

# *Heliconia Rostrata*

## **Monograph**

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## 1.0 Chapter 1: Introduction

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*Heliconia rostrata* is a tropical flowering plant widely recognized for its vibrant, pendulous inflorescences and ecological importance in rainforest ecosystems. Native to western South America, this species thrives in warm, humid environments and is especially common in countries such as Colombia, Ecuador, Peru, and Bolivia (Wikipedia, 2025). The plant is well known for attracting pollinators, particularly hummingbirds, which play a key role in its reproductive process (Missouri Botanical Garden, n.d.). It is highly valued in ornamental horticulture due to its striking red and yellow bracts, often referred to as "hanging lobster claws" (Chicago Botanic Garden, n.d.). In addition to its aesthetic value, *Heliconia rostrata* contributes to biodiversity by supporting pollination networks and providing nectar resources for birds.

This monograph explores the ecology, biology, propagation, and uses of *Heliconia rostrata*. It highlights the plant's environmental requirements, reproductive strategies, and significance in both natural ecosystems and human activities. The species represents an important component of tropical biodiversity and serves as an indicator of healthy rainforest environments.

## 2.0 Chapter 2: Ecology

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### 2.1 Affinity and Origin:

*Heliconia rostrata* belongs to the family Heliconiaceae, within the order Zingiberales (ITIS, n.d.). The Zingiberales order, sometimes called the "ginger order," includes eight families of tropical monocots: Musaceae (bananas), Strelitziaceae (bird-of-paradise), Lowiaceae, Heliconiaceae, Zingiberaceae (gingers), Costaceae (spiral gingers), Cannaceae (canna lilies), and Marantaceae (prayer plants). These families share common characteristics, including large, showy flowers, often brightly colored bracts, and pollination systems adapted to animals such as birds, bats, and insects.

Its scientific name reflects its distinctive morphology, with *rostrata* meaning "beaked" or "provided with a beak" in Latin, referring to the beak-like shape of its bracts (Wikipedia, 2025).

The genus *Heliconia* includes over 200 species, all adapted to tropical climates. Within this diverse genus, species vary dramatically in size, growth habit, inflorescence orientation (upright vs. pendant), bract color (red, orange, yellow, green, pink, or combinations thereof), and pollinator specialization. Some *Heliconia* species have upright inflorescences that collect rainwater in their bracts, creating small aquatic microhabitats that support specialized insects,

tadpoles, and other small organisms. *Heliconia rostrata*, with its pendant inflorescences, represents the opposite evolutionary strategy, one that avoids water accumulation and instead focuses on nectar production for bird pollinators.

The name *Heliconia* comes from Mount Helicon in Greece, a mountain that in Greek mythology was sacred to the Muses and symbolized beauty and artistic inspiration (Wikipedia, 2025; The Echo, 2018). According to mythological tradition, Mount Helicon was the favored haunt of the nine Muses—Calliope (epic poetry), Clio (history), Erato (love poetry), Euterpe (music), Melpomene (tragedy), Polyhymnia (sacred poetry), Terpsichore (dance), Thalia (comedy), and Urania (astronomy). The mountain was known for its fertile landscape with two springs, Aganippe and Hippocrene, which were said to gush forth with water that brought poetic inspiration to those who drank from them (The Echo, 2018). The naming of this tropical plant after a Greek mountain reflects the long-standing Western tradition of associating botanical beauty with classical mythology and artistic creativity.

The species was first described by botanists Hipólito Ruiz López and José Antonio Pavón Jiménez in their publication *Flora Peruviana, et Chilensis* in 1802 (ColPlantA, n.d.; Wikipedia, 2025). These Spanish botanists conducted extensive expeditions in South America during the late 18th century as part of the Royal Botanical Expedition to Peru and Chile (1777-1788), organized under the patronage of King Charles III of Spain. Over a decade of fieldwork, Ruiz and Pavón collected and described thousands of previously unknown plant species from the Andes and Amazon regions, establishing the taxonomic foundation for countless Neotropical plants. Their work remains highly respected among botanists today for its accuracy and attention to morphological detail.

### **Taxonomy and Nomenclature (ITIS, n.d.):**

Kingdom: Plantae

Taxonomic Rank: Family

Taxonomic Status:

Current Standing: accepted

Data Quality Indicators:

Record Credibility Rating: verified - standards met

Global Species Completeness: partial

Latest Record Review: 2014

### **Taxonomy Hierarchy:**

(Integrated Taxonomic Information System [ITIS], 2014)

Kingdom: Plantae - plantes, planta, vegetal, plants

Subkingdom: Viridiplantae - green plants

Infrakingdom: Streptophyta - land plants

Superdivision: Embryophyta

Division: Tracheophyta - vascular plants, tracheophytes

Subdivision: Spermatophytina - spermatophytes, seed plants, phanérogames

Class: Magnoliopsida

Superorder: Liliales - monocots, monocotyledons, monocotyledones

Order: Zingiberales

Family: Heliconiaceae

Genus: Heliconia L. - heliconia

## 2.2 Distribution:

*Heliconia rostrata* is native to western South America, where it grows naturally in humid forests, along riverbanks, and in shaded areas with rich, moist soil (Royal Botanic Gardens, Kew, n.d.). Its native range includes Bolivia, Colombia, Ecuador, and Peru (Wikipedia, 2025). Within these countries, the plant is most commonly found in the lowland rainforests of the Amazon basin, the foothills of the eastern Andes, and the humid forests of the Pacific coast of Colombia and Ecuador. In Peru, *Heliconia rostrata* occurs in the departments of Loreto, Ucayali, San Martín, and Madre de Dios, where it grows in floodplain forests (várzea) and along the margins of oxbow lakes. In Colombia, the species is found throughout the Amazon region (Amazonas, Caquetá, Putumayo, and Vaupés departments) as well as in the Chocó biogeographic region along the Pacific coast, one of the wettest places on Earth with annual rainfall exceeding 8,000 mm.

