acuidade e detalhamento para descrições.

Received 13 April 2021; Received in revised from 30 April 2021; Accepted 19 October 2021

ISSN: 2179-4804
DOI: https://doi.org/10.20873/jbb.uft.cemaf.v9n4.zottele

INTRODUCTION

Although plant taxonomic descriptions are predominantly morphological and also offer measurements indicating the dimensions of the structures presented, taxa comparative morphological and biometric approaches are scarce. This type of approach, in addition to giving more accuracy to taxa descriptions, can provide information and data usable for studies from autoecology to landscape ecology, and may also be of interest for cultivation (Stuessy, 2009).

Within Acanthaceae there are studies that evaluate leaf morphological aspects such as for species of *Justicia* L. (Aoyama and Indriunas, 2013) and *Megaskepasma erythrochlamys* Lindau (Jesus et al., 2020). However, addressing biometrics, these are restricted to reproductive structures such as in the work of Aoyama et al. (2015) on the morphology of mature fruits and seeds of *Justicia scheidweileri* V.A.W. Graham and, as well, in *Ruellia furcata* (Nees) Lindau (Monteiro et al., 2020), exclusively on seeds' morphology, we can cite the work with of *Ruellia* L. from an Atlantic Forest region of southeastern Brazil (Azevedo and Braz, 2018), of the Ruellieae tribe in Brazil (Azevedo and Moraes, 2020) and *Ruellia elegans* Poir seeds (Indriunas and Aoyama, 2020).

The genus *Aphelandra* R.Br. comprises shrubs or suffrutescent herbs; belong to Acanthaceae (ca. 3500 species) and include approximately 230 species of Neotropical distribution, ranging from southern Mexico to northern Argentina and Brazil, with some species being found also in western India (Wasshausen, 1975, 2013; Profice and Andreata, 2011).

Since the morphological characteristics and biometric data are scarcely explored, the present guiding question of the study is whether these aspects are relevant in *Aphelandra*. The present study aims to analyze the leaf morphological characteristics of *Aphelandra* species.

MATERIAL AND METHODS

Aphelandra species were sampled from October 2013 to August 2014. The selected species were *Aphelandra longiflora* (Lindl.) Profice, *A. harleyi* Wassh., *A. espirito-santensis* Profice & Wassh., collected in the Reserva Natural Vale (RNV), which is located in the city of Linhares, State of Espírito Santo; *A. nitida* Ness & Mart. collected in Liberdade, a neighbourhood of the city of São Mateus, State of Espírito Santo; *A. sinclairiana* Nees ex Benth., collected at the Museu de Biologia Prof. Mello Leitão, located in the city of Santa Teresa and *A. squarosa* Ness, obtained from cultivated specimens to also use in the comparisons. We sampled 20 adult leaves from the third node of each species to carry the morphological and biometric analyses.

Botanical identifications counted with the expertise of specialists from the Reserva Natural Vale and the Universidade Federal do Espírito Santo. Vouchers were deposited at the CRVD herbarium (Reserva Natural Vale), the VIES herbarium (Universidade Federal do Espírito Santo) and the MBML herbarium (Museu de Biologia Professor Mello Leitão).

Morphological characters of the leaves such as phyllotaxis, texture, leaf blade form, symmetry, apex, base, margin, venation and coloring pattern were described using the terminology proposed by Hickey (1973) and Ellis et al. (2009). For the biometrical analyses we evaluated the following parameters: total length, length and width of the leaf blade, length and diameter of the petiole, all using a graded centimetre rule and a digital pachymetre. We calculated mean and standard deviations to all quantitative data.

RESULTS AND DISCUSSION

Similarly to most Acanthaceae species, *Aphelandra* leaves exhibit oposite decussate phyllotaxis, according to Bell and Bryan (2008, p. 262) "when sucessive pairs are oriented at 90º to each other, four rows of leaves will be visible from above", a typical pattern for the family, corroborating Wasshausen (1975). From the six species analyzed (Fig. 1-24), all exhibit a symmetrical lead base, except for *A. squarrosa*, where it is asymmetrical. All species have a smooth texture, except for *A. squarrosa*, in which it is cartaceous. Leaf margins and venation was equal to all species, with entire margins and the camptodromous-brachidodromous venation, a pattern in which the secondary veins get together forming a series of prominent arcs (Fig. 7-12).

