



# primula: an all-time favorite

The many species, cultivars, flower types and colors of primula make it suitable for a variety of applications and markets. Learn how to produce the most important species for late winter sales.

By Meriam Karlsson

**T**he most important primula species in production today include English primrose or acaulis primula (*Primula vulgaris*, synonym *P. acaulis*), polyanthus, polyantha primrose or hybrid primrose (*P. xpolyantha*), fairy primrose or baby primrose (*P. malacoides*), German primrose or poison primrose (*P. obconica*) and cowslip (*P. veris*). Chinese primrose (*P. sinensis*) is also produced in limited numbers and some interest exists in producing drumstick primrose (*P. denticulata*) as a container plant.

Primula is widely produced in Europe as a flowering potted plant for the late winter or early spring market. In the United States, growing conditions in the Pacific Northwest are particularly well-suited for producing primula. For garden and bedding uses, English primrose and polyanthus are considered hardy to Zone 5, while fairy primrose, German primrose and Chinese primrose cannot withstand frost. Species that are more appropriate for garden plantings include garden auricula (*P. xpubescens*, a cross between *P. auricula* and *P. hirsuta*), cowslip, Julian primrose (*P. juliae*), siebold primrose (*P. sieboldii*) and red-leaf primrose (*P. rosea*).

## CULTIVARS

**English Primrose.** The English primrose has 2- to 10-inch-long leaves in a compact rosette, as suggested by the word acaulis, meaning "stemless." The flowers develop on individual, 2- to 8-inch-long pedicels from the center of the plant. The native English primrose has pale yellow flowers. Through breeding efforts and the development of F1 hybrids, cultivars of English primrose are now available with flowers in many colors from white to purple. The flowers may have a yellow or white eye and are sometimes fragrant.

English primrose has been extensively bred, and a large number of cultivars are available. The Danova series was introduced in 1989 by Dæhnfeldt Inc. (Odense, Denmark) and may be the most widely produced primula cultivar today. The Danova series is intended for early-season marketing in November and December in the Northern hemisphere from a June seeding. The Danova series comes in more than 20 colors and includes several cultivars with 2-toned flowers. Other early-season cultivars include the Lovely and Pageant series, bred by the Sakata Seed Corporation (Yokohama, Japan), and the

Quantum series from Goldsmith Seeds Inc. (Gilroy, Calif.). The Lovely series has smaller flowers than the Pageant series, although they both have a compact growth habit suitable for 4-inch or smaller pots. Several red and pink bicolors are included in the Pageant series. The Quantum series has uniform germination rates and good postharvest quality.

The Dania (Dæhnfeldt Inc.), Finesse (Ernst Benary Seed Growers Ltd., Hann. Muenden, Germany) and Gemini (Goldsmith Seeds Inc.) series are suitable for mid-season marketing (January and February). Compared to the Danova series, the Dania series has somewhat larger flowers but a more limited color range. A unique feature of the Finesse series is the narrow silver or gold border of the flower petals. The limited leaf growth of the Gemini series makes it suitable for 4-inch pots or in combination with other plants in patio planters or color bowls.

Cultivars for late-season marketing (February and March) include the Daniella (Dæhnfeldt Inc.), Joker (Ernst Benary Seed Growers Ltd.) and Paloma (Royal Sluis Ornamentals, Leyland, UK) series. The Daniella series was introduced



Dæhnfeldt *Primula vulgaris* 'Danova Blue'



Takii *Primula* 'Renaissance Mix'



Dæhnfeldt *Primula veris* 'Concorde Rose Bicolor'

in 1995 as a complement to the Danova series to extend the marketing period. The Joker series consists of both bicolored and clear flowers, and the Paloma series is a leading cultivar in Europe.

**Polyanthus.** Polyanthus is a hybrid, primarily between cowslip, oxlip (*P. elatior*), English primrose and Julian primrose. The flowers of polyanthus develop in a cluster on an extended main flower stalk or peduncle (4-6 inches). Sometimes this inflorescence is referred to as the polyanthus-type in contrast to the single-pedicel acaulis type. Production guidelines, flowering requirements and plant development are similar for polyanthus and English primrose.