In Bolivia, it is known as *patujú* and is considered one of the country's two national flowers (Wikipedia, 2025). The *patujú* holds deep cultural significance in Bolivian identity and appears in various cultural expressions and traditional ceremonies. The flower is particularly associated with the lowland departments of Beni, Pando, and Santa Cruz, where it grows abundantly along riverbanks and in seasonally flooded grasslands. During the annual Carnaval de Oruro, one of Bolivia's most important cultural festivals, the *patujú* is often depicted in traditional costumes

and decorations, symbolizing the connection between Bolivia's Andean highlands and Amazonian lowlands.

Over time, *Heliconia rostrata* has expanded beyond its native range through human cultivation. It has been introduced to tropical regions around the world, including Mexico, Puerto Rico, Bangladesh, Thailand, Vanuatu, and the Comoros (Royal Botanic Gardens, Kew, n.d.). In Mexico, the plant is cultivated in the states of Veracruz, Tabasco, Chiapas, and the Yucatán Peninsula, where it has naturalized in some areas. In Thailand, *Heliconia rostrata* is a popular ornamental in tropical gardens and is commercially grown for cut flower production in the northern provinces around Chiang Mai and Chiang Rai. The plant has also been introduced to Hawaii, Florida, and parts of the Caribbean, where it is grown as an ornamental but has not become invasive due to the absence of its specialized hummingbird pollinators.

In China, the species is cultivated in Taiwan, Fujian, Guangdong, Hong Kong, Macau, Hainan, Guangxi, and southern Yunnan (iPlant, n.d.). The plant has also been introduced to Australia, where it has become a popular ornamental in subtropical gardens, though no records explain exactly who first brought *Heliconia* or many of its relatives to the continent (The Echo, 2019). In Australian gardens, *Heliconia rostrata* is grown primarily for its spectacular flowers, though it rarely sets seed because Australia lacks native hummingbirds. Australian gardeners instead propagate the plant through rhizome division, which has been practiced successfully for decades.

The plant typically grows at low altitudes in humid forest margins and along watercourses (ColPlantA, n.d.). It flourishes in humid tropical climates where it receives partial shade to full shade, forming dense colonies that contribute to the structure and color of the forest understory (Chicago Botanic Garden, n.d.). Today, *Heliconia rostrata* is cultivated worldwide as an

ornamental plant due to its striking appearance and ecological importance. The global distribution of this species reflects both natural dispersal mechanisms and centuries of human movement of plants for ornamental, cultural, and economic purposes.

### **2.3 Elevation and Climate:**

*Heliconia rostrata* thrives in warm, humid tropical climates where rainfall is abundant and temperatures remain stable throughout the year. The species is highly sensitive to frost and requires temperatures well above 50°F (10°C) throughout the year to thrive and flower (Chicago Botanic Garden, n.d.). Exposure to temperatures below 10°C (50°F) for extended periods can cause leaf damage, stunted growth, and flower abortion. Brief exposure to frost (temperatures below 0°C or 32°F) is usually fatal to the above-ground portions of the plant, though the underground rhizomes may survive if the freeze is not too severe or prolonged. This frost sensitivity explains why the plant's natural distribution is restricted to equatorial regions where temperatures rarely drop below 15°C (59°F) even during the coolest months.

It is hardy in USDA zones 9 through 11, which encompass tropical and subtropical regions where minimum temperatures rarely drop below freezing (Missouri Botanical Garden, n.d.). Zone 9 (minimum temperatures 20-30°F / -7 to -1°C) represents the marginal range for this species, where plants can survive but may require winter protection such as mulching or covering during cold snaps. Zone 10 (minimum temperatures 30-40°F / -1 to 4°C) and Zone 11 (minimum temperatures above 40°F / 4°C) provide ideal growing conditions where plants can remain outdoors year-round without frost protection. In the United States, *Heliconia rostrata* can

be grown outdoors only in southern Florida, southern Texas, southern California, Hawaii, and Puerto Rico.

The plant grows best in partial shade to full shade conditions, with moist, well-drained soil (Missouri Botanical Garden, n.d.). In its natural habitat, *Heliconia rostrata* typically receives 30-50% of full sunlight, filtered through the forest canopy above. When grown in full sun, the plant can still thrive but requires significantly more water to prevent leaf scorch, and the leaves may develop a yellowish-green color rather than the deep green characteristic of shade-grown plants. In regions with intense summer sun, some shading (30-50% light reduction) is recommended, as exposure to less than 30% of full sun can reduce flower production (iPlant, n.d.).

Areas that provide consistent warmth, filtered sunlight, and high soil moisture favor optimal growth and flowering. For successful cultivation, winter day temperatures should be maintained at 20-24°C (68-75°F), with minimum night temperatures not falling below 15°C (59°F). Lower temperatures can slow down vegetation and may hinder blooming (Monaco Nature Encyclopedia, 2018). This sensitivity to temperature explains why the plant's natural distribution is restricted to equatorial regions where thermal variation remains minimal throughout the year. In regions with distinct wet and dry seasons, *Heliconia rostrata* typically produces more flowers during the wet season when soil moisture and humidity are highest. During the dry season, flowering may decrease or cease entirely, with the plant focusing its energy on rhizome expansion and vegetative growth.

## 2.4 Geology and Soil

The growth and distribution of *Heliconia rostrata* are strongly influenced by the soil characteristics of its habitat. This species thrives in moist, well-drained soils rich in organic matter (Missouri Botanical Garden, n.d.). The ideal soil pH is slightly acidic to neutral, ranging from 5.5 to 7.0, and the plant requires soils kept constantly moist but not waterlogged (Chicago Botanic Garden, n.d.). Soils with pH below 5.0 (very acidic) may cause nutrient deficiencies, particularly of calcium, magnesium, and phosphorus, which can result in stunted growth and poor flowering. Soils with pH above 7.5 (alkaline) may cause iron chlorosis, a condition where leaves turn yellow while veins remain green due to reduced iron availability.

