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Executive Secretary/Treasurer, Ann Reilly
210 Cartwright Blvd., Massapequa Park, NY 11762

COLD POTTED CROPS

John G. Seeley, Professor of Floricultural Science, Cornell University

For many years, energy has been a very small part of our production costs so we aimed to grow high-quality crops as fast as possible, often using 60, 65, and even 68-70°F night temperatures for that purpose. But energy has become much more expensive and growers are asking about cold crops or even considering closing down greenhouses during the winter months. In this discussion, I consider 50 and 55°F night temperatures (NT) to be cold, with day temperatures (DT) about 10-15° higher. (Except where specially noted, the temperatures are degrees Fahrenheit night temperature.)

WHY GROW COLD CROPS?

1. **ENERGY CONSERVATION:** Probably the #1 reason for cold crops is to save energy, because of escalating cost and potential restricted supply. In OARDC Special Circular 104, *Management Practices to Conserve Energy in Ohio Greenhouses*, Hugh Poole and Phillip Badger state that, for a year-round greenhouse operation, lowering the night temperature reduces annual fuel consumption by approximately 3 percent for each degree. With a heating cost of $100,000 per year, reducing the night temperature from 60° to 55° should save $15,000, and with 50°, the savings would be $30,000.

a) **The crop duration-temperature relationship.**

This is an important concept because the lower temperature will increase the crop time and may actually result in a higher fuel cost per plant, along with additional labor, water, fertilizer, etc. because of the longer growing time. Plant growth is essentially a combination of chemical processes; growth slows down as temperature is lowered.

1) **Kalanchoe production**—to illustrate the concept, analyze production of Kalanchoe from seed because it grows satisfactorily at 50° and at 60° night temperatures. At 50° we save energy each 24-hour period but the greater number of days of crop time at 50°, compared to that at 60°, offsets the energy saved per day. The important item is the amount of energy **per crop time** or amount of energy **per plant.** As a manager, you must make the analysis.

Let's review some figures for a crop of Tetra Vulcan kalanchoe. With the natural daylength and 60° NT in Ithaca, plants normally initiate flower buds in late September and flower in mid-January, but if grown at 50°, plants flower 4-5 weeks later. The 50° plants take less energy per day, but energy consumption extends over a longer period of time.

In a research study, Tetra Vulcan plants were grown with 60° NT and short days from September 1 to October 10, and then switched to natural short days with either 60 or 50° NT. The 60° plants flowered December 10; the 50° plants flowered about 5-6 weeks later in mid-January.

Using data developed by the greenhouse energy committee at Cornell, and assuming fuel oil at $1 per gallon, and a glass house with 60% of the ground area in actual growing space, I calculate the fuel cost for the October 10-December 10 crop at 60° to be 56.5 cents per square foot of bench area, whereas the 50° crop flowering January 17 had a fuel cost of 72.2. And, of course, there was the extra 4-5 weeks of labor, water, etc.

Whether or not you agree with the figures used in this example, it shows that, for this crop at least, growing at the lower temperature was **not** the more economical in fuel consumption. You as manager must consider the extent to which the daily fuel saving by lower temperature is offset by the extra crop time.

2) **Cyclamen production**—a similar situation occurs with modern cyclamen cultivars which can be grown "warm" or "cold". The "fast crop" technique recommended by the University of Minnesota researchers has a crop time of 8-9 months with warm temperatures as compared to the 13 to 15 months of the older schedules. And luckily, for the Christmas crop at least, much of the growing time is during the period of natural warmth. We'll discuss cyclamen again a little later.

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COLD POTTED CROPS (cont.)

3) **Hybrid seed geraniums**—another example of the temperature-crop duration relationship is illustrated by German research of Dr. W. Von Hentig with hybrid seed geraniums (November 1980 GROWER TALKS). Though not a cool crop, the principle is the same. Plants grown at 68° NT from March 21 until April 18 flowered 10-15 days earlier, than when grown at 59°. The question is whether the time saved offsets the extra fuel for the warmer temperature.

Here's another one to think about regarding geraniums. I recently read the suggestion that geraniums from a fall propagation may be rooted, potted in 2¼ or 3-inch containers and, when well established, may be held in a cold 50°, or 45°, greenhouse til spring. Then when shifted to a larger pot and given heat, the plants flower in 6 to 8 weeks. One can consider this a cold crop but I'd question the value of this technique since a well-rooted healthy geranium cutting flowers 6-8 weeks after potting in the spring with proper heat and care. Think about it! This leads us into a technique being tried in Holland.

4) **Cold crop hybrid seed geraniums**—the usual procedure in the U.S. is to plant seed in January for early May flowering. Since several of these months are high-fuel-requirement months, Dutch growers have been experimenting with low-temperature culture. Cultural directions from a Netherlands seed company out-

line a procedure of sowing seed in September, lowering night temperature to 40-45° in late November, keeping plants as dry as possible during December through February, and giving warmer temperatures in spring. A series of Cycocel sprays are used. From September sowing to May sales makes this a 7 to 8 month crop. This procedure is an alternative for those who cannot, or do not want to, heat their hybrid geraniums to the normal 60° and may want to try it on a small scale. BUT first analyze the costs in relation to planting the seeds later and growing warm, or buying "started plants" (liners) for growing on in the less energy-demanding months.

