Colegio de Postgraduados

Heliconias (Heliconiaceae) in rural landscapes

Baltazar-Bernal, Obdulia[1*]

[1] Colegio de Postgraduados - Campus Córdoba, Carretera Federal Córdoba-Veracruz Km 348, Congregación Manuel León, Municipio de Amatlán de los Reyes, Veracruz, México, C. P. 94946.
* Correspondence: obduliabb@colpos.mx

ABSTRACT

Objective: To research native, endemic, and introduced heliconia species and their size for use in rural landscaping and to describe the phenology of two species.

Design/Methodology/Approach: A bibliographical review was carried out in search for native and endemic heliconia species; a list of the introduced heliconias was developed with field data. The phenology of *H. psittacorum* and *H. wagneriana* was evaluated from June 2021 to September 2023. The *H. psittacorum* and *H. wagneriana* rhizomes used for this research measured 40 and 60 cm, respectively. They were washed with tap water and then immersed in 1 g L^{-1} of Captan® 500 for 10 min. Subsequently, they were established in a propagation bed for three weeks and then they were planted in the field, to record the vegetative and flowering stages.

Results: According to the bibliography, Mexico has 21 heliconia species and one hybrid; five of which are endemic species, while the rest are native. Eight of them are used in landscaping. *H. psittacorum* and *H. wagneriana* had a vegetative period of 10 and 33 weeks, respectively; meanwhile, *H. psittacorum* flowered at five weeks, while *H. wagneriana* flowered at eight weeks.

Study Limitations/Implications: The phenology of two species was just evaluated in the field..

Findings/Conclusions: Only eight out of the 21 species of Mexican heliconias are used in landscaping; however, 20 are introduced cultivars are used in Mexico landscaping. The production of flowers began after 10 (*H. psittacorum*) and 33 (*H. wagneriana*) weeks; both species are used in floral designs once they bloom. Heliconias are used in the gardens of rural tourism enterprises and educational institutions.

Keywords: native heliconia, endemic heliconia, introduced heliconia, heliconia phenology.

Citation: Baltazar-Bernal, O. (2024). Heliconias (Heliconiaceae) in rural landscapes. *Agro Productividad*. https://doi.org/10.32854/agrop.v17i7.2745

Academic Editor: Jorge Cadena Iñiguez
Guest Editor: Juan Franciso Aguirre Medina

Received: November 15, 2023.
Accepted: Junio 27, 2024.
Published on-line: August 05, 2024.

Agro Productividad, 17(7). July. 2024. pp: 105-114.

INTRODUCTION

The family Heliconiaceae is native to the American tropics (Kress *et al.*, 2001). It consists of over 250 species, 90 of which can be found in Colombia (Berry and Kress, 1991), while Mexico has 16 native species, including *H. veracruzensis* C. Gut. Báez (Gutiérrez-Báez *et al.*, 2016) and three species which are endemic to southeastern Mexico (Villaseñor, 2016). Heliconias are herbaceous perennials with very attractive and exotic inflorescences (Kress *et al.*, 2001; Loges *et al.*, 2016). According to their size, they are classified as: small (1-1.5 m), medium (1.5-3.0 m), and big (>3 m) (Baltazar-Bernal *et al.*, 2011).

Heliconias achieve a better development in the valleys and hillsides than in the top of tropical and subtropical

forests (Tokarz *et al.*, 2019), where they engange in multitrophic interactions with hervibores, pathogens, pollinators, and seed spreaders (Benítez-Malvido *et al.*, 2014). Their roots play a major role in the conservation of the undergrowth soil; when they flourish, they are food for hummingbirds (Torres-Vanegas *et al.*, 2019) and bats (Benítez-Malvido *et al.*, 2014).

These plants grow from seeds, in their natural environment, and from rhizomes, in *ex situ* enviroments (Berry and Kress, 1991). They have vegetative, reproductive, and senescence phases. Small heliconias flower all year long; however, medium-sized and big heliconias have reproductive peaks throughout the year (Baltazar-Bernal *et al.*, 2011). The aim of this research was to determine the starting point and the duration of the flowering. *Heliconia wagneriana* Peterson, *H. orthotricha* L. Anderson, *H. bihai* L., and *H. stricta* Huber flower sooner than *H. rostrata* Ruiz & Pavon. Meanwhile, *H. wagneriana* starts blooming 30 weeks after planting (Huaranga-Herrera, 2019).

