Section 12

Cyclamen

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Introduction

Cyclamen has been a popular flowering potted plant and cut flower in Europe for many years. The demand, popularity, and marketing opportunities of cyclamen in the United States have increased during recent years (Figure 12-1). Improved cultivars, growing techniques, and schedules have reduced production time from more than a year to seven or eight months. Efficient production and increased demand have made cyclamen a more lucrative crop for commercial production. Cyclamen is primarily marketed and sold as a flowering potted plant in Europe, Asia, and the United States. Use as a bedding plant for early spring plantings in areas with mild winters is an additional emerging market for cyclamen in the United States.

Figure 12-1. The beauty of vivid or pastel pink, red, purple, or white flowers borne above a canopy of dark green foliage enhances cyclamen popularity.

Propagation and Early Plant Development

Cyclamen used to be propagated by dividing and planting pieces of the tubers, or as they usually are called, corms. Propagation by corms is a labor-intensive and impractical method, and it is no longer used in commercial production. Seed is the preferred propagation method. Cyclamen seeds average 2,500 seeds per ounce, although the seeds are sold by count rather than weight. The original, large-flowering, standard cyclamens are open-pollinated, while most cultivars today are F_1 hybrids. Although the F_1 hybrids are more uniform than earlier available cyclamen cultivars, more variations in production time and growth habit can be expected than in F_1 hybrids of other species.

Several series of F_1 hybrid cultivars are available in a wide range of pleasing flower colors, from white to pink, red and purple. Some of the more recently developed cultivars also have fragrance. There are three main types of F_1 hybrid cultivars. The maxi-type or large-flowered F_1 hybrids are similar to the open-pollinated standard cyclamens. These types are recommended for production in 6- to 7-inch pots with wide final spacing for production of large, high-quality florist cyclamen. The mini-type or miniature F_1 hybrid cyclamens have become very popular in Europe. The miniature cyclamens can be produced at high density spacing in 3- or 3.5-inch pots. The miniatures are also nice compact plants for production and marketing in 4-inch pots. Sometimes miniature cyclamens are produced in 6- to 7-inch pots with two or three plants per pot. The intermediate flowered F_1 hybrids or midi-type cyclamens were developed in efforts to combine the earliness and abundant flowering ability of the miniature cyclamens with the growth habit and larger flower size of the maxi-type hybrids. The midi-type cyclamens are excellent for production year-round in 4- or 5-inch pots. The number of available cultivars and the production of intermediate flowering cyclamens is rapidly increasing. F_1 hybrid-type cyclamens are also available with non-traditional flower forms such as ruffled or wavy flower petals and bicolored flowers.

Cyclamen seedlings are usually produced as plugs or somewhat larger plants in flats with 50 to 100 cells. A peat-lite germination mix works well as long as the pH does not drop below 5.5. A pH value above 6.0 is recommended for germination of cyclamen seeds. Soaking the seed in warm water overnight prior to planting has been recommended. Soaking may facilitate seed germination, but it is not a requirement. Growers are advised to only use seed that is less than 1 year old, although the seed may be viable for longer than one year with proper storage at low humidity and 40 to 45°F. The seed should be covered with 0.125 to 0.25 inch of media to facilitate maintaining an even moisture content for good seed germination in the seedling flat. The flats may also be drenched with a fungicide at seeding to decrease the risk of disease during germination and early seedling development. Optimum germination temperature recommendations vary from constant 60°F to constant 68°F. Temperatures

above 72°F result in decreased germination and should be avoided. Seed germination does not require light, and the seeded flats should be kept dark.

Germination and early seedling development of cyclamen are slow. The primary root appears first as the seed germinates, followed by the swelling of the hypocotyl to form the corm. The cotyledon emerges from the seed three to four weeks after seeding. When the cotyledons appear, the seed flats should be moved to a lighted, high humidity (75 percent to 90 percent relative humidity) area. Failure to provide light to the germinating seeds when the cotyledons emerge results in excessive elongation of the cotyledon petiole and poor seedling quality. Cyclamen is a pseudomonocot with only one cotyledon emerging from the seed. The first true leaf develops opposite to the single cotyledon and can be expected to unfold 60 to 70 days from seeding. The plant should have at least six unfolded leaves by day 120 after seeding.

