

Coreopsis:

A Great All-American Genus

Research to help you sort through all the great new coreopsis cultivars on the market.

By Sonali Padhye and Art Cameron



Coreopsis grandiflora 'Sunfire'.

The genus coreopsis offers a diverse mix of perennial and annual species and cultivars that work great in a variety of garden settings. Coreopsis belongs to the asteraceae family, and the daisy-like flowers come in yellow, white, pink and red, some with dark brown, mahogany or maroon centers. The petal forms range from single to fully double, and some even have serrated petal margins, giving flowers a delicate appearance. Many coreopsis cultivars are tolerant to cold, heat, humidity and adverse soil conditions, thus providing extensive choices of plant material to Northern and Southern gardeners. Most coreopsis cultivars are easy to grow in the garden and make an excellent plant choice for even novice gardeners. Coreopsis can be used in the landscape as a specimen or in borders and mass plantings. Some species are also used in mixed containers and hanging baskets.

Native Coreopsis Species. All garden coreopsis species are native to the United States. The Plants Database maintained by the Natural Resources Conservation Service of USDA has 33 different native species and their native habitats listed on its Web site. Coreopsis has been the designated wildflower of the state of Florida since 1991. The unique *Coreopsis gigantea* grows on Southern California coastal islands while *Coreopsis lanceolata* grows on sand dunes along the Great Lakes of Michigan. Coreopsis species have been recommended for roadside plantings in several Central and Southeastern states and can be niche-marketed for conservation projects and native-plant gardens.

Figure 1. Annual coreopsis selections

Species	Cultivar	Description
Tinctoria	'Calliopsis'	Yellow flowers with maroon centers.
	'Mahogany Midget'	Mahogany flowers; looks beautiful in the landscape; blooms all summer long.
	'Seashells'	Golden yellow flowers with tubular petals that resemble seashells.
	'Tiger'	Dark red flowers with a yellow, exotic-looking pattern on petals.

Annual and Perennial Species. Cultivars of the annual *Coreopsis tinctoria* are great garden performers yet underutilized in the floriculture industry. This is probably because they can be difficult to manage in a typical cell pack. On the other hand, the perennial cultivars are very popular and have consistently been among the top 10 perennials sold in the United States over the last decade. Most commercial cultivars of coreopsis belong to species

auriculata, grandiflora, lanceolata, rosea or verticillata. Many of these coreopsis species hybridize freely and have contributed to the plethora of excellent hybrid cultivars available (see Figure 2, below). The prestigious Fleuroselect Award has been given to seed-propagated coreopsis 'Sunray' (1980), 'Early Sunrise' (1989), 'Heliot' (2004) and 'Rising Sun' (2005). 'Early Sunrise' was also named as an All-American Selections winner in 1989.

Figure 2. Perennial coreopsis selections

Species	Cultivar	Description
Auriculata	'Nana'	Dainty plants form golden yellow flowers; day neutral.
	'Zamphir'	Yellow flowers with a unique fluted shape; vigorous sport of 'Nana'; day neutral.
Grandiflora	'Baby Sun'	Large, semi-double, yellow flowers; petite perennial.
	'Domino'	Bright yellow flowers with a maroon eye.
	'Early Sunrise'	Fleuroselect gold medal winner and All American Selections in 1989; great cultivar bearing large, bright yellow, semi-double flowers; prolific bloomer; attracts butterflies.
	'Flying Saucers'	Patented cultivar with large, golden yellow flowers.
	'Heliot'	Produces abundant yellow flowers with brown centers; 2004 Fleuroselect gold medal winner.
	'Mayfield Giant'	One of the older cultivars, known for its tall plant height; large yellow flowers.
	'Mayfield Maiden'	Large double yellow flowers.
	'Rising Sun'	Bright yellow, semi-double flowers with a maroon center; early blooming cultivar; winner of 2005 Fleuroselect gold medal.
	'Sundancer'	Bears bright yellow flowers.
	'Sunfire'	Medium sized, yellow flowers with single petals and maroon centers.
Lanceolata	'Goldfink'	Plants are short, only 1 foot tall; flowers are large and bright yellow in color.
	'Ruby Throat'	Flowers are yellow with ruby colored eye.
	'Sterntaler'	Large flowers with yellow serrated petals and brown centers.
Rosea	'Alba'	Fine foliage and beautiful white daisy-like flowers.
	'American Dream'	1993 Dutch Plant of the Year; beautiful when covered with dainty pink flowers that have yellow centers.
	'Sweet Dreams'	Bi-colored petals that are pale pink towards the outside and crimson towards the center.
Verticillata	'Golden Gain'	Golden yellow flowers.
	'Golden Showers'	Upright, clump-forming plants with fine foliage; produces bright, golden yellow flowers all summer; vigorous growth habit.
	'Moonbeam'	1992 Perennial Plant Of The Year; great garden performer; suitable for hanging baskets and mixed containers; fine foliage is covered with tiny lemon yellow flowers.
	'Zagreb'	Fine foliage and deep yellow flowers; forms nice mounds.
Hybrids	'Crème Brulee'	Hybrid of verticillata and grandiflora; foliage and form are similar to 'Moonbeam' but habit is improved; large pale yellow flowers.
	'Tequila Sunrise'	Probably a hybrid between grandiflora and lanceolata; variegated foliage gives a unique appearance; bright yellow flowers with a brown eye.
	'Limerock Ruby'	Natural cross between unknown coreopsis; truly spectacular ruby red flowers are about 1½ inches in diameter on a tidy plant; not reliably hardy.
	'Limerock Passion'	A sport of 'Limerock Ruby'; lavender pink flowers with yellow centers; hardy to Zone 7; best as an annual.