*Heliconia rostrata* prefers loamy soils that provide both moisture retention and proper drainage. Loam is a balanced mixture of sand (40%), silt (40%), and clay (20%) that offers the ideal combination of drainage, water-holding capacity, and nutrient retention. Sandy soils drain too quickly and may not retain sufficient moisture for this water-loving plant, while clay soils drain too slowly and may lead to waterlogging and root rot. For container cultivation, a mixture of organic substrate with the addition of 30% siliceous sand or perlite is recommended to improve drainage and prevent water stagnation, which can cause root rot (Monaco Nature Encyclopedia, 2018). Perlite, a volcanic glass that expands when heated, creates air pockets in potting mix that improve drainage and aeration around roots.

The plant's soil requirements reflect its evolutionary adaptation to tropical rainforest floors, where organic matter from decomposing plant material continuously enriches the soil. In a mature tropical rainforest, the top 10-20 cm of soil may contain 50-80% organic matter derived from fallen leaves, branches, fruits, and animal remains. This organic layer, called the "O

horizon," is where most of the plant's fine feeder roots are concentrated. Below this layer, tropical rainforest soils are often surprisingly poor in nutrients, as heavy rainfall quickly leaches minerals from the subsoil. *Heliconia rostrata* has adapted to this nutrient stratification by developing a dense mat of shallow roots that efficiently capture nutrients from decomposing organic matter before they are washed away by rain.

Excess water in the soil can lead to root rot or fungal infections, while overly dry or compacted soils may restrict root growth and nutrient absorption. Root rot, caused by waterlogged conditions that promote the growth of pathogenic fungi such as *Phytophthora* and *Pythium*, is one of the most common causes of failure in cultivated *Heliconia rostrata*. Symptoms include yellowing leaves, wilting despite moist soil, and a foul odor from decaying roots. Maintaining fertile, moist, and well-drained soil is essential for ensuring the plant's long-term survival, especially in cultivated settings where natural forest floor conditions must be replicated as closely as possible.

## **2.5 Fossil Record**

The fossil record of the genus *Heliconia* is limited due to the plant's soft tissue composition, which does not easily fossilize in humid tropical environments. Unlike woody plants with hard, lignified tissues that can be preserved for millions of years, herbaceous plants like *Heliconia* have soft stems, leaves, and flowers that decompose rapidly after death. In tropical rainforests, where warm temperatures and high humidity accelerate decomposition, the chances of a plant body being preserved as a fossil are extremely low. Most of what is known about the evolutionary history of *Heliconia* and its relatives comes from fossilized pollen grains, which

have tough outer walls made of sporopollenin, a highly resistant organic polymer that can survive for millions of years in sediments.

However, the Zingiberales order (to which Heliconiaceae belongs) is believed to have diversified around 124 million years ago during the Gondwana era (Wikipedia, 2025). This timeframe places the origins of this plant group in the Cretaceous period, when the supercontinent Gondwana was still largely intact. The Cretaceous period (145-66 million years ago) was a time of warm global temperatures, high sea levels, and the first appearance of flowering plants (angiosperms). The Zingiberales were among the early lineages of monocots to diverge from the main evolutionary line of flowering plants.

The evolutionary history of Zingiberales is closely tied to the breakup of Gondwana and the subsequent separation of South America, Africa, Australia, and other landmasses. As continents shifted and climates changed over millions of years, Australian species of Zingiberales died out, with only two members of the banana family (Musaceae) still found in northern Australia today (The Echo, 2019). The separation of South America from Africa around 100 million years ago, followed by the connection of South America to North America via the Isthmus of Panama about 3 million years ago, profoundly influenced the distribution of Zingiberales. South American lineages, including the ancestors of modern *Heliconia*, continued to evolve in isolation from their African relatives, leading to the distinct Neotropical character of the family Heliconiaceae.

This biogeographic pattern explains why *Heliconia* and its relatives are now primarily Neotropical in distribution, despite their ancient Gondwanan origins. Today, the family Heliconiaceae is entirely New World in distribution, occurring from southern Mexico and the Caribbean islands south to northern Argentina and Paraguay. The hummingbird pollinators that

now service *Heliconia rostrata* are much younger in evolutionary terms, dating from only about 22.4 million years ago, with some species still rapidly evolving today (The Echo, 2019). The coevolutionary relationship between *Heliconia* and hummingbirds is therefore a relatively recent phenomenon in geological time, even though the plant lineage itself is ancient.

## **2.6 Soil Environment and Effects of Soil**

The soil environment plays a fundamental role in the growth, health, and reproduction of *Heliconia rostrata*. This species depends on moist, nutrient-rich, and well-aerated soils that allow its rhizomes to expand and absorb nutrients efficiently (Missouri Botanical Garden, n.d.).

Because *Heliconia rostrata* is a tropical plant, it thrives in soils with high organic content. The ideal soil for this species contains 5-10% organic matter, which improves water-holding capacity, provides a slow-release source of nutrients, supports beneficial soil microorganisms, and improves soil structure by binding mineral particles into stable aggregates.

The soil's texture and structure also have a significant effect on the plant's growth. *Heliconia rostrata* grows best in loamy or sandy loam soils, which provide both moisture retention and proper drainage (Chicago Botanic Garden, n.d.). Soil texture refers to the relative proportions of sand (0.05-2.0 mm diameter particles), silt (0.002-0.05 mm), and clay (<0.002 mm) in the soil. Sandy loam soils contain approximately 60-70% sand, 15-25% silt, and 15-25% clay. This texture allows water to drain through the soil at a moderate rate—fast enough to prevent waterlogging but slow enough to retain moisture for plant use. Clay soils, with their tiny particles and small pore spaces, drain slowly and can become waterlogged after heavy rain. Sandy soils,

with their large particles and large pore spaces, drain too quickly and do not retain sufficient moisture for this water-loving plant.