Regarding the leaf blade form, apex and base, there was variation among the species. *A. longiflora*, *A. harleyi*, *A. nitida*, and *A. sinclairiana* have elliptical blades (Fig. 1, 2, 4, 5), while *A. espirito-santensis* and *A. squarrosa* exhibit ovate to elliptical blades (Fig. 3, 6, 9, 12). Regarding the apex, *A. longiflora* and *A. harleyi* have acuminate (Fig. 13, 14); *A. espirito-santensis* obtuse (Fig. 15), *A. nitida* and *A. squarrosa* acute (Fig. 16, 18) and *A. sinclairiana* have attenuated apexes (Fig. 17). This same variation of apex form was observed also by Profice and Andreata (2011) to *Aphelandra* species of curve-billabiate corollas and Profice

ISSN: 2179-4804
DOI: https://doi.org/10.20873/jbb.uft.cemaf.v9n4.zottele

(1990/92) to *Aphelandra* of Rio de Janeiro. Regarding the leaf base, five species have decurrent leaf bases (Fig. 19, 20, 22, 23, 24), except for *A. espirito-santensis*, which has a cordate leaf base (Fig. 21).

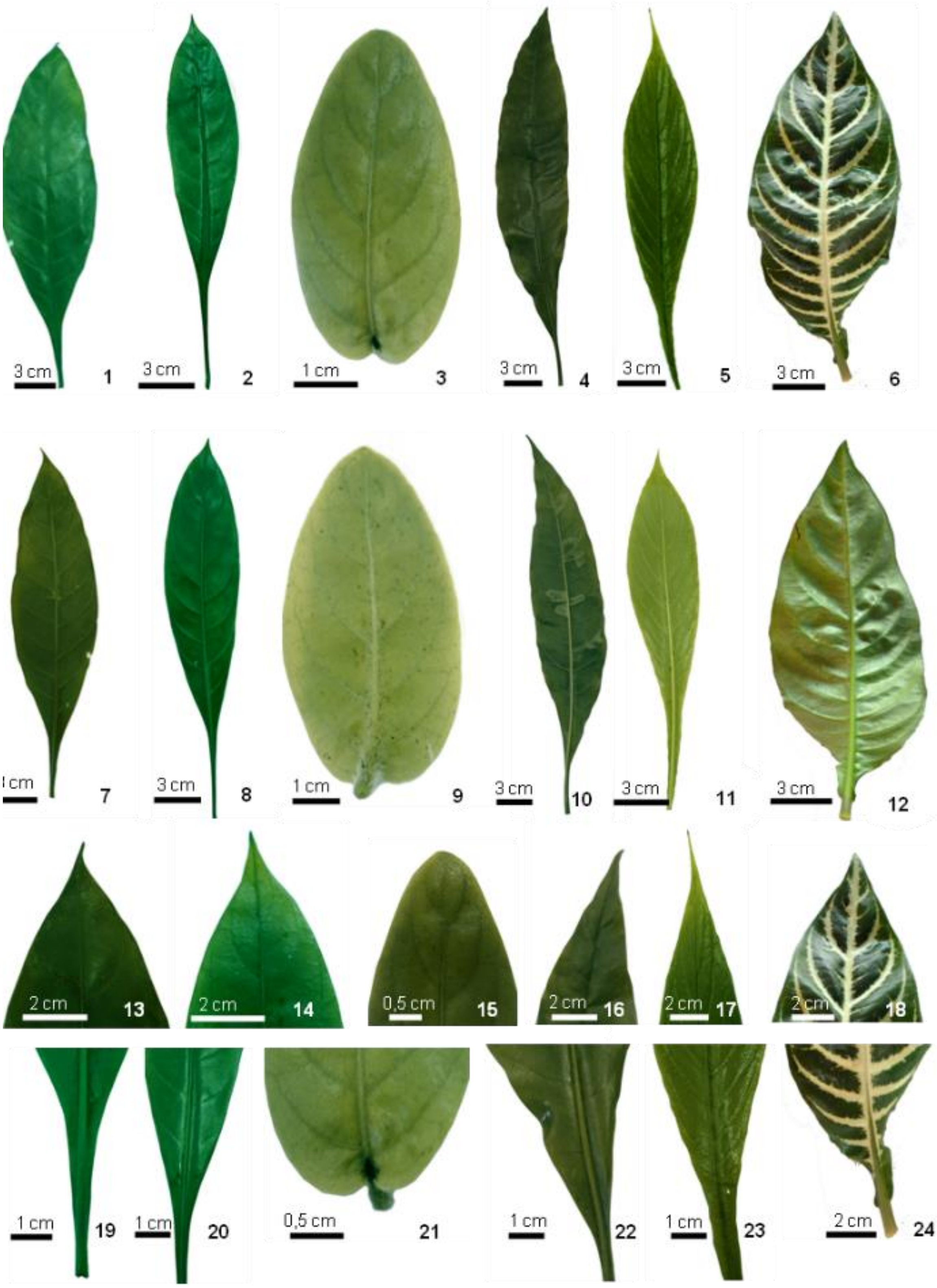

Figure 1-24 - Morphological aspects of the leaves of *Aphelandra*. 1-6 Adaxial face; 7-12 Abaxial face; 13-18 Detail of apex; 19-24 Detail of base. 1, 7, 13, 19 *A. longiflora*; 2, 8, 14, 20 *A. harleyi*; 3, 9, 15, 21 *A. espirito-santensis*; 4, 10, 16, 22 *A. nitida*; 5, 11, 17, 23 *A. sinclairiana*; 6, 12, 18, 24 *A. squarrosa*.

ISSN: 2179-4804
DOI: https://doi.org/10.20873/jbb.uft.cemaf.v9n4.zottele

According to Profice and Andreata (2011) the form and size of the leaf blade varies intraspecifically and is of minor taxonomic utility. Leaf blade variation depends on the genetic intraspecific variability and environmental factors. According since the classic work of Hickey and Wolfe (1975) about 75 to 90% of the leaves from tropical forests exhibit entire margins, consistent to what we observed in the six species of *Aphelandra*. According to Profice and Andreata (2011), leaf texture of *Aphelandra* varies from cartaceous to smooth. Several studies with Acanthaceae also describe the leaves in the family as smooth, as observed by Braz et al. (2002) in *Aphelandra* (= *Geissomeria* Lindley), *Ruellia* L., and in the genus *Justicia* L. (Oliveira and Andrade, 2000). Regarding the leaf venation, all species analyzed exhibit the same camptodromous-brachidodromous venation, as observed from the species