About *Codariocalyx motorius*: The Rapidly Moving Plant That's Rapidly Moving Its Way Into Your Gardens

Rachael Norton, Undergraduate,

Bachelor of Science in Plant Sciences at the University of Minnesota,

College of Food, Agricultural and Natural Resource Sciences

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EXECUTIVE SUMMARY

Codariocalyx motorius may be moving itself into the plant market sooner than anticipated! This plant is a one-of-a-kind addition to flower beds and potted arrangements with its potential to be a perennial shrub in USDA Hardiness Zones 10 and 11. Or as a small and simple summer annual in every other zone. The light pink flowers are small and only begin to occur in the late season of the second year, and every year after, turning into seed pods that can be used to make more plants. It has the unique capability to move its leaves at a rate visible to the naked eye. The foliage is the star of the show, as the leaves are a bright light green, thin on their own but densely packed all throughout the plant. The leaves follow the circadian rhythm, meaning they fold downward when the sun begins to set at night, only to unfold again with the sunrise. *Codariocalyx motorius* is native to 24 different Tropical and Subtropical countries in Asia. Therefore, warmer temperatures and more humid climates are where this plant thrives best. This plant can also be highly marketable as a houseplant, as it stays relatively small, is easy to care for, and is fun to observe! Out of 33 untreated seeds sown, and lightly covered in vermiculite, this plant had a germination rate of 60.6%, or 20 out of the 33 successfully germinated. 10 of these 20 germinated within one full week, whereas the remaining 10 germinated in two full weeks. By the fifth week after sowing these seeds, all 20 had true leaves that began to respond to claps and were drooping at night. This species is proven to be fast growing, and doesn't disappoint to prove that it's not like any other plant on the market.

INTRODUCTION

A. Taxonomic Classification and Geographic Distribution in the Wild

Figure 1: Watercolor painting of *Codariocalyx motorius* by an anonymous artist in Bengal circa 1775.

Codariocalyx motorius is a flowering plant that belongs to the *Fabaceae* family, also commonly known as the Pea family. It belongs to the *Codariocalyx* genus, which has been debated when comparing this genus with the *Desmodium* genus, as some claim them to be too close in characteristics to be separated (United States Department of Agriculture). This plant is known by many common names and has undergone many scientific name changes. Beginning with the common names, the most notable are ‘The Telegraph Plant’ and ‘Semaphore Plant’ which come from the rotation of the leaflets that move in periods between three to five minutes. Which was named after a notable and common 18th-century structure, the semaphore telegraph, as seen in Figure 2 (Kumar et al. 2003; Liberty Hyde Bailey Hortorium, 1976; National Museum

of Natural History). Another common name for *Codariocalyx motorius* is the 'Dancing Plant' as the leaves move at a rate visible by the naked eye.

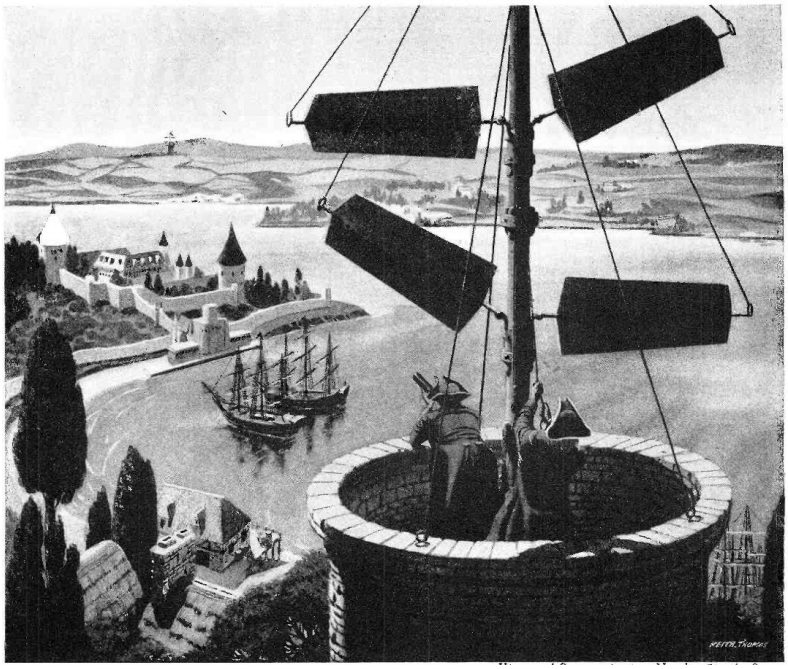

Figure 2: Illustration of an optical semaphore telegram in 18th-century France. Provided by American Radio History Magazine archives.