PRODUCTION REQUIREMENTS

Hardiness Zones. Most garden-worthy perennial coreopsis cultivars are reported to be cold-hardy to USDA Zone 4, with some notable exceptions. Suppliers now list 'Limerock Ruby' as Zone 6, while the new introduction 'Limerock Passion' is listed as a tender perennial (Zone not yet established). Despite their lack of hardiness in the Northern states, these cultivars still have great market potential.

Propagation. Most tinctoria, grandiflora, auriculata and lanceolata cultivars are commercially propagated by seed. They are quick to germinate and relatively true-to-type.

Though typically produced from seed, cuttings of *Coreopsis grandiflora* selections are easy to root if adequate cuttings can be obtained. 'Flying Saucers' is a patented cultivar that is largely sterile; therefore, it must be produced from cuttings. Vegetative cuttings of 'Sunray' and 'Rising Sun' root within 10 days of sticking in a high humidity house at 73° F with bottom heat. If maintained under conditions non-inductive for flowering (long days without cold), 'Sunray' stockplants produce a large number of vegetative cuttings. Therefore, propagation by vegetative cuttings can be a viable option for this cultivar.

Coreopsis verticillata 'Moonbeam' is essentially sterile and thus is propagated by vegetative means only. As 'Moonbeam' and all other verticillata cultivars are photoperiodic and remain vegetative at photoperiods of 12 hours or shorter, ≤12-hour photoperiods may seem ideal for holding stockplants. However, the number of cuttings produced under these

Coreopsis grandiflora 'Sunfire' plants forced without cold at 68° F under the following photoperiods (from left to right): nine-hour, 16-hour provided by incandescent lamps and 16-hour provided by high pressure sodium lamps. Note: The plants did not flower under short days and when day length was extended with incandescent lamps, plants stretched and were taller than the ones forced under high pressure sodium lamps.



photoperiods is very low. Researchers at Michigan State University have tested the use of Florel on 'Moonbeam' stockplants grown at 68° F under a 16-hour photoperiod to promote branching and decrease the number of flowers and buds on the stockplants. The results have shown that a biweekly application of 600 ppm Florel reduced the number of reproductive buds by 90 percent and increased the number of vegetative cuttings harvested by 78 percent between the

Figure 3. Flowering time for select coreopsis cultivars when forced at 68° F. The time given is the number of weeks from the beginning of the force (usually the commencement of long days) to first open flower.

Cultivar	Weeks
'American Dream'	7
'Limerock Ruby'	6-7
'Moonbeam'	6-7
'Nana'	6
'Rising Sun'	6-7
'Sunfire'	7
'Sunray'	7-8
'Sweet Dreams'	8-9
'Zagreb'	6

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total of all three cutting harvests over a 10-week period.

Most perennial coreopsis cultivars can also be propagated successfully by division of field grown plant material. Propagation by division yields large sized plants for further forcing, and these plants typically do not need to be bulked to fill the containers.

Coreopsis 'Limerock Ruby' forced at 68° F without cooling did not flower under nine-hour photoperiod but all plants did flower under 16-hour photoperiod provided by incandescent lamps (order from left to right, respectively). (Photo courtesy of Cathy Whitman)



Juvenility. We have documented that coreopsis 'Sunray' has a distinct juvenile phase, meaning that 'Sunray' seedlings do not respond to inductive flowering treatments until they have reached a mature stage. Typically, we recommend that 'Sunray' seedlings have an average of at least 16 leaves, or eight nodes, before the beginning of vernalization.

