

CALIFORNIA POPPY

Eschscholzia californica Cham.

Plant Symbol = ESCA2

Common Names: California goldenpoppy, golden poppy, flame flower, copa de oro (cup of gold), dedal de oro (thimble of gold)

Scientific Names: Subspecies

Eschscholzia californica ssp. *californica* (ESCSC), *Eschscholzia californica* ssp. *mexicana* (ESCAM)

Description

General: California poppy is a flowering herbaceous annual to deep-rooted perennial. It is native to the western United States from southern Washington south into Baja Sur, and from the Channel Islands and Pacific coastline east to the Great Basin and regions of the Sonoran Desert (Hannan and Clark, 2012; Hickman, 1993). California poppy is one of 11 species of the *Eschscholzia* genus naturally occurring in the western United States.

In general, California poppy exhibits a growth form that is low-spreading to erect (0.5 – 2 ft) with basal and cauline foliage which is generally blue-green (glaucous) in appearance. Leaves are ternate, with three finely divided lobes, and are nearly glabrous. Plants produce upright flowers on freely branching stems with four satiny petals, colored bright orange to light yellow; flowers may also have distinct, darker orange centers. Within the genera, California poppy can be distinguished from the other species by the presence of a torus rim, a collar-like pedestal at the receptacle measuring from, which is unique to the species (Hickman, 1993). Flowers respond phototropically to low light levels, closing at night and on cloudy days. Plants with a perennial growth habit can produce flowers in the first year (Cook, 1962).

General observations for *Eschscholzia californica* indicate floral induction is a function of growth habit and plant age, occurring under optimum long day light conditions (day length greater than 12 hours) (Lyons and Booze-Daniels, 1986). Flowering is indeterminate, although plants occurring on harsh sites may appear determinant in nature due to environmental stress. In the Sacramento Valley of California, perennial forms begin flowering in early-March and can flower through mid-October with small amounts of supplemental irrigation. Growth habit (annual or perennial) as well as a number of environmental factors will influence actual bloom period and intensity.

Seed capsules are cylindrical in shape and dehisce longitudinally from the base when ripe. The capsules dehisce explosively, providing the primary means of seed dispersal, ejecting the small seed up to 6 feet from the parent plant. Seeds are spherical with a microsculpted surface, gray to gray-brown in color when mature. Seeds number from a few to greater than 100 per capsule.

There are two subspecies currently recognized: *Eschscholzia californica* ssp. *californica* and *E. californica* ssp. *mexicana* (USDA ARS, 2010). The subspecies are generally distinguished by seedling cotyledon appearance (Figure 2), seed dormancy, and the development of perennial structures such as taproots (Cook, 1962; Clark, 1978). Perennial plants of ssp. *californica* may also be distinguished by the accumulation of dried foliage around the base as older stems and foliage are replaced by new growth from the central crown of the plant.

Distribution: California poppy is native to the western United States from southern Washington south into Baja Sur, and from the Channel Islands and Pacific coastline east to the Great Basin and regions of the Sonoran Desert (Hickman, 1993).



Figure 1. California poppy in bloom, showing unopened bud in left foreground. Photo C. Smith, Lockeford Plant Materials Center, 2011.

Eschscholzia californica ssp. *mexicana* is endemic to the Sonoran desert region, occurring from eastern California to the Organ Mountains of Arizona, and from southwestern Utah into the Franklin Mountains of west Texas. It is postulated that the subspecies was isolated from the *californica* subspecies after the last glacial period, some 7,800 years ago (Clark, 1978). Within this desert region, the *mexicana* subspecies has adapted to the comparatively low annual precipitation, increased depth to ground water, and the duration and variation of extreme temperatures by shifting to an annual reproductive strategy that favors seed production over taproot development. Seeds germinate with the winter rains and shorter day lengths when temperatures are cooler and adequate soil moisture is available. Unlike the *californica* subspecies, *mexicana* does not form a traditional rosette before flowering, but rapidly grows and flowers while conditions are optimum. No variant forms of ssp. *mexicana* have been described within microclimatic regions of the subspecies Sonoran range.