As for the scientific name changes, the first notable mention of *Codariocalyx motorius* was around 1790 by Hufeland, a physician interested in the way the plant moved, and Carl von Linné, who named it *Hedysarum gyrans* motitans L.f. *Hedysarum* is another taxonomic genus within the *Fabaceae* family, *gyrans* in Latin translates to "spinning," motitans translates to "moving," and L.f. was added for "Linné's son" or "Linnaeus the younger." Synonymous scientific names used less often today include *Codariocalyx gyrans* (L.f.), *Desmodium gyrans*, *Desmodium motorium*, *Desmodium roylei*, *Hedysarum motorium*, *Hedysarum motorius*, and *Meibomia gyrans* (L.f.) (National Museum of Natural History).

Codariocalyx motorius is a tropical shrub that grows in the hardiness zone 10b, which contains plants that can withstand low temperatures between 35ºF to 40ºF according to the

USDA's Plant Hardiness Zone Map. Due to the desire for a tropical climate, *C. motorius* has minimal risk for invasiveness beyond its native region. According to the Royal Botanic Gardens, the Telegraph Plant is native to 24 Tropical and Subtropical Asian countries, as seen in Figure 3. These countries include Assam, Bangladesh, Borneo, Cambodia, China South-Central, China Southeast, East Himalaya, India, Jawa, Laos, Lesser Sunda Islands, Malaya, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Sulawesi, Sumatera, Taiwan, Thailand, Tibet, Vietnam, and West Himalaya.

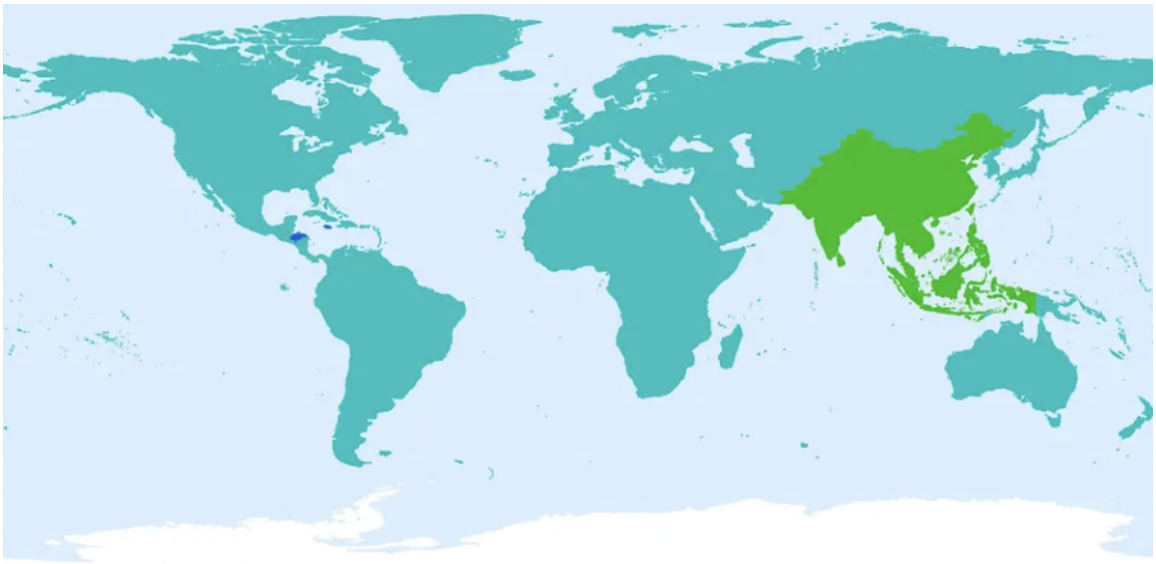

Figure 3: Countries in Asia where *Codariocalyx motorius* is naturally occurring, as noted by the green coloring. Countries where *C. motorius* is exotic are shown in dark blue, and countries where it is cultivated are shown in teal. Map provided by Glority LLC Limited.

In the United States, the Telegraph Plant is commercially grown and cultivated to be distributed for purchase to the public, primarily used in potted arrangements, hanging pots, or as house plants (National Gardening Association). Today, the commercial production of the Telegraph Plant is relatively small, and oftentimes sold in the form of seeds available from various online seed sellers. The seed pods are representative of the Pea family, with pods containing anywhere from one to seven seeds ranging anywhere from just over one inch to a

couple centimeters in length, green when it is maturing, and brown when it is fully matured as shown in Figure 4 below. The seeds within share visible characteristics with beans, are black in color and only a couple of centimeters long, seen in Figure 5 below.

Figure 4: Numerous seed pods on *Codariocalyx motorius*. Photo by Fair Dinkum Seeds.

Figure 5: Several black, bean-like seeds. Photo by Ceylon Green Taste.