Low light intensities are sufficient initially to avoid excessive elongation of the hypocotyl petiole. As additional leaves initiate and develop, the seedlings benefit from higher light intensities. Light averaging 700 to 1,000 footcandles during a 16-hour day will produce high quality young cyclamen plants. Approximately four weeks after seeding, when the cotyledons are emerging from the seed, the temperature should be kept at 68°F to support good vegetative growth. Cyclamen plugs and liners are available from well-established professional propagators. Many growers buy in eight-week or older cyclamen plants and grow them to marketable plants in 8 to 24 weeks depending on type and size of the purchased young plants and the finished plant product. The time-consuming and sometimes less successful germination process is then eliminated, making cyclamen a feasible crop for an additional number of growers.

Depending on the size of individual cells in the plug flat and the cultivar type, seedling transplanting can be done as early as eight weeks from seeding the flats. The miniature and midi-type cyclamens are usually transplanted directly into the final 3-, 4- or 5-inch pots. The maxi-type cyclamens may first be transplanted into 2- or 3-inch pots and then moved to the larger final pot at the five to six leaf stage. Peat-lite media works well for continued growth and development following transplanting. A pH value close to 6.0 is recommended, although established cyclamen plants tolerate pH values down to 5.0. The small corm formed by the seedling should be planted level with the media surface. Deeper planting with the crown of the plant buried in media increases the risk for crown rot and poor growth. The media should be kept continuously moist. Allowing cyclamens to dry and wilt even for a short time quickly results in yellowing lower leaves.

Fertility Regimes

The amount of applied fertilizer should be adjusted to the type and size of cyclamen produced. Miniature and intermediate-type cyclamens require less fertilizer than the standard or large-flowered cultivars. Application of fertilizer to the seedling flats may be necessary when a germination mix contains limited initial amounts of nutrients. Watering with a weak fertilizer solution (50 ppm N) may be necessary as early as the cotyledon stage (four weeks after seeding). During the vegetative stage immediately following transplanting to the five- to six-leaf stage, constant liquid fertilization with 150 to 200 ppm N in combination with 150 ppm K has worked well. Nitrogen in relation to potassium can be decreased in the fertilizer at the five to six leaf stage to encourage bud and flower development. Cyclamen responds best to nitrogen supplied by a fertilizer with a balance of nitrate and ammonium forms. Applications of small amounts of phosphorous (30 to 50 ppm) are also recommended when cyclamen is grown in peat-lite media. Micronutrient applications may be necessary unless a complete fertilizer containing micronutrients is used. Cyclamen plants receiving too much fertilizer will have large, dark green leaves, short flower stems, and continued production of new leaves – which results in increased production time. Not enough fertilizer results in weak plants with light green leaves and sparse early flowering on long flower stems.

Flower Initiation

Flowering occurs as the cyclamen plant reaches a certain vegetative size and stage. The first flower initiates at the node of the sixth true leaf in many cyclamen cultivars, and flowers continue to initiate at the nodes as leaves develop. Axillary branch shoots form at the nodes of the leaves below the sixth leaf. Several primary shoots develop from the corm to produce well-balanced bushy plants without any requirements for pinching. Since the first flower initiates at the node of the sixth leaf, conditions that hasten overall plant growth and the development of lower leaves are expected to result in quicker flower formation. Rate of leaf unfolding has been found to be an average daily temperature response for many plants. A higher temperature in a species specific range will result in faster leaf initiation and unfolding. Temperatures less than 68°F

from the cotyledon stage to the five- to seven-leaf phase have been reported to delay cyclamen development and flowering. The recommended 68°F temperature during early cyclamen production may provide an optimum leaf unfolding rate without interfering with other processes in the plant. Good growth response has been achieved by increasing the CO_2 level to 1,000 ppm during the leaf-unfolding stage.

Temperature Regimes

A temperature below 68°F has been beneficial for the final phase of cyclamen development. The recommended production temperature from the five- to six-leaf stage to flower is 57 to 60°F. A different production schedule than decreasing the temperature at the five- to six-leaf stage has been suggested by Richard E. Widmer. During the first six months (to the 16- to 18-leaf stage), he recommends a root temperature of 68 to 70°F in combination with an ambient temperature of 50°F. The ambient temperature could increase during the six-month period to 65 to 68°F. The night temperature during the final six to seven weeks of development should be kept at or below 62°F with a 70 to 74°F maximum day temperature. Flower initiation and flower bud development occur simultaneously in cyclamen plants from the five- to six-leaf stage. The environmental conditions need to be selected to support both processes and may explain the different temperature schedules proposed. Plant growth and leaf unfolding occur fast at 68°F, while the formation and development of flower buds may be delayed. Different day and night temperatures may provide opportunities to support optimum conditions for both flower initiation and development. At 65°F day and 50°F night temperature, increased and faster flowering have been reported compared to a constant 58 to 60°F temperature. Day or night temperature should never be allowed to rise above the suggested relatively low maximum 77°F for cyclamen development.