The more “typical” and widely distributed California poppy, *E. californica* ssp. *californica*, occurs over a much broader array of habitats including coastal dunes, open slopes in redwood forest, arid plains, inland valleys, and desert fringes (Clark, 1978). Unifying environmental characteristics for these sites include sun exposure, available water (in the form of rainfall, fog drip or ground water) and a low to moderate level of competition for both sunlight and soil resources. In coastal areas where there is nearly year-round available water, *E. californica* ssp. *californica* are frequently perennial and may not enter a pronounced dormancy period if growing conditions remain suitable. When inhabiting arid regions, or in soils with low available water-holding capacity, subspecies *californica* is more likely to be characterized, as a summer dormant perennial or annual. Some populations are so consistent in their dormancy cycling that they are characterized as facultative annuals, while others are obligate annuals.

Three variants, or forms of *E. californica* ssp. *californica* are often identified: variant *crocea* (syn: var. *douglasii*) is a non-coastal perennial plant of medium size with dormant seeds. Flowers of this form can vary in color, size and number relative to resources and prevailing weather over the course of the season (Cook, 1962). This variant is considered adapted to conditions from Washington state south through the Central Valley regions of California and into southern California. Another variant which co-occurs, and may have displaced variant *crocea* in regions of the Sacramento and San Joaquin Valley and into southern California, is an annual form, variant *peninsularis*, which also has dormant seeds. Few distinctions beyond the variant’s annual life form adequately characterize or contrast *crocea* and *peninsularis*. It should be emphasized that the major distinction between *E. californica* ssp. *californica* perennial and annual growth forms, as described by Cook (1962), are the initiation of, and resources expended in the development of the root system: annuals tend to have an unthickened and slender tap root, while perennials tend to produce a deeper penetrating and much thickened root (Cook, 1962). The third variant, var. *maritima*, is described as residing on sand dunes and coastal bluffs from San Miguel Island to Monterey Co., California. These perennial plants produce multiple small rosettes from a large thickened taproot, have a prostrate habit, gray foliage and non-dormant seeds (Munz and Keck, 1968). A potential fourth form of *Eschscholzia californica* ssp. *californica* is var. *procea*, the Kernville Poppy. This variant is unresolved as to whether it is a subspecies variant or another species entirely (Hannan and Clark, 2012; Hickman, 1993); the plant grows in the foothills of Sierra Nevada in California.

For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Habitat: Other herbaceous plants which co-occur in native stands of subspecies *californica* include those associated with grassland and oak savanna in California, such as lupines (*Lupinus* spp.), clovers (*Trifolium* spp.), fringe pods (*Thysanocarpus* sp.), Lomatium (*Lomatium* sp.), and yarrow (*Achillea millefolium*). Notable for the desert adapted annual ssp. *mexicana* are annual lupines, Mariposa lily (*Calochortus concolor*), larkspur (*Delphinium hansenii*), and clarkia (*Clarkia* spp.) (CalFlora, 2010).

Adaptation

Within its historical range, California poppy occurs across a number of habitats including coastal, valley, foothill and desert regions, at elevations below 7000 ft (Hickman, 1993). California poppy establishes well on marginal disturbed sites, but

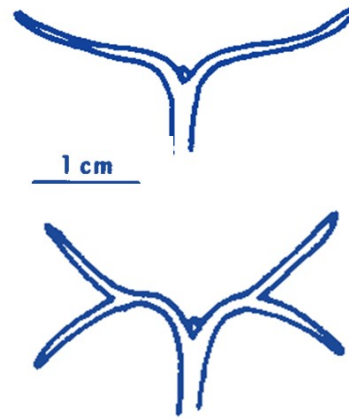


Figure 2. Top, *Eschscholzia californica* ssp. *mexicana* with two cotyledons; bottom, *E. californica* ssp. *californica* with bifid cotyledons. Diagram after C. Clark, 1978.

populations can be expected to decline in areas where competition for light and water becomes intense (Ratcliff et al., 1972), yet, what the species lacks in competitive ability, it regains in adaptive ability (Leger and Rice, 2003, 2007). In general, the species is capable of recovering from freeze events, as well as tolerating high temperatures, drought, variable precipitation regimes, and a wide range of soil textures, chemistries, and levels of fertility (Hickman, 1993; Munz and Keck, 1968; Ratcliff et al., 1972; McCully et al., 2004). The ability of this species to colonize varied environs of moderate to low competition contributes to success of the species as a horticultural plant as well as to its weediness in regions well beyond its natural range (Randall, 2007; Kirkpatrick, 1998; Leger and Rice, 2003, 2007).