As a resource, landscape provides information about the overall state of the environment (Picuno *et al.*, 2019). Rural landscape is the result of the interaction between natural elements and human activities, in time and space. According to Xie *et al.* (2022), it has various characteristics resulting from strictly cultural aspects. Therefore, preserving the forests that host the greatest heliconia diversity is a very important task (Benítez-Malvido *et al.*, 2014; Bruna *et al.*, 2023). Since heliconias are a shared property in rural landscapes, studying the biotic and abiotic factors that influence their establishment is fundamental, along with the preservation of their rural landscapes.

Consequently, the aim of this research was to study native, endemic, and introduced heliconia species, as well as their size and use in the rural landscape, describing the phenology of two species. Therefore, this study sought to determine which heliconias can be considered Mexican and which heliconia size is used in landscaping. They hypothesis of this work was that the heliconias found in rural landscapes are mostly introduced medium-sized species.

MATERIALS AND METHODS

Based on the bibliographical information available, heliconias found in Mexico were classified according to their origin (native, endemic, and introduced), their size, and their use in landscaping. In the case of introduced heliconias, the information was taken from the field databases that this team has collected. For more than ten years, this team has established and advised clients regarding the handling of heliconias in anthropized landscapes. Two species were established in the field for phenological purposes.

Study area

The study was carried out in the experimental area and the gardens of the Colegio de Postgraduados-Campus Córdoba (CPCC), located in Amatlán de los Reyes, Veracruz (18° 51' 21" N, 96° 51' 35" W, 627 m.a.s.l.). The climate is humid subtropical, with abundant summer rains, an annual precipitation of 2,150 mm, and a mean annual temperature of 22 °C (INAFED, 2023). The local vegetation is composed of plants that have been introduced from the mesophytic forests and low rainforests (Baltazar-Bernal *et al.*, 2020).

Plant material

The phenology of heliconias was studied from June 2021 to September 2023. Forty *Helicona psittacorum* L. f. (Figure 1A) and 20 *H. wagneriana* Peterson (Figure 1B) rhizomes were used. Both species are native to Mexico. The former is small in size and flowers all year long, while the latter is medium-sized and has flowering peaks throughout the year (Figure 1). The rhizomes of *H. psittacorum* and *H. wagneriana* (Figure 2) measure 40 and 60 cm, respectively; they have two shoots, with an average length of 8 cm. They weight 60 (*H. psittacorum*) and 400 g (*H. wagneriana*). The rhizomes were rinsed with tap water and then immersed in a water solution with a 1 g L^{-1} of Captan® 500 solution for 10 min.

Establishment of the experiment

The rhizomes were established in a propagation bed for three weeks (Baltazar-Bernal *et al.*, 2011). Afterwards, they were planted in a previoulsy prepared plot (Figure 3). The

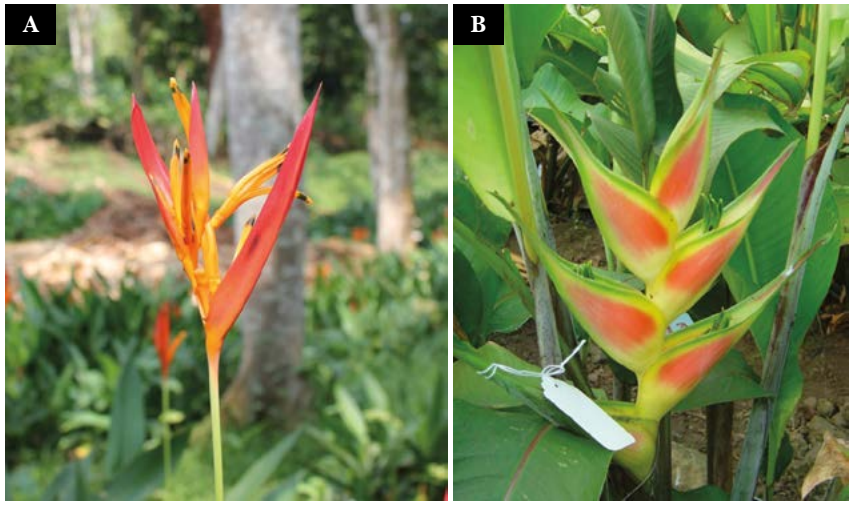

Figure 1. Inflorescences of *Heliconia psittacorum* L. f. (A) and *H. wagneriana* Peterson (B).