Bulking. Coreopsis 'Early Sunrise' and 'Sunray' develop rapidly and can be forced from 128-cell plugs (as long as they have eight nodes) without any specific pretreatments to increase plant size. However, *Coreopsis verticillata*, when started from a single rooted cutting and forced without bulking, produces a very scrawny looking plant. Coreopsis 'Moonbeam' and related selections produce much higher quality plants when started from field grown plants, since plants spread by underground runners under short days in the fall. In our trials coreopsis 'Nana' flowered without reaching adequate size when forced

under long days, and in order to obtain a marketable plant bulking would be essential.

VERNALIZATION

In coreopsis, the vernalization requirement for flowering is limited to a few cultivars such as 'Sunray'. When grown from seedlings, plant responses are more variable compared to clonally propagated plants. Therefore, the precise vernalization requirements of different seedlings may vary slightly. When forcing 'Sunray' from seedlings, it is necessary to ensure that the duration of the cooling treatment is long enough to fill the vernalization requirement of all seedlings. Vernalization duration of 10 weeks at 41° F has proven to be successful for forcing 'Sunray' seedlings, though it is likely that six weeks is adequate in most cases.

Short day substitution. 'Sunray' can be forced into flower without a cooling treatment if it is given short days followed by long days. Plants showing this type of flowering

response are referred to as short-long-day plants. The short-long-day response of 'Sunray' is unique because the short days actually act as a substitute for vernalization. We have found that the critical photoperiod for short days is less than 11 hours when short days are given for four weeks and the critical photoperiod for long days is 12 hours.

No-Chill Selections. The deservedly popular coreopsis 'Early Sunrise' was selected and bred as a seedling line from 'Sunray' and does not need vernalization for flowering. Thus, 'Early Sunrise' can be forced straight to flower from plugs in the spring. There has been an ever-increasing trend to "breed out" the vernalization requirement, and the list now includes 'Heliot', 'Sunfire' and 'Rising Sun'.

PHOTOPERIOD REQUIREMENTS

Most coreopsis cultivars that we have tested are obligate or near obligate long-day plants. When grown under short days, plants

form rosettes and continue to unfold leaves; whereas, when grown under long days, plants bolt and flower. The photoperiodic regulation of flowering of most coreopsis cultivars allows growers to easily schedule them for forcing in the greenhouse.

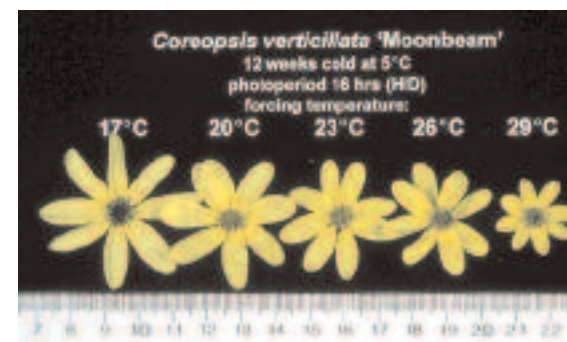
We have found that 'Early Sunrise' and 'Moonbeam' flower when the daylength exceeds 14 hours; whereas, 'Sunray' flowers when daylength exceeds 12 hours.

Long days can be provided by daylength extension with cool white fluorescent, incandescent, metal halide or high pressure sodium lamps. Long day photoperiods can also be provided using a four-hour night interruption from 10 p.m. to 2 a.m. We have found that *Coreopsis grandiflora* selections stretch under far red light, so it is advisable to keep the length of night interruption to a minimum when using incandescent lighting. Another method of day length extension is cyclic lighting when the lights are mounted on booms that move back and forth in the middle of the night.

The only exception to the photoperiodic regulation for flowering described above is *Coreopsis auriculata* 'Nana'. We have found that 'Nana' is a day neutral cultivar. It flowered equally under short and long days in our trials, though plants were more compact under short days.

Limited Induction Photoperiod for Height Control. When coreopsis plants are initiated ▶

The flower size of Coreopsis verticillata 'Moonbeam' decreases as the forcing temperature increases from 63° F to 84° F. (Photo Courtesy of Allison Frane)



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into flower under long days and then transferred to short days, they continue to bloom, but the final plant height is considerably shorter. We have found that plants transferred to short days after three weeks of long days remain compact, though flower number is reduced.

