Crop: Hiemalis begonia
Scientific Name: Begonia x hiemalis (Begoniaceae)

I. Introduction

A. *Begonia x hiemalis* is a group of cultivars derived by crossing *B. socotrana* from South Arabia and several tuberous species (*B. tuber hybrida* complex) from Peru and Bolivia.

B. These *B. x hiemalis* hybrids combine the short day flowering characteristics of *B. socotrana* with the large and colorful flowers of the *B. x tuber hybrida* parents.

II. Species, Cultivars, Breeding, Development

A. The company Veitch & Sons of the United Kingdom produced the first *B. x hiemalis hybrid* ('John Heal') in 1883.

B. Dutch breeders introduced cultivars with double flowers and the Netherlands became the leading source of cultivars in the 1930's.

C. Since 1955, Otto Rieger from Germany has released some of the most important cultivars for commercial production including 'Leuchtfeuer' (1956), 'Lachsorange' (1961), 'Goldlachs' (1964), 'Schwabenland' (1965), 'Aphrodite' (1967), 'Ballerina' (1974) and 'Nixe' (1975).

D. The T-cultivars ('Tiara I, 'Tiara II', 'Tacora', 'Toran' and 'Turina') were developed by Dr. Doorenbos in the Netherlands and the miniature begonias ('Anita', 'Valentine', 'Melanie', 'Lucy' and 'Rosita') were also developed in the Netherlands.

E. Mikkelsens Inc. of Ashtabula, Ohio has promoted the commercial production of Hiemalis begonia in the United States. The breeding program at Mikkelsens, Inc. continues to release new cultivars. Among the cultivars developed by Mikkelsens, Inc. are 'Appleblossom,' 'Chantilly,' 'Cheers,' 'Enchantment,' 'Guinevere,' 'Lancelot,' and 'St. Helena.'

F. Additional cultivars have been introduced during recent years by Daehnfeldt in Denmark ('Barbara', 'Connie', 'Dorthe' and 'Ninon').

G. Ljones, Gladstad and Lon in Norway have also introduced some good selections including 'Aida,' 'Rosil,' 'Nelson,' and 'Charm.'

H. Current breeding is aimed at developing cultivars that are easy to propagate, can be produced during a larger proportion of the year and have increased disease resistance, especially towards powdery mildew.

III. Flower Induction Requirements

A. Flowering is promoted by short days and delayed by long days. The critical day length for flower initiation is between 10 and 13 hours (11 to 14 hours of dark).

1. There are large differences in photoperiodic response among cultivars and some cultivars may even be day neutral.

2. Short days (10 hours of light) for an extended period will induce dormancy and tuber formation in some cultivars.

3. Dormancy will also occur from prolonged low temperatures 12-15°C (54-59°F) independent of photoperiod although short days accentuate dormancy.

B. Two weeks of short days at 9 to 10 hours of light are recommended for flower initiation during winter conditions and 3 weeks of short days during the summer in northern latitudes. The longer duration of short days during the summer is required to reduce plant height and leaf size.

C. Long day conditions (16 hours of light) are necessary to stimulate vegetative growth prior to and after flower initiation.

1. Vegetative growth for 3-6 weeks after transplanting into the final pot is normally required to reach the desired plant size for short day treatment.

2. Plants having at least 3 shoots with either 3 well developed leaves or with 5-6 cm (2 inches) long shoots are considered suitable for short day treatment.

3. The continued development after short day treatment requires about 3 weeks of long days to reach marketing stage.

IV. Environmental Requirements

A. Light

1. High light conditions cause sun scald (marginal leaf desiccation and burning), vegetative hardening and growth reduction.

2. Temperature affects the level of high light tolerance. The plants can safely be exposed to 3,000 foot-candles (600 μmol $s^{-1}m^{-2}$) at temperatures below 18°C (64°F), to 2,000 foot-candles (400 μmol $s^{-1}m^{-2}$) at 21°C (70°F) and to 1,500 foot-candles (300 μmol $s^{-1}m^{-2}$) at 27°C (81°F).

3. Plants will perceive photoperiodic light when exposed to light levels of 15-20 foot-candles (2-3 $\mu mols^{-1}m^{-2}$) or more. Night interruptions given soon after initiation of the dark period or towards the end of the dark period are most effective in promoting long day effects.

4. Supplemental lighting is beneficial during production periods of low light conditions. Recommended supplemental light levels are 500-600 foot-candles (65-80 μmol $s^{-1}m^{-2}$) for 24 hours per day prior to flower initiation, for 10-12 hours per day during the short day treatment and for 16-24 hours per day after flower initiation.

B. Temperature

1. The three developmental phases of *Hiemalis begonia* (vegetative, flower initiation and flower development) have different temperature requirements.

2. Recommended temperature during the vegetative phase (planting to the start of short days) is 19°C (66°F).

3. During the short days of flower initiation, a higher temperature (21°C, 70°F) is required than during the vegetative phase for complete flower initiation of the plants.