Uses

Horticulture:

California poppy has been an important gardening plant in California and on multiple continents for almost 200 years. In 1826, ten years after Chamisso described *Eschscholzia californica*, English collector David Douglas collected seeds from a southern Oregon population for the Royal Botanical Society of England (Beidleman, 2006; McClintock, 1976). The collection would be amongst the first of a number of horticultural introductions of California poppy to regions far beyond the western United States. The popularity of gardens in the Victorian era, the global extent of European influence, and the development of international travel contributed to the plant's early distribution worldwide.

Wildlife

The California poppy has some direct wildlife value, with seed and seed pod comprising less than 5% of small mammal diets and providing minor cover for small birds (Martin et al., 1951). The importance of the species to mammals is likely increased in certain resource-limited environments. Indirect benefit to other animal species may be substantial as insect visitation and overall insect abundance may increase relative to the pollen-rich flowers. This floral resource, as a member of a diverse plant community, may serve as an important link in the food web.

Pollinators and Beneficial Insects:

From late February to late September, numerous and varied insects are attracted to the vibrant flowers and abundant pollen of the California poppy. The species is an obligate out-crosser, relying upon the pollination services of insects for reproductive success (Beatty, 1936; Cook, 1962) though reports of sterile plants have been recorded (Wright 1979). Common pollinators include bumble bees (Apidae), sweat bees (Halictidae), mining bees (Andrenidae) and European honey bees (Apidae: *Apis mellifera*). There is also evidence that up to five specialist pollinators (oligoleges) of the genus *Perdita* (Apidae) may gather pollen from California poppy and perhaps one other plant species, the mariposa lily (*Calochortus splendens*) (Timberlake, 1956). Other floral visitors in pursuit of food or refuge include thrips, hover flies, butterflies, minute pirate bugs and beetles (Cook, 1962). While incidental transfer of pollen can occur, these latter insects are generally not considered significant pollinators.

Erosion Control and Revegetation:

Seeds are used in erosion control mixtures, roadside plantings, and in restoration projects in California:

Medicinal:

Over 30 chemicals and secondary metabolites, many unique to the species, have been isolated from the California poppy (Duke, 1992; Kalvana et al., 2006). At least two of these, the alkaloids sanguinarine and chelerythrine, have generated interest for their anti-bacterial and cancer treating potential.

As with most plant chemicals, especially those derived from the poppy family (Papaveraceae), there is an implied dose-dependent toxicity.

Caution: California poppy may be toxic when taken internally without sufficient preparation.

Ethnobotany

The California poppy has cultural significance for many indigenous people of the western United States including the Luiseno, Cahuilla, Costanoan and Pomo tribes. While some tribes consider the plant poisonous, such as the Mahuna, most make routine use of the plant, or specific parts of the plant, as both a food source and drug. The roots, which generally contain higher levels of alkaloids, have been used as sedatives and analgesics (Moerman, 1998); one reference notes the stupefying effect being used to stun companions when gambling (Foster and Hobbs, 2002). The flowers, high in carotenoids and somewhat sweet, may be chewed as a gum or candy, while the rich pollen of the flowers serves as eye shadow or body paint for special occasions. Entire plants have been placed under the bed of children to hasten a restful sleep (Moerman, 1998).

Status

California poppy was proclaimed the official state flower of California in 1903.

Weedy or Invasive: This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed. Please consult with your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use.

Please consult the PLANTS Web site (<http://plants.usda.gov/>) and your state's Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Planting Guidelines

Seed Source Considerations:

Selection of varieties for urban and garden plantings should be made with consideration to the local climate, soil or potting media, and whether the planting will receive supplemental irrigation. For urban areas, planting objective, floral qualities, and the price of seed are often the main factors in selecting a seed source.

