

‘Yellow Spiderflower’ (*Cleome lutea*):
Investigating the Floricultural Potential of a
Peculiar Forb

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EXECUTIVE SUMMARY

Are you ready for a fresh new addition to your pollinator gardens and flower vases? Well the time is here to introduce to you the Yellow Spider Flower, a brilliantly unique annual sure to attract all sorts of life to your garden. As long as you can make sure to give this plant adequate sunlight and keep the soil from becoming waterlogged, you will be rewarded with bright yellow flowers buzzing with pollinators. Start the vernalized seeds indoors or in a protected environment to give this plant a jumpstart on life and transplant outdoors once the fear of frost has resided. No time to grow this beauty yourself? No problem! Soon, local garden centers and retailers will be stocking up on this beautiful plant and will have large, yellow blooms ready to burst come summertime. Plant in a pot, bed, or in a stand of wildflowers, either way this plant will show you why it's going to be the next new bloom you can't wait to have!

I. INTRODUCTION

A. Study Species.

When early EuroAmerican explorers set out to discover the western United States in the 1500s, while traveling through the desert scrub they may have discovered a peculiar forb with beautiful yellow flowers buzzing with insects. This species, later described by English botanist



Figure 1. Photo of *Cleome lutea* by Max Licher (SEINet)

Sir William Jackson Hooker in *Flora Boreali-americana* in 1833, is *Cleome lutea*, commonly referred to as ‘Yellow Spiderflower’ or ‘Yellow Bee Plant’ (Hooker, 1833). This species produces an indeterminant apical inflorescence that develops into long, seed-bearing pods once fertilized (Fig 1). It is a valuable pollinator food source for bees, wasps, butterflies, and other insects in its native range (Tilley, D., et al., 2012). The Yellow Spiderflower has potential to be an exciting new product in the floriculture industry as a cut flower, potted annual, and pollinator plant to the garden. This report will investigate this species’ taxonomy, distribution in the wild, history, potential uses, cultural requirements, market potential, and production information guide for cultivation.

B. Taxonomic Classification and Geographic Distribution in the Wild.

Table 1. Taxonomic Classification of *Cleome lutea* (ITIS Standard Report Page, 2014).

<u>Kingdom:</u> Plantae	<u>Subclass:</u> Rosanae
<u>Subkingdom:</u> Tracheobionta	<u>Order:</u> Brassicales
<u>Superdivision:</u> Spermatophyta	<u>Family:</u> Cleomaceae
<u>Division:</u> Magnoliophyta	<u>Genus:</u> <i>Cleome</i> L.
<u>Class:</u> Magnoliopsida	<u>Species:</u> <i>Cleome lutea</i>

Cleome lutea, commonly known as ‘Yellow Spiderflower’ or ‘Yellow Bee Plant’ and formerly known as *Peritoma lutea* is classified as a member of the family *Cleomaceae*. This family is closely related with the mustard family (*Brassicaceae*) and the caper family (*Capparaceae*). In 2009, the Angiosperm Phylogeny Group released an update of classifications for flowering plants that noted the segregation of genera from the order Brassicales to the *Capparaceae* family and the generation of a new family, *Cleomaceae* (Botanical Journal of the Linnean Society, 2009). This segregation is supported by a study by Iltis et. al (2011) that used molecular data and seed morphology to show basic differences between genera of these families. This species is in the genus *Cleome*, which is comprised of 180-200 species commonly referred to as ‘spider flowers’ or ‘bee plants’ (Cane, J., 2008). Species closely related to *Cleome lutea* are *Cleome serrulata* (*Peritoma serrulata*), or ‘Rocky Mountain Bee Plant’ and *Cleome platycarpa*, or ‘Golden Spiderflower’ (U.S. Forest Service). *Cleome serrulata* is an annual forb found throughout most of North America and is morphologically similar to *Cleome lutea*. A distinct difference between these species is in the coloration of their inflorescences. *Cleome serrulata*

produces pink pigmentation while *Cleome lutea* produces yellow pigmentation in the inflorescences. *Cleome platycarpa* is native to western United States and has a much smaller geographic distribution than its relative *Cleome serrulata* (USDA NRCS). *Cleome platycarpa* has a similar inflorescence coloration as *Cleome lutea* and is somewhat more difficult to distinguish from one another. *Cleome platycarpa* grows to about 40” tall while *Cleome lutea* often exceeds a meter in height (Tilley et al., 2012). *Cleome platycarpa* also has hairs on stems and leaves tipped with glands, features that are not seen on *Cleome lutea* (Spellenberg, 2004).