The height of the plant remains between 2 feet to 4 feet tall, though it has been said it rarely ever reaches 4 feet in height, and 1 foot to 2 feet in width. As seen in Figure 6 below, the

leaflets of *C. motorius* are lanceolate shaped, with lateral leaflets ranging between 1 to 3 centimeters long, and 3 to 5 centimeters wide. The terminal leaflets are 2 to 7 centimeters long, and 6 to 13 centimeters wide. The stalks on the leaflets are about 3 millimeters in length. Figure 7 shows that the older leaves on *Codariocalyx motorius* are significantly larger, at around 8 to 10 centimeters in length ("*Codariocalyx motorius*..." 2014).

Figure 6: Leaves, leaflets, and stems of *C. motorius*. Photo by Biswarup Ganguly.

Figure 7: A young Dancing Plant, no more than a foot tall. Photo by Prasanths.

The structure of the flower in Figure 8 below on *Codariocalyx motorius* is considered tiny, measuring around 7 to 9 millimeters long with sepal characteristics described as cups, representative of the flower structures within the Pea family. Flower color is consistently a light pink with white.

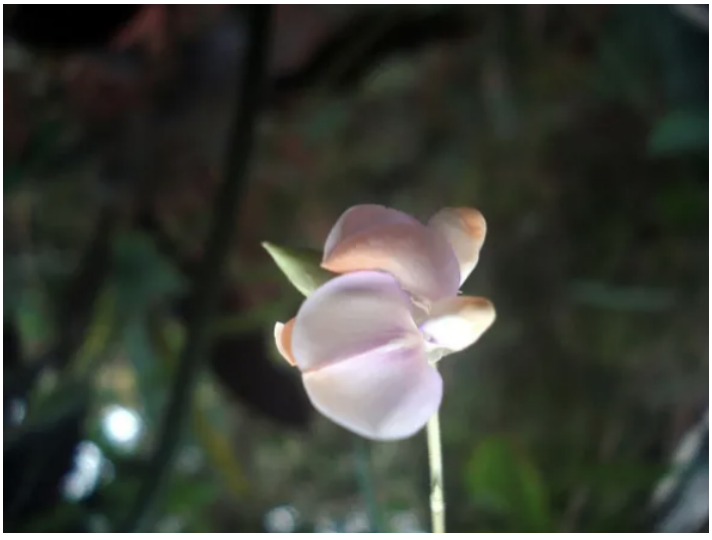

Figure 8: A single, pinkish-white flower of *C. motorius*. Photo retrieved from WordPress.

CROP SPECIES

A. History and Potential Use

Codariocalyx motorius has a well-documented history, with mentions in multiple works by renowned naturalists such as Carl Von Linné and Charles Darwin. In Darwin's 1880 *The Power of Movement in Plants*, *C. motorius* was described in an astounding amount of detail, aiding scientists today who study the movement of the leaves and how they respond to light, sound, and their environment. The behavior of the terminal leaves of *C. motorius* has been confirmed over time to follow the sun in a circadian rhythm, meaning that these leaves droop down in conditions that represent night, and lift again once the conditions represent the daytime, as seen in Figure 9 below. For the lateral leaves, they follow an ultradian rhythm where they are fast-moving on an elliptic circle that has a rotational period of three to five minutes (Peter, P. K. 2021).

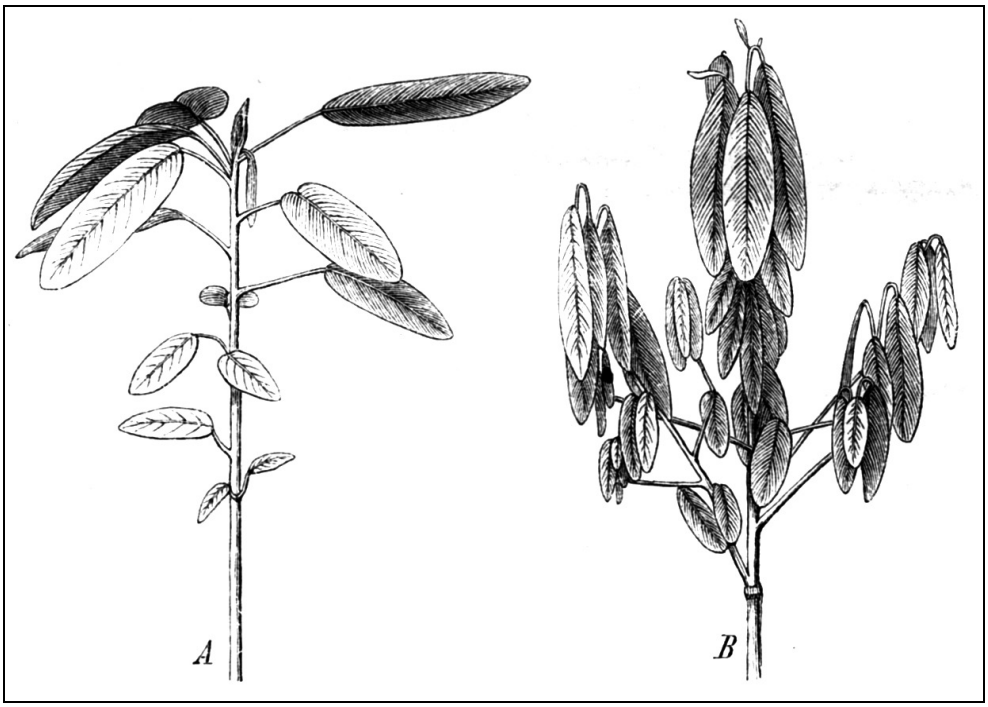

Figure 9: Illustration of circadian rhythm in *Codariocalyx motorius*. (A) represents the terminal leaves in their daytime positions; (B) represents the terminal leaves in their nighttime positions.

