ISRG Journal of Arts, Humanities and Social Sciences (ISRGJAHSS)

ISRG PUBLISHERS

Abbreviated Key Title: ISRG J Arts Humanit Soc Sci

ISSN: 2583-7672 (Online)

Journal homepage: https://isrgpublishers.com/isrgjahss

Volume – IV Issue - II (March – April) 2026

Frequency: Bimonthly

POSTHARVEST HANDLING OF BIHAI (HELICONIA BIHAI L.) FOR PRESERVATION DURING TRANSPORT AND AT THE POINT OF SALE.

M.C. JUAN FRANCISCO CHÁVEZ DEHESA[1], M.C. MANUELA DE JESÚS CAMBRANES CHI[1], DR. MARTIN GERARDO MARTINEZ VALDÉS[1,2], DR. CESAR ORLANDO POZO SANTIAGO[2], DR. FACUNDO SÁNCHEZ GUTIÉRREZ[2]

UNIVERSIDAD TECNOLÓGICA DEL USUMACINTA, TABASCO MÉXICO[1]

DIVISIÓN ACADÉMICA DE BIOTECNOLOGÍA

UNIVERSIDAD AUTÓNOMA DE CHIAPAS, MÉXICO[2]

FACULTAD MAYA DE ESTUDIOS AGROPECUARIOS

| **Received:** 19.03.2026 | **Accepted:** 23.03.2026 | **Published:** 25.03.2026

*__Corresponding author:__ DR. MARTIN GERARDO MARTINEZ VALDÉS

Abstract

When people see flowers and experience their aromas, they evoke memories associated with nature, freshness, and pleasant environments. Heliconias are a family of flowers that have gained popularity among florists due to their beauty, abundance, and elegance. Therefore, proper handling is essential to extend their shelf life while preserving their anatomical characteristics. The present study was conducted with the aim of determining the most suitable solution to improve water absorption, thereby reducing wilting and transpiration of Bihai flowers (Heliconia bihai L.) from harvest through transport, storage, and vase life. The study also includes a proposed packaging method for transporting this species. The methodology involved using sucrose, Tween, and BAP solutions at different concentrations for flower hydration, followed by preservation at room temperature and under refrigeration at 15°C. The results show that the sucrose solution allows the flowers to maintain freshness for 6 days after harvest at room temperature, while under refrigeration, the Tween solution was the most effective, preserving freshness for 12 days. During vase life, no significant differences were observed among the evaluated solutions. For packaging, it was determined that single-wall corrugated cardboard, white on one side with a 26ECT rating, is suitable for flower transport. In conclusion, sucrose is recommended for transport, Tween for refrigeration, and for vase conditions, any of the solutions can be used.

Keywords: storage, freshness, heliconias, solutions, transport.

DOI: 10.5281/zenodo.19280572

Introduction

One of the major problems faced by flower producers, particularly those dealing with tropical plants, is how to maintain the shelf life of the specimens they commercialize. In most cases, these are delicate products that are highly susceptible to changes in temperature and humidity. For this reason, when packaging and transporting these types of flowers (such as heliconias), in addition to proper packaging and transportation, the latter sometimes depends on external services. This implies the need to develop both physical and physiological handling strategies to ensure that the flowers reach their destination with their shape intact, as well as their texture, fragrance, color of bracts, leaves, and stems undamaged, ultimately promoting effective commercialization.

The design of quality processes lies not only in cultivation conditions which account for one-third of a quality flower (de la Riva-Morales, 2011) but also in maintaining quality during the postharvest stage so that shelf life is extended and the acquisition of flowers and foliage remains viable. This includes treatments to prevent wilting, as well as packaging and packing systems that are sustainable and meet environmental protection demands.

The challenges faced by perishable products, particularly tropical plants, include proper methods of packaging and transportation, as these flowers are highly susceptible to physical damage. Therefore, the objective of this research is to propose a physical and chemical method to extend the shelf life and improve the transport of bihai heliconia (*Heliconia bihai* L.), allowing the flower's texture, bract color, leaves, and stems to be preserved for as long as possible during storage.