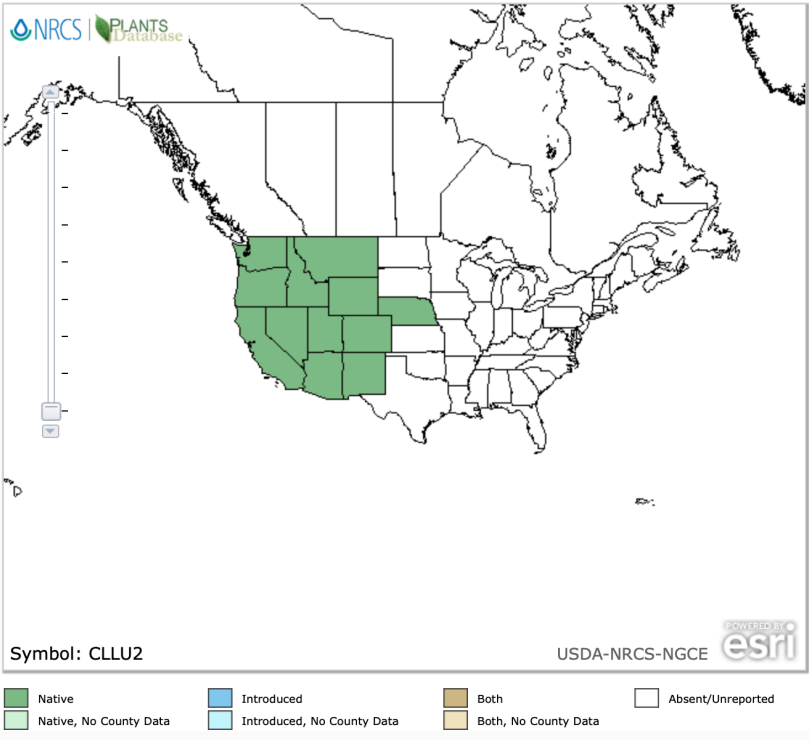


Figure 2. Geographic Distribution of *Cleome lutea* (USDA Plants Database)

Cleome lutea species' native range throughout the western United States. It can be found as far east as Nebraska, as far north as northern Washington, and as far south as California. Western Native Seed notes this species is hardy from USDA Zones 5-8. It can be found in arid to semi-arid environments throughout its native range such as desert plains and plateaus and is able to thrive in disturbed sites such as along roadsides and soils formerly flooded or filled with water

(Spellenberg, 2004; Vanderpool). Soils in this area are sandy to loamy and well-drained with a pH range of 6.0 – 8.0 (Tilley et al., 2012). Elevation in this species natural range ranges from 823 – 2195 meters (Utah State University Extension). Pictured in



Figure 3. Photo of *Cleome lutea* population by Jim Cane, USDA ARS, Logan, Utah (Tilley, D., et al., 2012)

Figure 3 is a stand of *Cleome lutea* in its native habitat (Cane, 2013). Other types of flora that are also in the native range of *C. lutea* are *Atriplex confertifolia*, *Artemisia tridentata*, *Tetradymia sp.*, *Juniperus spp.*, and *Sarcobatus vermiculatus* (Cane, 2013).

As previously mentioned, this species is in the Cleomaceae family which is very closely related to the Brassicaceae family, a family that consists of multiple invasive species in the United States such as *Alliaria petiolate*, *Brassica rapa*, *Capsella bursa-pastoris*, *Descurainia sophia*, etc. (USDA Forest Service). *Cleome lutea* is a potential invasive species due to its ability to produce

a large amount of seed, self-compatible characteristics (ability to self-pollinate), and its ability to survive on disturbed soils.

