

***Oenothera stricta*: A Future Addition to Bedding Flowers**

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EXECUTIVE SUMMARY

Oenothera stricta, commonly known as Chilean evening primrose, is an herbaceous perennial native to the mountainous regions of Chile. Although naturalized in the United States,

the plant has yet to be subject to any large-scale domestication project intended for cultivation and market production. Despite being slightly wild in appearance, *Oenothera stricta* has showy, fragrant flowers and growing tendencies practical for commercial production. The potential for popularity as a bedding plant is high due to the species' ability to be readily propagated and grown in a wide range of environmental conditions. While only hardy to warmer climates found in the southern regions of the United States, there exists the possibility of *Oenothera stricta* to be grown as an annual in colder climates. Its unique form and appearance in the garden will attract consumers interested in a new ornamental addition to the bedding plant market.

I. INTRODUCTION

A. Study Species.

[Goal 1. The New Crop Species] *Oenothera stricta*.

B. Taxonomic Classification and Geographic Distribution in the Wild.

[Goal 2]

Oenothera stricta, also known as Chilean evening primrose, South American evening primrose, fragrant evening primrose, or sweet sundrop, is a flowering annual/biennial plant. It is a member of the Onagraceae family also known as the willowherb or primrose family (Wagner, 2017). The known subspecies is *Oenothera stricta ssp. Stricta*. It is native to South America, specifically Chile. However, it has been widely naturalized in southern California as well as Hawaii in the United States. Due to the plant's origin in arid, mountainous Chile, it is best suited for well-drained growing conditions where it thrives and multiplies readily (Wagner, 2017).

Oenothera stricta is native to temperate latitudes within the Andes mountains but is known to rapidly spread in lower elevation areas. Additionally, it has recently been discovered to colonize areas of high elevation in the Hawaiian Islands (Robberetch, 1983). Considering its native habitat, *Oenothera stricta* can be expected to grow best in well moist environments and flower under full sun, long day conditions. However, it seems rather adaptable and may suit dryer

growing conditions as well. It is also important to note this plant species exhibits invasive, spreading tendencies and has naturalized itself outside of its native range in the United States. Preventing crop spread may be an issue if it is not cost-effective.

Appearance-wise, *Oenothera stricta* is comprised of a bushy, grass-like base in which it sends out long inflorescence stalks. In bloom, the species reaches sixty to ninety centimeters in height and continues to spread widthwise. The flowers themselves are often yellow but sometimes contain white, orange, or red hues and take the form of a hypanthium. The exact time of bloom depends on location, but generally flowers appear from mid-spring until late summer and are quite fragrant. The leaves are long, narrow, and linear in shape with a crinkled or wavy appearance to them. Fruits are cylindrical and green in nature in accordance with the primrose family and are seen during flowering season. Overall, it is a unique plant that is appealing to the eye and would make a great garden plant based off aesthetics. Pictures are shown below in Figures 1-3.



FIGURE 1. Flowering *Oenothera stricta* in its natural habitat. Dave's Garden.

<https://davesgarden.com/guides/pf/showimage/246644/>



FIGURE 2. *Oenothera stricta* flower. Dave's Garden.

<https://davesgarden.com/guides/pf/showimage/246644/>



FIGURE 3. *Oenothera stricta* reproductive flower parts. Dave's Garden.

<https://davesgarden.com/guides/pf/showimage/246644/>

Although it could be assumed that indigenous peoples in South America most likely came into contact with this plant and used it, specific information on this topic is unavailable and therefore cannot be stated officially. The plant is entirely edible including the flowers, leaves, fruit, seeds, and roots. The seed oil is especially sought after, and the crop has been subject to many studies experimenting with its potential for becoming an oil production crop (Groenewald, 1994).