Successful natural area plantings depend on proper site preparation and the selection of adapted plant materials, i.e. seed from local populations or from populations with similar climate, soil texture and chemistry. In general, annual growth forms of California poppy may be better suited to short-term or interim groundcover applications, especially on arid sites with shallow or sandy soils, provided that a minimum level of precipitation is received during the critical winter growing season. Perennial forms are recommended for sites with moderate to deep soils (>18") and good drainage which allows for healthy tap root development. Evergreen perennial forms may persist best in coast environments and in areas where moisture stress is minimized.

The production history and identification of the origins of seed source are important considerations for restoration of natural areas, augmentation plantings, or if seeding areas are adjacent to native stands of poppy. Because of the physiological uniformity achieved in the horticultural breeding process, varietal releases may be ill-adapted to less managed settings. Non-varietal seed may be available as various types or classes of pre-variety germplasm such as "sourced identified", "selected", "tested" class germplasm. For current information on the seed certification programs and agencies please consult your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department. Wildland collected seed is also an option, though non-varietal agronomically cultivated seed can often be produced more economically than wild collected seed, and therefore greater quantities are made available for revegetation efforts.

Additional consideration may be warranted for plantings near historical populations since annual and perennial forms of California poppy readily hybridize as they are both considered obligate outcrossing plants and share common pollinators (Cook, 1962). In order to conserve genetic integrity within and among populations, the introduction of distant populations into historical populations or to areas where subspecies overlap is discouraged until more information is known.

Seed Dormancy:

Through the domestication process and the selection of horticultural traits, most complex seed dormancy requirements for garden variety California poppy have been reduced or eliminated. Domesticated California poppy seed germinated consistently, with little regard to treatment, except for high-heat treatments which have been shown to harm the seeds from most populations tested (Montalvo et al., 2002b). Any remaining seed dormancy can generally be overcome by sowing seeds in the fall as day-length decreases in locations with mild winters, or seeds may be sown in early spring in areas with harsh winters.

In contrast to horticultural varieties, seeds from wild California poppy populations often retain the seed dormancy characteristics correlated to the environmental conditions to which they have adapted. This is true for many wild populations, both annual and perennial, whether increased under agronomic conditions or wildland collected. In germination trials on southern California populations of *E. californica* ssp. *californica*, year of harvest affected dormancy in wild annual populations more than wild perennial forms, but seed dormancy was not significantly different after two years of storage (Montalvo et al, 2002b). For all wild populations included in the study, dormant seed treated with smoke increased mean germination rates above untreated dormant controls, though populations differed substantially in response to treatment and in baseline dormancy. The smoke treatments did not appear to be as significant for some populations aged more than 8 months before treatment. For some populations, mean germination of dormant seed was improved in 10 out of 13 trials with the addition of a cold moist stratification period following a dry smoke treatment (Montalvo et al, 2002b).

Wildland or natural area plantings should occur in the fall for most Pacific regions, including deserts, to allow for exposure to natural precipitation, light, and temperature conditions which favor dormancy release mechanisms. Pre-treatment of seed prior to planting is generally not recommended for wildland reestablishment, as seed dormancy will be naturally broken if adapted seed is sown at the appropriate time.

Agronomic seed increase plots are best established in the fall, though seed pre-treatment may need to start well in advance of planting. The more similar the seed increase fields are to the original wildland collection site, the less effort may be involved in pre-treating seed to break dormancy. In an agronomic seed increase planting, addressing seed dormancy requirements for

a given population at time of establishment should limit the unintentional selection against genes conferring dormancy and maximize seed germination rates (Montalvo, 2002b).

Seed may be relatively short-lived under room temperature storage, perhaps maintaining viability for about five years (Montalvo et al., 2002b). Seeds stored in paper envelopes in a tin box at the California State Seed Laboratory dropped to about 50% of initial germination rates in years 8 to 10 (Goss, 1937). More research is needed into the optimum seed storage conditions for *Eschscholzia californica*.