The flower colors of polyanthus are dominated by yellows and reds but cultivars with white, purple, bronze or gold flowers, with or without a yellow or white eye, are available. For years, the most important polyanthus cultivar has been the Pacific Giant series. The Sakata Seed Corporation has been maintaining and developing the Pacific Giant series since 1968. This vigorous-growing series with long peduncles has large clusters of flowers. The newer Concorde (Dæhnfeldt Inc.), Hercules (Royal Sluis Ornamentals) and Rumba (Goldsmith Seeds Inc.) series have more compact but stronger peduncles than Pacific Giant. The Hercules series is also known for its postharvest ability to ship well.

**Fairy Primrose.** The flowers of the fairy primrose are arranged in a loose cluster with 2-6 superimposed whorls of 4-6 flowers. The flowers come in white, pink, red, mauve or lavender shades. The leaves are 1-2 inches in length with 2- to 3-inch-long petioles. The primary use of the fairy primrose is as a flowering potted plant, since sensitivity to frost limits bedding and landscape applications.

The Prima series (Dæhnfeldt Inc.) is the most commonly grown fairy primrose. This series comes as a seed mix of pastel flower colors with a large proportion of bicolored pink and rose flowers or segregated into specific flower colors. The expected production time is 5-6 months, and the growth habit is uniform and compact.

**German Primrose.** The German primrose has leaves up to six inches long with petioles of 2-4 inches. Flowers appear in loose, upright clusters on 6- to 7-inch-long peduncles. Cultivars are available with flowers in many pleasing, soft pastel shades from white to lilac, purple, pink and orange. Expected production time for German primrose varies from 4-6 months. The leaves of some German primrose cultivars produce the allergen primin, which may cause skin dermatitis. The risk for allergic reactions has limited

its use and production. It is advisable to observe caution when producing, handling and marketing the German primrose and limit exposure by wearing gloves and long sleeves.

The German primrose series Juno (S&G Flowers, Downers Grove, Ill.) has been grown extensively in the United States. The Juno series has a height of 12 inches, relatively small leaves and abundant flowering. The recent development and introduction of cultivars that do not produce primin has reduced the skin rash problem and renewed the interest in German primrose. The first cultivars stated to lack primin were introduced in 1990 under the names 'Freedom' and 'Beauty'. Some individuals, however, developed a skin rash following direct contact with these cultivars. In 1995, the Libre series (Goldsmith Seeds Inc.) was released as the first true primin-free selection of the German primrose. The Libre series grows shorter than the Juno series at 8-10 inches, is suitable for 4- to 6-inch pots and comes in several flower colors, including white, pink,

salmon, red and blue. Schoneveld Twello b.v. (Twello, The Netherlands) recently released the primin-free Twilly series Touch Me.

**Chinese Primrose.** The leaves of the Chinese primrose have a rounder shape than the other species discussed here, and the leaf margins are scalloped. Cold hardiness is limited to Zones 8-10. The flowers of the Chinese primrose form clusters on 4- to 6-inch-long peduncles. Various flower colors are available, from white and purple to pink. Pigments often color the roots and the lower sides of the leaves red. The Fanfare series (Dæhnfeldt Inc.) is produced in 5-6 months and has exceptionally good shelf life, with large flowers. ♦



Goldsmith Primula vulgaris 'Quantum Carmine'



### **Drumstick Primrose.**

Selections of drumstick primrose are suggested to survive temperatures down to 50° F and have potential for marketing as a flowering potted perennial for Northern landscapes. Flowers appear in a dense, globular cluster on a peduncle. The flower color is white or various shades of purple.

**Cowslip.** The cowslip has fragrant, bright yellow flowers on an extended peduncle and is used in rock, alpine or other types of gardens. Flower colors

other than yellow (orange, apricot, crimson, light purple and white) are now offered. The ability to withstand low temperatures varies for cowslip from Zone 3 (-40 to -30° F) to Zone 8 (10-20° F).