Currently, the floriculture sector in Mexico has experienced significant growth. It is one of the agricultural activities that has demonstrated high profitability, surpassing other traditional crops. Governments in some states, along with producers, have established programs and policies to promote value chain processes, especially in export-related aspects for certain species, resulting in a positive trade balance (Ramírez-Hernández and Avitia-Rodríguez, 2017). Some countries have found in this sector an opportunity for economic growth. In Mexico, this market has shown considerable development, and due to its characteristics, it also contributes to the conservation of insect species and promotes suitable environments within households (Méndez-Rojas et al., 2024).

Therefore, floriculture is currently an important global economic activity. In recent years, the flower trade has become a highly profitable business within the agricultural sector due to the continuous demand for new species and varieties (Tejeda, Ríos, Trejo, and Vaquera, 2015). By 2022, the main exporters of fresh flowers were the Netherlands with 30% of total sales volume, Ecuador with 25.6%, Kenya with 18.3%, and Colombia with 14.1%, out of a total of 3.159 billion dollars. Regarding commercial destinations, the United States accounted for 22.4%, the Netherlands 15.9%, Germany 10.4%, and the United Kingdom 6.18% of the same total. Mexico represented 0.29% of exports, mainly to the United States and Japan, and 0.0042% of imports, with the State of Mexico, Mexico City, and Baja California being the states with the highest flower trade (Data México, 2022).

With gladiolus, chrysanthemums, roses, and carnations, on average 90% of production is destined for the domestic market and only 10% for export, mainly to the United States. Within the national territory, around 55 types of flowers are cultivated and commercialized, of which chrysanthemum, carnation, marigold, baby's breath, and celosia represent 29.5% of trade, largely due to their cultural significance within the country (Ministry of Agriculture and Rural Development, 2023).

Among tropical species known for production and commercialization in Mexico are those of the order Zingiberales, which includes the families Heliconiaceae (heliconias), Musaceae (bananas and plantains), Strelitziaceae (bird of paradise), Lowiaceae, Zingiberaceae (gingers), Costaceae, Cannaceae, and Marantaceae. These are mainly grown in the states of Chiapas, Tabasco, and Veracruz, mostly in open fields and often in association with other crops (Díaz, 2006; Linares-Gabriel et al., 2023).

Bihai (*Heliconia bihai* L.) belongs to the Zingiberaceae family, also associated with Musaceae, and is classified within the genus Heliconia, which includes more than 100 species of tropical plants originating from Colombia, Brazil, Venezuela, and India. The main species include *Heliconia bihai*, *Heliconia metallica*, *Heliconia latispatha*, *Heliconia rostrata*, and *Heliconia schiedeana*. It is also commonly known as "platanillo," "wild plantain," and "bijao," and is native to New Guinea. It is a herbaceous, perennial, rhizomatous plant with slender stems that can reach heights of 1.5 to 3 meters. Its leaves can grow up to 70 cm long and 20 cm wide. Its inflorescence is terminal, consisting of 4 to 7 red, yellow, or green bracts that last between 2 to 3 weeks. These are long spikes measuring 30–40 cm with bright red bracts of a slightly greenish appearance, within which the flowers emerge. The plants require 30–50% shade for optimal vegetative growth (Molnar-Alonso and Sousa-Silva, 2010; Armas-Marín, 2012; Franke, 2015).

One of the main challenges faced by producers is postharvest management, which allows them to obtain additional income depending on vase life. Florists require longer-lasting flowers to meet the demands of specialized and high-standard markets such as hotels, restaurants, and other commercial activities (Blanco, 2007). In cut flowers, it is estimated that one-third of their preservation depends on environmental conditions, while the remaining two-thirds depend on handling and conditions after harvest. This has led to research focused on generating technologies that help preserve flowers (De la Riva, 2011). The use of biological products as environmentally friendly alternatives promotes acceptance in commercialization and encourages sustainable preservation processes.