Figure 2. Rhizome of *Heliconia wagneriana* Peterson.

Figure 3. Establishment of *Heliconia wagneriana* Peterson.

soil was irrigated to a saturation point. Subsequently, humidity was kept at field capacity irrigating by hand with a water stream, twice per week. The number of weeks required to reach the flowering stage was recorded.

RESULTS AND DISCUSSION

Native Mexican and introduced heliconias used in landscaping

Based on the bibliographic review, 21 native heliconia species were found in Mexico (Table 1). Villaseñor (2016) classified *Heliconia mooreana* R. R. Sm., *H. uxpanapensis* Gutiérrez-Báez, and *H. wagneriana* Peterson (Figure 1B) as endemic species, while Gutiérrez-Báez *et al*. (2016; 2022) included *H. veracruzensis* C. Gut. Báez and *H. chiapensis* Gutiérrez-Báez in this category. For their part, Curiel *et al*. (2022) generated a hybrid of heliconia Karely. *H. psittacorum* L. f. —a native species commonly known as avecilla ("little bird")— is not only used in landscaping (Figure 1A), but also as an indoor plant, as a result of its small size (<1.5 m) (Baltazar-Bernal *et al*., 2011). *H. adflexa* (Griggs) Standl. is seldom used in lansdcaping, in slightly more temperate climates, with temperatures of ≤5 °C. Little value has been attached to *H. latispatha* Benth, likely as a result of its wide distribution as a wild species; however, it s a versatile species with high commercial potential. *H. librata* Griggs requires a lot of care and is used in Teapa, Tabasco, for lanscaping purposes. *H. rostrata* is one of the most popular landscaping species, in Mexico and the whole world (Pinheiro *et al*., 2012; Naik *et al*., 2019), as a result of its high adaptability, its attractive colors, and its pendulum-like bracts (Berry and Kress, 1991). The use of *H. collinsiana* has increased in landscaping; nevertheles, its great size (>3 m) (Table 1) limits its use (Baltazar-Bernal *et al*., 2011). Heliconias are part of the tropical landscapes of the world (Baltazar-Bernal *et al*., 2011; Benítez-Malvido *et al*., 2014). In Mexico, the most beautiful and most widely distributed heliconias are *H. collinsiana* Griggs, *H. latispatha* Benth., and *H. schiedeana* Klotzsch (Villaseñor, 2016).

The states that shows more than 12 native species are Veracruz, Oaxaca, Chiapas, and Tabasco; meanwhile, Mexico City, the State of Mexico, and the states of Chiapas

Table 1. Size of the endemic and native heliconias in Mexico.

Cientific name	Origin	Size	Used in landscape
Heliconia aurantiaca Ghiesbr. ex Lem.	N	S	No
H. psittacorum L. f.	N	S	Yes
H. adflexa (Griggs) Standl.	N	M	Yes
H. latispatha Benth.	N	M	Yes
H. librata Griggs	N	M	Yes
H. lophocarpa G. S. Daniels & F. G. Stiles	N	M	No
H. chiapensis Gutiérrez-Báez	E	M	No
H. rostrata Ruiz & Pavon	N	M	Yes
H. schiedeana Klotzsch	N	M	No
H. spissa Griggs	N	M	No
H. subulata Ruiz & Pav.	N	M	No
H. tortuosa Griggs	N	M	No
H. vaginalis Benth.	N	M	No
H. wagneriana Peterson	E	M	Yes
H. uxpanapensis Gutiérrez-Báez × *H. latispatha* Benth. Var. Karely	---	M	---
H. bihai L.	N	B	Yes
H. bourgeana Petersen	N	B	No
H. collinsiana Griggs	N	B	Yes
H. dielsiana Loes.	N	B	No
H. mooreana R.R. Sm.	E	B	No
H. uxpanapensis Gutiérrez-Báez	E	B	No
H. veracruzensis C. Gut. Báez	E	B	No

Origin: Endemic (E), Native (N)
Size: Small (S), Medium (M), Big (B)
Source: Elaborated with data from Villaseñor, 2016; Gutiérrez-Báez *et al.*, 2016; Gutiérrez-Báez *et al.*, 2022; Curiel *et al.*, 2022 and field data.

and Veracruz stand out for the development of *H. adflexa* in their more temperate climate (Villaseñor, 2016) (Figure 4).