Warmer nights and cooler days are used to control stem and plant height in several greenhouse-produced plants. Shorter internodes are expected to develop as DIF (the difference between day and night temperatures) decreases from positive to negative values. Overall plant height is usually not a major concern or problem with cyclamen, and there is no need to use DIF. Excessively long or short flower stems and leaf petioles can sometimes result in inferior plant quality. Low-light, crowded growing conditions, or improper fertilizer practices with too low or high fertilizer rates may produce cyclamens with unproportionally long or short flower stems or leaf petioles.

Light And Photoperiod

Flower initiation in cyclamen has been reported to occur independent of daylength. Lower light during a longer day has been suggested to be a better growing environment for cyclamen than higher light during a shorter day. At the same instantaneous irradiance, a longer day provides a higher total daily irradiance than a shorter day. In recent studies, instantaneous light levels were adjusted to provide the same total amount of light each day independent of daylength. Cyclamens were grown at 8 or 16 hours daylength for eight weeks starting at transplant (eight weeks after seeding). The temperature was a constant 68°F during the eight weeks followed by 60°F. Total amount of light was more important in determining growth and flowering than daylength. At the end of the eight weeks, plants grown at approximately 500 footcandles during an 8-hour day and 250 footcandles during a 16-hour day had on average seven to eight leaves, and plants grown at 2,100 footcandles during the 8-hour day and 1,050 footcandles during the 16-hour day had 12 to 15 leaves. Flowering occurred first for plants grown at high light compared to lower light for eight weeks during early development, and there was no difference in rate to flower for plants grown at 8- or 16-hour daylength.

Light levels of 500 footcandles are commonly encountered during short winter days with a few limited periods of sunshine in midwestern United States greenhouses. Under these conditions, supplemental lighting would significantly speed up development and improve plant quality. Conditions with 2,100 footcandles can be expected at plant level in the greenhouse during cloudy summer days. Shading is recommended as light reaches an instantaneous level of 4,000 footcandles. The ability of cyclamen to endure and benefit from high light is correlated to the temperature level. If the temperature can be maintained below the maximum 77°F, cyclamen can be exposed to "full sunshine." At the recommended 68°F until the six-leaf stage, followed by 60°F to flower, cyclamen is expected to respond well to light levels at or above 2,100 footcandles.

Gibberellic Acid

Applications of gibberellic acid (GA_3) have successfully been used to improve uniformity and accelerate flowering. A 10 ppm GA_3 solution is prepared from one of the available commercial formulations. To ensure good coverage, a wetting agent must be used. The plants are treated when flower buds can barely be seen in the leaf axils as "pin heads." At this stage, approximately 20 weeks after seeding, plants will have 10 to 12 leaves. The crown of the

plant is sprayed with enough solution (5 to 8 ml) to wet the growing points and buds of the plant. Spraying the foliage with GA_3 solution is not effective. The crown should not be flooded with excess solution. Repeated and late applications or high rates result in long, weak flower stems that are unable to support the weight of the flower. It is advisable to test the GA_3 treatment on a limited number of plants prior to treating an entire crop. Proper application of GA_3 can reduce the production time by two to four weeks. The ability to enhance flowering using GA_3 is expected to decrease as good growing and production conditions are maintained.

Keeping Quality

Growing conditions with 60 to 62°F night and maximum day temperature of 74°F during the final six to seven weeks of development result in high quality cyclamens for marketing. Production temperatures of 55°F, compared to 62°F, reduce shelf life performance. Bud abortion and poor plant quality can be expected when the night temperature is around 68°F for final stages of development. Cyclamens placed in a bright, relatively cool location (65°F night) in a home or office will remain attractive for four to six weeks. The media should be kept continuously moist. Removing old flowers before seeds have developed encourages continuous flowering. Old leaves and flower stems should be pulled or snapped from the corm without leaving a stub. Disease can easily enter a decaying flower or leaf stub and quickly decrease the keeping quality of a cyclamen plant.