Although its management in Mexico is relatively recent, there is ongoing research providing references for its postharvest handling. According to Carrera-Alvarado et al. (2019), due to the lack of vascular connections between the floral peduncle and the leaves, water absorption is low, leading to wilting and reduced shelf life. It is also noted that storage temperatures should not fall below 10°C to prevent damage. Additionally, practices such as the use of hydrogels, salicylic acid, leaf waxing, preservatives, mineral oils, and coatings have provided alternatives for improving postharvest management and extending shelf life (Leyva-Ovalle et al., 2011; Bañuelos-Hernández et al., 2017; Linares-Gabriel et al., 2019). Therefore, the objective of this research was to determine the postharvest management of *Heliconia bihai* L. for its transport and shelf life, to propose alternatives for its efficient commercialization.

DOI: 10.5281/zenodo.19280572

Materials and Methods

Chemical Treatment Conditions

Open flowers and flower buds were used from the rubber plantations in Palenque, located at Km 18.5 on the Palenque–La Libertad highway, Chiapas, at 17°38'42.1" N latitude and -91°54'25.3" W longitude. These were subjected to hydration solutions (sucrose solution, Tween 20, BAP [6-benzylaminopurine], and water) for transport.

At the postharvest site (Chemistry Laboratory at the Universidad Tecnologica del Usumacinta, Emiliano Zapata, Tabasco), eight treatments were established by varying temperature (14°C and 16°C) and storage days (0, 4, 6, and 8 days). The following variables were evaluated: weight loss during transport with hydration solutions, weight loss during storage, vase life, and weight loss after storage in a refrigeration chamber.

For weight loss during transport, a completely randomized design was used, while for the remaining dependent variables, a randomized complete block design was applied, with treatments consisting of combinations of temperature and storage days (Figure 1). The analysis was performed using the statistical package SAS V 9.1, and the results included Tukey's mean comparison tests with $\alpha = 0.05$.

Figure 1. Hydration conditions of bihai (*Heliconia bihai* L.)

Physical Treatment Conditions

For packaging conditions, flower measurements were taken from the base to the inflorescence in centimeters. Based on these measurements, corrugated cardboard sheet material was selected following the qualitative procedure established by Guerrero-García and Vera-Izquierdo (2020), considering the Edge Crush Test (ECT) standard according to packaging used for flowers available in the market.

Additionally, factors such as the basic weight of the cardboard per unit area, rigidity (the property of maintaining shape when the material is held by its edges), moisture resistance (the ability to resist water penetration), compression strength (the amount of load the box can withstand), and production cost were considered. These factors were evaluated on a scale from 1 to 4, where for production cost, 4 represents the lowest cost and 1 the highest cost; for basic weight, 4 represents the lightest and 1 the heaviest; for rigidity, 4 indicates less rigid and 1 more rigid; for moisture resistance, 4 indicates the highest resistance and 1 the lowest; and for compression strength, 4 indicates the lowest resistance and 1 the highest. Evaluation criteria were established for both the lid and the base, as detailed below (Table 1).

Table 1. Factors for evaluating cardboard, lid, and base

Production cost	Basis weight	Rigidity	Moisture resistance	Compression strength	Weight
5%	18%	18%	27%	32%	100%

Source: Own elaboration

Results and Discussion

Flower sampling was carried out at the Comalcalco site, Tabasco, Mexico. Flowers of the same species were harvested, trying to select specimens as similar as possible in color, height, developmental stage, and without apparent damage in the experimental units, to minimize potential sources of error in the results. Flowers were cut between 8:00 and 9:00 a.m. using chef-style knives, which had been previously treated with a 2% chlorine solution to prevent pathogen contamination from the tools. Stems were cut at an angle.

Table 2. Determination of days of deterioration of bihai (*Heliconia bihai* L.

	Refrigeration		Vase life	
Storage (days)	Average %	Tukey Test	Average %	Tukey Test
0	32.572	a	5.333	d
4	28.297	a	9.200	c
6	19.311	b	10.533	b
8	15.855	b	13.467	a

Source: Own elaboration

The results of the treatments during transport showed that 1% of sucrose promoted the least weight loss compared to the other treatments, showing a significant difference among them. In refrigerated flowers, differences were observed between treatments: Tween and water alone suffered greater weight loss, followed by sucrose and BAP, which proved to be the best treatments.