In addition to the Telegraph Plants' history in its characteristic to move at a speed visible by the naked eye, as well as its ornamental value in gardening, the plant has medicinal value as well. It has documented use in traditional Chinese and Indian medicine, due to the chemical properties of the shrub. According to K. Trout in their publication titled “Trout’s Notes on the Genus *Desmodium*…” *Codariocalyx motorius* has been used in Siddha medicine as an antidote, cardiac-tonic, and wound healing ointment, and has been used to heal poisonous snake bites. Trout also reported that the roots of *C. motorius* contain low concentrations of alkaloids such as 5-Methoxy-N,N-dimethyltryptamine (5-MeO-DMT), hypaphorine, and phenethylamines. 5-MeO-DMT is a natural psychoactive indolealkylamine drug that behaves like a nonselective serotonin agonist, meaning it can cause changes in the consumers behavior and physiology (Shen, H.-W. et al. 2010). Hypaphorine is an indole alkaloid that has sleep promoting effects, and increased non-rapid eye movement in rest (Ozawa, M. et al. 2008). Lastly, phenethylamines are substances that promote stimulant effects in low doses, such as bursts in energy (United Nations Office on Drugs and Crime, 2011). *C. motorius* is also used in China as Ayurvedic medicine in the form of an herbal tea (Sharma, V. K. et al. 2003). Another study examined the phenolic content results in root extractions from *C. motorius* and determined that the Telegraph Plant can be used as an effective and safe source of antioxidant intake, and with more research, this plant could be used to develop new pharmaceutical medicines to combat stress, and in turn, any diseases that result from stress, such as heart diseases (Chidambaram, U. et al. 2013).

Product Information

A. Anticipated Cultural Requirements

The species *Codariocalyx motorius* is a tropical Asian shrub defined as an annual plant in cooler climates, and an evergreen perennial in warmer climates. It grows best as a perennial in

consistently moist soil that is a sandy loam, with bright full sun to part shade, and temperatures during the growing season ranging from lows at 68°F to highs around 95°F. The minimum cold hardiness *Codariocalyx motorius* can withstand is around 30°F, or USDA Plant Hardiness Zone 10a, whereas the maximum recommended hardiness zone is zone 11, both outlined in Figure 10 below. In geographical regions that get to the temperatures reached in zone 10a, the plant will go into dormancy and shed its leaves. *Codariocalyx motorius* likes a soil pH of around 6.1 to 7.3, ranging from slightly acidic to neutral ("*Telegraph Plant (CODARIOCALYX motorius)*"...).

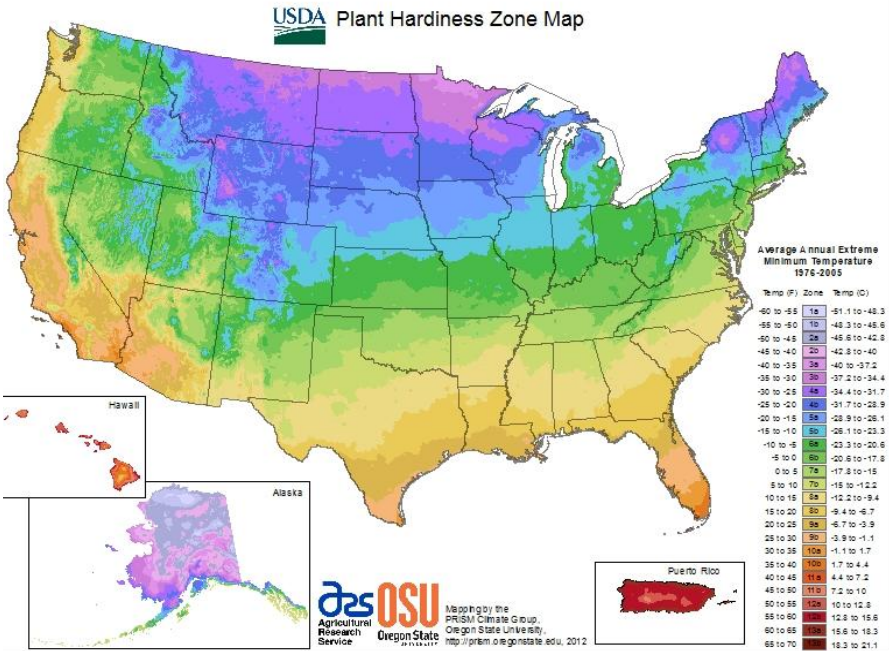

Figure 10: United States Department of Agriculture's Plant Hardiness Zone Map. Zone 10a and 10b are the darker orange areas seen along the lower border of the country, and Hawaii. Zone 11a is the darkest orange seen in Hawaii, and zone 11b is a light pinkish orange seen in central Puerto Rico. Photo by USDA.