4. The fastest development of flowers after initiation occurs at high temperatures (24°C, 75°F). Such high temperatures however, cause undesired internode and inflorescence elongation, small and poorly colored flowers and large leaves. To obtain good plant and flower

quality, 18°C (64°F) is recommended after short day treatment is completed.

5. Further temperature reductions to 15-17°C (59-63°F) may be desired to intensify flower color as plants approach marketing.

C. Water

1. The fibrous root system of Hiemalis begonia can easily be damaged by uneven moisture content in the media and high salt concentrations.

2. Frequent watering may be necessary to keep the plants evenly moist.

3. Wetting of the foliage should be avoided and a tube watering system or subirrigation (capillary mat or flow irrigation) are suitable irrigation methods.

D. Nutrition

1. Hiemalis begonias do not require high nutrient levels.

2. Good production results have been received using 100 to 150 ppm nitrogen and 50 to 125 ppm potassium at every irrigation.

3. For an artificial medium, 200 ppm nitrogen, 190 ppm $P_2 0_5$ and 200 ppm K_2 has been recommended until the middle of the short day treatment. Fertilizing is then discontinued for one week and resumed with 100 ppm nitrogen, 190 ppm $P_2 0_5$ and 150 ppm $K_2 0$ every other watering until flowering.

4. Adequate phosphorous levels are critical during early development since phosphorus deficiency causes stunted growth that the plants do not recover.

E. Gases

1. Carbon dioxide is beneficial to Hiemalis begonia. An increased CO_2 level results in better growth, better branching, more leaves, more buds and flowers, shorter production time and better quality. Recommended concentration for CO_2 enrichment is 700 to 900 ppm.

2. High relative humidity should be avoided. The potential for infection

and development of powdery mildew, *Xanthomonas*, and foliar nematodes increase with high or fluctuating relative humidity.

3. Hiemalis begonia is sensitive to air pollutants. Low ozone concentrations cause red-brown to brown pigmented spots and a bronze appearance of the upper leaf surface. Necrotic lesions on the flower can also develop at low ozone levels.

V. Cultivation

A. Propagation

1. Hiemalis begonia is vegetatively propagated by either leaf or terminal cuttings. Cultivars with poor development from leaf cuttings are propagated by terminal cuttings.

2. Rooted cuttings of many cultivars are available from commercial propagators.

3. Propagation by terminal cuttings

   a. The stock plants should be vegetative. Long days (more than 16 hours of light) and high temperatures (22-24°C, 72-75°F) are required to keep the stock plants vegetative.

   b. Terminal cuttings with 1 1/2 expanded leaves are planted in plugs, small pots (4 cm, 1 1/2 inch) or in final pots.

   c. During the rooting process, long days and high temperatures (22°C, 72°F) are necessary to keep the cuttings vegetative.

   d. The cuttings are ready for transplanting or delivery after 4-5 weeks.

5. Propagation by leaf cuttings

   a. Shoot formation is promoted on leaf cuttings taken from reproductive stock plants compared to vegetative stock plants. Stock plants exposed to four weeks of short days (12-13 hours of light), give good quality cuttings. Days with less than 10

hours of light will induce stock plant dormancy and should be avoided.

b. The recommended temperatures for stock plant production vary with cultivars and have been recommended from 16-20°C (61-68°F). Cutting production increases with increasing stock plant temperature. A lower (15°C, 59°F) stock plant temperature however, encourage shoot formation of the cutting after planting.

c. The leaf cuttings are harvested by breaking the leaf from the stem at the base of the petiole.

d. The smaller leaves at the top of the stock plant are more suitable for leaf cuttings than older leaves.

e. The ideal rooting temperature is 18°C (64°F).

f. Short days may improve shoot formation of the cutting during rooting. The short day period should be discontinued 2 weeks after planting the cutting to avoid flower initiation.

g. The cuttings can be transplanted after 10-13 weeks when 3-5 shoots and good roots have developed.

6. Propagation by tissue culture can be used to rapidly propagate large quantities of plants.

B. Medium and planting

1. Hiemalis begonia requires a fast draining, well structured medium.

2. A large proportion of peat (45-50%) is used in most media for begonia production. A mixture consisting of 50% peat and 50% vermiculite is an example of a suitable medium.

3. The medium should be sterilized, lightly fertilized and have a pH of 5.5- 6.5.

4. Plants received from a propagator should be planted with the root ball 0.5 cm (1/4 inch) above the surface of the pot medium. This planting procedure decreases the risk for stem rots.

C. Spacing

1. Mode of propagation, desired final plant size, production under natural or artificial day lengths, and the season are factors influencing suitable spacing.

2. The plants can initially be grown pot to pot but should be spaced before the leaves touch, about 3-4 weeks after planting.

3. A final spacing of 2-2.5 plants/ft^2 (10 cm, 4 inch pots) for pinched or strong growing cultivars and 3.0-3.5 plants/ft^2 (10 cm, 4 inch pots) for unpinched or weak growing cultivars have successfully been used. For 13 cm (5 inch) pinched product, the final spacing is 1.6-2.0 pots/ft^2 and 1.3-1.7 for 15 cm (6 inch) pots.

