

Crop: Calceolaria

Scientific Name: *Calceolaria herbeohybrida* (Scrophulariaceae)

I. Introduction

- A. Calceolaria is native to the Andes of South America. Most species grow in Chile and Peru.
- B. *C. herbeohybrida* is considered to be derived by crosses of the species *C. arachnoidea*, *C. purpurea* and *C. crenatiflora*.
- C. The common name Pocketbook plant comes from the unique pouch-shaped flowers.
- D. Traditionally, the plants were grown for marketing in late winter, for Easter and Mother's Day. Year-round production is possible by photoperiodic manipulation but is not commonly practiced.
- E. The plant has relatively poor keeping quality in room temperature. As a bedding plant, it performs well in the cool climate of northern Europe.

II. Cultivars, Clones, Breeding, Development

- A. Calceolaria cultivars can be divided into four groups based on flower and plant size:
 - 1. Grandiflora with 3.8-5 cm (1 1/2 - 2 inch) large flowers and 30-40 cm (12-16 inch) tall plants.
 - 2. Grandiflora primula compacta with 4.5-5 cm (2 inch) large flowers and 20 cm (8 inch) tall plants.
 - 3. Multiflora with 3-4 cm (1 1/2 inch) large flowers and 25-30 cm (10-12 inch) tall plants.
 - 4. Multiflora nana with 2-3 cm (1 inch) large flowers and 30 cm (12 inch) tall plants.

III. Flower Induction Requirements

- A. Calceolaria can be induced to flower by photoperiod and temperature manipulations.
1. Flower induction is promoted by low temperatures.
 - a. The temperature must be below 16°C (60°F) for flower bud initiation.
 - b. Optimum flower induction occurs after a minimum of 6 weeks at 9-10°C (48-50°F).
 2. Flower induction is also promoted by long days.
 - a. Calceolaria is a long day plant with a critical daylength of 14-15 hours.
 - b. Day length has little effect on flower induction during the cool temperature period.
 - c. After 70-75 days of cool temperatures, the plants develop similarly under short and long photoperiods.
- B. Generalized diagram

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

- C. If plants are placed back into warm temperatures or under SD too soon, insufficient cold treatment or long days may result in phyllody (leaf like flowers).
- D. Light intensity for long day treatment should be at least 10 foot-candles ($2 \mu\text{mol s}^{-1}\text{m}^{-2}$). Fluorescent or high pressure sodium light is preferred to incandescent light to prevent excessive stem elongation.

- E. Long days can be provided either by day extension (18 hours light per day) or night interruptions (4 hours of light from 2200 to 0200).
- F. New cultivars including the 'Anytime' series don't need a cold treatment to induce flowers under short day conditions. They are grown at 16°C (60°F) year-round and will flower 3-6 weeks earlier than traditionally grown cultivars.

IV. Environmental Requirements

A. Light

1. Quantity

- a. In late fall and winter, plants should be given full sunlight.
- b. Partial shade to reduce the maximum light intensity to 5,000 foot-candles ($1,000 \mu\text{mol s}^{-1}\text{m}^{-2}$) is required during spring and summer. The flowers are easily burned by full sunlight.

2. Duration

- a. Appropriate day lengths are required for flower induction see section III A. Flower Induction Requirements.
- b. Photoperiod control for flowering year-round

Event	Temp(°C)		Daylength (hours)	Winter ²	Spring ²	Summer ²
	Day	Night				
sow seed	21	18	12	Sept 27	Jan 2	April 1
transplant 10 cm pots	20	16	18	Oct 27	Jan 23	April 22
begin SD ^y	20	16	8	Nov 17	Feb 22	May 23
begin LD	20	16	18	Dec 26	April 3	July 1
flower				late Jan	early May	late July

² For 13 cm (5 inch) pots, sow seeds 1 month earlier, transplant to small pots and finally to finish pots 1 months earlier than the 10 cm (4 inch) pots schedule. Start SD the same date for 10 and 13 cm pots.

^y Temperature must not exceed 20°C (68°F), since a high temperature under short days will inhibit flowering. SD should be started by the time plants have developed 4 true leaves to prevent premature flower initiation. The 8 hour day length is essential.

3. Quality

- a. Cool white fluorescent lamps are preferred over incandescent lamps for long day treatment, since incandescent light causes excessive stem elongation.

B. Temperature

1. Temperature during seed germination should be 18-20°C (64-68 °F).
2. Good vegetative growth occurs at temperatures in the range from 15-20°C (59-68°F).
3. During cold treatment for flower initiation, the temperature should be about 10°C (50°F).

C. Water

1. Media should be moist but not excessively wet. Calceolaria plants have a small root system and can easily be damaged by overwatering.

