

CALCEOLARIA HERBEOHYBRIDA VOSS

Calceolaria cultivars can be divided into four groups as follows:

1. Grandiflora. They produce large 1.5- to 2-inch wide flowers on 12- to 16-inch plants.
2. Grandiflora primula compacta. Flowers of 1.8 - 2 inches develop on 8-inch plants.
3. Multiflora. Smaller (1.2 - 1.6 inch) flowers develop on plants 10 - 12 inches high.
4. Multiflora nana. Small (0.8 - 1.2-inch) flowers are produced on 12-inch plants.

Cultivars

The most popular cultivars today are the dwarf compact growers with many small flowers. The F<sub>1</sub> hybrids are uniform in size and color and flower 4 - 5 weeks earlier than others. Scandinavian favorites selected for earliness follow:

Portia F<sub>1</sub> hybrids have yellow flowers spotted red or brown, or red and orange flowers. They are the earliest and have a very dwarf, compact plant habit.

Gemünder Zweig F<sub>1</sub> hybrids with early, various colored flowers on dwarf, compact plants.

Dondozwergschartach which displays scarlet flowers on dwarf, compact plants. There is also a yellow flowered Dondozwerg.

Lenz, from Holland, is a mixture of colors and flowers develop on compact plants 10 days later than Portia.

Harting's Yellow and Red, also from Holland, flower on compact plants 10 - 14 days after Portia.

Gemünder Melodie F<sub>1</sub>, from West Germany, is available in many colors. It is appreciably later to flower and requires more bench space than the preceding cultivars.

Swedish trials showed that Portia (yellow with spots), Harting's Yellow and Lenz were the best cultivars. Swedish production increased from 350,000 plants in 1970 to over 2 million in 1975 at a 75¢ wholesale price. Sales peak in January, early February, and at Easter. Yellow is a popular Easter flower color in Scandinavia. There are no sales after Easter.

Propagation

Calceolaria seed is very small with 21,000 per gram or 600,000 per ounce. Roughly 1/4 gram or 5,000 seeds should be sown to obtain 1,000 salable plants. Broadcast the seed on a well-drained, pasteurized (sterilized) germination medium and do not cover. Mixing the seed with clean, fine sand will permit more uniform sowing. Keep moist with intermittent mist or subirrigation. The germination area may be covered with polyethylene film until the seeds germinate. Seeds germinate in 8 - 10 days at 18° - 20°C (65° - 68°F). Excessive moisture encourages damping-off. Drench with a fungicide if necessary.

Maintain the 18° - 20°C (65° - 68°F) temperature until transplanting in approximately 3 weeks. Seedlings are transplanted to a 2 by 2 or 2 by 3 inch spacing in flats. The spaced seedlings are kept at 15°C (59°F) night and 18°C (65°F) day temperature until start of cooling or long day treatment. After 6-8 weeks, plants of Portia, Gemünder Zweig, Dondozwerg, Lenz, and Harting's are planted in 4-inch pots. Plants of more vigorous cultivars, such as Gemünder Melodie are planted in 4.5-inch pots.

Carpenter (while at Michigan State) accelerated production time with high intensity lighting of the seedlings. He lighted seedlings sown from October to December for 2 - 5 weeks after transplanting, using Gro Lux WS fluorescent lamps at 10 watts per square foot.

Medium - Nutrition

A limed, nutrient-enriched moss peat or moss peat and clay mix medium is used. A pH of 6-6.5 is desired; avoid high soluble salt levels. Use a dilute fertilizer solution starting when the seedlings are growing well. Suggested solution levels according to Wikesjo follow:

nitrogen	80-100 ppm
phosphorus	20-25 ppm
potassium	100-130 ppm
magnesium	20-25 ppm
calcium	100-150 ppm

Fritted trace elements should be incorporated into the growth medium at the rate of 1 ounce per 10 cubic feet.

Do not use capillary mats for watering in winter as the soil remains too wet and stem elongation results.

#### Flower Formation

In 1942, Post reported that low, below 15°C (59°F), temperatures were necessary for flowering. Recent work by Moum at Ås, Norway reported that the critical flower initiation temperature was about 15°C (59°F), and that duration of low temperature was also a factor. He concluded that best flower initiation was obtained at 9°C-10°C (48°F-50°F) for approximately 6 weeks. Temperature, light intensity, and daylength after flower initiation were found to influence flower opening. Increasing the length of low temperature treatment lessened the long day requirement after cooling.