Site Preparation and Seeding Rates:

In general, California poppy grows well in full sun in soil with textures ranging from sand to clay loam, but not in sites with pooled water, or where soils are saturated or excessively moist for extended periods of time, either from irrigation or precipitation. Both subspecies are capable of colonizing marginal sites low in fertility, but do not compete well with established stands of grasses such as annual oat (*Avena fatua*) and perennial ryegrass (*Lolium perenne*) (Cook, 1962; Kirkpatrick, 1998). Best establishment, either in mixes or solitary stands, is achieved on low stubble or clean seedbed sites (Cook, 1965; Ratcliff et al., 1972). Further, California poppy may establish and respond to supplemental applications of nitrate fertilizer and to increased rooting depth provided by ripping site prior to seeding; poppy may establish poorly on sites with high soil organic matter (Montalvo, 2002a)

California poppy is successfully and most easily established from direct seed application. Non-dormant seed may be surface sown (broadcast) and harrowed to cover the seed to approximately 1/8"; the species has also been successfully established in hydroseeding mixes (Montalvo, 2002b). If seeding plants from dormant seed populations, deeper planting to between ¼ and ½" is more successful because light inhibits germination of the small dormant seeds (Montalvo, pers.comm.). If using California poppy in a seed mix, seeding rates will depend on desired objectives for site. Recommended broadcast rates for solitary stands are 3-4 lbs per acre (Brenzel, 2007), or 18-24 seeds per square foot. Rates for other seeding methods will vary based on desired objective.

The species is not tolerant of transplantation, unless the plug or container plant is very young.

Management

Once established, many adapted populations become self-perpetuating, both in terms of reseeding and plant density. Persistence within a site is dictated by the level of competition for soil and light resources. In a Madera California field mowed or grazed to unspecified stubble height, Ratcliff et al. (1972) attributed an increase in the density of poppy to a reduction in competition for light from an accumulated mulch layer and a reduction in the naturalized annual species rigput brome (*Bromus diandrus*) and broadleaf filaree (*Erodium botrys*).

Pests and Potential Problems

Though California poppy has a number of floral insect visitors, there are only a few recorded pests that inflict damage to the plant. Insects that feed on the sap of plants, such as thrips, aphids and leafhoppers, and Lepidopteran larvae which feed on leaves and flowers, are the most commonly encountered pests. Significant visual symptoms of damage, such as leaf stippling in the case of leaf hoppers and thrips, or malformed leaves with aphids, can be encountered in most plantings, although they are often more evident on stressed plants. Alfalfa looper infestation in California poppy has been observed to substantially reduce floral counts (Leger, 2007). In addition to causing leaf damage, plant pests are capable of vectoring disease. Of most concern for neighboring crops are the phytoplasm aster yellows spread by leafhoppers, as well as various complexes of the Tosspoviruses tomato spotted wilt and impatiens necrotic spot, most notably vectored by western flower thrips (*Frankliniella occidentalis*) (Dreistadt, 2001). Concerned growers should rogue suspicious plants as active infections of these diseases can produce various symptoms. Laboratory analysis of symptomatic plants may be considered in situations where the health or productivity of economic crops may be jeopardized.

The Papaveraceae family is susceptible to a variety of diseases of the roots (*Verticillium*, *Rhizoctonia solani*, *Sclerotinia sclerotiorum*), leaves and flowers (leaf spots *Cercospora* and *Septoria*) (Dreistadt, 2001). Powdery mildew (*Erysiphe*) and gray mold (*Botrytis*) are the most commonly encountered in California poppy; both are generally transient, non-lethal infections of aerial plant parts, and plants recover as the environmental conditions become less favorable for disease development. Stand reduction from disease may be exacerbated due to abiotic conditions, such as prolonged periods of saturated soil, over-fertilization, overcrowding and other conditions that induce plant stress.

Avoidance of disease is the best strategy: plants require good drainage, adequate sunlight (preferably full sun) and low to moderate ambient humidity.

Environmental Concerns

California poppy may be toxic to livestock (USDA, 2010). Monitor animal response and behavior for potential toxicity in grazing situations where poppy densities are high or where other forage resources are limited. Livestock palatability of *Eschscholzia sp.* as well as potency of the plant itself may depend on the growth stage of the plant as well as the age and class of animal.