II. CROP SPECIES

A. History and Potential Uses.

[Goal 3]

The history of *Oenothera stricta* is rather unclear as most of the official documentation of the species consists of brief mentions in an overall analysis of the genus *Oenothera* at large. The history of *Oenothera* is based widely in scientific research with the plants serving as an early template in studies on plant genetics, evolutionary biology, and cytogenetics (Greiner, 2014). It has been subject to lab studies since the late 1800's, contributing to a long term and well-built

understanding of the genus in regard to population trends, role in the environment, and taxonomy. More recent research on *Oenothera*, including *Oenothera stricta* is based on oil seed content, as mentioned previously. The seeds are known to be high in fatty acids and the genus has the potential to serve as a future oil seed crop (Greiner, 2014). Although there is substantial history of the crop based in biological study, there is an obvious lack of research in the area of cultivation. *Oenothera stricta* specifically as a species has even less data on any attempts at greenhouse production.

Oenothera stricta, based on present research, has been subject to few attempts at domestication. For the most part, it is simply a wild species that grows in its native habitat and has naturalized in areas of the United States where it has acclimated. There is currently one cultivar currently on the market known as ‘Sulphurea’ sold at Dorset Perennials. A picture of this cultivar is shown in Figure 4. Additionally, the plant is sold as a wild species at “Digging Dog Nursery” in California. This is depicted in Figure 5. In order to further introduce this crop to the market, it would first need to be bred for domestication in the private sector at a breeding firm such as Progeno or BioConsortia. It could also be bred within a public sector such as at a state university or college. A research center in Hawaii or California may be best fit since the species already grows wild in those regions and would be the most easily accessible. Domestication and selective breeding would need to be done to help eliminate spreading factors of the plant and further curate it for a garden environment.



FIGURE 4. *Oenothera stricta* 'Sulphurea' sold at Dorset Perennials.

[https://dorsetperennials.co.uk/product/oenothera-stricta-sulphurea-odorata/#iLightbox\[product-gallery\]/1](https://dorsetperennials.co.uk/product/oenothera-stricta-sulphurea-odorata/#iLightbox[product-gallery]/1)



FIGURE 5. *Oenothera stricta* sold at Digging Dog Nursery.

<https://www.diggingdog.com/plant/P-0108>

Considering the aspect of propagation, this crop would most likely be propagated asexually via vegetative cuttings of the roots to speed up production and have the plant readily available to consumers for planting. Additionally, the germination rate of seed is rather low, further advocating for vegetative propagation. However, seed packets may also be a potential addition to the market for this plant, given that consumers are aware of the rates of successful germination. Since this species is new and undomesticated, seed propagation during the selective breeding process would be essential to producing genetically diverse offspring with an array of characteristics to be analyzed. Of course, further seed propagation would continue if breeders wanted to produce additional different cultivars or varieties of the plant in the future. Certain cultivars may move further down the distribution chain if breeding companies do not also overlap in the vegetative propagation production stage as well as the distribution, commercial growing, and retail sectors. A visualization of the horticultural distribution chain is shown below in Figure 6.