For this reason, natural and cultivated *Heliconia* populations tend to favor sloped terrains, riverbanks, or areas with good water flow, where moisture remains consistent but does not accumulate excessively. On slopes, gravity helps drain excess water away from the root zone while the soil retains sufficient moisture for plant growth. Along riverbanks, the plant can access the water table while benefiting from the well-drained, aerated soils of natural levees. Regular watering must be abundant in summer, avoiding stagnations that cause root rot, and more spaced in winter, allowing the substrate to partially dry before watering again (Monaco Nature Encyclopedia, 2018).

The soil's microbial community also plays a critical role in plant health. Healthy soils contain billions of bacteria, fungi, protozoa, and other microorganisms per gram of soil. Many of these microorganisms form beneficial relationships with plant roots. Mycorrhizal fungi, for example, colonize plant roots and extend their thread-like hyphae into the surrounding soil, dramatically increasing the root system's effective surface area for water and nutrient absorption. In return, the plant provides the fungi with carbohydrates produced through photosynthesis. This mutualistic relationship is particularly important in tropical rainforest soils, where nutrients are concentrated in the thin organic layer at the surface. *Heliconia rostrata* likely forms mycorrhizal associations, though specific studies on this species have not yet been published. Maintaining fertile, moist, and well-drained soil is essential for ensuring the plant's long-term survival, especially in cultivated settings where natural forest floor conditions must be replicated as closely as possible.

## 3.0 Chapter 3: Biology

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### 3.1 Chromosome Complement

*Heliconia rostrata* is a flowering monocot belonging to the family Heliconiaceae. Like other members of the genus *Heliconia*, the species is a rhizomatous geophyte, meaning it propagates via underground rhizomes (ColPlantA, n.d.). The term "geophyte" comes from Greek *geo-* (earth) and *phyton* (plant), referring to plants that survive unfavorable seasons as underground storage organs such as bulbs, corms, tubers, or rhizomes. This life strategy allows *Heliconia rostrata* to persist through brief dry periods and regenerate quickly after disturbance.

The plant is herbaceous, erect, and perennial, forming dense tufts that can reach 1 to 5 meters in height (Monaco Nature Encyclopedia, 2018). Under optimal conditions, some specimens may grow as tall as 6 meters (iPlant, n.d.; Royal Botanic Gardens, Kew, n.d.). The plant's growth habit is columnar and upright, with leaves forming in clumps as the plant ages (RHS, n.d.). Each clump, or "ramet," consists of multiple shoots (pseudostems) emerging from the same underground rhizome system. A single mature plant may produce 10-30 individual shoots, each bearing its own set of leaves and, when mature, an inflorescence. The oldest shoots eventually senesce and die back, but the rhizome continues to produce new shoots, allowing the plant to persist indefinitely under favorable conditions.

### 3.2 Seedling protection

During early developmental stages, seedlings of *Heliconia rostrata* are particularly vulnerable to dehydration, herbivory, and nutrient limitation. In natural rainforest ecosystems, seedlings typically establish beneath dense forest canopies where filtered sunlight, high humidity, and moderate temperatures reduce environmental stress. These shaded microhabitats prevent excessive transpiration and protect delicate tissues.

Protection is further enhanced by the plant's rhizomatous growth system. The underground rhizomes function as storage organs, accumulating carbohydrates, water, and essential nutrients that can be mobilized during unfavorable conditions. When grown from seed, seedlings will produce only one embryonic leaf (monocotyledon), which is characteristic of monocots and distinguishes them from dicot plants that produce two seed leaves (The Echo, 2019).

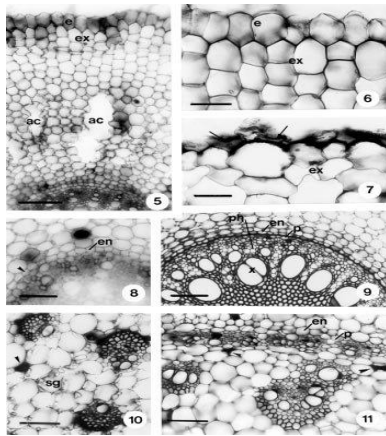
### **3.2.1 Life Cycle and Phenology**

*Heliconia rostrata* is a long-lived perennial species that regenerates continuously from underground rhizomes. Its life cycle begins with seed germination, followed by seedling establishment, vegetative growth, floral initiation, fruiting, and eventual seed dispersal. Unlike annual species, *H. rostrata* does not senesce after flowering. Instead, individual shoots may die back while the rhizome persists and produces new vegetative shoots, enabling long-term survival and clonal expansion. The plant typically takes 5 to 10 years to reach its ultimate height (RHS, n.d.).

The plant blooms during various times depending on the region, with bloom periods recorded from January through August and November through December in some locations (Chicago

Botanic Garden, n.d.). In Chinese cultivation, flowering occurs from May to October (iPlant, n.d.). The inflorescences open sequentially, with bracts opening one by one over a period of up to three months, which extends the reproductive window and increases opportunities for successful cross-pollination (The Echo, 2019).

Root and rhizome cross sections of *Heliconia* (Kress et al., n.d.):



### 3.2.2 Flower production

The inflorescence of *Heliconia rostrata* is pendant (hanging downward) and composed of bright red bracts edged with yellow or green margins (Wikipedia, 2025). Unlike other *Heliconia* species that grow upright with cup-shaped flowers that store water, *H. rostrata's* flowers hang downward and serve as a nectar source, especially for hummingbirds (Chicago Botanic Garden, n.d.). This pendant orientation is an adaptation that prevents rainwater from accumulating inside the flowers, which could dilute nectar or promote fungal growth.