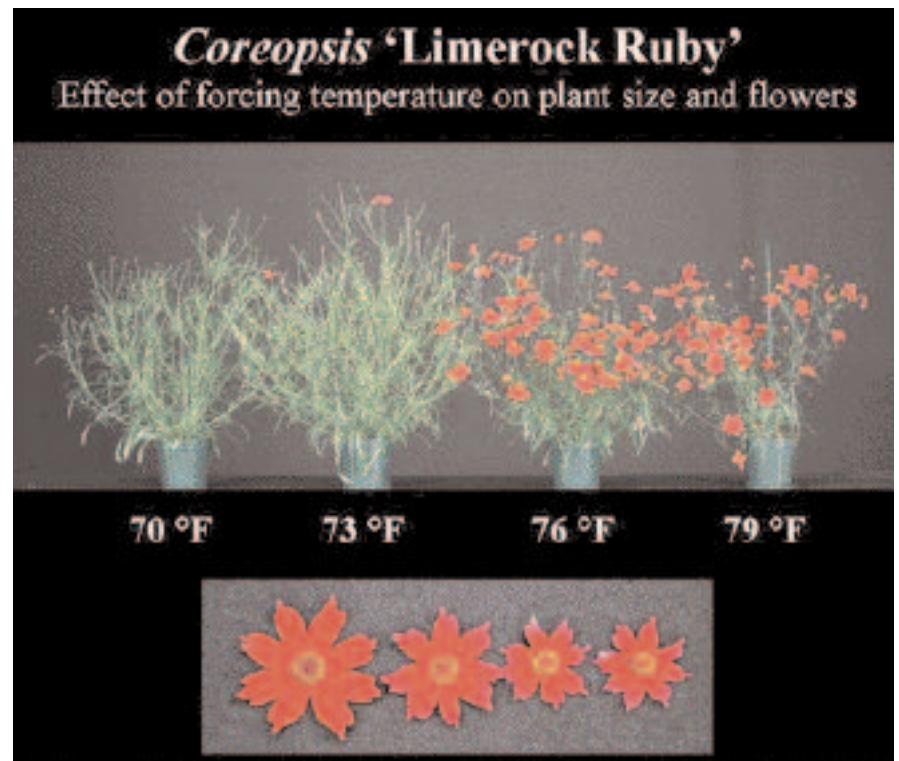
Response to Light Quantity. All coreopsis cultivars are full sun plants that thrive in higher light intensities. During greenhouse production, plants grown under supplemental lighting are better branched, have stronger stems and produce more flowers. We recommend forcing coreopsis under a minimum of $10 \text{ mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ daily light integral. If the daily light integral is higher than this recommendation, we expect that plant quality would further improve.

Forcing Temperature. Most coreopsis species can be forced well in the greenhouse at an average growing temperature of 68°F . Like several other herbaceous perennial species, when grown under cooler temperatures, many species produce larger and brighter flowers, and as the temperatures increase, the flower size is decreased and flowers are more faded in color.

PEST AND CULTURAL PROBLEMS

It has been reported that aphids can be a problem on flowering *Coreopsis grandiflora* plants (*Ball Redbook*). However, we have not had many problems with aphids in our trials. Although we have occasionally had spider mite and whitefly attacks, they have been easy to control with insecticides.

Coreopsis 'Limerock Ruby' plants are better branched and produce larger and more flowers when forced at 70°F compared to ones forced at 73 , 76 or 79°F . Note: The plants at 69 and 73°F flowered after the photograph was taken. (Photo courtesy of Cathy Whitman)



We have often seen that 'Sunray' and 'Early Sunrise' are susceptible to powdery mildew when grown at very close spacing. Good airflow between plants and commercial fungicide applications can successfully control powdery mildew during greenhouse production.

In our greenhouses, all the 'Sweet Dreams' plants grown at 68°F developed numerous spots on their leaves and stems. When grown at 79°F 'Sweet Dreams' did not show these symptoms, and the cause of these symptoms was not identified.



Coreopsis tinctoria 'Tiger'

SUMMARY

In a nutshell, coreopsis provides a great number of diverse cultivars for annual, perennial and native gardens. Most of the commercial cultivars are easy to force in the greenhouse. All auriculata and verticillata cultivars fill the pot when first bulked under short days or field grown until they reach a desired plant size. 'Sunray' is the only cultivar tested by us that required cold for flowering. With the exception of 'Nana', all coreopsis cultivars flower under long days when the daylength exceeds 14 hours. When forced under a 16-hour photoperiod at 68°F , cultivars flower after 6-9 weeks, depending on the cultivar. Numerous additional native species offer even more opportunities for breeding and development of new selections in this versatile genus. GPN

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