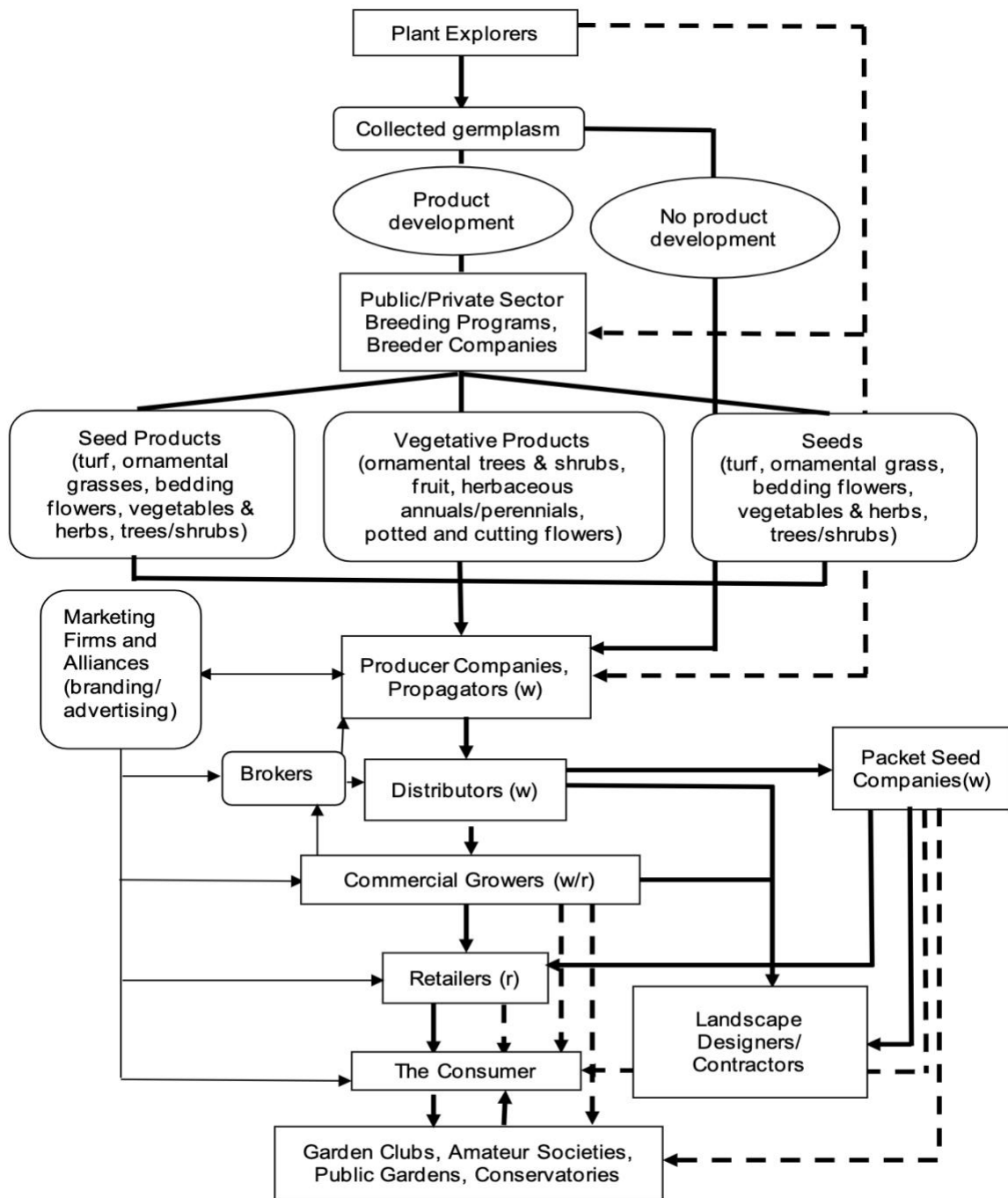


FIGURE 6. The Horticultural Distribution Chain (Drew, et al. 2010).

III. PRODUCTION INFORMATION

A. Anticipated Cultural Requirements.

[Goal 4]

Oenothera stricta functions primarily as a perennial, reseeding itself in the warm climates it is native to year-round. On the other hand, it also had the potential to be grown as an annual in

colder climates (Mihulka, 2001). It could be positioned in the horticultural market as a perennial garden plant for warmer climates and an annual for colder climates. It is unknown how cold hardy the species is and how it would function in certain USDA hardiness zones. Research on that aspect of the species is needed in order to domesticate it as a marketable plant for some colder regions. Based on current information, the species may not survive winters in the northern United States and would need to be replanted as an annual.

Depending on the location of distribution to consumers, the marketing of this plant would be for an outdoor garden space. *Oenothera stricta* could be labeled as an herbaceous garden perennial for warmer climates or an annual bedding plant for cooler climates. The plant would most likely be prized for its showy flowers and unique form in the garden and would be grown and sold primarily as an ornamental. The flowers are known to give off a sweet fragrance when in bloom which would appeal to the consumers who partake in flower gardening. However, all parts of the plant are edible which could also be attractive to the herbal garden market. It is unknown whether the leaves, flowers, roots, etc. have much of a flavor and whether or it would attract consumers. More research is needed on the edible aspect of the plant and its marketability.

Oenothera stricta is known to have colonized its native regions in South America as well as the warmer regions of the United States in California and Hawaii. With specific regards to sell this as a garden plant in the United States, only the climates of this region will be taken into account. Based on the native habitat and colonization areas, *Oenothera stricta* would be best suited to be grown in USDA hardiness zones of six and above in the United States as a perennial. A map of the USDA certified climate zones is depicted in in Figure 7 below. The species could also be grown in hardiness zones below six, but only during the summer after the risk of frost has passed.

