

Minnesota Commercial Flower Growers Association Bulletin

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CALCEOLARIA PRODUCTION

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Common Name: Calceolaria, Pocketbook Plant
Latin Name: *Calceolaria x herbeohybrida* Voss.

Introduction

The genus *Calceolaria* L. (Scrophulariaceae) is comprised of approximately 500 herbaceous and shrub-like plants. Calceolaria are native to the mountainous regions of Central and South America ranging from Mexico to Chile.

Calceolaria are grown as pot plants in the United States but can be grown as an outdoor pot or bedding plant in cooler climates such as the Pacific Northwest portion of the United States. Calceolaria are often grown as an outdoor plant in northern Europe.

Calceolaria are grown for their showy pouched shaped flowers that are yellow orange or red. Flowers may be solid or have spots. Flower size varies with origin and cultivar (see page 2).

Calceolaria are grown in greenhouses during cooler periods of the year in the United States and are, therefore, considered a 'low temperature-crop'. Marketing dates are typically Easter and/or Mother's Day in the United States.

Morphology

Leaves are opposite, pubescent, obovate and toothed. Lower leaves have visible petioles. In contrast, upper leaves do not have visible petioles are, therefore, considered sessile. Leaf size decreases as leaves become more distal.

Flowers are borne on irregular cymes. The calyx is in 4 parts: the corolla is 2-lipped and pouched - the upper lip is smaller and the lower lip is much larger and is inflated. There are 2 stamens per flower.



When scheduling calceolaria it is critical that you identify your marketing date and the method that you will use to induce flowering.

Calceolaria flower induction is controlled by temperature, photoperiod and light intensity (irradiance).

Delivering long-days by night interruption lighting is less effective in promoting calceolaria flowering than delivering long-days by day extension lighting.

Breeding

The common *Calceolaria herbeohybrida* Voss. is believed to be derived from *C. arachnoidea*, *C. purpurea* and *C. crenatiflora* Cav.

Calceolaria cultivars are divided into four groups based on plant and flower size:

- 1) *Grandiflora* - Tall plants (12-16 inch) with large flowers (1-2 inch).
- 2) *Grandiflora primula compacta* - Medium sized plants (8 inch) with large flowers (2 inch).
- 3) *Multiflora* - Medium sized plants (10-12 inch) with 1 1/2 inch flowers.
- 4) *Multiflora nana* - Small to medium sized plants (6-12 inch) with small to medium sized flowers (1/2 - 1 inch).

Some effort has been made to breed day-neutrality into the crop. In other words, flowering would occur under a variety of environmental conditions and is controlled by the level of maturity of the crop rather than solely the environmental conditions the crop is being grown under, i.e. temperature and/or photoperiod.

Scheduling

When scheduling calceolaria it is critical that you identify your marketing date and the method that you will use to induce flowering. In addition, each grower has an expected product size at flower. Obviously, the larger plants are allowed to grow prior to flower induction, the larger the plant at flower and the more flowers on the plant. In general, calceolaria production requires approximately 4 months when inducing plants to flower using long days. In contrast, calceolaria induced to flower using temperature only will generally require 6 months. Newer day-neutral cultivars require less than 4 months to flower. Obviously, the size of the plant that you want to produce will have an impact on production where larger 5-6 inch pinched plants can require up to 1 to 1 1/2 months longer to flower than a 4 inch size potted crop.

Keep in mind that each cultivar may have slightly different inductive requirements. In other words, schedules will have to be adjusted for each cultivar, especially if you are growing some of the 'day-neutral' cultivars. General schedules are given at the end of this article.

Flower Induction

Calceolaria flower induction is controlled by temperature, photoperiod and light intensity (irradiance). Early work by Post (1937) determined that calceolaria flowering was hastened by temperatures from 50-63°F and inhibited by temperatures from 63-70°F (Table 1). Optimal flowering occurred when plants were held at 46-50°F. In general, flower induction of most calceolaria will not occur unless temperatures are held below 60°F for a minimum of 6 weeks.

Calceolaria flower induction is also affected by photoperiod (Table 1) and irradiance. Calceolaria is a long-day-plant. In other words, flower induction is promoted when the length of the day exceeds the length of the night. The critical daylength is 14-15 hours (night length of 9-10 hours). A minimum of 10 long days are required for flower initiation. Although less 'clear-cut' than photoperiod, higher irradiance appears to hasten flowering of calceolaria.

Therefore, calceolaria flower induction is stimulated by both cool temperatures and long-day conditions (Table 1). These two flower promoting processes appear to be additive in their effect on calceolaria flower induction. In other words, the shorter the chilling period, the greater then need for continued growth under long day conditions to maximize flower induction. If plants receive a 30-40 day cool temperature period, plants will require at least a 2 week long-day treatment.

Delivering long-days by night interruption lighting is less effective in promoting calceolaria flowering than delivering long-days by day extension lighting. In addition, day extension lighting using incandescent lamps is more effective than day extension using fluorescent lamps but fluorescents are most often used to provide long-days since incandescent lamps cause excessive stem elongation. A minimum of 10 footcandles ($2 \mu\text{mol m}^{-2} \text{s}^{-1}$) is required for the plant to perceive long days.

Table 1. Flower induction requirements for Calceolaria.

Temperature	LD	SD
cool temp. 10°C (50°F)	flowers	flowers
warm temp. 20°C (68°F)	flowers	no flowering

As mentioned before, breeding programs have developed seemingly day-neutral cultivars (Anytime Series and others). These cultivars do not appear to require a cold treatment or long days to promote flowering. These plants are typically grown at constant 60°F and will typically flower 3-6 weeks earlier than the traditional cultivars. However, we have recently noticed that environmental, water or nutritional stress early in development may promote excessively early flower initiation.