*S&G Flowers Primula acaulis 'Corona Rose'*

### **PROPAGATION**

Primula is exclusively propagated by seed. Germination is often erratic and low, but improved seed quality and close attention to moisture and temperature conditions have improved germination uniformity and rates. A well-drained peatlite medium works well for germination and early seedling development. A medium with 60 percent fine peat, 25 percent perlite and 15 percent vermiculite may be recommended for primula plug production. The sowing medium should have a low nutrient content and a pH between 5.5 and 6.0. A medium electrical conductivity (EC) less than 0.75 dS·m<sup>-1</sup> is essential as high soluble salt levels may interfere with germination.

Recommended germination temperature is 60° F for English primrose, polyanthus and Chinese primrose; 60-65° F for the fairy primrose; and 65-68° F for German primrose. For good germination, maintaining the temperature below 70° F for English primrose and polyanthus is important. Chilling the English primrose seed to 40-50° F for one or two weeks to improve germination at 65° F has been suggested. The response to chilling has been variable and may depend on the cultivar and seed quality. One breeding goal has been to improve germination. The currently available cultivars have faster and more uniform germination rates and do not appear to require or benefit from a low-temperature seed treatment.

Several reports indicate that light is required for maximum germination. In other studies, light was not necessary for germination but useful for controlling the height of seedlings immediately after germination. In addition to providing light, sufficient moisture appears crucial for good germination and early seedling development. Covering the seeds with a layer of vermiculite, perlite or any well-aerated medium can be used to improve the humidity around the seeds. The layer must remain thin due to the potential light requirement. The small seeds of fairy and German primrose especially benefit from a thin cover to avoid desiccation. For English primrose and polyanthus, a protective layer can be added later when the radicle emerges 7-10 days after seeding.

### **EARLY PLANT DEVELOPMENT**

The germination process requires 10-14 days. Following germination, the temperature can continue at 60-65° F for English primrose, polyanthus and fairy primrose, and 65-68° F for German primrose. After 6-8 weeks, seedlings should have two or three true leaves and are suitable for transplanting.

A single seedling is planted in a 3- or 4-inch pot. For larger pots, two or more seedlings are used. Similar to the germination medium, the growing medium should be high in organic matter and well-drained at a pH of 5.5-6.0. The planting depth should be the same as in the seedling flat to avoid crown rot and other diseases. Plants are spaced when leaves reach the edge of the pot. Suitable final spacing for 4-inch pots is four pots per sq ft. ♦

## FLOWERING REQUIREMENTS

**English Primrose and Polyanthus.** Production guidelines for flower initiation in English primrose and polyanthus include several weeks at 40-50° F. The temperature is dropped when plants have developed a good root system and 6-10 leaves. To promote bud set, some growers increase the fertilizer rate from 60-200 ppm nitrogen and double the potassium rate in relation to nitrogen two weeks prior to temperature drop. The use of calcium nitrate and potassium nitrate with low-proportion ammonium nitrogen has worked well. When flower buds are visible, the temperature can increase to between 50 and 55° F or remain below 50° F.

Cooling plants for up to 10 weeks increases the quality of English primrose and polyanthus by increasing flower number, maintaining smaller leaf size and reducing the pedicel length. The lower temperature, however, slows overall plant development. Flower initiation has been observed in plants grown continuously at 60-68°F, and the newer cultivars do not require a cold treatment.

Slower flower initiation at lower temperatures has been confirmed in more recent studies with rapidly flowering. Flower initiation at 46° F was especially slow when combined with low light ( $2 \text{ mol}\cdot\text{d}^{-1}\cdot\text{m}^{-2}$ ) and short days (eight hours). Estimated optimum temperature for flower initiation was 55° F. At 75° F, the English primrose *Dania* failed to initiate flower buds.