Heliconias have been introduced to Mexico by flower farms and institutions such as the Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP). The aim of INIFAP was to train producers, mainly in the production and commercialization of heliconias as cut flowers. However, over the course of the last decade, the price of cut flowers has fallen more than 50%; consequently, producers are forced to sell rhizomes of the introduced cultivars at $15 to $100 Mexican pesos, to be used in landscape gardening. The flowers of introduced cultivars of *H. bihai* are very popular, because they are smaller and more colorfoul than wild species (Table 2). Nevertheless, before producers use a new cultivar, they should study their physiological characteristics (Naik *et al.*, 2019). It is important to carry out research with native heliconias so that they are used in the landscape, instead of using introduced heliconias.

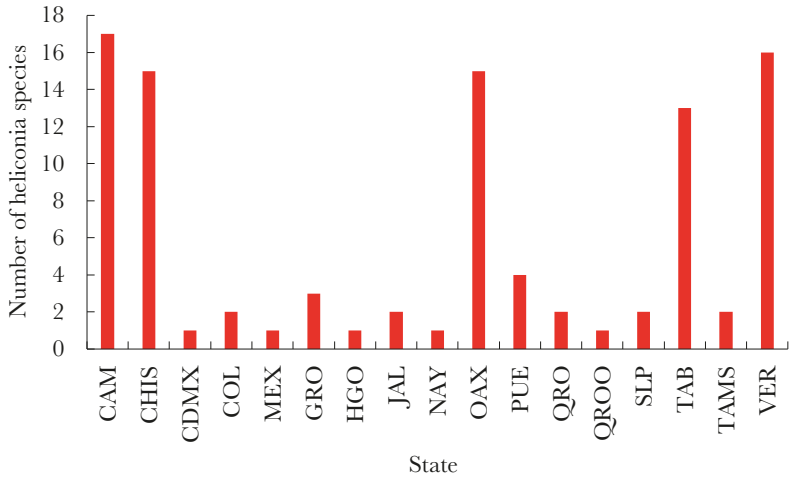

Figure 4. Number of Mexican heliconia species per state. Source: Figure developed by the authors based on data recorded by Villaseñor (2016), Gutiérrez-Báez *et al.* (2016), Gutiérrez-Báez *et al.* (2022), Curiel *et al.* (2022), and field data.

Table 2. Size of heliconia cultivars introduced in Mexico.

Heliconia cultivars	Origin	Size	Used in landscape
Heliconia psittacorum L. f. cv. Andromeda	I	S	Yes
H. psittacorum L. f. cv. Lady di	I	S	Yes
H. psittacorum L. f. cv. Sassy	I	S	Yes
H. psittacorum L. f. cv. St. Vincent red	I	S	---
H. psittacorum × *H. spathocircinata* cv. Golden Torch	I	S	Yes
H. psittacorum × *H. Spathocircinata* cv. Golden Torch Adrian	I	S	Yes
H. psittacorum × *H. spathocircinata* cv. Alan Carle	I	S	Yes
H. stricta Huber	I	M	Yes
H. stricta Huber cv. Fire Bird	I	M	Yes
H. stricta Huber cv. Fire Opal	I	M	Yes
H. stricta Huber cv. Tagami	I	M	Yes
H. orthotricha L. Anderss. cv. She lisa	I	M	---
H. bihai Huber cv. Lobster claw two	I	B	Yes
H. bihai Huber cv. Aurea	I	B	Yes
H. bihai Huber cv. Nappi	I	B	Yes
H. caribaea Lamarck cv. Chartreuse	I	B	Yes
H. chartacea Lane ex Barreiros cv. Sexy Pink	I	B	Yes
H. chartacea Lane ex Barreiros cv. Sexy Scarlet	I	B	---
H. caribaea × *H. bihai* cv. Jacquinii	I	B	Yes
H. champneiana Griggs	I	B	Yes
H. latispatha Benth. cv. Butter	I	B	---
H. stricta Huber cv. Iris Red	I	B	Yes

Origin=Introduced (I);
Size: Small (S), Medium (M), Big (B)
Source: Elaborated with field data.