The inflorescence is a terminal spike measuring 30 to 80 cm in length, with 10 to 40 bracts arranged alternately along a markedly waved red rachis (ColPlantA, n.d.; Monaco Nature

Encyclopedia, 2018). The bracts are distichous (arranged in two opposite rows), imbricate (overlapping like roof tiles), coriaceous (leathery in texture), and pointed, measuring 6 to 15 cm in length (Monaco Nature Encyclopedia, 2018). Their shape distinctly resembles a parrot's beak, which is reflected in the species name *rostrata*. The bracts are bright red with cream or yellow apices and green margins, creating a striking tri-colored appearance that attracts pollinators from a distance.

Each bract encloses up to 18 tubular flowers measuring 3.5 to 4.5 cm in length, which are white at the base and pale yellow at the apex, rich in nectar (Monaco Nature Encyclopedia, 2018). The flowers have bilateral symmetry (zygomorphic) with 3 sepals (two of which are fused together and one free), 3 petals fused together with little differentiation between them, 5 fertile stamens, and one staminode (a sterile stamen) positioned opposite the free sepal (Monaco Nature Encyclopedia, 2018).

### **3.3 Foliage and Growth**

The foliage of *H. rostrata* consists of large, elongated leaves arranged alternately along pseudostems formed by tightly overlapping leaf sheaths. The leaves grow on petioles 20 to 30 cm long and measure 0.40 to 1.20 meters in length and 10 to 20 cm in width (ColPlantA, n.d.; Monaco Nature Encyclopedia, 2018). They are oblong with a brusquely pointed apex, dark green on the upper surface and paler green below, with prominent central venation on the lower surface (Monaco Nature Encyclopedia, 2018). The leaf bases are sheathing, forming a false trunk (pseudostem) approximately 50 to 90 cm in length (ColPlantA, n.d.). In some Chinese

specimens, leaves measure 16-40 cm in length and 5-7 cm in width, with slender lateral veins that are densely packed and obliquely ascending (iPlant, n.d.).

Vegetative spread via rhizomes allows clonal colony formation, enhancing resource acquisition and competitive dominance within rainforest understories. The plant's rapid growth rate and ability to form dense tufts make it an effective ground cover in suitable tropical environments.

### **3.3.1 Seed Pods**

Following fertilization, *H. rostrata* develops fleshy, berry-like fruits that mature to a vivid blue or dark purple coloration. Smithsonian Tropical Research Institute (2022) stated that brightly pigmented tropical fruits function as visual attractants for frugivorous birds. Each fruit typically contains one to three seeds protected by a firm outer layer. Royal Botanic Gardens Kew (2024) stated that bird-mediated seed dispersal promotes genetic mixing and reduces density-dependent competition. By transporting seeds away from the parent plant, dispersal agents increase colonization opportunities and population resilience.

### **3.3.2 Productivity and Biology**

*Heliconia rostrata* demonstrates high biological productivity through rapid vegetative growth and prolonged reproductive periods. Missouri Botanical Garden (2024) stated that rhizomatous tropical species can reproduce both sexually and asexually, increasing ecological persistence.

Asexual propagation ensures rapid local spread, while sexual reproduction introduces genetic variation essential for long-term adaptation.

### 3.3.3 Pollen

The flowers of *Heliconia rostrata* are adapted for bird pollination. The plant produces pollen that adheres to the foreheads of hummingbirds when they hover to sip nectar, facilitating cross-pollination (Chicago Botanic Garden, n.d.). The specialized pollination system involves a trigger mechanism at the back of the flower that ensures the seed becomes receptive to pollen only when a hummingbird inserts its beak of the exact shape and length to reach it (The Echo, 2019). This precise morphological matching represents a classic example of coevolution between a plant and its pollinator.

Pollen von *Heliconia psittacorum* (Tstebler Pollen Database, n.d.):



### 3.3.4 Sexuality and Reproduction

Flowers of *Heliconia rostrata* are bisexual (hermaphroditic), containing both male and female reproductive structures within a single floral unit. The flowers have bilateral symmetry, with 3 sepals (two fused and one free) and 3 petals fused together, with 5 fertile stamens and one staminode opposite the free sepal (ColPlantA, n.d.; Monaco Nature Encyclopedia, 2018). Vegetative reproduction through rhizomes enables rapid regeneration after disturbance events. The coexistence of sexual and asexual reproduction provides a balance between genetic variability and population stability.

### **3.3.5 Pollination and Potential Pollinators**

Pollination is primarily conducted by hummingbirds attracted to the red coloration and abundant nectar (Missouri Botanical Garden, n.d.). The pendant inflorescences and tubular flower structure are specifically adapted to hummingbird feeding behavior (Chicago Botanic Garden, n.d.). Some hummingbirds have learned to poke holes in the side of the flower to access nectar without getting pollen on their foreheads, effectively bypassing the pollination mechanism (Chicago Botanic Garden, n.d.). Each of the approximately 90 species of *Heliconia* has a specialized pollinator partner with a beak of the exact shape and length to reach the nectar trigger (Chicago Botanic Garden, n.d.). This one-to-one specialization reduces competition among *Heliconia* species for pollinator services and promotes reproductive isolation.

In regions where *Heliconia rostrata* has been introduced outside its native range (such as Australia), the plant lacks its specialized hummingbird pollinators. In these locations, the plant may occasionally self-pollinate, but the successful seed set is limited (The Echo, 2019). Other

birds, including blue-eyed fig-birds, friar-birds, and mynahs, may visit the flowers for nectar, but they do not effectively pollinate them (The Echo, 2019).

### **3.3.5.1 Anthesis**

The flowers open sequentially along the inflorescence, with bracts opening one by one over a period of up to three months (Chicago Botanic Garden, n.d.). This staggered flowering pattern ensures repeated pollinator visits rather than a single pollination event, extending the reproductive window and increasing the probability of successful fertilization. Each bract opens in succession from the base of the inflorescence toward the tip, ensuring a continuous supply of fresh flowers over an extended period.