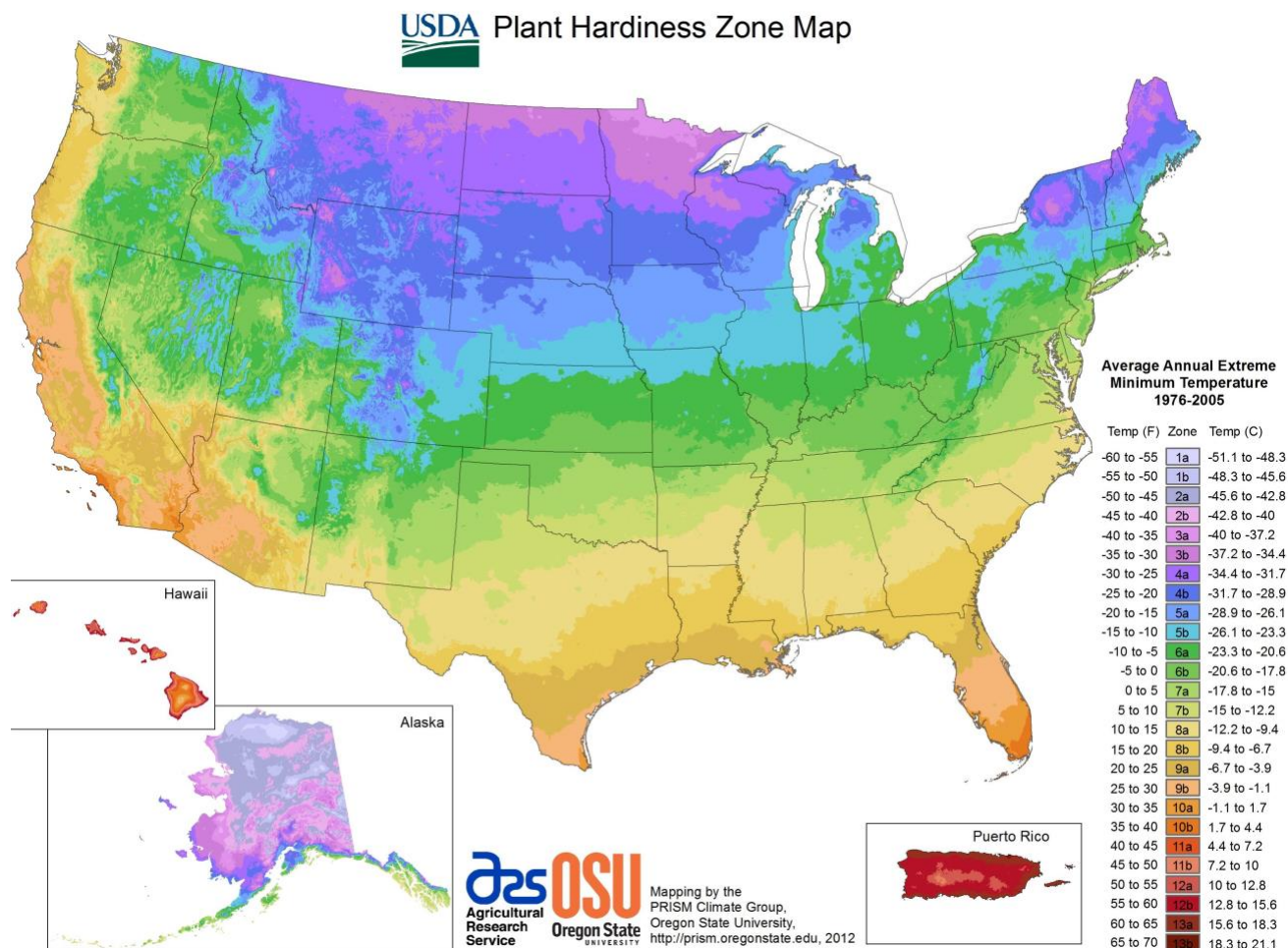


FIGURE 7. Hardiness zones of six and above are seen in green, yellow, orange, and red on the map. *Oenothera stricta* is hardy to these zones. USDA Hardiness Zone Map.