For post-refrigeration treatments applied in vase conditions under regional conditions, no significant differences were observed between treatments; all treatments produced similar results during the cold storage process. It was noted that using Tween resulted in higher weight loss compared to using water alone as a hydration medium for flower preservation.

Regarding vase life treatments, under the conditions for determining storage days for *Bihai* (*Heliconia bihai* L.), no significant differences were found among the hydration solutions during the transport of flowers in containers. This suggests that transporting flowers in water alone is recommended to minimize weight loss.

Table 3. Behavior of hydration solutions for bihai (*Heliconia bihai* L.)

	Transporting		Refrigeration		Vase life	
Tratamiento	Average %	Tukey Test	Average %	Tukey Test	Average %	Tukey Test
Sucrose	5.875	a	9.432	ab	8.000	a

DOI: 10.5281/zenodo.19280572

Tween	3.250	a	11.803	a	7.630	a
BAP	4.125	cb	7.156	b	7.750	a
Water	4.750	ba	10.241	ab	6.380	b

Source: Own elaboration

Harvest conditions for heliconias are important for their commercialization. The treatments applied depend on the intended market, which can be local, regional, national, or for export (Suárez and Alcívar, 2018). Working with hydration solutions is fundamental to maintaining freshness and preserving the flowers in refrigeration chambers, ensuring that they reach consumers in optimal vase conditions. Success also depends on atmospheric conditions and the species, so standardized treatments must be applied to achieve the best results upon delivery. The tests conducted helped florists standardize the type of solution, temperature, humidity, and duration in days for treating the flowers before reaching the market.

This is particularly important because flowers are often harvested with only two or three bracts open, as further opening may not occur even with the use of solutions. Therefore, flowers are cut at the base of the pseudostem, leaving some bracts to protect the flower during transport, since they are marketed without leaves. This reduces physiological respiration and, when combined with antitranspirants, helps preserve the flowers (Jerez, 2007).

Regarding bouquet preparation for packaging, heliconia flowers are tied into bunches. The flowers are bound with paper-coated wire or elastic bands and protected with a cap made of waxed or unwaxed paper, as well as smooth corrugated cardboard around the flowers. Sometimes bubble polyethylene is added for extra protection. Flowers are placed in cardboard boxes with sheets of paper to prevent stem abrasion. Occasionally, wedges or elastic bands are used to secure the flowers and prevent movement inside the box. The box design is complex because it is not tailored to a single variety; they are general-purpose boxes with interior adjustments to prevent damage (Reid, 2009).

Packaging Prototype

For the development of the box, a comparison of criteria was carried out based on the types of commercially available corrugated cardboard, including single-wall, double-wall, and triple-wall options. After applying the evaluation criteria, it was determined qualitatively that single-wall cardboard meets the requirements for developing flower packaging, scoring 2.96 out of 4.0. This is due to its lower production cost, lighter basis weight, and intermediate rigidity and compression strength, which allow for dynamic and efficient handling during the packaging process (Table 4).

Table 4. Evaluation criteria for cardboard used in bihai (*Heliconia bihai* L.) flower packaging

Criteria	Single-wall	Double-wal	Triple-wall	Factor %	Single-wall	Double-wal	Triple-wall
Production cost	4	2	2	5	0.20	0.10	0.10
Basis weight	4	3	2	18	0.72	0.54	0.36
Rigidity	3	2	1	18	0.54	0.36	0.18
Moisture resistance	2	3	3	27	0.54	0.81	0.81
Compression strength	3	3	3	32	0.96	0.96	0.96
			Total	100	2.96	2.77	2.41

Source: Own elaboration

For the evaluation of single-wall cardboard, it was determined that out of a total of 50 points, it achieved 37.88 points, which is considered acceptable for handling red ginger flowers. Some risks were noted in terms of moisture resistance and compression, which must be carefully considered when preparing flower beds, which should not exceed six units, as well as the conditions of the refrigeration chamber (Baltazar-Bernal et al., 2011). Therefore, maintenance and handling should follow the maintenance program and the conditions of the existing packaging facilities (Table 5).