All of these growth characteristics and requirements would allow for this plant to be a great container pot plant during the summer in zones outside 10 and 11, and an even better houseplant in all geographical regions. In zones 10 and 11, this plant would be a great small shrub for landscape fillers, or centerpieces in large pot arrangements. In these zones, the plant

does have potential to spread, but can be easily controlled by removing the new seedlings or removing the full taproot of the mature plant. In the ideal zones of 10 to 11, the lifecycle of the plant would represent the reproduction as an angiosperm, like that of the Pea family, outlined below in Figure 11. Starting by germinating by seed in ideal temperature conditions seen in the summer months, followed by vegetative growth as a seedling, sprouting up around a foot with just leaves and stems. Flowering very rarely occurs in the first year growth of *Codariocalyx motorius*, and is very common in its second year, producing the small flowers throughout the plant, which would mature into the seed pod containing the bean-like seeds, and eventually mature and dry enough to drop from the plant and repeat the life cycle. The total lifespan of *C. motorius* is typically only 2 years, but has the potential to continue for a few years beyond this expectation (Gilbert, S.F. 2000).

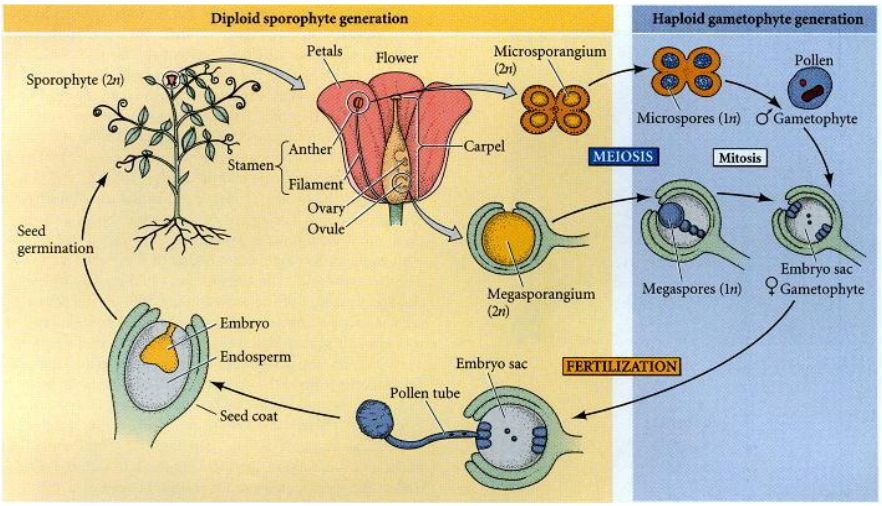

Figure 11: The life cycle of an angiosperm, as represented by a pea plant. Photo from "Plant Life Cycles" by Gilbert, S.F.

Since *Codariocalyx motorius* has a shorter life cycle in its ideal growing conditions, and doesn't survive winters in hardiness zones below zone 10, it typically isn't sold in trays at nurseries or plant wholesalers. Similar to other plants in the Fabaceae family, this plant would solely be sold in seed form if intended for garden or flower bedding and pot uses. However, in

the sense of selling *C. motorius* as a houseplant, there is limited information as the primary market for this species is by seed. Fortunately, similar familial species such as *Robinia hispida,* or moss locust, is also a small shrub in the Fabaceae family. From the information we know about *R. hispida*, the market would see the Telegraph Plant being sold young, likely around 10 months to one year aged from seed, so that it is established well in 3.5 inch to 4.5 inch circular pots and the stem becomes woody. When sold as a perennial in zones 10 and 11, the plant would be sold in its second year of growth in a gallon pot (Vandevender, J. 2016). Selling this small shrub while it is still young will appeal to the consumer as they will get to experience its growth to maturity, and witness healthy activity and movement of the leaves. Selling it while it's still in its first year as an annual appeals to the consumer, who will then get to see the plant produce flowers and seed pods. As a perennial, selling when the plant is in its second year is ideal in order to have a larger shrub with established trunks and stems as well as the presence of flowers will appeal to landscape plantings.