Cleome lutea is an annual forb that grows to a height of 45 – 150cm tall on one to several branched or simple erect stems bearing branches with palmately compound lanceolate leaves containing three to seven leaflets, each 6 – 6.3cm long (Spellenberg, 2004). The flowers develop on an indeterminate terminal raceme, each bearing 4 petals and 6 racemes. These flowers appear from May to September and develop into fruit pods 1.3 – 3.8cm long on long, arched stalks that are jointed at the middle. Flowers alternate between hermaphroditic or staminate forms throughout the blooming period (Cane, 2008; Tilley et al., 2012). Staminate flowers begin as hermaphroditic but fail to develop functional pistils. These flowers resemble flowers of the mustard family (*Brassicaceae*) very closely. One characteristic that distinguishes the two families is the length of the stamens, which in *Cleomaceae* are long and exerted (Tilley et al., 2012). Another characteristic of the reproductive system of *Cleome lutea* is its ability to express autogamy or self-fertilization (Cane, 2008). This is facilitated by coiling of the stamens inward, which occurs later in the day. This allows the plant to set a large amount of seed for the following year even when pollinators may be lacking due to the environmental conditions of its native habitat. An interesting phenological trait associated with flowering is the time in which flowers open. In a study by Cane (2008), flowers were observed opening 1 -3 hours after sunset. This contradicts previous



Figure 3, Anthophora Digger Bee feeding on *Cleome lutea* nectar (Cane, J., 2013)

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assumptions that a plant which attracts many pollinator insects such as bees, wasps, and butterflies would open new flowers during daylight hours when these pollinators are most active. It was observed by Cane (2008) that flowers accessible to pollinators were two-threefold more fruitful. It was concluded that the stigmas of this species receive some pollen at night through self-fertilization and in the morning are completely pollinated by activity of pollinators. Polylectic bees comprised of 31 genera were found to make up the majority of fauna that visit *C. lutea* for nectar and pollen (Cane, 2008). This species, like others in the *Cleome* genus, are tap-rooted, which allows the plant to reach deep soil depths to obtain water and nutrients (Tilley et al., 2012).

Native American tribes have used *C. lutea* as a remedy for colds by preparing the branches and flowers of the plant into a drink (Hunn, 1990). Leaves and flowers may also be boiled to make a dark pigment for painting pottery (Utah State University Extension). The leaves of this plant are known to be a good source of calcium and vitamin A and are eaten raw or cooked. Seeds are also edible. The Yellow Spiderflower's edible and medicinal qualities adds to its dynamic profile. *Cleome serrulata*, a close relative of *Cleome lutea*, is also used by Native American tribes and has many uses from culinary to medicinal (Belladonna, 2019).

II. CROP SPECIES

A. History and Potential Uses.

There are currently no commercial cultivars of *Cleome lutea* (Tilley et al., 2012). There is also no evidence that this species has been the subject of domestication or breeding programs. There are, however, multiple seed companies that sell seed of this species from wild sources. These companies are conservation seed companies that carry [open-pollinated](#) seed stock of many

species used in restoration and naturalization projects. Stevenson Intermountain Seed, Inc. (<http://stevensonintermountainseed.com>) has this species available for purchase through its website. Price is available by quote and no information was available about source of seed. Granite Seed and Erosion Control (<https://graniteseed.com>) has seed available for purchase by quote on their website and also provides product cultivation information. L&H Seeds (<http://www.lhseeds.com>) is another company that has this species in their seed catalog. A distribution chain for the domestication and production of *Cleome lutea* is depicted in Figure 5. This is not a complete distribution chain and only shows hypothetical firms that may be involved in the chain (Figure 5).