Table 5. Evaluation of single-wall cardboard for flower packaging

Criteria	Production cost	Basis weight	Rigidez	Moisture Resistance	Compression strength	Total	Weight %	Factor
Production cost	8	8	9	7	8	40	5	2.00
Basis weight	8	9	9	8	8	42	18	7.56
Rigidity	8	8	9	7	8	40	18	7.20
Moisture Resistance	7	7	5	8	5	32	27	8.64
Compression strength	8	6	9	8	8	39	32	12.48
						Total	100	37.88

DOI: 10.5281/zenodo.19280572

Source: Own elaboration

Note: Evaluation: 1 = low, 10 = high; maximum factor = 50

For the case of material by wall type, it was determined that single-wall corrugated cardboard continues to show feasible indicators for both the lid and the base, scoring 2.82 each (maximum evaluation = 4). Potential risks were identified in terms of moisture and compression resistance, which require careful handling in the packaging facilities and refrigeration chamber. Personnel should be properly trained to ensure the process is carried out smoothly (Table 6).

Table 6. Decision matrix for material by wall type

Criteria s	Production cost	Basis weight	Rigidez	Moisture Resistance	Compression strength	Weight
Weight	5%	18%	18%	27%	32%	100%
Lid						
Single-wall	4	4	4	2	2	2.82
Double-wall	1	2	3	3	3	2.72
Triple-wall	1	1	2	3	3	2.36
Base						
Single-wall	4	4	4	2	2	2.82
Double-wall	2	2	3	3	3	2.77
Triple-wall	1	2	2	3	3	2.54

Source: Own elaboration

Based on the results for single-wall cardboard, white on one side, with a 26 ECT (Edge Crush Test) strength, consistent with flower packaging available on the market, the cardboard exhibits an average resistance of 26 pounds per linear inch in the corrugated edge crush test. It is C-flute type (theoretical flute coefficient of 1.3–1.51 m, with a thickness of 0.142 in, and 39 ± 3 linear flutes), with dimensions of 2.00 m width × 2.20 m length (Guerrero-García and Vera-Izquierdo, 2020).

The box dimensions, based on flower measurements for transport, are 1.20 m in length, 0.40 m in width, and 0.15 m in height. The box is designed to hold whole flowers, with a capacity of 10 heliconias per box (Figures 1, 2, 3, and 4).

Figure 1. Bottom base of the box

Figure 2. Bottom base of the box, top view

Figure 3. Top lid, internal view

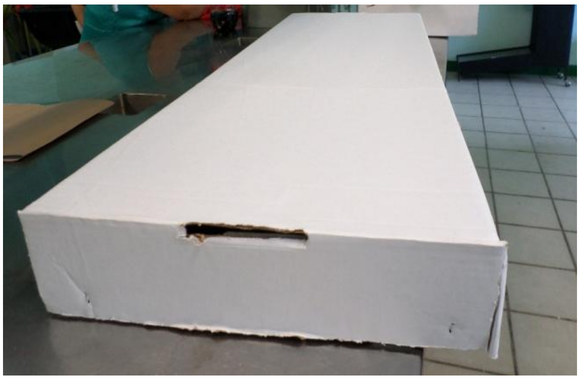

Figure 4. Top lid, external view

DOI: 10.5281/zenodo.19280572

The lid can be fully closed, with a transparent section to allow the flowers to be seen from the outside (Figures 5, 6, 7)

Figure 5. Top lid with plastic view

Figure 6. Top lid with plastic view

Figure 7. Complete box with bottom base and top lid with plastic view

Some precautions for transport must be observed to prevent movement within the shipping cardboard box and between boxes due to compression strength concerns. Shredded paper (bond paper or tissue paper) should be placed at the bottom of the box. If the plant moves inside the box, the stem and leaves may break, so it is recommended to use a corrugated cardboard divider to secure the pot within the box. Additionally, a fabric-covered strap can be applied to prevent the stems from being damaged by friction, which could reduce their commercial value (Reid, 2009).

The flowers are protected at the bracts using plastic sheets or bags made of the same material. Flowers are arranged in alternating directions five facing one way and five in the opposite direction relative to the bracts of the first row to prevent friction and breakage (Figures 8, 9, 10, 11, 12).