Oenothera stricta, based on recommended growing conditions for the genera, would take up a six-month production schedule. Propagated from seed, the plant would require light and moisture for germination and seedlings can be expected to emerge in one to two weeks (Bell, 2009). Light requirements are depicted in figure eight. It is also recommended to soak seeds for a twenty-four-to-forty-eight-hour period before planting due to a thick seed coat. Continuing onward from germination, long days with sixteen hours of light and eight hours of darkness are recommended for a daily schedule throughout the rest of production. Short days are known to inhibit flowering in the reproductive stages. Temperatures throughout the entire production should range from eighteen to twenty-one degrees Celsius. Soilless germination media is

recommended for early growth stages. Around the ten-day mark, seedlings should be transplanted into individual pots with a well-drained potting medium such as a mixture of sand, vermiculite, and peat. Final size pots are a recommended eighteen centimeters. *Oenothera* are often tolerant of a range of substrates and can thrive in low nutrient conditions, but well-drained soil along with proper fertilization are recommended for optimal growth. The genera have been noted to grow best provided with the following nutrient supplements: 150 mg/l microelements, 100 mg/l Fe-chelate, and 1g/l slow release NPK fertilizer (Greiner, 2014). A characteristic of *Oenothera* is the variation of flowering conditions for each species. Since there is no current data on the flowering behavior of *Oenothera stricta*, research is needed in this area. It is unknown whether vernalization is required to induce flowering and when bolting occurs. Additionally, disease and insect problems for commercial production of *Oenothera* in the United States are not known to exist.

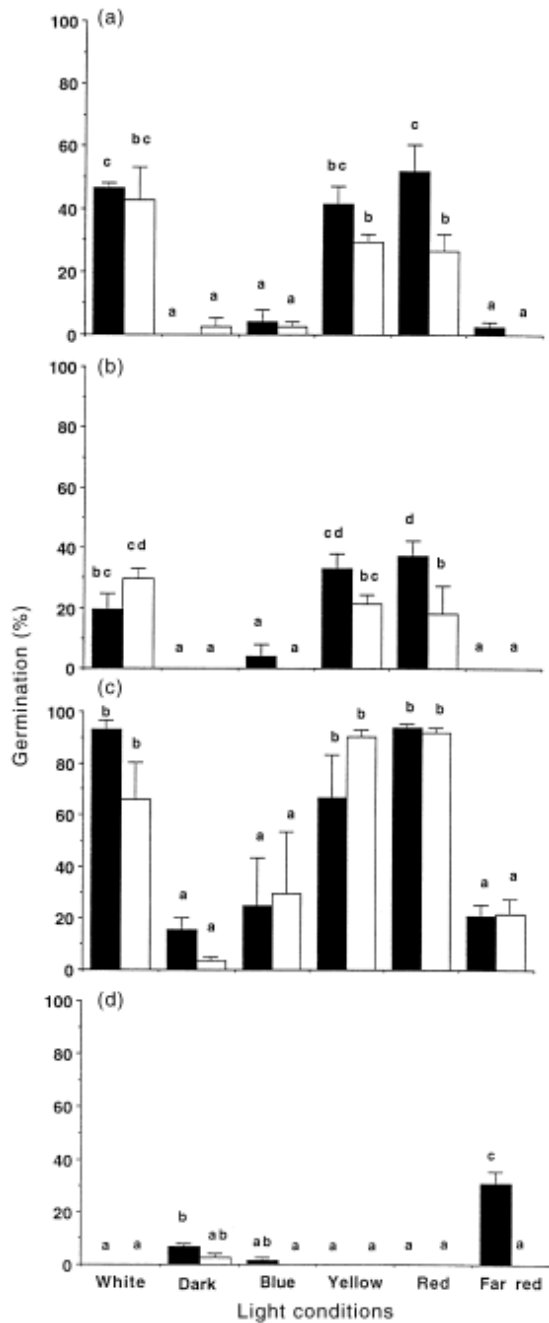


FIGURE 8. Germination of *Oenothera stricta* under specific lightning conditions shown in (a), the top graph (Bell, 2009).