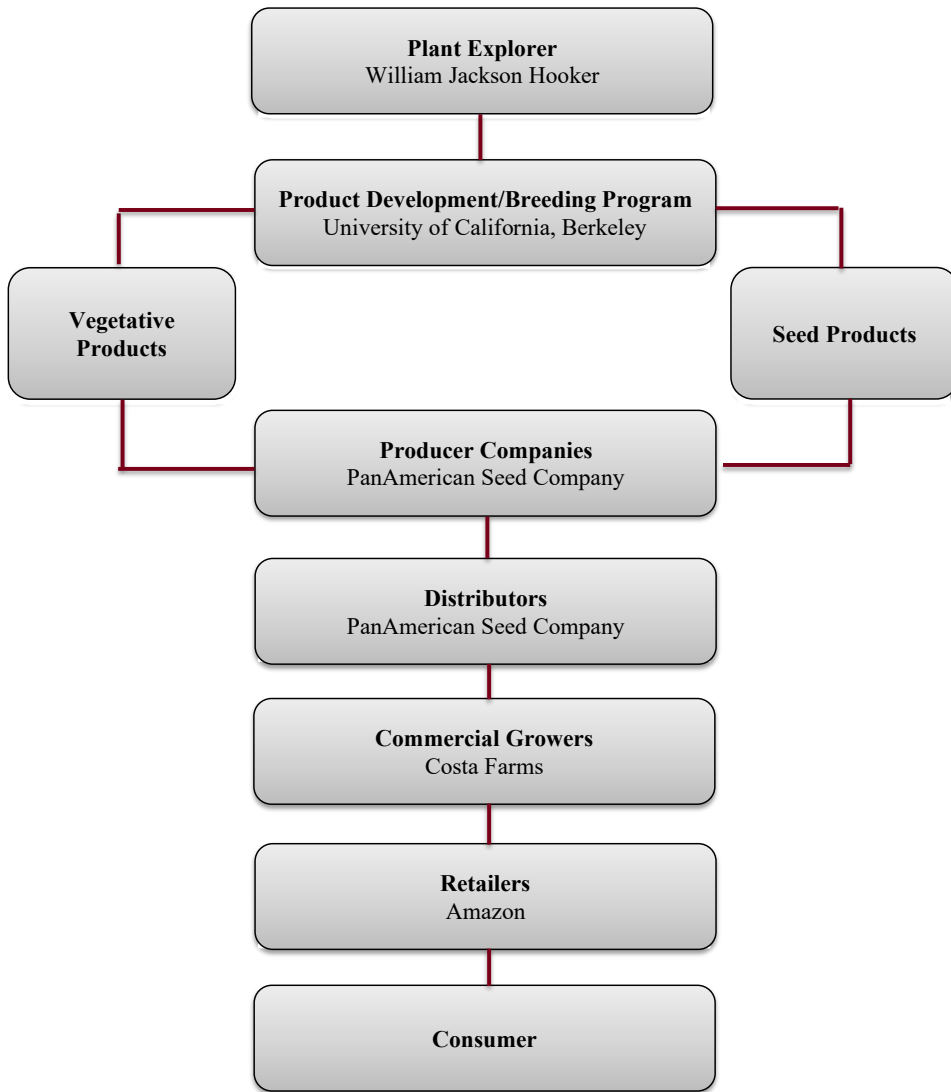


Figure 5. Potential horticultural distribution chain of *Cleome lutea*

III. PRODUCTION INFORMATION

A. Anticipated Cultural Requirements.

The Yellow Spiderflower is an annual forb that prefers full sun and fine to medium-textured, well-drained soils with a pH range of 6.0 to 8.0 (Tilley et al., 2012). This species is adapted to areas where annual precipitation rates average 20 to 45 cm. Seeds require stratification for 30 – 190 days in a cold, moist environment before germinating. Moisture is key to germination success as this species does not germinate if winter conditions are dry. Temperatures during stratification should range from 4 – 5 degrees C. After stratification, plant seeds 6 mm deep in germination media and cover. Seeds will germinate 10 – 14 days after planting (Tilley et al., 2012). Review of the literature for *Cleome lutea* produced no information on light requirements or photoperiod sensitivity in this species. It can be inferred that this plant does not flower in response to photoperiod but will flower once it reaches a minimum size requirement, which makes sense considering the natural habitat of this species. Western Native Seed notes that *Cleome lutea* has a bloom period ranging from May to July. If grown in northern climates, the bloom period may be different due to environmental conditions related to how much light the plant receives. This plant is noted to be hardy from USDA Zones 5-8 and will be susceptible to frost damage if grown as an annual in northern climates such as Minnesota (Western Native Seed). Excessive moisture may also be an issue for areas with medium to high precipitation as this species is adapted to arid conditions with low rainfall. No literature was found that refers to the fertility requirements for *Cleome lutea*. Its adaption to arid conditions with low moisture and

fertility suggests that this species would be on the lower end of the feeding spectrum if grown in greenhouse conditions. Plant growth regulators (PGRs) could be an option to decrease internodal spacing and height. Suggested optimal finishing container size for Yellow Spiderflower is 4” or 10.16 cm.

B. Market Niche.

Cleome lutea may find its niche in the market as an addition to pollinator gardens, a container plant, or possibly a cut flower. Modern breeding research is needed to investigate the phenotypic variation of this species and determine its potential in these various markets. A targeted sales date for this species as a container crop in Minnesota would begin in May and go on throughout the summer season. This coincides with the flowering time of the crop and when it is most attractive to consumers. Potential for invasiveness in Minnesota is low as this species’ seed is not hardy enough to survive Minnesota winters.