Control

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Seeds and Plant Production

Seed size for the species will vary; for large seeded types, there are approximately 270,000 seeds per pound. One pound of large-sized seed spread over one acre will result in approximately 6 seeds per square foot. For seed production, California poppy is typically grown as an annual, regardless of actual (variant-dependent) life history, though there are exceptions where production fields may be held over for additional years. The species is planted at 3-5 pounds per acre in the fall. For fields in Central California, a single harvest is completed in early to mid-spring, depending on the production year and the development of the plant. Plants are swathed when a majority of the seed capsules show pronounced longitudinal veins, and just begin to change color from green to tan. The plants are field-dried on tarps, then either direct combined or the seed is collected from the tarps after pods have dried and shattered. Some growers report success using chemicals specifically developed as anti-transpirants to slow the moisture loss in seed pods, aiding in their retention on the plant. This production method requires the seed be harvested with a combine after being swathed. Seed yield varies between 200-500 pounds per acre. Seed is cleaned using standard seed cleaning technology.

Cultivars, Improved, and Selected Materials (and area of origin)

Cultivars should be selected based on the local climate, resistance to local pests, and intended use. California poppy has been actively propagated in the horticultural trade for at least 150 years. In that time, a number of traits have been purposely selected such as unique flower color, petal shape or petal number (Gould, 1976). Such poppies are often available as named varieties and are readily available from commercial sources. Germplasm collections and pre-varietal germplasm may be available. Consult with your local land grant university, local extension or local USDA NRCS office for recommendations on adapted cultivars for use in your area.

Literature Cited

- Beatty, A.V. 1936. Genetic studies on the California poppy. *J. Hered.* 27:330-338
- Beidleman, R.G. 2006. *California Frontier Naturalists*. Univ. of California Press, Ltd.. London.
- Brenzel, K.N. editor. 2007. *Sunset western garden book*. Sunset Publishing Inc. Menlo Park, California.
- Calflora. 2010. *The Calflora Database*. (www.calflora.org. 1 January 2010). Calflora Database. Berkeley, CA 94709.
- Clark, C. 1978. Systematic studies of *Eschscholzia* (Papaveraceae). I. The origins and affinities of *E. mexicana*. *Syst. Bot.* 3(4): 374-385
- Cook, S.A. 1962. Genetic system, variation and adaptation in *Eschscholzia californica*. *Evolution.* 16(3):278-299.
- Dreistadt, S.H. 2001. Integrated pest management for floriculture and nurseries. Regents of the Univ. of California, Division of Agric. and Nat. Resources. Oakland, CA.
- Duke, J.A. 1992. *Handbook of phytochemical constituents of herbs and other economic plants*. Boca Raton, FL. CRC Press. [Online database: <http://www.ars-grin.gov/duke/plants.html>. 1 January 2010].
- Foster, S, and C. Hobbs. 2002. *A field guide to western medicinal plants and herbs*. Houghton Mifflin Company, New York.
- Gould, R. 1976. The California poppy-garden hybrids. *Pacific Hortic.* 37(1):6-8.
- Goss, W. L. 1937, Germination of flower seeds stored for ten years in the California State Seed Laboratory. *Bulletin of the Department of Agriculture, State of California.* 26(3):326-333.
- Hannan, G.L. and C. Clark. 2012, *Eschscholzia californica*, in Jepson Flora Project (eds.) *Jepson eFlora*, http://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=25206, accessed on July 20, 2018.
- Hickman, J.C., editor. 1993. *The Jepson manual: higher plants of California*. Univ. of California Press, Ltd. Los Angeles.
- Kirkpatrick, E.H. 1998. Factors affecting the success of California poppy (*Eschscholzia californica*) introduced into western Washington state. *Northwest Sci.* 72(3):180-189.
- Kalvana, M., J. Chen, F. Lepine, R. Legros and M. Jolicoeur. 2006. Analysis of secondary metabolites from *Eschscholzia californica* by high-performance liquid chromatography. *Phytochemical Analysis.* 17:236-242.
- Leger, E.A. and K.J. Rice. 2003. Invasive California poppy (*Eschscholzia californica* Cham.) grow larger than native individuals under reduced competition. *Ecol. Lett.* 6:257-264.
- Leger, E.A. and K.J. Rice. 2007. Assessing the speed and predictability of local adaptation in invasive California poppies (*Eschscholzia californica*). *J. of Evolutionary Biology.* 20(3):1090-1103.