B. Market Niche.

[Goal 5]

Oenothera stricta is best suitable to be sold in the spring in order for consumers to sow seeds or transplant pre-grown plants into their outdoor garden for summer growth and flower bloom. It also has the potential to be sold year-round in warmer climates of the United States. Based on primary literature on the species, problems with invasiveness and spread are a

possibility. The genus *Oenothera* is characterized by its ability to easily spread and take over a garden. If breeding techniques cannot eliminate this factor prior to introducing the species to the market, gardeners must be advised to keep the plant well maintained.

Competitors of *Oenothera stricta* would include other market available evening primrose species as well as other semi-tall, spring and summer blooming flowers such as lilies. *Oenothera speciosa*, *Oenothera macrocarpa*, *Oenothera pallida*, etc. are all prime examples of other evening primroses that are currently available to consumers and would compete with *Oenothera stricta*. Important to note, also, are the dominant plants of the bedding plant market. Consumers are largely familiar with a small group of very popular plants such as impatiens, petunia, alyssum, marigold, chrysanthemum, and a few others. While *Oenothera stricta* is relatively distinct and different from the most popular species on the market today, there will still need to be marketing efforts in order to make Chilean evening primrose a known competitor.

Chilean Evening Primrose, scientifically known as *Oenothera stricta*, is the new up-and-coming addition to the garden bed market. Similar to other evening primroses, the species blooms continuously throughout the growing season producing beautiful yellow flowers from April through September. Looks aside, the flowers also give off a sweet aroma which makes any walk through the garden simply divine. However, unlike its cousins which stay low to the ground, Chilean evening primrose grows two to three feet upright due to its long flowering stalks. Perfect for the back and edges of the garden, this unique specimen adds a splash of interest to the onlooker's gaze. This garden showstopper is anticipated to hit the market in spring of 2024. Consumers best keep an eye out for the debut of Chilean evening primrose.

IV. PRODUCT INFORMATION GUIDE (PIG) & CROP SCHEDULE

[Goal 6]

Oenothera stricta are a robust species, but greenhouse production of the plant is optimal since the purpose of the plant is a garden perennial/annual. If produced in the warmer regions

such as the southern United States, field production may be viable. A finalized production schedule differs whether the grower chooses to grow from seed or root cuttings. In the case of seed, planting should be done in a well-drained, soilless germination mix. In contrast to the literature cited above in the potential product environment which recommends a twenty-four to forty-eight hour soaking period of the seeds, personal research found that soaking seeds inhibits germination. Germination only occurred when seeds were planted dry and occurred in a time period of seven to fourteen days. Germination rate was found to be very low at about 30%. For this specific reason, it is highly recommended to commercially produce this crop asexually via vegetative cuttings of the roots if the end goal is large scale production for market sales.

Furthermore, light is required for seed germination, so it is best recommended to sow seeds on top of the germination medium without covering. Long days are required, so it is essential to keep them under a schedule of sixteen hours of light per day throughout the entirety of the growth period in order to produce a viable crop. Additionally, the size of the seed is very small. If commercial production were to take place in a greenhouse, which is recommended in order to yield best results from a controlled environment, seeds should be sown in 288 plug trays. If possible, research should be done on germination rates on pelleted seed in order to provide easier planting during the production process. A depiction of seed size and profile is provided in Figure 9 below. Temperature throughout germination should range from eighteen to twenty-one degrees Celsius and soil should be kept consistently moist. This temperature is also expected to be used throughout the rest of the growth stages as well.