A higher night than day temperature (negative DIF) has been suggested to hasten flower initiation in English primrose. Flower formation and development was faster at the negative (54/70° F, day/night) than the positive DIF (75/54° F) at the same average daily temperature. Especially under short days (eight hours), negative DIF appears to promote faster bud formation and flowering than constant or positive DIF.

Even though primula is considered a low-light crop, daily irradiance affected flower initiation efficiency. From seeding to floral initiation at 54° F and long days (more than 12 hours), time to initiation decreased from 72-57 days for English primrose at  $10 \text{ mol}\cdot\text{d}^{-1}\cdot\text{m}^{-2}$  compared to  $2 \text{ mol}\cdot\text{d}^{-1}\cdot\text{m}^{-2}$ . The optimum daily irradiance for flower initiation was estimated to be  $11 \text{ mol}\cdot\text{d}^{-1}\cdot\text{m}^{-2}$  or approximately 1,250 foot-candles ( $250 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) for 12 hours. High natural light conditions may warrant shading to prevent sunscald and improve temperature control since plant quality of English primrose decreases above 68° F. Maximum peak irradiance in primula production should not exceed 3,000 foot-candles ( $600 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ). For most rapid flower initiation, the optimum daily light integral appears to increase from 11-13  $\text{mol}\cdot\text{d}^{-1}\cdot\text{m}^{-2}$  with either an increasing or decreasing temperature from 55° F.

In contrast to earlier studies and recommendations, long days have been found more beneficial than short days (less than 12 hours) for rapid flower initiation and development. Cultivars that initiate flowers without a drop in temperature appear to also have altered response to day length. Long days are more beneficial for flowering of cultivars that do not require a low temperature exposure. When natural day lengths are less than 12 hours, extending the day to 16 hours or utilizing 4-hour night interruptions at a minimum of 10 foot-candles ( $2 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) is now recommended.

Unusually long and large leaves have been correlated to long days or night break treatments and therefore avoided in primula production. However, temperature now appears to be more critical than day length for plant morphology. In polyanthus, more and smaller leaves were recorded at 68° F than at 50° F, although plant leaf areas remained similar at the two temperatures. High fertilizer levels and nitrogen in ammonium form are also factors likely to result in large plants and leaves. ▶



Primula flower initiation probably does not relate to plant leaf area, leaf number or plant maturity. In Dania, flower initiation was identified in plants with 6-26 leaves. At 46° F, 10 mol·d<sup>-1</sup>·m<sup>-2</sup> and 11-hour day length, plants with six leaves initiated flowers in 72 days from seeding. At 68° F, 2 mol·d<sup>-1</sup>·m<sup>-2</sup> and 8 hours day length, plants initiated flowers in 138 days but had 26 leaves.

**Fairy Primrose.** A drop in temperature for six weeks is recommended for flower bud initiation of fairy primrose. The temperature is reduced to between 45 and 50° F when plants have reached the desired marketable size. Following six weeks of reduced temperatures, 57-65° F is recommended. Fairy primrose will initiate flowers without a reduction in temperature, although the final plant and flower quality may not be as high.

Flower bud formation in the fairy primrose 'Prima' was independent of day length when grown at 60 or 68°F. The appearance of flower buds was 20 days earlier at 60° F than at the higher temperature. The development of buds into flowers on the other hand, was affected by day length and was more rapid with long (16 hours) than short (8 hours) days at either temperature.

**German Primrose.** German primrose is commonly grown commercially at 65-68° F. Reducing the temperature to induce flowers is not recommended; however, the temperature can be dropped to lower than 65° F during the final stages of plant development to improve plant quality, flower color and size.