An important feature to note is the label, which must include all the producer's information, flower type, harvest date, species name, packaging date, exporter's name or legal entity, producer and packer's name, and the city of origin for product traceability in accordance with NOM-050-SCFI-2004, the packaging and labeling standards.

Figure 8. Paper used as support for the flowers

Figure 9. Flowers tied with straps

DOI: 10.5281/zenodo.19280572

Figure 10. Flowers tied with straps and covered with fabric, secured to the box

Figure 11. Arrangement of flowers in alternating directions

Figure 12. Arrangement of flowers with shredded paper and covered with plastic

Boxes containing flowers for storage are heavy, as each hold 10 flowers. Therefore, no more than six boxes should be stacked per pile to prevent damage to the flowers and the boxes, allowing them to be reused if permitted by the importer, exporter, or local, national, or international regulations (Figure 13).

Figure 13. Boxes stacked in refrigeration (Maximum stack: 6 boxes)

DOI: 10.5281/zenodo.19280572

It is important to understand the conditions required for commercializing flowers, because even with full knowledge of packaging, proper postharvest handling during subsequent transport in boxes is crucial. The most important factor in maintaining the quality of cut flowers is ensuring rapid cooling immediately after harvest and maintaining optimal temperatures throughout the distribution process (Sosa-Rodríguez, 2012).

Most flowers should be stored at temperatures between 0 and 2 ºC, except for cold-sensitive flowers (anthuriums, birds of paradise, gingers, tropical orchids, and heliconias), which must be maintained at temperatures above 10 ºC (Colombian Association of Flower Exporters, 2010).

Individually, flowers cool (and warm) very quickly, with average cooling times of just a few minutes. While each flower can cool rapidly, when flowers are removed from cold storage and placed in a warmer packing area, condensation can develop quickly before they are packaged. It is estimated that up to two-thirds of vase life depends on the postharvest stage (de la Riva-Morales, 2011).

The simplest way to ensure that packaged flowers remain adequately cold and therefore dry is to pack them inside the cold room. Although this method is not always favored by packers, as it increases labor costs and may slow the packing process, it guarantees that the product is cold and dry (Hernández-Gallo et al., 2022).

Whether exposed to high or low temperatures, flowers can suffer severe damage and complete senescence within just a few hours. Damage from high temperatures not only increases transpiration and water loss but also accelerates a series of enzymatic reactions that cause flower senescence much more rapidly. Conversely, low temperatures can be either beneficial or lethal to flowers, depending on their intensity (Baltazar-Bernal et al., 2011).

When applied in a controlled manner, low temperatures help preserve the plant because they slow microbial development and reduce the plant's respiratory activity. For exotic flowers like heliconias, careful temperature management is essential: high temperatures accelerate senescence, while excessively low temperatures can induce a physiological disorder known as chilling injury, resulting in symptoms such as necrosis of petals and leaves and general discoloration of the corolla and petals (Simao and Scatena, 2001; Díaz-López et al., 2016).

Chahín-Ananía et al. (2002) state that one of the most important factors in postharvest management of tropical flowers is maintaining turgor, color, and weight—that is, fresh biomass. Together, these factors help preserve and extend the vase life of heliconias. However, once flowers are removed from their natural environment, catabolism and senescence begin. This underscores the importance of cold storage for this species, as it reduces the respiratory rate of plant material, decreases water loss through transpiration, slows microbial proliferation, delays floral aging, and allows more time for distribution.

Therefore, it is recommended that flowers be stored at 16°C for up to 4 days (Gómez, Herrera, and Flórez, 2017). Prolonged storage at low temperatures can cause chilling injury, significantly reducing vase life. Additionally, it is recommended to transport flowers from the plantation to the postharvest site in water or a sucrose solution, which helps the plant manage nutrients, reduces weight loss, and increases vase life.

Conclusions

For the transport of Bihai (*Heliconia bihai* L.), it is preferable to transfer flowers in a 1% sucrose solution in containers for delivery to markets or florists. Under refrigeration at an average temperature of 16°C with 90% relative humidity, flowers can be optimally preserved for approximately 4 days for commercial purposes. In vase conditions, there are no significant differences among the hydration solutions, indicating that flowers can be maintained in water alone, although a 1% weight difference between treatments was observed. Environmental conditions should also be considered when applying hydration treatments.