from Rio de Janeiro (Profice 1990/92). This is a common pattern in the family, as has been noted by Aoyama and Indriunas (2013) for *Justicia* species. The species have a coloration ranging from dark olive in *A. longiflora*, *A. harleyi*, *A. nitida* and *A. squarrosa*, to light olive in *A. espirto-santensis* and *A. sinclairiana*, all with a lighter abaxial surface colours (Fig. 1-6). According to Wasshausen (1975) this type of coloration is common in species of this genus. *A. squarrosa* has variegated leaves, with leaf veins strongly marked by a whitish colour (Fig. 6).

Regarding the biometric data, *A. espirito-santensis* exhibited higher differences (Table 1) when compared to the others, with relatively small leaves, a distinctive character when compared to the other studied species. These biometric differences may be attributed to the herbaceous to reptant stem this species has (Profice and Wasshausen, 1993). This taxon deserves special attention, since it is endemic to the Reserva Natural Vale (Profice and Wasshausen, 1993).

Table 1 - Biometric parameters of the leaves of *Aphelandra* R. Br.

Species	Total length (cm)	Length - blade (cm)	Width - blade (cm)	Length - petiole (cm)	Diameter – petiole (mm)
A. longiflora	21.55 ± 3.88	19.31 ± 0.78	4.76 ± 0.89	1.92 ± 0.68	2.48 ± 0.61
A. harleyi	16.35 ± 1.66	15.5 ± 0.39	4.64 ± 0.95	1.75 ± 0.62	2.19 ± 0.42
A. espirito-santensis	5.10 ± 0.70	4.20 ± 0.74	2.88 ± 0.42	0.87 ± 0.38	0.59 ± 0.31
A. nitida	30.97 ± 3.76	27.71 ± 3.40	7.13 ± 1.53	3.87 ± 2.3	3.27 ± 0.29
A. sinclairiana	18.55 ± 2.33	17.21 ± 2.54	4.32 ± 0.41	1.35 ± 0.28	1.69 ± 0.16
A. squarrosa	15.64 ± 3.07	13.82 ± 3.21	6.69 ± 1.69	1.64 ± 0.60	3.34 ± 0.65

A. nitida has also shown biometric variations when compared to the other species, with the highest averages to all leaf parameter analyzed, which may be an environmental response, since this species occurs in a low light insulation conditions within the Atlantic rain forest. According to Martin et al. (2020) specimens occurring in places of high solar incidence exhibit shorter leaves, since they tend to be thicker than those growing under low solar incidence. Monteiro and Aoyama (2012) have also reported biometric differences in *Ruellia furcata*, with variations between specimens collected under shadows and bushes of higher insulation.