The distribution chain for *Codariocalyx motorius* would begin with the product development. Breeding for cultivation purposes would be desired in order to achieve more frequent and consistent flowering that would produce larger and more appealing flowers, a larger density of leaves and branches, as well as hardiness to cooler climates. With the time it would take to develop characteristics through breeding that would aid in the sale of this plant product, continued research would continuously establish new cultivars and new characteristics. Breeding programs would likely be developed from public companies rather than private, as this is a plant from the Pea family which already has an abundance of research and development. Using a private breeding program would not be necessary, though it would be acceptable to use if desired. Once developed through a breeding program, the breeders would work with producers

and plant marketing companies to begin the outreach for *C. motorius*. The producers would bring in distributors who would expand to larger commercial growers and larger seed companies for the retail aspect of this plant to reach the market. It is important to note that retail growers should be informed of growth habits and structure to ensure they have the proper setting for the commercialization of this product. For *Codariocalyx motorius*, they should be alerted that if sown and germinated faster than anticipated, the plant should be put into long-day cycles to prevent premature flowering. From there, the product would develop and establish in gallon pots and consumers would begin to purchase and distribute the product to their gardens, planters, and homes. With characteristics of a visibly moving product that would bring something new to the market and the consumers' willingness to try the product, the demand for *Codariocalyx motorius* would bloom. With this process, the demand would be met, and with the presence of the breeding programs, the plant would be able to adapt to new market needs, wants, and desires.

B. Market Niche

Codariocalyx motorius's target sell date in consumer markets would be anywhere around May to June. For the annual product, selling by early summer would allow for full development of leaves and the presence of their sound responses, but allow them to still be small and not flowering. For the perennial product, May of year two growth would supply the plant with a suitable shape for market, with branches and leaves full and lush. The flowers from the first year, if any, would have bloomed from September to March of the year prior, therefore the consumer would be able to experience the next full bloom cycle, and the consumer wouldn't be overwhelmed with seed pods soon after buying the plant.

It is known that this plant follows the same flowering requirements of the Fabaceae family, and needs around 16 consecutive short-days of growth in order to promote flowering.

Because of this, homeowners should expect a primarily vegetative plant, and an abundance of seed pods when days become shorter. The production of the seeds on this plant may also cause homeowners to be upset with the mess and reduced aesthetic when the seasons come to an end. In zones 10 and 11, where *Codariocalyx motorius* has evergreen growth, the production and maturation of the seed pods may cause the seeds to germinate for the next growing season and cause a small spread of the small shrub. This could be combated if the homeowner would be willing to remove seed pods before they fall from the plant, but if not, the plant would only survive for two years at maximum, and can easily be pulled. From this habit, however, *Codariocalyx motorius* is best fit for experienced houseplant owners.

With over 670 genera, and 20,000 species, there are many crops within the Fabaceae family that already have a strong existence within the perennial and annual market. Some strong contenders against *Codariocalyx motorius* in both markets include lupine, sweet pea, wisteria, and sensitive plant. In addition to the flowering perennials and annuals in this family, there are also established agricultural crops within the Fabaceae family as well, such as pea, common bean, soybean, peanut and many more (Petruzzello, M. 2021). However, as seen in Figure 12, all of these plants have distinguishing characteristics and looks that make each of them unique. It is obvious that lupine, sweet pea, and the telegraph plant all have the same flower shape, and what differentiates them is the amount of flowers per stem, their color and size of the flowers, and their leaf shapes. For the sensitive plant, it looks quite different from the rest, but the leaves have the same moving properties as the telegraph plant. They all also differentiate in the growth requirements within the plant market, as noted in Table 1 below.