Heliconia phenology

The vegetative stage of *H. psittacorum* lasted 10 weeks, far shorter than the period reported by Da Silva *et al.* (2017) for *Heliconia psittacorum* × *H. spathocircinata* 'Golden Torch' (18 weeks). On the one hand, *H. psittacorum* is smaller and, on the other hand, rhizomes with two shoots were planted; nevertheless, the vegetative phase falls within the normal parameters reported by Berry and Kress (1991) for small heliconias (16 to 20 weeks). The vegetative phase of *H. wagneriana* ended 33 weeks after its establishment, a longer period than the one reported by Huaranga-Herrera (2019). This difference may be attributed to the slighty lower altitude and higher temperatures of the experiment site, which reduced the vegetative phase of *H. wagneriana* to 30 weeks.

The flowering phase of *H. psittacorum* (Figure 5A-C) and *H. wagneriana* takes place at five and eight weeks, respectively. Once this phase starts, *H. psittacorum* continues flowering throughout the year; nevertheless, the plantation should be replaced every five years, because the quality of the plant decreases and empty spaces appear between them. Consequently, a new *H. wagneriana* plantation should be established every seven years.

Heliconias in landscaping

Heliconia are not only used as cut flowers; they are also used in gardening and landscaping (Pinheiro *et al.*, 2012; Malcar and Biswas 2022). Several *H. psittacorum* cultivars have been introduced to Mexico, because they are readily available and their small size facilitates the renovation of a plantation, although some medium-sized cultivars also exist (Table 2). Only introduced cultivars are sold in selling points. Meanwhile, native species can be found in some institutions and botanical gardens in Mexico.

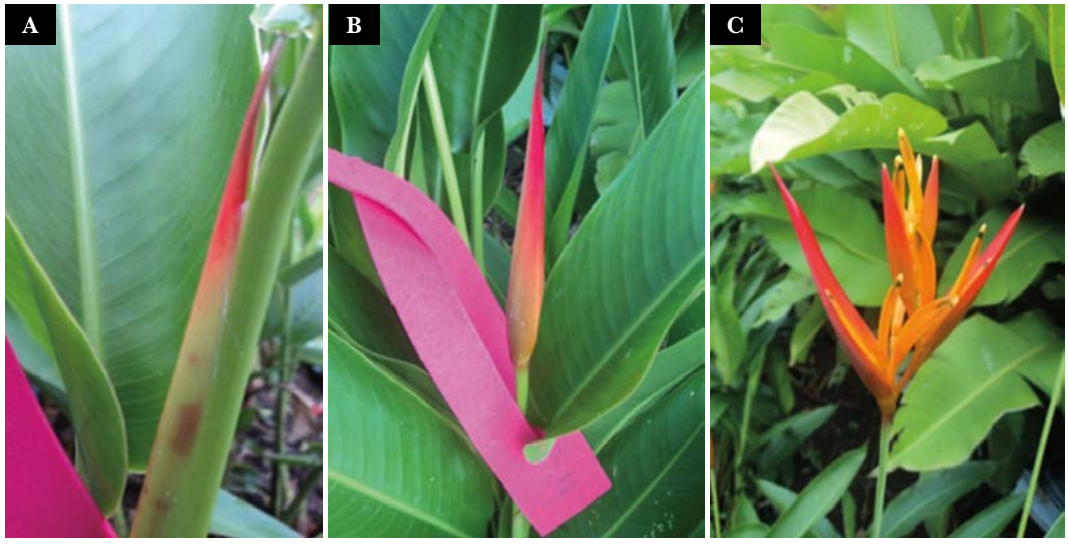

Figure 5. Phenology of the flowers of *Heliconia psittacorum* L. f. at the first (A), third (B), and fifth (C) week of development.