Guidelines for producing German primrose usually do not include specific recommendations for day length. A high light integral (minimum 10 mol·d<sup>-1</sup>·m<sup>-2</sup>) may shorten the production time, although during the summer, shading is required to control temperature and avoid burning of the foliage. The response to day length is temperature-dependent. The German primrose Libre had 0.08-inch-large flower buds 90 days from seeding when grown at 60° F and 8- or

### Culture Quickie for Primula

**Fertilization.** Begin about two weeks from seeding, as soon as the cotyledons start to develop. Initial rate should be at 60 ppm nitrogen and potassium, which can increase to 200 ppm nitrogen immediately prior to transplanting. During production, rates of 90-100 ppm nitrogen and potassium from a complete fertilizer with micronutrients are suitable. German primrose requires higher levels than other species (250 ppm nitrogen with equal or greater potassium levels are recommended).

**Watering.** Never allow the medium to dry out during germination and early seedling development. Seedlings are sensitive to over-watering; when seedlings of English primrose and polyanthus have established following transplant, they can dry out slightly before watering thoroughly again. Fairy and German primroses are more sensitive to moisture stress, so media should be kept continuously moist.

**Media.** Use a well-drained peatlite medium for germination and early seedling development. A medium with 60 percent fine peat, 25 percent perlite and 15 percent vermiculite is recommended for plug production. The sowing medium should have a low nutrient content and a pH between 5.5-6.0.

**Production temperatures.** Germination temperature is 60° F for English primrose, polyanthus and Chinese primrose; 60-65° F for fairy primrose; and 65-68° F for German primrose. For good germination, maintain the temperature below 70° F for English primrose and polyanthus.

**Light level.** For English primrose and polyanthus, maximum peak irradiance should not exceed 3,000 foot-candles; high natural light conditions may warrant shading to prevent sunscald and improve temperature control. For German primrose, a high light integral may shorten production time, but shading is required during the summer to control temperature and avoid foliage burn.

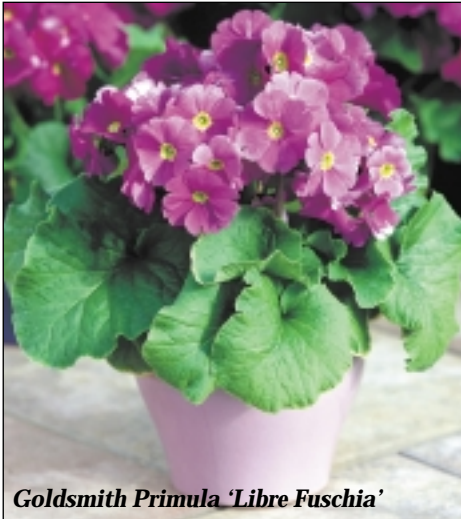
**Propagation.** Exclusively propagated by seed.

**Crop timing.** Varies by cultivar; Fairy types require 5-6 months.

**Flowering.** For English primrose and polyanthus, drop the temperature after plants have developed a good root system and 6-10 leaves. Increase fertilizer rate from 60-200 ppm nitrogen and double the potassium rate in relation to nitrogen two weeks prior to temperature drop. When buds are visible, increase temperature to between 50 and 55° F or remain below 50° F. For fairy cultivars, drop temperature for six weeks for bud initiation, and for German cultivars, drop temperature to lower than 65° F during final stages of plant development to improve plant quality, flower color and size.

**Growth regulators.** B-Nine at 1,000-2,000 ppm reduces stem elongation.





Goldsmith Primula 'Libre Fuschia'

16-hour day length or under 16 hours at 68° F. Short days (eight hours) at 68° F delayed bud appearance by two weeks and flowers failed to develop within 145 days from seeding. In contrast, long days at 68° F resulted in flowering after 111 days. At 60° F, the primin-free Libre flowered faster under long (122 days) rather than short day length (133 days).