Calceolaria plants respond to cold treatment when they are 6-7 weeks old. Size of plant at the start of cold treatment influences final plant size. In Scandinavia cold or long day treatment is usually initiated when the plants have 4 - 6 pairs of leaves.

#### Flower Development

Moum (1976) reported that following the cold treatment, flower bud development was stimulated at 15°C (59°F). Then from visible bud stage to anthesis, 18°C (65°F) was optimum. These temperatures were beneficial only if the plants had been adequately cold treated. Without adequate cold treatment, the plants were devernalized, stems elongated undesirably and meristems became vegetative again. Moving the plants directly from 10°C (50°F) to 18°C would produce similar symptoms to a lesser extent. Low light intensity also stimulated stem stretch.

Johansson (1974), Runger (1975), and White (1975) found that calceolaria flowering results from a temperature, photoperiod, light intensity interaction. At low temperatures, flower initiation occurs in both long and short photoperiods. In short photoperiods flower initiation occurs only at temperatures below 15°C - 18°C (59°F - 65°F). No flowers develop at temperatures above 20°C - 25°C (68°F - 77°F) in long photoperiods. The critical photoperiod point was a 14-hour day. In a long photoperiod, flowering was delayed by low 10°C - 12°C (50°F-54°F) temperatures and accelerated by higher temperatures if light intensity was high. Long days encouraged greater flower development.

#### Day Lengthening

In Norway, day extension is provided by cool white fluorescent lamps at 2.5 watts per square foot (30 footcandles at plant level). Stems elongate excessively when incandescent lamps are used. In Germany, stem elongation and slight leaf yellowing occurred when incandescent lamps were used. Cyclic lighting of 4 minutes on and 6 minutes off or continuous lighting were effective. The long photoperiod must be continued until flower buds show color.

#### Growth Regulators

Proper temperature is the key to plant quality. Excessive temperatures, especially at low light intensities encourage plant stretch. Thus temperatures in long photoperiods during the winter should not exceed 13°C - 15°C (55°F - 59°F). A growth regulator is usually necessary when incandescent lamps are used for daylength extension.

No growth regulator is needed with Portia which is very compact. Cycocel is recommended for use on the cultivars Harting's and Lenz. Apply two 400 ppm spray applications, the first when the flower buds are 1 - 1.5 mm, and the second spray 2 weeks later. Higher concentrations are not necessary, and they may cause leaf chlorosis. If only one spray application is used, the maximum concentration should be 1000 ppm.

Red cultivars are more responsive than yellow cultivars.

## Summary

### Program I Cold treatment production program (Moum, 1975)

1. Sow seed first week of July (Portia, 10 days later). Maintain 20°C (68°F) through transplanting to potting in 4- or 4 1/2-inch pots at the end of August.
2. Grow at 18°C (65°F) in short days to keep plants vegetative until they have 4 - 6 developed pairs of leaves (about October 1). Substitute 16°C (60°F) if weather is cloudy. Portia is faster than Harting's.
3. Lower temperature to 9°-10°C (48°-50°F) for 6 weeks.
4. November 15 raise temperature to 12°-15°C (53°-59°F) and provide 16-18 hour days. Use cool white fluorescent lamps at 2.5 watts per square foot.
5. Spray with Cycocel (if necessary) and plants should flower the first week in January.

### Program II Long day production program (Johansson, 1975)

1. Sow seed of Portia and Harting's Red and Yellow August 1. Germinate at 18°C (65°F), then lower to 16°C (62°F) nights and 20°C (68°F) days until transplanting.
2. Transplant August 22 and maintain 15°C (59°F) nights and 18°C (65°F) days.
3. Plant in 4- or 4 1/2-inch pots at end of September, and continue at same temperature.
4. Extend daylength to 18 hours with incandescent lamps at 1.0 watts per square foot starting about October 1-10 for Harting's Yellow, October 10 for Harting's Red, and October 20 for Portia. Temperatures during long days are 13°C (55°F) nights and 14° to 16°C (57° to 61°F) days until flowering in late December.
5. For successive flowering during the winter, the long day treatment can be started at 8-10 day intervals.