- Lyons, R.E. and J.N. Booze-Daniels. 1986. Characteristics of photoperiod response of California poppy. *J. Amer. Soc. Hort. Sci.* 111(4):593-596.
- Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. *American wildlife and plants: A guide to wildlife food habits*. Dover Publ., New York.
- McClintock, E. 1976. The California poppy: A natural history. *Pacific Hort.* 37:3-5
- McCully, M.E.; M.J. Canny, and C.X. Huang. 2004. The management of extracellular ice by petioles of frost-resistant herbaceous plants. *Ann. Bot.* 94:665-674.
- Moerman, D.E. 1998. Native American ethnobotany. Timber Press, Portland, Oregon.
- Montalvo, AM, PA McMillan, and EB Allen. 2002a. The relative importance of seeding method, soil ripping, and soil variables on seeding success. *Restoration Ecology*. Vol 10 1:52-67.
- Montalvo, A.M., L.J. Feist-Alvey and C.E. Koehler. 2002b. The effect of fire and cold treatments on seed germination of annual and perennial populations of *Eschscholzia californica* (Papaveraceae) in southern California. *Madroño*. 49(4):207-227.
- Munz, P.A. and D.D. Keck. 1968. A California flora with supplement. Univ. of California Press, Berkeley.
- Randall, R. 2007. Summary listing from the global compendium of weeds for *Eschscholzia californica* (Papaveraceae). [Online database: http://www.hear.org/gcw/eschscholzia_californica/. Updated January 2009]
- Ratcliff, R.D.; S.E. Westfall and R.W. Robarts. 1972. More California poppy in stubble field than in old field. USDA, USFS Res. Note PSW-271. Pacific Southwest Forest and Range Ext. Stn., Berkeley, CA.
- Roseberg, R.J. 1996. Herbicide tolerance and weed control strategies in *Lesquerella* production. *Ind. Crops and Products*. 5:133-139.
- Smith, C. 2012. Plant guide for California poppy (*Eschscholzia californica*). USDA-Natural Resources Conservation Service, Plant Materials Center. Lockeford, CA 95237
- Timberlake, P.H. 1956. A revisional study of the genus *Perdita* F. Smith, with special reference to the fauna of the Pacific Coast. Univ. of California publ. in Entomol.. 11:247-350.
- USDA, ARS, National Genetic Resources Program. *Germplasm Resources Information Network - (GRIN)* [Online Database: <http://www.ars-grin.gov/cgi-bin/npgs/html/paper.pl?language=en&chapter=scient> 23 November 2010]. Natl. Germplasm Resources Laboratory, Beltsville, Maryland.
- USDA, NRCS. 2010. The PLANTS Database (Online database: <http://plants.usda.gov>. 1 January 2010). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
- Wright, GM. 1979. Self incompatibility in *Eschscholzia californica*. *Heredity*. 4(3):429-31.

Citation

Smither-Kopperl, M.L. 2018. Plant guide for California poppy (*Eschscholzia californica*). USDA-Natural Resources Conservation Service, Plant Materials Center. Lockeford, CA 95237.

Published: September 2018

Edited: 28Sep2010 kdl; 29Sep2010 aym; 29mar2012msk; 16Apr2012 jab, 20Jul2918msk

For more information about this and other plants, please contact your local NRCS field office or Conservation District at <http://www.nrcs.usda.gov/> and visit the PLANTS Web site at <http://plants.usda.gov/> or the Plant Materials Program web site: <http://plant-materials.nrcs.usda.gov>.

PLANTS is not responsible for the content or availability of other Web sites.

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotope, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [How to File a Program Discrimination Complaint](#) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

Helping People Help the Land

USDA IS AN EQUAL OPPORTUNITY PROVIDER, EMPLOYER, AND LENDER