## **3.4 Fruit Development and Seed Set**

Successful fruit development depends on effective pollination and adequate environmental resources. The fruits mature gradually over several weeks, accumulating pigments and nutrients necessary for seed viability. The fruits are dispersed by birds that eat the dark blue drupes (ColPlantA, n.d.). The small blue-black fruits, when ripe, can be collected for propagation. To extract seeds, the fruits should be soaked for several days in water until the fruit flesh can be scrubbed off, revealing the very hard seeds within (The Echo, 2019).

### **3.4.1.1 Ovule Development**

In *H. rostrata*, successful fertilization results in viable seed production and fruit maturation. The seeds require scarification (mechanical breaking of the seed coat) and soaking in water for four days to soften the tegument before germination (Monaco Nature Encyclopedia, 2018; Royal Botanic Gardens, Kew, n.d.). Germination should be conducted in organic loam with the addition of 30% siliceous sand or agri-perlite, maintained at 26-28°C (79-82°F), with humidity kept constant (Monaco Nature Encyclopedia, 2018). Germination time is variable, ranging from one to six months or longer, and the first flowering occurs after 3 to 4 years when grown from seed (Monaco Nature Encyclopedia, 2018; Royal Botanic Gardens, Kew, n.d.).

### **3.5 Ecophysiology**

*Heliconia rostrata* demonstrates efficient growth under partial shade to full shade conditions (Missouri Botanical Garden, n.d.). The plant requires consistently moist soil and protection from wind (Missouri Botanical Garden, n.d.). These ecophysiological adaptations enable *H. rostrata* to thrive in both natural habitats and cultivated tropical environments. The plant is sensitive to environmental stress; lower temperatures slow down vegetation and may hinder blooming (Monaco Nature Encyclopedia, 2018). When cultivated in containers or in regions with seasonal temperature variations, plants should be moved to greenhouses, verandas, or luminous winter gardens during the coldest months to ensure survival (Monaco Nature Encyclopedia, 2018).

## 4.0 Chapter 4: Propagation and management

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### 4.1 Natural regeneration

Natural regeneration of *Heliconia rostrata* occurs through seed dispersal by birds that eat the dark blue fruits (ColPlantA, n.d.). The seeds are dispersed away from the parent plant, promoting genetic mixing and reducing density-dependent competition. Seeds require specific conditions for germination, including scarification to break the hard seed coat (Royal Botanic Gardens, Kew, n.d.). In its native range, natural regeneration maintains wild populations, though the species is now classified as vulnerable in some areas and locally extinct where deforestation has been extensive (The Echo, 2019).

### 4.2 Vegetative regeneration

Vegetative regeneration is the most common and reliable method of propagating *Heliconia rostrata*. The plant spreads naturally via underground rhizomes, forming dense clonal colonies (ColPlantA, n.d.). This method ensures that new plants are genetically identical to the parent plant, preserving desirable characteristics such as flower color and growth habit. In spring, rhizome division is typically performed, with each section containing several vegetative buds (Monaco Nature Encyclopedia, 2018; RHS, n.d.).

### **4.3 Nursery propagation**

In nursery settings, *Heliconia rostrata* is typically propagated by rhizome division in spring, with each section provided with several vegetative buds (Royal Botanic Gardens, Kew, n.d.; Monaco Nature Encyclopedia, 2018). This method produces flowering plants more quickly than seed propagation, which can take 3-4 years to produce the first flowers (Royal Botanic Gardens, Kew, n.d.). Tissue culture (micropropagation) methods have also been developed for this species, though they are less commonly used in commercial production (iPlant, n.d.).

### **4.4 Cuttings**

While stem cuttings are not the primary propagation method for *Heliconia*, rhizome divisions function similarly to cuttings in practice. Each rhizome section with viable buds can be planted to produce a new plant. When taking divisions, it is recommended to cut back the stems to 20-30 cm in length to reduce water evaporation and increase survival rates (iPlant, n.d.). For container cultivation, a neutral growing medium consisting of a 50:50 mixture of peat substitute and coarse sand or grit is recommended (RHS, n.d.).

### **4.5 Plantings**

Proper planting techniques for *Heliconia rostrata* include selecting locations with partial to full shade (Missouri Botanical Garden, n.d.), ensuring soil rich in organic matter (Chicago Botanic Garden, n.d.), and maintaining consistent moisture without waterlogging (Missouri Botanical

Garden, n.d.). Plants should be protected from strong winds (Missouri Botanical Garden, n.d.) and spaced adequately to allow for clump formation. The species is suitable for border planting, flower borders and beds, patio and container plants, and conservatory cultivation (RHS, n.d.). In cooler climates, the plant can be successfully grown in pots, particularly the compact varieties, and overwintered in greenhouses or bright winter gardens (Monaco Nature Encyclopedia, 2018).

#### **4.6 Management of pests and diseases**

*Heliconia rostrata* is relatively resistant to pests but can occasionally attract common pests such as aphids, spider mites, mealybugs, scale insects, whiteflies, and fungus gnats (Greg App, 2024).

Specific pests affecting the plant include:

**Spider mites:** Tiny spider-like creatures that hide on leaf undersides, causing yellowing and browning of leaves. Treatment includes miticides or organic options like neem oil (Greg App, 2024).

**Scale insects:** Small oval pests appearing as bumps on stems and leaves, causing sticky leaves and stunted growth. Treatment includes systemic insecticides or rubbing alcohol applied with a cotton swab (Greg App, 2024).

**Mealybugs:** White cottony masses found in leaf axils and on stems, causing yellowing leaves and sooty mold. Treatment includes insecticidal soap or neem oil (Greg App, 2024).