FIGURE 9. Seeds of wild *Oenothera stricta*. Measured to be slightly bigger than a centimeter. Chileflora. <http://www.chileflora.com/Florachilena/FloraEnglish/HighResPages/EH0012A.htm>

After seedling emergence, which takes one to two weeks, plants should be given time to develop a set of true leaves before transplanting. This practice will help ensure the seedlings remain healthy through the acclimation process for their new container. True leaf development usually occurs by the two-week mark, as true leaves show about seven to ten days after germination. Seedlings should then be transplanted into bigger individual containers, ideally somewhere around ten centimeters wide. These containers will function as an in-between before eventually transplanting again into final eighteen-centimeter containers. Another well-drained potting mix is recommended. This potting mix should ideally consist of sand, peat, and vermiculite. It is recommended the transplanting mix have supplemental nutrients, otherwise fertilization will be required in the form of a slow release NPK fertilizer. From this point on, *Oenothera stricta* can be left to grow until the three to four-week mark after germination where it

reaches its rosette stage. This is the ideal time to transplant into final eighteen-centimeter containers. The same light, water, and soil conditions can be carried through the second transplanting process. Watering should ideally be done at least once a day from the time of transplanting germinated seedlings to mature plants.

Around the six-week mark (after germination) is when plants will likely begin to bolt, but this may also not happen until the eight-week mark. There is no conclusive data on the specific growth period times and bolting habits of *Oenothera stricta*, but general time periods can be given based off data found on similar evening primrose species. Flowering can be expected to occur ten to fifteen weeks after germination. This is six to eleven weeks after final transplanting.

Important to detail is the vegetative propagation and production of *Oenothera stricta*. Parent plants will be needed in order to take root or stem cuttings, so a substantial population of mature plants will be needed in order to vegetatively produce the plant. *Oenothera stricta* has a long, thick taproot in which smaller roots extend outwards of. A visualization of the root is depicted in Figure 10. The smaller horizontal roots or stem cuttings taken may be severed and placed in germination medium where they root readily. Time allotted for the growth and development of stem or root cuttings is unknown but can be assumed to be around a one-to-two-week period. In the case of root cuttings, the same guidelines described for seed germination may be applied for the continued production process. Stem cuttings, on the other hand, should be allowed time to substantially root in germination media and develop true leaves before transplanting to larger, individual containers.



FIGURE 10. Taproot of *Oenothera biennis*. The rooting system of *Oenothera stricta* can be assumed to look quite similar. USGS. <https://warcapps.usgs.gov/PlantID/Species/Details/3047>

The entire growth process from cutting/seed to selling point would be completed by the commercial grower and would take up a time slot of around five weeks. After mature development of the plants, they would be relocated to the retail sector for sales. This may or may not require shipment, depending on whether or not the commercial growers are part of a larger retail company. Ideally, plants are to be shipped out a week after being transplanted into final containers. This allows plenty of time for acclimation to the new container as well as at least a week before plants begin to bolt. The selling point of *Oenothera stricta* are the fragrant blooms, therefore it is ideal for the plants be at the flowering stage when placed on the shelves for consumers to view, buy, and transplant into their gardens.

In regard to the entire lifecycle of *Oenothera stricta*, a grower can assume a much longer period. The *Oenothera* genus can be expected to comprise a complete generation time of around five months. Plants take up to fifteen weeks to reach flowering stage with an additional four to

six weeks for seeds to mature and drop. Seeds can be planted directly after being released from the mother plant capsule for another cycle of cultivation. *Oenothera stricta* will die after flowering and seed drop has been completed.

Since greenhouse production of *Oenothera stricta* is highly recommended, production could potentially occur anywhere around the globe. The species is best suited to be produced by well-established garden plant producers who are willing to accommodate a new flowering plant in their production schedules. This would be the most efficient and sustainable method of production since it takes advantage of existing systems. *Oenothera* can be produced in unheated polyethylene foil greenhouses, structures that allow for prolonged growing seasons while additionally outcompeting traditional glass greenhouses in regard to lower cost (Greiner, 2014). Production of *Oenothera stricta* in a polyethylene foil greenhouse is one of the most efficient and sustainable methods of market cultivation. A visual depiction of a polyethylene greenhouse is provided in Figure 11 below.



FIGURE 11. Polyethylene foil greenhouse. Fruit Security Holland.

<https://www.fruitsecurityholland.com/en/polyethylene-foil>

V. ACKNOWLEDGEMENTS

The published literature, “Growing evening primroses (*Oenothera*)” was a major source of information and further resources used in this new crop paper (Greiner, 2014).

VI. LITERATURE CITED

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