Non-perennial pollinator garden species and species in the genus *Lilium*, particularly cultivars grown as annuals and cut flowers, may be possible competitive crops to *Cleome lutea* due to similar uses and morphology, respectively.

Are you looking for a dynamic, stunning annual flower that attracts an abundance of pollinators and has multiple edible and medicinal uses? Are drought resistance, ease of growth, and showy yellow flowers characteristics that you’re looking for in your plants? Look no further because the Yellow Spiderflower is here and is all those things and more for you and your garden. Is *Cleome lutea* going to be an exciting new addition to *your* shopping list this growing season?

IV. PRODUCT INFORMATION GUIDE (PIG) & CROP SCHEDULE

LITERATURE CITED

Belladonna. "Cleome Serrulata: A Native American Addition to the Witch's Garden and Table, and a Friend to Bees and Butterflies." *Wytchery: A Gothic Cabinet of Curiosities and Mysteries*, 3 Oct. 2019, www.gothichorrorstories.com/witches-garden/witch-garden-feature/cleome-serrulata-also-known-as-a-native-american-addition-to-the-witchs-garden-and-to-the-table-as-well/.

Cane, James H. "Breeding Biologies, Seed Production and Species-Rich Bee Guilds of Cleome Lutea and Cleome Serrulata (Cleomaceae)." *Plant Species Biology*, vol. 23, no. 3, 2008, pp. 152–158., doi:10.1111/j.1442-1984.2008.00224.x.

Cane, James H. "Gardening for Native Bees in Utah and Beyond." *Utah Pests Fact Sheet*, Utah State University Cooperative Extension, Jan. 2013, digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1907&context=extension_cural.

Hooker, William Jackson. *Flora Boreali-Americana or the Botany of the Northern Parts of British America*. Verlag Nicht Ermittlbar, 1833.

Hunn, Eugene S. (1990). *Nch'i-Wana, "The Big River River": Mid-Columbia Indians and Their Land*. University of Washington Press. P. 352. ISBN 0-295-97119-3.

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Iltis, Hugh H, et al. “Studies in the Cleomaceae I. On the Separate Recognition of Capparaceae, Cleomaceae, and Brassicaceae1.” *Annals of the Missouri Botanical Garden*, vol. 98, no. 1, 2011, pp. 28–36., doi:10.3417/2007017.

ITIS Standard Report Page: Cleomaceae, 2014.

www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=822944#null.

“Part II: Family and Species Description.” *National Audubon Society Field Guide to North American Wildflowers: Western Region*, by Richard Spellenberg, Knopf, 2004, pp. 445–446.

Plants Profile for Cleome Lutea (Yellow Spiderflower),

plants.usda.gov/core/profile?symbol=CLLU2.

Plants Profile for Cleome Platycarpa (Golden Spiderflower), USDA NRCS,

plants.usda.gov/core/profile?symbol=CLPL.

Prendusi, Teresa. “Plant of the Week.” *U.S. Forest Service*, USDA,

www.fs.fed.us/wildflowers/plant-of-the-week/cleome_serrulata.shtml.

“Range Plants of Utah.” *Yellow Beeplant*, Utah State University Extension,

extension.usu.edu/rangeplants/forbsherbaceous/yellow-beeplant.

SEINet Portal Network - Cleome Lutea, swbiodiversity.org/seinet/taxa/index.php?taxon=12573.

Plant Materials Technical Note. Natural Resources Conservation Service, Sept. 2014,
www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mtpmctn12314.pdf.

Tilley, Derek, et al. "NRCS Plant Guide." *Natural Resources Conservation Service*, USDA, Jan. 2012, plants.usda.gov/plantguide/pdf/pg_cllu2.pdf.

"An Update of the Angiosperm Phylogeny Group Classification for the Orders and Families of Flowering Plants: APG III." *Botanical Journal of the Linnean Society*, vol. 161, no. 2, 2009, pp. 105–121., doi:10.1111/j.1095-8339.2009.00996.x.

"USDA Forest Service." *Brassicaceae*, USDA,
www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev2_037651.pdf.

Vanderpool, Staria S. *UC/JEPS: Jepson Manual Treatment for CLEOME Lutea*. Jepson Flora Project, ucjeps.berkeley.edu/cgi-bin/get_JM_treatment.pl?2852%2C2853%2C2854.

Wildflower Guide A to C, Western Native Seed,
westernnativeseed.com/wildflowers_A_C.html#clelut.