The exotic colors of their bracts (commonly called "flowers") make heliconias a tropical genetic resource and an alternative for rural landscaping. Therefore, to sucessfuly recreate a heliconia landscape that resembles natural landscapes, heliconias must be reintroduced to wide spaces. Additionally, as a result of their evolution, the most important environmental interaction of heliconias is with hummingbirds (Janeček *et al.*, 2020). Finally, the rhizome growth of heliconias protects the soil and consequently has a positive impact in the landscape (Woods *et al.*, 2022; Krishna *et al.*, 2023).

The flowers and leaves of heliconias grown by entrepreneurship tourism rural are also used for the floral designs (Figure 6A and 6B) that decorate bedrooms and halls of ecotourism centers and hotels.

Using native heliconias for landscaping is a feasible effort: however, their propagation and establishment should be researched to guarantee the continuation of the species, taking into consideration the microclimatic conditions required for their development. Additionally, heliconias should be subject to appropriate management practices to transform *ex situ* landscapes into shelters for hummingbirds (Torres-Vanegas *et al.*, 2019) and bats (Benítez-Malvido *et al.*, 2014), both of which feed on the nectar of heliconias.

Figure 6. Floral designs made with heliconia flowers (A) and leaves (B) as focal points.

CONCLUSIONS

Only eight out the 21 Mexican heliconias, along with 20 introduced species of small and medium-sized plants are used for landscaping. *H. psittacorum* and *H. wagneriana* bloomed between 10 and 33 weeks after they were planted. *H. psittacorum* blooms all year long and *H. wagneriana* has two flowering periods. The use of native heliconias in landscaping is crucial to guarantee their conservation.

REFERENCES

Baltazar-Bernal, O., De la Cruz-Martínez, V.M., & Zavala-Ruiz, J. (2020). Las orquídeas del Campus Córdoba, su estudio y preservación. Texcoco, México: Colegio de Postgraduados.

Baltazar-Bernal, O., Zavala-Ruiz, J., & Hernández-Nataren, S. de J. (2011). Producción comercial de heliconias. Montecillo, Texcoco: Colegio de Postgraduados.

Benítez-Malvido, J., A. P. Martínez-Falcón, W. Dáttilo, & E. Del Val. (2014). Diversity and network structure of invertebrate communities associated to individuals of two Heliconia species in natural and human disturbed tropical rain forests. *Global Ecology and Conservation* 2: 107-117. http://dx.doi.org/10.1016/j.gecco.2014.08.007

Berry F., & Kress W.J. (1991). Heliconia. An identification guide. Washington: Smithsonian Institution Press.

Bruna, E.M., Uriarte, M., Darrigo, M. R., Rubim, P., Jurinitz, C.F., Scott, E. R., Ferreira da Silva, O., & Kress, W. J. 2023. Demography of the Understory Herb *Heliconia Acuminata* (Heliconiaceae) in an Experimentally Fragmented Tropical Landscape. *Ecology 104*(12): e4174. https://doi.org/10.1002/ecy.4174

Curiel, S.O., Avendaño-Arrazate, C.H., & Iracheta-Donjuan, L. (2022). Karely, new variety of cut flower heliconia, suitable for the humid Mexican tropics. *Agro Productividad 15*(2): 3-8. https://doi.org/10.32854/agrop.v15i2.2161

Da Silva, M.W., Ono, E.O., Santos, M.H.L.C., Beckmann-Cavalcante, M.Z., Oliveira, G.M., Ferreira, D.N.C., & Lopes, C.C. (2017). Growth and production of Heliconia under different light conditions. *Semina: Ciências Agrárias 38*(1): 7-17. https://doi.org/10.5433/1679-0359.2017v38n1p7

Gutiérrez-Báez, C., Avendaño-Reyes, S., & Zamora-Crescencio, P. (2016). Heliconia veracruzensis, nueva especie de Veracruz, México. *Bouteloua* 25: 101-103.

Gutiérrez-Báez, C., Duno de Stefano, R., Avendaño-Reyes, S., & Zamora-Crescencio, P. (2022). *Heliconia chiapensis* (Heliconiaceae) nueva especie del sureste de México. *Bouteloua* 31: 28-31.