Aphids: Small soft-bodied insects in various colors that cause curling leaves and stunted growth. Treatment includes broad-spectrum insecticides or strong water spray (Greg App, 2024).

Whiteflies: Tiny white moth-like insects that fly up when the plant is disturbed, causing yellowing leaves. Treatment includes yellow sticky traps and insecticidal soap (Greg App, 2024).

Fungus gnats: Small dark flies around the soil whose larvae feed on roots. Treatment involves allowing soil to dry between waterings (Greg App, 2024).

The plant is also susceptible to Phytophthora root rot and Pythium stem rot, which can be problematic in poorly drained soils (RHS, n.d.). The plant demonstrates some natural resistance to certain pests, including thrips, which tend to avoid it (Greg App, 2024). Maintaining proper cultural conditions—including adequate light, appropriate watering, and good air circulation—is the first line of defense against pest problems. Regular inspection of plants (at least once weekly) is recommended for early detection and intervention (Greg App, 2024).

#### **4.7 Pest and disease control**

*Heliconia rostrata* is cultivated in tropical and subtropical humid regions, in full sun or slightly shaded locations (ColPlantA, n.d.). The plant requires rich, acidic or neutral soils that are well-drained and kept constantly moist but not flooded (ColPlantA, n.d.). When grown in full sun, the plant must be provided with adequate water to prevent leaf scorch (iPlant, n.d.). In regions with intense summer sun, some shading (30-50% light reduction) is recommended, as

exposure to less than 30% of full sun can reduce flower production (iPlant, n.d.). In greenhouse or conservatory cultivation, bright filtered light is ideal (RHS, n.d.).

#### **4.8 Cultivation**

*Heliconia rostrata* is cultivated in tropical and subtropical humid regions, in full sun or slightly shaded locations (ColPlantA, n.d.). The plant requires rich, acidic or neutral soils that are well-drained and kept constantly moist but not flooded (ColPlantA, n.d.). When grown in full sun, the plant must be provided with adequate water to prevent leaf scorch (iPlant, n.d.). In regions with intense summer sun, some shading (30-50% light reduction) is recommended, as exposure to less than 30% of full sun can reduce flower production (iPlant, n.d.). In greenhouse or conservatory cultivation, bright filtered light is ideal (RHS, n.d.).

#### **4.9 Fertilizing**

The species thrives in soils rich in organic matter (Chicago Botanic Garden, n.d.). Regular application of organic compost or balanced fertilizer supports healthy growth and abundant flowering. Before planting, well-decomposed organic manure mixed with superphosphate is recommended as a base fertilizer at a rate of 800-1000 kg of organic fertilizer (including decomposed cake fertilizers, chicken manure, or pig manure) and 50-60 kg of superphosphate per 100 square meters (iPlant, n.d.). After planting, no fertilizer should be applied for 20-25 days to allow root establishment. During the active growing season, diluted cake fertilizer should be

applied every two weeks, with supplemental phosphorus and potassium fertilizers applied 3-5 times starting in May when flower stalks begin to emerge (iPlant, n.d.). Fertilization should be reduced or stopped in fall and winter (Shape My Garden, 2023).

#### **4.10 Growth stages**

The plant goes through distinct growth stages from rhizome sprouting to vegetative growth, flowering, fruiting, and seed production. With proper care, established plants will flower year after year. The time to ultimate height is 5-10 years (RHS, n.d.). The plant's growth is influenced by photoperiod, with 12 hours of light per day producing optimal results; longer photoperiods (16 hours) may reduce flower production, while shorter photoperiods (8 hours) produce shorter flower stems (iPlant, n.d.).

#### **4.11 Fruiting**

Fruiting occurs after successful pollination. The fruits are small drupes that ripen from green to glossy dark blue, containing 1-3 seeds each (ColPlantA, n.d.; Monaco Nature Encyclopedia, 2018; Royal Botanic Gardens, Kew, n.d.). Fruits are attractive to frugivorous birds that aid in seed dispersal (ColPlantA, n.d.). In cultivation outside the native range, fruit set may be limited due to the absence of specialized hummingbird pollinators (The Echo, 2019).

## **4.12 Harvesting**

For cut flower production, *Heliconia rostrata* inflorescences are harvested when the bracts are fully developed. The flowers are valued for their long vase life and striking appearance. Cut inflorescences have great ornamental effect and can last approximately two weeks in floral arrangements (Monaco Nature Encyclopedia, 2018). A study evaluating heliconias for cut flower use found *H. rostrata* to be among the outstanding species suitable for the floral market (Ribeiro et al., 2010). When harvesting, flower stems should be cut from the base to avoid leaving stubs that could affect appearance and new growth (iPlant, n.d.).

## **4.13 Pruning - re-planting**

Regular removal of dead or damaged leaves and spent flower stalks helps maintain plant health and appearance. After flowering, faded flower stems and damaged or dying leaves should be cut out (RHS, n.d.; iPlant, n.d.). Pruning improves plant vigor and redirects energy to new growth. During the growing season and harvest period, care should be taken not to damage leaves and leaf stalks, and any broken leaves, diseased leaves, or yellowed leaves should be promptly removed (iPlant, n.d.). Rhizome division and replanting every 1-2 years can rejuvenate older plantings and prevent overcrowding (iPlant, n.d.). Adult plants, whether potted or grown in the ground, become dense and crowded after many years of growth, which affects ventilation and growth, necessitating regular division (iPlant, n.d.).

## 5.0 Chapter 5: Heliconia Value Chain and Uses

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### 5.1 Global and Regional Trade (Imports and Exports)

*Heliconia rostrata* is part of the global ornamental flower trade, especially in tropical and subtropical regions. The species is one of the few heliconias with pendant inflorescences that are commercially produced for the cut flower market, particularly in Brazil (Ribeiro et al., 2010). A study characterizing heliconia accessions for cut flower use identified *H. rostrata* as an outstanding species for this purpose (Ribeiro et al., 2010). The plant is commercially cultivated in tropical countries including Brazil, Colombia, Ecuador, Costa Rica, and Thailand for both cut flower production and landscape use.