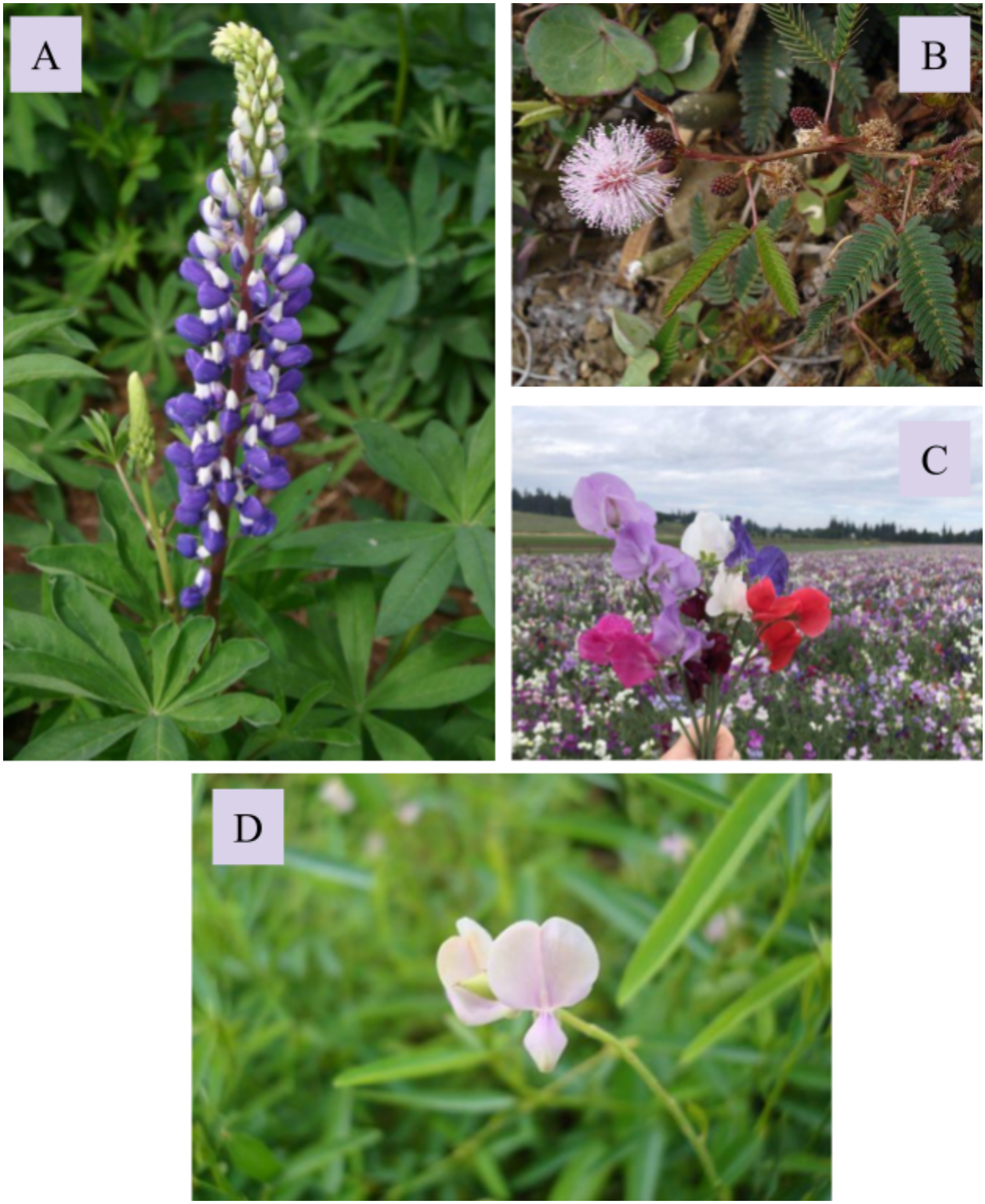

Figure 12: Comparison of (A) Lupine, (B) Sensitive Plant, and (C) Sweet Pea to (D) Telegraph Plant. Photos by Silver Falls Seed Company, Britannica, and Kwan Han.

Table 1: *Codariocalyx motorius* compared to other Fabaceae family plants			
Plant Species	**Plant Height x Width (inches)**	**Flower Color**	**Sun Requirements**
Codariocalyx motorius	H 24-48 x W 12-24	Light Pink/Purple	Full sun
Lupinus	H 12-36 x W 12	Blue/Pink/Purple/ Red/White/Yellow	Full sun
Lathyrus odoratus	H 36-96 x W 96	Blue/Pink/Red/ White	Full sun
Mimosa pudica	H 18 x W 12-60	Pink	Full sun/Partial sun

Codariocalyx motorius would be an excellent low-growing foliage shrub addition to a patio container, flower pot, or houseplant with its unique characteristic to move its leaves based on sound and light. It would pair beautifully in a container pot with sweet peas, which have brightly colored flowers and vine out and down, allowing for *C. motorius* to fill out the upper portion of the container.

PRODUCT INFORMATION GUIDE (PIG) & CROP SCHEDULE

Codariocalyx motorius is a seed propagated plant, since it is a member of the Pea family, and does not produce a woody stem. However, since the plant begins to produce seed pods in its second year, this plant has no problem relying on the production of seed for cultivation (Gilbert, S.F. 2000). These seeds will be sown in a 72-cell plug tray for their initial germination. In the non-native range of *Codariocalyx motorius*, seeds can be sown indoors at any time of the year, so long as they receive growing temperatures between 75ºF to 80ºF (Telegraph Plant (CODARIOCALYX motorius)...). The use of a greenhouse and a mist house would be optimal for growing this species as a houseplant or for nursery stock. This would ensure minimal pest damage, prevent weeds from getting too out of hand, and allow for consistent optimal growing temperatures and lighting until they’re ready for retail sales.