Based on the work conducted on cold storage and packaging, it is concluded that heliconias should be maintained at 14–16°C with 100% relative humidity. Most heliconias should not be stored for more than five days. Regarding packaging, box dimensions must match the cut size of the heliconias; otherwise, flowers are exposed to irreversible damage. Good manufacturing practices (GMP) should be observed in production fields to maintain flower quality.

For future studies, it is recommended to adjust treatments according to climatic conditions and the type of refrigeration chamber, as well as to establish study perspectives following good handling practices (GHP) to optimize resources and minimize production losses.

References

1. Armas-Marín, E. (2012) *Heliconias***.** Manual. Colombia.
2. Asociación Colombiana De Exportadores De Flores, (2010). *Manual de buenas prácticas de poscosecha para flor de corte y follajes asociados***.** Manual. ASOCOFLORES, Colombia. https://rutadelasostenibilidad.org/wp-content/uploads/2020/02/Manual_poscosecha_2010-V-2-0.pdf
3. Baltazar-Bernal. O.; Zavala-Ruiz, J.; & Hernández-Nataren, D. de J. (2011). *Producción comercial de heliconias*. Libro. Colegio de Posgraduados México.
4. Bañuelos-Hernández, K.; García-Nava, J.; Leyva-Ovalle, O.; Peña-Valdivia, C.; Trejo, C., & Ybarra-Moncada, M. (2017). Chitosan coating effect on base life of flowering stems of *Heliconia bihai* (L.) L. cv. Halloween. *Postharvest Biology and Technology***,** 32, 179-187.
5. Blanco-Metzler, H. (2007). Manejo de Cholus pilicauda (*Coleoptera: Curculionidae*) en flores de ginger (*Alpinia purpurata*). *Agronomía Costarricense***,** 31(1), 95-100. http://unpan1.un.org/intradoc/groups/public/documents/icap/unpan046934.pdf.
6. Carrera-Alvarado, G.; Arévalo -Galarza, M. L.; Velasco-Velasco, J.; Baltazar Bernal, O.; & Salinas Ruíz, J. (2019). Effect of waxing, cold storage and salicylic acid on the quality and base life of Heliconia wagneriana. *Acta Horticulturae***,** 1237, 221-226.
7. Chahín-Ananía, M. G.; Verdugo-Ramírez, G., & Montesinos-Vásquez A. (2002), *Manejo de poscosecha de flores*, Boletín n. 82. Chile.
8. Cruz, L. (2013). *Memoria Profesional, Manejo Poscosecha de Flores y Follajes Tropicales*, Universidad Tecnológica del Usumacinta, Tabasco, México.