### NUTRITION

Fertilizing should start as soon as the cotyledons begin to develop, about two weeks from seed-

ing. The initial fertilizer rate should be low at levels of 60 ppm nitrogen and potassium. The rate can increase up to 200 ppm nitrogen immediately prior to transplanting. During the production phase, fertilizer rates of 90-100 ppm nitrogen and potassium from a complete fertilizer with micronutrients are suitable. Excessive nitrogen and fertilizer easily result in plants with too much leaf growth. Primula is sensitive to high soluble salt levels that may result in necrotic leaf margin burns. Avoid nitrogen in ammonium form under growing conditions with low temperature and irradiance. High ammonium nitrogen levels may result in plants with disproportionately long leaves. Micronutrient deficiencies or toxicities are common in primula production and a medium pH between 5.5 and 6.2 is essential for micronutrient availability. Regular monitoring of pH, soluble salts and nutrient balance, through soil tests, is highly recommended.

Nitrogen deficiency appears as chlorosis in newly developing leaves and as a chlorosis and necrosis of older plant tissues. Premature flowering may also occur under nitrogen deficiency. The initial symptoms of a phosphorous deficiency are bronzing of older leaves, inward curling of younger leaves and leaf tip necrosis. Similar to nitrogen deficiency, plants may prematurely flower. Signs of low potassium are chlorotic lower leaves slowly turning necrotic and curling of leaf margins. Some plants may also die following unexpected and sudden wilting with potassium deficiency. Polyanthus grown with low or no calcium had poor root growth and pale green foliage. Magnesium deficiency appeared as interveinal chlorosis with tip and marginal necrosis of older leaves.

Primula is highly sensitive to reduced iron availability, and deficiency symptoms are common. Early symptoms of iron deficiency are chlorotic new growth followed by completely bleached white tissue due to a lack of chlorophyll. Iron uptake and availability are greatly restricted above pH 6. A boron deficiency initially appears as a light green color later turning into chlorosis of recently matured leaves. The leaves may get cupped or crinkled with leaf edges turning downward. The veins become excessively prominent, especially on the lower side of the leaf. If a boron deficiency is not corrected, the apical growing point dies and the stem becomes hollow.

German primrose requires higher fertilizer levels than the other primula species. Nitrogen rates of 250 ppm with equal or greater potassium levels are recommended for German primrose. On the other hand, German and fairy primrose are highly sensitive to elevated soluble salts, which manifests as leaf edge necrosis. Leaching at regular intervals is recommended to avoid salt buildup.

### IRRIGATION

During germination and early seedling development, the medium should never be allowed to dry out. Seedlings are, however, sensitive to over-watering. When seedlings of English primrose and polyanthus have established following transplant, they can be allowed to dry slightly before being watered thoroughly again. Fairy and German primrose are more sensitive to moisture stress, and the media should be kept continuously moist. Plants allowed to dry or grow at uneven moisture readily develop brown, dried leaf edges. High salt levels in the medium result in similar symptoms as water stress in fairy and German primrose.

### DISEASES AND INSECTS

Primula is relatively pest-free. Aphids, thrips, whiteflies and caterpillars are the most commonly encountered pests. The primin-free Libre is reported to be more susceptible to thrips than primin-containing cultivars. During germination and early seedling development, fungus gnats and shoreflies may become a problem. Control of algae growth and the use of insecticides may be required to restrict the fungus gnat populations during early stages of plant growth.

Tomato spotted wilt virus (TSWV) and impatiens necrotic spot virus (INSV) have been identified in primula. The symptoms include browning along the veins of the leaves and yellow mottling. No chemical controls exist for viral diseases. The best control of TSWV and INSV is to rogue infested plants and eliminate thrips, the insect vector that spreads the virus.

### POSTHARVEST

Primula is marketed when the first 5-7 flowers have opened. Proper temperatures for shipping and holding are 36-43° F, and maintaining well-watered plants is vital for longevity. Primula is highly sensitive to ethylene. A silver thiosulfate spray application at 65-165 ppm has successfully improved the keeping quality of English primrose.

The home environment is often at low relative humidity and higher temperatures than the preferred 60-65° F. Although the keeping quality is expected to be limited under these conditions, a high-quality primula should flower and remain attractive for 10-12 days. With proper care, the German primrose is expected to continue flowering for 2-4 weeks in an appropriate postharvest environment. GPN

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