4. Crowded plant spacing will result in undesired stem elongation and poor quality.

D. Support

1. No support is normally required for plants grown in 10 cm (4 inch) pots.

2. Larger plants in 6 inch pots may need staking.

E. Pinching

1. No pinching is required for small plant production from either leaf or terminal cuttings.

2. A soft pinch almost immediately after potting will give large plants with more uniform and concentrated flowering.

3. Dominate shoots on plants propagated from leaf cuttings should be pinched no later than the first week of short days.

4. Plants propagated from leaf cuttings should only be pinched if the cuttings were induced to flower. The pinch is made at or immediately after transplanting.

5. If desired, cuttings can be harvested from plants if pinching is delayed 3-5 weeks after potting. The pinched shoots should have at least 2

remaining leaves to ensure continued plant development. This type of pinch will delay flowering 4-5 weeks.

F. Growth regulators

1. Cycocel and Ancymidol are effective in controlling height of Hiemalis begonia.

2. Spray applications of Cycocel at 500-1,000 ppm are recommended for height control in commercial production. Leaf chlorosis may occur after Cycocel application. Leaves normally do not re-green from Cycocel induced chlorosis.

3. For plants propagated by leaf cuttings, one application (500 ppm) is made at the start of short days and if needed a second application (1,000 ppm) 3-5 weeks later. Plants propagated by terminal cuttings and pinched plants are treated by Cycocel when the developing shoots are 4-5 cm (1 1/2 inch) in length.

4. Cycocel applications late in development inhibit flower elongation and plants develop undersirably with flowers below the leaf canopy.

VI. Problems

A. Insects

1. Poor rooting and root development may be caused by fungus gnats.

2. Small, brownish leaves, short internodes and dried flowers bud are characteristics of cyclamen mite infested plants.

3. Crinkled and light green leaves are sometimes caused by aphids.

4. Thrips generate long, white strikes on the leaves.

5. White fly infested plants can become sticky with occasional black covering.

B. Diseases

1. Root and stem rots are caused by *Rhizoctonia solani, Pythium*

debaryanum and *Thielaviopsis basicola*. The best control of these diseases are good sanitation and sterilization of media, benches, flats and pots.

2. *Botrytis* blight and stem rot is caused by *Botrytis cinerea*. Infected leaves and stems show brown spots and as the disease progress, gray fungus growth become visible. High humidity and water on the foliage favor spreading and development of botrytis blight.

3. Powdery mildew is caused by *Oidium begoniae* and occurs frequently in begonia production. Leaves and shoots are covered with a white fungus growth and severe infections can result in death of flowers and marring of leaf surfaces. Unevenly moist plants and high humidity favor development. Good control can be received by vaporized sulfur from sulfur pots.

4. Bacterial leaf spot is caused by *Xanthomonas begoniae*. The symptoms are small, circular, greasy spots on the underside of the leaf. As the disease progress, the spots become translucent in light. The best control is preventive measures such as clean stock plants and cuttings, avoid high temperatures and humidities, keep foliage dry, and remove infected plants immediately.

C. Physiological

1. Oedema can be a problem under conditions with low light and variable humidity. Small, water-soaked blisters develop on the leaf surface that subsequently turn brown and corky.

2. High temperature conditions result in small and pale flowers and low temperature in combination with highlight result in hard leaves with red edges.

D. Other

1. Foliar nematodes (*Aphelenchoides* spp.) are serious pests causing yellow-brown spots between leaf veins and defoliation. A film of water is required for nematode movement and dry foliage lessen the spread.

VII. Harvesting, Handling, Marketing

A. Hiemalis begonia is sold in full bloom.

B. In the marketing stage, the plants are sensitive to ethylene. Significant flower drop occurs after 24 hours exposure to 0.1 ppm ethylene.

C. Silver thiosulphate (STS) sprays at the rate of 1.0 mM (220 ppm) are effective in controlling flower drop during marketing.

VIII. Scheduling

A. Leaf cutting propagation

Growing Time for Cultural Segment	Cultural Procedure	Temperature	Photoperiod
	Plant leaf cutting	18°C (64°F)	SD
1-2 weeks	↓		
	Start long days (LD)	18°C (64°F)	LD
10-12 weeks	↓		
	Transplant	19°C (66°F)	LD

B. Terminal cutting propagation

Growing Time for Cultural Segment	Cultural Procedure	Temperature	Photoperiod
	Plant terminal cutting	18°C (64°F)	LD
4-5 weeks	↓		
	Transplant	18°C (64°F)	LD

C. Terminal cutting propagation

Growing Time for Cultural Segment	Cultural Procedure	Temperature	Photoperiod
	Transplant	19°C (66°F)	LD
3-6 weeks	↓		
	Start short day (SD)	21°C (70°F)	SD
2-3 weeks	↓		
	Transfer to LD	18°C (64°F)	LD
3-5 weeks	↓	finish at 15-17°C (59-63°F)	
	Flower		

Short days can be started immediately after transplanting for production of small Hiemalis begonia in 10 cm (4 inch) pots.