Problems

Diseases can be a major problem in cyclamen production. Good sanitation, irrigation practices, and air circulation decrease the risk of disease problems. Root rots are caused by *Pythium*, *Phytophthora*, *Rhizoctonia*, and other fungi; they may appear in the seedling flat or in older plants. Use media with good drainage and careful watering to minimize root rots. A fungicide drench of the seedling flats may also be required. *Fusarium* wilt (*Fusarium oxysporum*, *F. cyclaminis*) causes progressive yellowing and wilting of the leaves. Seedlings, transplants, and plants in the flowering stage can be attacked by *fusarium* wilt. The vascular system is affected, showing brown and reddish-purple discolorations in the corm. Symptoms of crown rot or *Botrytis* blight (*Botrytis cinerea*) are soft rots resulting in collapse of leaves and flowers. In later stages, a gray mold develops. Crown rot often appears under conditions with night temperatures below 62°F, high humidity, and less-than-optimal fertilization.

Bacterial soft rot (*Erwinia carotovora*) causes the entire plant to suddenly wilt and collapse. The tuber becomes soft and mushy, although the roots stay intact. Good irrigation practices, avoiding wet foliage and water splash, are essential to limit the spread and severity of bacterial soft rot. Plants stressed by improper environmental or cultural conditions are more susceptible, and wounds or damage to plant tissue provide entry paths for the disease. The spread and severity of bacterial soft rot can be rapid and uncontrolled in warm weather. Deep transplanting, with the crown of the young plant buried, predisposes the plant to diseases such as bacterial soft rot and crown rot.

Tomato spotted wilt virus (TSWV) and impatiens necrotic spot virus (INSV) can appear as a brown line pattern, chlorotic rings, or round yellow spots that develop into dry brown areas on the leaves. In severe cases, TSWV and INSV cause stem browning, stunted growth, and plant death. Both TSWV and INSV are spread by thrips. Viral diseases are controlled by indirect methods such as the elimination of the insect vector and making every attempt to start with virus-free plant material. There is no chemical control available for viral diseases.

The major pest problems in cyclamen are fungus gnats, thrips, and mites. Aphids are usually not a major problem when good management and pest control strategies are used. The fungus gnat larvae feed on fungi, decaying organic matter, and plant tissue. Young plants are especially injured as the larvae feed on the limited root systems. Larger plants with a well-developed root system are usually not severely impacted by fungus gnat larvae. Adult fungus gnats usually do not cause any direct damage to plants, but may be a nuisance. Fungus gnats thrive in media with bark or peat especially when algae grows on the media surface. Allowing the media surface to slightly dry between irrigations, eliminating algae growth, or applying a layer of sand on top of the media discourages the adult fungus gnats from laying their eggs in the media.

Thrips are small, narrow insects with wings. They are not strong fliers, but move easily with air currents. Thrips adults and larvae feed on leaves and flowers. The damage appears as white, silvery, or dark streaks. Thrips hide in flowers and are difficult to control once established in a flowering plant. An additional reason to monitor and control thrips is their ability to transmit TSWV.

Cyclamen mites and spider mites feed on plant tissue by removing the cell content. Affected areas appear chlorotic and light colored. Growth distor-

tion and curling are other types of damage caused by mites. Cyclamen mites are too small to be detected without a magnifying glass. Spider mites are larger and form webs. Under hot and dry conditions, spider mites can quickly develop into large populations.

Schedule

A schedule of expected plant development is shown in Table 12-1 for cyclamens grown in 4-inch pots for Christmas. The expected total production time is 24 to 28 weeks (six to seven months). Seed is scheduled to be sown on May 1, and average time of flowering is planned for December 15. Cyclamens grown in larger pots usually require longer time to flower. For a 1-inch increase in pot size diameter, the production time is expected to increase an average of four weeks. When grown under natural light conditions, crops scheduled for Valentine's Day are expected to develop slower due to lower winter light conditions.

Table 12-1. Schedule for 4-inch cyclamen being grown for Christmas.

Time	Cultural Procedure	Environmental Conditions
4 weeks	Sow seeds	60-68°F
	↓	dark
	Germination	
4 weeks	↓	68°F
	↓	approximately 500 footcandles for 16 hours per day
	Transplant	
8 weeks	↓	68°F
	↓	approximately 850-1,000 footcandles for 16 hours per day
	5- to 6-leaf stage	
8-12 weeks	↓	60°F
	↓	approximately 850-1,000 footcandles for 16 hours per day
	Flowering	

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