### 5.2 Packing, Transporting, and Marketing

Heliconia flowers are valued in the cut flower industry because of their durability and striking appearance. Revista Mexicana de Ciencias Agrícolas (2019) said that heliconia flowers are “long-lasting” with a vase life of “10 to 14 days.” This durability makes them suitable for long-distance transport and export markets. Proper packing involves maintaining hydration and

preventing mechanical damage to the bracts. The Ornamental Horticulture Journal (2016) said that heliconias are widely used “as cut flowers” and for commercial ornamental purposes. Marketing focuses on their exotic appearance, making them popular in floral arrangements, events, and decorative industries.

### **5.3 Consumption and Cultural Uses**

In Bolivia, *Heliconia rostrata* (known as *patujú*) is culturally significant as one of the country's two national flowers (Wikipedia, 2025). The plant is also used in ceremonial decorations and cultural expressions in some regions. The genus name's connection to Mount Helicon and the Muses reflects the plant's long-standing association with beauty and artistic inspiration (The Echo, 2018). In Southeast Asia, particularly among Chinese communities, the plant is highly valued during the Spring Festival (Chinese New Year), where its flower spikes, which resemble colorful firecrackers, are hung on doors to add festive color and symbolize celebration (iPlant, n.d.). The plant is known as "Golden Mouth Scorpion Tail Banana" (金嘴蝎尾蕉) in Chinese, referring to the golden-yellow tips of the red bracts (iPlant, n.d.; Baidu Baike, 2025).

### **5.4 Economic, Ecological, and Medicinal Benefits**

*Heliconia rostrata* provides multiple benefits across different sectors. Economically, it contributes to the ornamental plant industry, particularly the cut flower trade in tropical countries (Ribeiro et al., 2010). Ecologically, heliconias play an important role in tropical ecosystems as a food source for hummingbirds and other nectar-feeding birds (Chicago Botanic Garden, n.d.).

The plant contributes to biodiversity by supporting pollinators and providing habitat for small organisms.

Medicinal and Therapeutic Uses (Based on peer-reviewed research): Recent scientific studies have documented significant medicinal potential for *Heliconia rostrata*:

Hepatoprotective (Liver-Protecting) Activity: A 2021 study published in the *Journal of Ethnopharmacology* evaluated the hepatoprotective efficacy of ethanol and methanol extracts of *H. rostrata* rhizomes. The study found that both extracts were safe for therapeutic use, with an LD50 value exceeding 2000 mg/kg in rats, confirming Category 5 toxicity level according to the Globally Harmonized System (Roy et al., 2021). The extracts demonstrated dose-dependent protection against chemically induced liver injury in both cell cultures (HepG2 cells) and rat models. At 400 µg/ml, the ethanol extract showed 65.53% protection against ethanol-induced hepatotoxicity, while the methanol extract showed 57.98% protection. The plant's hepatoprotective activity is attributed to its antioxidant efficacy, with the ethanol extract demonstrating superior antioxidant properties compared to the methanol extract (Roy et al., 2021).

Anti-cancer Potential: A study published in the *Research Journal of Pharmacy and Technology* (2019) investigated the cytotoxicity and anti-angiogenic activity of petroleum ether extracts of *H. rostrata* rhizomes and inflorescences. The rhizome extract demonstrated potent cytotoxicity against brine shrimp with an LC50 value of 85.04 µg/ml, indicating strong anti-cancer potential (Roy et al., 2019). In the chick embryo chorioallantoic membrane (CAM) assay, the rhizome extract showed strong anti-angiogenic effects at 150 µg/ml, suggesting it may

inhibit the formation of new blood vessels that tumors need to grow. The inflorescence extract was less potent, with an LC50 of 801.03 µg/ml (Roy et al., 2019).

**Traditional Ethnomedicinal Uses:** Ethnobotanically, *Heliconia rostrata* has been traditionally used for various medicinal purposes across different cultures: In Panama, the plant has been used by traditional people for the treatment of skin cancer (Roy et al., 2019).

In Malaysia, the plant is traditionally used to cure jaundice, intestinal pain, diabetes, and hypertension (Roy et al., 2021).

In Brazil, roots and seeds have been used for centuries to treat various ailments (Roy et al., 2021).

In Bangladesh, Kavirajes (traditional medical practitioners) use the leaves and seeds as a tonic and to treat headache, sprains, and pain (Shahriar et al., 2017; Roy et al., 2021). Additionally, leaves have been used by a folk medical practitioner to treat diabetes and diabetes-induced swelling in the legs (Shahriar et al., 2017). The plant is recognized to have anti-ophidic properties against the venom of *Bothrops asper* (the fer-de-lance snake) (Roy et al., 2021).

**Antioxidant Properties:** Both ethanolic and methanolic extracts of *H. rostrata* rhizomes have been shown to contain flavonoids, tannins, saponins, proteins, and carbohydrates, which contribute to their antioxidant and antibacterial effects (Roy et al., 2021).

## **5.5 Ornamental and Landscaping Applications**

*Heliconia rostrata* is widely cultivated for ornamental and landscaping purposes due to its striking inflorescences and tropical appearance (Missouri Botanical Garden, n.d.). It is one of the

most cultivated ornamental species of *Heliconia*, valued for its brightly colored inflorescences and very long duration on the plant (ColPlantA, n.d.). Numerous varieties have been selected, including some of more compact dimensions suitable for cultivation in tropical and subtropical humid regions (ColPlantA, n.d.).

The plant is suitable for bedding, border planting, and as a specimen plant in tropical and subtropical gardens (Missouri Botanical Garden, n.d.). Its long-lasting bracts and bold colors make it ideal for bouquets, event decorations, and interior displays.

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