CONCLUSIONS

The most relevant morphological variations are the shape of the blade, the apex and the base and the biometric data point out differences between the analyzed species. Among them, *A. espirito-santensis* is the one that showed the most distinct results, since this taxon has a reptant habit and the others are subshrubs. Thus, the proposed question proves to be an instrument of greater accuracy and detailing for descriptions.

ISSN: 2179-4804
DOI: https://doi.org/10.20873/jbb.uft.cemaf.v9n4.zottele

ACKNOWLEDGMENTS

In the Reserva Natural Vale and to Museu de Biologia Professor Mello Leitão, at given way to realization of part of the collections made. The Geovane de Souza Siqueira curator of the herbarium CVRD, which contributed immensely to identifying, locating and gathering of species.

REFERENCES

Aoyama EM, Indriunas A. Morfoanatomia foliar de três espécies de *Justicia* L. (Acanthaceae). Enciclopédia Biosfera, v.9, p.2833-2844, 2013.

Aoyama EM, Indriunas A, Vitoria EL, Monteiro MM. Caracterização morfológica de frutos e sementes maduros de *Justicia scheidweileri* V.A.W. Graham (Acanthaceae). Natureza On Line, v.13, p.134-140, 2015.

Azevedo IHF, Braz DM. Seed morphology of Ruellia L. (Acanthaceae) from the southeastern Brazilian Atlantic rain forest: Taxonomic, phylogenetic, and ecological. Flora, v.240, p.48-57, 2018. https://doi.org/10.1016/j.flora.2017.12.011

Azevedo IHF, Moraes P. Seed morphology of Ruellieae species (Acanthaceae) in Brazil and Its Taxonomic Implications. Systematic Botany, v.44, n.3, p.631-651, 2019. https://doi.org/10.1600/036364419X15620113920662

Bell AD, Bryan A. Plant form: an illustrated guide to flowering plant morphology. London:Timber Press, 2008.

Ellis B, Daly DC, Hickey LJ, Johnson KR, Mitchell JD, Wilf P, Wing SL. Manual of Leaf Architecture. New York: Ithaca, 2009.

Hickey LJ. Classification of the architecture of dicotyledonous Leaves. American Journal of Botany, v.1, p.17-33, 1973.

Indriunas A, Aoyama EM. Microescultura da testa da semente madura de *Ruellia elegans* Poir. (Acanthaceae). Journal of biotechnology and biodiversity, v.8, n.4, p.349–352, 2020. https://doi.org/10.20873/jbb.uft.cemaf.v8n4.indriunas

Jesus GS, Indriunas A, Aoyama EM. Caracterização morfológica de *Megaskepasma erythrochlamys* Lindau (Acanthaceae). 2020. 40, Encontro Regional de Botânicos MG, BA e ES. Anais... Vitória, ES.

Martin RE, Asner GP, Bentley LP, Shenkin A, Salinas N, Huaypar KQ, Pillco MM, Delis F, Álvarez C, Enquist BJ, Diaz S, Malhi Y. Covariance of sun and shade leaf traits along a Tropical Forest Elevation Gradient. Frontiers in Plant Science, v.10, p.1-13, 2020. https://doi.org/10.3389/fpls.2019.01810

Monteiro MM, Indriunas A, Aoyama EM. Morphological characterization of fruits and seeds of *Ruellia furcata* (Nees) Lindau (Acanthaceae) from Espírito Santo State, Brazil. Multi-Science Journal, v.3, n.3, p.65-68, 2020. https://doi.org/10.33837/msj.v3i3.1265

Profice SR. Espécies de *Aphelandra* R.Br. (Acanthaceae) no estado do Rio de Janeiro - Morfologia foliar e das brácteas. Rodriguésia, v.42, p.51-65, 1990/92.

Profice SR, Andreata RHP. Revisão taxonômica de Aphelandra R. Br. (Acanthaceae) de corola curto-bilabiada. Instituto Anchietano Pesquisa, v.62, p.7-70, 2011.

Profice SR, Wasshausen DC. *Aphelandra espirito-santensis* (Acanthaceae), a new species from Espírito Santo, Brazil. Novon, v.3, p.280-283, 1993.

Stuessy TF. Plant taxonomy: the systematic evaluation of comparative data. New York: Columbia University Press, 2009.

Wasshausen DC. The genus *Aphelandra* (Acanthaceae). Smithsonian Contributions to Botany, v.18, p.1-157, 1974.

ISSN: 2179-4804
DOI: https://doi.org/10.20873/jbb.uft.cemaf.v9n4.zottele