DOI: 10.5281/zenodo.19280572

9. Data México. (2022). *Rosas "Flores y Capullos", Cortadas para Ramos o Adornos, Frescas.* Gobierno de México, Blog.
10. De La Riva-Morales, F. (2011). Poscosecha de flores de corte y medio ambiente**.** *Idesia (Arica),* 29(3), 125-130. https://scielo.conicyt.cl/pdf/idesia/v29n3/art19.pdf.
11. Díaz López, E.; Loeza Corte, J. M.; & Brena Hernández, I. (2016). Comportamiento poscosecha en girasol (Helianthus annuus L.) en función de soluciones pulso. *Investigación y Ciencia*, 69, 26-31.
12. Díaz M. J. A. (2006). *Diagnóstico de la cadena productiva de heliconias y follajes en los departamentos del eje cafetero y Valle del Cauca*, UNCTAD, Colombia.
13. Franke, S. (2015). Zingiberaceae. Discover the biodiversity, *Monaco Nature Encyclopedia*. https://www.monaconatureencyclopedia.com/alpinia-purpurata/?lang=es.
14. Gómez G.C.A.; Herrera A.H.A.; & Flórez R. V. J. (2017). *Consideraciones sobre factores que influyen en la longevidad poscosecha de flores de corte. En: Flórez R.V.J. Consideraciones sobre producción, manejo y poscosecha de flores de corte con énfasis en rosa y clavel.* Bogotá, Colombia. 191-212.
15. Guerrero-García, J. R.; & Vera-Izquierdo, L. A. (2020). *Metodología para el diseño de empaques de cartón corrugado para transporte de banano.* Tesis. Escuela Superior Politécnica del Litoral. Ecuador.
16. Hernández-Gallo, O. P.; Guzman-Lozano, A. G.; Moyano-Alulema, J.; & Acosta-Velarde. I. (2022). Estandarización del proceso productivo de área de postcosecha de las florícolas, *Polo del Conocimiento*, 7(7),294-310. http://doi.org/10.23857/pc.v7i7
17. Jerez, A. (2007). El cultivo de Heliconias. *Cultivos tropicales*, 28(1), p. 29-35.
18. Leyva-Ovalle, O. R.; Rodríguez-Goya, A. Y.; Herrera-Corredor, J. A.; Galindo-Tovar, M. E.; & Murguía-González, J. (2011). Polímero hidrofílico combinado con soluciones preservadoras en la vida de florero de tallos florales de rosa y heliconia. *Tropical and Subtropical Agroecosystems***,** 13(3), 551-559.
19. Linares-Gabriel A.; Rodríguez-Orozco, N.; & Hernández-Chontal, M. A. (2023). Aportes Científicos en el Cultivo de Heliconias en México. *Tropical and Subtropical Agroecosystems***,** 26(13), 1-15.
20. Linares-Gabriel, A.; Rodríguez-Orozco, N.; & Hernández-Chontal, M. A. (2019). Effect of hydration in vase life of two Heliconia cultivars. *Ornamental Horticulture***,** 25, 74-79.
21. Mendez-Rojas, D. M.; Lobato-Garcia, J. M.; & Benítez-Malvido, J. (2024). Heliconias: de plantas ornamentales a pequeños microhábitats dentro de las selvas tropicales. Revista Digital Universitaria, 2(2), 1-20. http://doi.org/10.22201/cuaieed.16076079e.2024.25.2.2
22. Molnar-Alonso A., & Sousa-Silva J.C. (2010). *Alpina purpurata K.Schum, ornamental para cultivo no cerrado*. *Embrapa cerrados*, Documento 298. https://ainfo.cnptia.embrapa.br/digital/bitstream/item/77798/1/doc-298.pdf
23. Molnar-Alonso A.; Suárez-Benalcázar, P.R.; & Alcívar-Avilés, M.T. (2018). *Elaboración del perfil de mercado para la exportación de flores tropicales del Guayas al mercado español*, Tesis. http://repositorio.ucsg.edu.ec/handle/3317/10284.
24. Ramírez-Hernández J.J.; & Avitia-Rodríguez J.A. (2017). Floricultura mexicana en el siglo XXI: su desempeño en los mercados internacional. *Revista Economía*, 34(88), 99-122. http://www.revista.economia.uady.mx/2017/XXXIV/88/4.pdf.
25. Reid, M. S. (2009). *Poscosecha de las flores cortadas. Manejo y recomendaciones***.** Traducción**.** Ediciones Hortitecnia Ltda.
26. Secretaria de Agricultura y Desarrollo Rural. (2023). *Floricultura Mexicana aporte en la celebración del día de muertos***.** Boletín.
27. Simao. D.; & Scatena. V. (2001). Morphology and anatomy in Heliconia angusta Vell. And H. velloziana L. Emygd. (Zingiberales: Heliconiaceae) from the Atlantic forest of southeastern Brazil. *Revta brasil. Bot,* 24(4), 415-424. https://doi.org/10.1590/S0100-84042001000400007
28. Sosa-Rodríguez. F. M. (2012). Revisión bibliográfica, cultivo del género Heliconia. *Cultivos tropicales*, 34(1), 24-32.
29. Tejeda-Sartorius, O.; Ríos-Barreto, Y.; Trejo-Téllez, L.I.; & Vaquera-Huerta, H. (2015). Caracterización de la producción y comercialización de flor de corte en Texcoco, México. *Revista mexicana de ciencias agrícolas***,** 6(5), 1105-1118. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S2007-09342015000500016&lng=es&tlng=es

DOI: 10.5281/zenodo.19280572