A general growth experiment was conducted to determine germination rate of *Codariocalyx motorius* seeds and days until true leaf formation, as well as lateral leaf movement response. This was conducted at the University of Minnesota Twin Cities' Plant Growth Facilities on their St. Paul campus. 33 cells of a 72-cell plug tray were seeded into a germination mix, covered lightly with vermiculite, and then placed into the mist house in the Plant Growth Facilities. Germination of 20 out of the 33 seeds took approximately two weeks, resulting in a germination rate of 60.6% success. The plug tray was moved onto a capillary mat in the main greenhouse where it received morning and evening daily watering with fertilizer on monday through friday, and without fertilizer on saturday and sunday. They were moved off of the capillary mat after one week, totaling to three weeks of observed growth. In the fourth week, they were transplanted into 3-inch square pots using a regular growth soil medium and no vermiculite. In week five, all seedlings had four leaves, were around 2-3 inches tall, and were responding to claps by moving their leaves as well as showing signs of following the circadian rhythm.

The germination and growth habit tests of *Codariocalyx motorius* were successful in all aspects from rate of germination to movement response from claps. The *Codariocalyx motorius* seeds were fairly large and came in a small quantity, therefore only one seed was planted per plug cell. These seeds did not receive any treatments before sowing, however other growers have stated that soaking the seeds in warm water for up to two days prior to planting helps increase germination success (Dyer, M.H. 2021).

Like in this experiment, once the seedlings have germinated and have grown about an inch in height, they should be transplanted into larger pots and placed in the greenhouse. Placing them into 3 or 4-inch square pots while they are still young allows for their roots to grow at a

faster rate, as with *Codariocalyx motorius*, the seedlings grow faster than the mature shrub (Codariocalyx motorius… 2014). If intended for perennial uses in hardiness zones 10 or 11, then they can be transplanted into 3 or 4-inch square pots to help accelerate growth. However, they would need to be transplanted into gallon pots as they begin to fall over onto other seedlings seen in Photo A of Figure 13 below. Branching will occur within one month of growth off of the main stem, and they will begin to take a shrub-like form once they exceed 8-inches tall, as seen in Photo B of Figure 13 below.

Figure 13: (A) Mature *Codariocalyx motorius* in 3.5-inch pots falling onto the surrounding seedlings. (B) Mature *Codariocalyx motorius* beginning to take on a shrub-like appearance. Photos taken by Rachael Norton.

Flowering will not occur on *Codariocalyx motorius* in the first year of growth, therefore the next steps are to induce growth and ensure the main stem is retaining strength. Since this is in the *Fabaceae* family, and naturally grows and flowers in warmer climates, this species is assumed to be a day-neutral plant, therefore will be kept in the regular greenhouse and monitored

weekly for growth and movement. If kept in the greenhouses for the second year to begin producing flowers, budding will occur naturally off of the first year growth stems, and will not require any treatments beyond watering with fertilizer. Right before budding or when the buds are forming on this plant is when they are ready for perennial and annual shipment to retail stores. However, they can be ready for houseplant retail sales as early as three months after germination. After the product is decided for houseplant retail or nursery retail, the product is prepared to ship out to wholesalers and retailers around the country.

Table 2: *Codariocalyx motorius* Time Periods of Each Growth & Distribution Phase

Stages	**Time Frame (in days)**	**Description**
Soaking Seeds	2	Soaking the seeds for 48 hours in warm water.
Germination	7-14	In 72-cell plug trays, and an area with moisture and light for one to two weeks.
Transplant to Pots	21-28	Transplanting to 3 or 4-inch pots after three to four weeks in plug trays.
Branching	28-50	Branching develops four to five weeks after germination.
Houseplant Distribution	50-72	Shipment and sales for houseplant use begin within three months of germination.
Annual & Perennial Distribution	365+	Shipments and sales for annual and perennial use begin after at least one year.

Since the *Codariocalyx motorius* species has only been cultivated and sold for seed sales and not vegetative, there will need to be research and refinements made to nursery production practices. It is known that *Codariocalyx motorius* is tolerant of higher humidity, however it

would be beneficial to research other conditional needs and the ability to withstand other severe weather conditions like drought ((Telegraph Plant (CODARIOCALYX motorius)...). Additionally, there are other species within the *Fabaceae* family that can withstand colder temperatures, such as the hardiness of *Dalea purpurea* in Zone 3 (Dalea Purpurea. 2009). Improving cold hardiness would be the first step into expanding the marketability of this species. Until then, knowing the impact of various weather conditions on this species will help to determine which markets will have a higher success in selling *Codariocalyx motorius* as an annual or perennial. However, impact on weather would not be necessary to know for houseplant sales of this shrub.

There may be some resistance from consumers to buy such a foreign concept of a visibly moving shrub and use it in their landscapes and potted arrangements. However, if working alongside plant breeders, there could be ways to accomplish making this plant more aesthetically desirable for seasonal landscapes. With such a small flower, and the main appeal being in the foliage, many consumers may desire a more colorful or flashy fluorescence, which can potentially be improved with selective breeding. However, the breeders would need to be conscious of the aspect that makes this plant stand out: its ability to move. Losing this characteristic would reduce its marketability for something unique and available in the market.

Acknowledgments

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