Cultivation

Propagation: Calceolaria is seed propagated. There are approximately 17,000-40,000 seed in a gram. Sow seed directly on the media surface in a plug tray in a finely ground germination mix. Make sure the seed is exposed to light as calceolaria seed germination is light requiring. Provide light with fluorescent lamps in a seed germination chamber. In addition, make sure media pH ranges from 5.7-6.5.

Germinate seed with a media temperature of 68-72°F. Germination typically occurs in 8-10 days. Transplant seedlings from the plug tray after 3-4 weeks when seedlings are large enough to handle.

Nutrition: Calceolaria require relatively low nutritional requirements. Fertilize weekly with a 100-0-100 to 200-0-200 ppm fertilizer solution. Alternatively, fertilize every other week with 300-0-300 ppm solution.

Calceolaria are sensitive to high levels of ammonia. Therefore, apply nitrate forms of nitrogen only rather than urea or ammonium based fertilizers, i.e. many of the 'premixed' fertilizers should be avoided unless they are low in ammonium or urea such as the more recent 'dark mix' fertilizer blends. Apply supplemental magnesium monthly in the form of magnesium sulfate (epsom salts) at a rate of 8 oz/100 gallons. In addition, apply 1/2 rate S.T.E.M. once a month to insure adequate micro-nutrient levels in the media.

Spacing: Space as necessary to avoid leaves from adjacent plants touching each other. Overlapping of leaves will result in increased stem elongation. Do not place any hanging baskets over calceolaria as this will increase stem elongation.

Pinching: Plants produced in 4 inch pots are usually not pinched. In contrast, plants produced for sale as 5-6 inch potted material is usually pinched

once to increase size. If pinching is desired/required pinch 2 weeks prior to an inductive cold treatment or long-day treatment.

Growth Regulators: Growth retardants are necessary for calceolaria production. Use DIF when possible to limit growth retardant use. In general, more growth retardant will be required when plants are induced to flower using photoperiod than with temperature as long days in any form increase stem elongation compared to short days. Cycocel is the most common growth retardant used to control stem elongation in calceolaria. Apply two applications of cycocel (400 ppm): one application when flower buds are visible and another 2 weeks later. Concentrations of cycocel in excess of 500 ppm can cause foliar burning so frequent low concentrations are preferred to few higher concentration applications.

Problems

Insects: Aphids, white flies and mites are the primary pests of calceolaria. White flies are the most difficult to control and are usually the greatest problem. Application of a systemic pesticide such as Marathon (no endorsement intended) is the best method of control since it is difficult to get good spray coverage on calceolaria.

Diseases: Calceolaria are susceptible to *Pythium*, *Rhizoctonia* and *Sclerotinia* root rots when plants are planted too deep and/or seedlings are grown too wet. Apply appropriate fungicides for root rot control. Appropriate fungicides include Banrot (*Pythium* and *Rhizoctonia* control), or combinations of Subdue (*Pythium* control) and either Fungo (*Rhizoctonia* control) or Cleary's 3336 (*Rhizoctonia* control).

In addition to root rots, calceolaria is susceptible to tomato spotted wilt virus (TSWV). Symptoms of TSWV on calceolaria include spotting of foliage and/or flowers. Spots often have concentric rings. TSWV is spread by the western flower thrips. Infected plants and thrips must be eliminated to control this disease. Do not let TSWV get out of control! Take action immediately as TSWV can completely 'wipe out' a crop in a short period of time and spread to a variety of other crops in your greenhouse.

Botrytis can be a problem with calceolaria late in production, during flower development or during shipping. Do not water plants late in the day when flowers may not have an opportunity to dry prior to

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night. Also, plants should not be shipped for more than 1-2 days as *Botrytis* can quickly spread over an inflorescence in enclosed moist environments such as a shipping crate.

Example Schedules (exclusive of newer day-neutral plants):

Traditional Schedule -- Production in 13 mm (5 inch) pots with sowing early September

Growing Time for Cultural Segment	Cultural Procedure	Temperature	Day Length
	Sow Seed	18°C (65°F)	Natural
3-4 weeks	↓ Transplant 6-8 cm pot	15-18°C (59-65°F)	Natural
2-3 weeks	↓ Transplant to 9 weeks	13°C (55°F)	Natural
4-5 weeks	↓ Transplant to 13 cm pot and begin cool treatment	7-10°C (45-50°F)	Natural
6 weeks	↓ End cool treatment	13°C (55°F)	Natural
	↓ Flowering		



Fast Crops production of 10 cm (4 inch) pots			
Winter Flowering Schedule			
Growing Time for Cultural Segment	Cultural Procedure	Temperature	Day Length (hours)
Late September	Sow Seed	18°C (65°F)	18
	↓		
Mid October	Transplant 6-8 cm pot	18-21°C (65-70°F)	18
	↓		
Mid November	Transplant to 10 cm pot and begin short days	15-18°C (59-65°F)	8
	↓		
Late December	Begin long days	13°C (55°F)	18
	↓		
Late January	Flowering		

Summer Flowering Schedule			
Growing Time for Cultural Segment	Cultural Procedure	Temperature	Day Length (hours)
Early April	Sow Seed	18°C (65°F)	18
	↓		
Mid April	Transplant 6-8 cm pot	18-21°C (65-70°F)	18
	↓		
Mid May	Transplant to 10 cm pot and begin short days	15-18°C (59-65°F)	8
	↓		
Early June	Begin long days	13°C (55°F)	18
	↓		
Late July	Flowering		

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