Huaranga-Herrera, G.G. (2019). Fenología de heliconia (*Heliconia* sp.) en condiciones agroecológicas de ramal de Aspuzana-San Martin-Perú. *Revista Investigación Agraria 1*(1): 33-41.

Janeček, Š., Chmel, K., Uceda Gomez, G., Janečková, P., Chmelová, E., Sejfová, Z., & Luma Ewome, F. (2020). Ecological fitting is a sufficient driver of tight interactions between sunbirds and ornithophilous plants. *Ecology and Evolution 10*(4): 1784-1793. https://doi.org/10.1002/ece3.5942

Krishna, S.S., Jasmine, A.J., Sundar, S.T., Rajakumar, D., & Vethamoni, P.I. (2023). Growth traits of pendent Heliconia genotypes in Kanyakumari conditions. *International Journal of Plant & Soil Science 35*(19): 726-730. https://doi.org/10.9734/ijpss/2023/v35i193604

Kress, W.J., L.M. Prince, W.J. Hahn, & E.A. Zimmer. (2001). Unraveling the evolutionary radiation of the families of the Zingiberales using morphological and molecular evidence. *Systematic Biology* 51: 926-944.

Loges, V., de Castro, C.E.F., de Castro, A.C.R., & Gonçalves, C. (2016). Characteristics of pendent heliconia for use in landscape and as cut flower. *Ornamental Horticulture 22*(3): 287-295.

Malakar, M., & Biswas, S. (2022). Heliconias: Dramatic flowers of the tropics and subtropics. In Datta, S. K., & Gupta, Y. C. (Eds.). Floriculture and ornamental plants (pp. 729-776). Singapore: Springer Nature Singapore.

Naik, M.D., Naik, M.R., Ramakrishna, M., Lalitha, K., Arunodhayam, K., & Reddy, Y.S.K. (2019). Multiple Heliconia genotypes under 50 per cent shadehouse conditions: Physiological and biochemical responses. *International Journal of Current Microbiology and Applied Sciences 8*(8): 220-229.

Picuno, P., Cillis, G., & Statuto, D. (2019). Investigating the time evolution of a rural landscape: How historical maps may provide environmental information when processed using a GIS. *Ecological Engineering* 139: 105580. https://doi.org/10.1016/j.ecoleng.2019.08.010

Pinheiro, P.G.L., Leite, K.P., Lira Junior, M.A., Castro, M.F.A., & Loges, V. (2012). Heliconia characteristics for landscape use. *Acta Horticulturae* 953: 293-298.

Rodríguez-Herrera, B., Rodríguez, P., Watson, W., McCracken, G. F., Medellín, R. A., & Galván, I. (2019). Sexual dichromatism and condition-dependence in the skin of a bat. *Journal of Mammalogy 100*(2): 299-307. https://doi.org/10.1093/jmammal/gyz035

Tokarz, E.L., Álvia, P., Valencia, R., & Queenborough, S.A. (2019). Habitat filtering of six coexisting Heliconia species in a lowland tropical rain forest in Amazonian Ecuador. *Journal of Tropical Ecology 35*(2): 91-94. https://doi.org/10.1017/S0266467419000026

Torres-Vanegas, F., Hadley, A.S., Kormann, U.G., Jones, F.A., Betts, M.G., & Wagner, H.H. (2019). The landscape genetic signature of pollination by trapliners: evidence from the tropical herb, *Heliconia tortuosa*. *Frontiers in Genetics* 10: 1206.

Villaseñor J.L. (2016). Checklist of the native vascular plants of Mexico. *Revista Mexicana de Biodiversidad* 87: 559-902. http://dx.doi.org-/10.1016/j.rmb.2016.06.017

Woods, C.E., Leimberger, K.G., Hadley, A.S., Frey, S.J., & Betts, M. G. (2022). Independent, but not synergistic, effects of climate and landscape structure drive pollination and subsequent reproduction in a tropical plant, *Heliconia tortuosa*. *Landscape Ecology 37*(4): 1059-1073. https://doi.org/10.1007/s10980-022-01407-x

Xie, H., Zhu, Z., He, Y., Zeng, X., & Wen, Y. (2022). Integrated framework of rural landscape research: Based on the global perspective. *Landscape Ecology 37*(4): 1161-1184. https://doi.org/10.1007/s10980-022-01401-3