D. Nutrition

1. Calceolaria plants have relatively light nutritional requirements. Fertilize every 3-4 weeks with 300 ppm nitrogen from a 20-20-20 fertilizer.
2. Use primarily nitrate forms of nitrogen in the winter to avoid ammonium toxicity.
3. Supplements of iron and manganese may be required to avoid chlorosis.

E. Gases

1. CO₂ enrichment at 800 ppm enhances vegetative growth.

V. Cultivation

A. Propagation

1. Calceolaria is seed propagated.
2. The seeds are small with 17,000 to 40,000 seeds per gram.
3. Seeds are sown directly on top of a well-drained, sterile germination medium. Seeds should not be covered but exposed to light.
4. Germination occurs in 8-10 days at 18-20°C (65-68°F).
5. Seedlings are large enough for transplanting in 3-4 weeks at 18°C (65°F) minimum temperature.

B. Medium and Planting

1. A light medium with large proportion of peat is a suitable media.
2. Adjust pH to 5.8-6.2. Higher pH induces iron chlorosis.

3. Transplant seedlings 3-4 weeks after germination into 6-8 cm (2 1/4 - 3 inch) pots.
4. When the leaves begin to overlap, transplant the plants into 10-13 cm (4-5 inch) finishing pots.

C. Spacing

1. The transplanted seedlings in 6-8 cm (2 1/4 - 3 inch) pots are grown pot to pot.
2. The 10-13 cm (4-5 inch) pots are grown pot to pot and later spaced to a 25x25 cm (10x10) inch final spacing.
3. Proper spacing and good air circulation is important to minimize the events of diseases.

D. Support

1. None normally required unless plants grow excessively tall.

E. Pinching

1. Pinching is not necessary for plants produced in 10 cm (4 inch) pots. Plants in 13 cm (5 inch) and 15 cm (6 inch) pots are pinched to increase plant size.

F. Disbudding

1. None

G. Growth Regulators

1. Cycocel will provide height control.
 - a. Two sprays (2 weeks apart) of 400 ppm Cycocel with the first application when the flower buds are 1.5 mm (1/16 inch) in diameter will give about 20% height reduction.
 - b. A single application of 800 ppm Cycocel when flower buds are 1.5 mm (1/16 inch) large will also give about 20% height reduction. Marginal leaf burn may occur.

- c. A Cycocel drench at 3,000 ppm can also be used at the 1.5 mm (1/16 inch) bud stage. The drench will reduce height up to 50%.
- d. Flowering time is not affected by Cycocel application.
- e. High rates of Cycocel applied as spray or drench will cause leaf burn.

VI. Problems

A. Insects

- 1. Aphids, white flies and mites are the major insect pests. White flies are most serious. Common pest control measures should be used for control.

B. Diseases

- 1. Root and stem rots caused by *Pythium*, *Rhizoctonia* or *Sclerotinia* are aggravated when seedlings are planted too deep or watered too much.
- 2. Botrytis blight (*Botrytis cinerea*) is best controlled by preventive measures such as good sanitation, avoid high humidity and careful watering.

C. Physiological

- 1. Chlorosis can be a problem at low temperatures, high pH, poor root system, poor media drainage, too frequent irrigation or too much fertilization.

VII. Harvesting, Handling, Marketing

- A. Leaves and flowers are brittle and easily break during marketing.
- B. The plants are susceptible to botrytis during shipping and therefore should not be shipped for more than 1-2 days.
- C. Majority of calceolaria is now produced in 10 to 14 cm (4 to 5 1/2 inch) pots.

VIII. Scheduling

A. Traditional schedule -- Production in 13 cm (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	↓ V		
	Transplant 6-8 cm pot	15-18°C (59-65°F)	Natural
2-3 weeks	↓ V		
	Transplant to 9 weeks	13°C (55°F)	Natural
4-5 weeks	↓ V		
	Transplant to 13 cm pot and begin cool treatment	7-10°C (45-50°F)	Natural
6 weeks	↓ V		
	End cool treatment	13°C (55°F)	Natural
	↓ V		
	Flowering		

B. 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
	↓ v		
Mid October	Transplant 6-8 cm pot	18-21°C (65-70°F)	18
	↓ v		
Mid-November	Transplant to 10 cm pot and begin short days	15-18°C (59-65°F)	8
	↓ v		
Late December	Begin long days	13°C (55°F)	18
	↓ v		
Late January	Flowering		

Summer Flowering Schedule

Growing Time For Cultural Segment	Cultural Procedure	Temperature	Day Length (hours)
Early April	Sow Seed	18°C (72°F)	18
	↓ v		
Mid-April	Transplant to 6-8 cm pot	18-21°C (65-70°F)	18
	↓ v		
Mid-May	Transplant to 10 cm pot and begin short days	15-18°C (59-64°F)	8
	↓ v		
Early June	Begin long days	13°C (55°F)	18
	↓ v		
Late July	Flowering		