2. **LOW TEMPERATURE FOR QUALITY CONTROL:** This is another reason for growing crops cold. Usually this is for only a part of the crop period such as temperature reduction in the last month of a poinsettia or kalanchoe crop to induce brighter flower color. But crops such as cineraria, calceolaria, primula, and potted carnations in general are grown better at 50-55° than at 60-65° but that depends somewhat on the cultivar. However, as with most crops, for these cold crops we should think of **stages of growth.** Most seeds germinate best at warm temperatures of 70° in the germinating medium. And early stages of growth will be faster in a warm (60°F) house than a cold house. Then the plants can be finished off cold. Figure on the first ⅓ to ½ of the crop time being warm. This leads us into the subject of "started plants" as an aid to reducing the long crop time, from potting seedlings to flowering plants, if grown cold.

STARTED PLANTS

To help minimize energy costs, consider purchase of "started plants" (sometimes called liners) from a specialist. Many are being grown in the south where energy requirements and inadequate sunshine are not as serious as in northern areas. The northern grower then finishes the plants as **cold potted crops** at 50-55° NT, depending on the crop. Of course, you can grow some from seed or cuttings but, make a decision, after considering the relative costs of the fuel needed for the early stages of growth.

COLD POTTED CROPS

1. **KNIGHT CARNATIONS:** A 4-month-old liner shipped from Florida already has a pinch for branching and Cycocel for height control and is scheduled to finish off as an excellent selling item with 12 weeks at 55° NT in a northern greenhouse. Put 1 liner in a 4-inch pot or 2-3 in a 6-inch pot.

Plants can be grown from seed in northern greenhouses also but for the first couple months, grow warm at 60°; then finish off with several months at 55°. One can save 3 weeks growing time by using seedlings (3-4 per 6-inch pot or 2 per 5-inch pot) with no pinch. During dark months Cycocel is usually needed at least several times. Monitor the growth, and apply Cycocel at about 3-week intervals, holding off if plants are not getting leggy. You'll need to experiment a bit; some cultivars seem to do better with spray and some prefer drench. Scheduling and growth vary with season of year and location in the country.

2. **POTTED SNAPDRAGONS:** Excellent in a winter and spring flowering program, especially as an extra holiday crop for Valentine's Day and Mother's Day. Jim Irwin of Canyon, Texas had an article in the July 1978 OFA Bulletin 585, describing Promenade series and Sweetheart F-1 hybrids with 3 plants per 6-inch pot and a single pinch; these come in single colors. Little Darling, a F-1 dwarf butterfly type, makes nice pots of mixed colors. The Sprite series and the new Gigi mix would be worth trying. Pixie, Kolibri, and Floral Carpet are rated as 6-8 inches in height; give a trial as pots of mixed colors, and without a pinch.

Jim's directions were to germinate seed at 70° and 4 weeks later, pot seedlings directly in the finish pot and grow warm (65° NT) for 2-3 weeks, and then switch to 55°. Four weeks after potting, give a pinch. Plants should be salable 8-9 weeks later. Thus you have a crop 12 weeks after potting the seedlings, or 16 weeks after sowing seed.

3. **SCHIZANTUS:** Another cool one from seed. For flowers in late February-March, sow seed in late August-early September. Germinate warm but after plants are established in pots, grow at 48-50° NT. Use dwarf types or a single pinch with taller cultivars. Using 4 hours of "chrysanthemum lighting" starting in November gives flowering in January but stems may tend to be weak. The Poor Man's Orchid may have appeal similar to the potted snapdragon. Along this line we could include some other plants such as pansies, garden primulas, ranunculus, etc.

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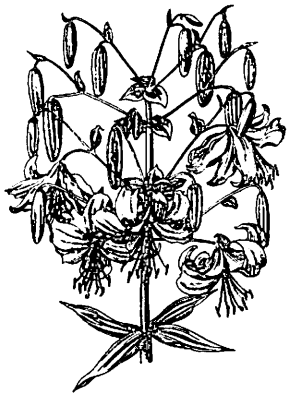
COLD POTTED CROPS (cont.)

4. **HARDY COLORED LILIES:** The Asiatic hybrid lilies come in many colors such as Enchantment (orange), Firecracker (red), Connecticut Lemon Glow (yellow), and have potential for a good "cold pot plant" because forcing temperature is 55° nights, and 10-15° higher in daytime. Rate of growth varies with cultivar; check with your sales representative. Some guidelines mention flowering in 70-85 days; others state 60-100 days depending on variety and season. Flowering is usually about 30 days after buds show but varies with cultivar and weather. Timing can be regulated by adjusting growing temperatures but not over 75° days. General culture is similar to Easter lilies.

The bulbs need low temperature vernalization before planting. It is convenient to obtain pre-cooled bulbs, or the grower can give the 34-36°F storage for 6 weeks before forcing.

Some cultivars are genetically short and do not need a growth retardant. If needed, the usual recommendation is a soil drench of ancymidol (A-Rest) of 0.25 mg active ingredient per plant at shoot emergence and a second application 7 to 14 days later, but one must determine cultivar response.



5. **PRIMROSES:** As with most crops, the early stages are grown warm. Sow the seed on surface of the germinating medium to expose seed to light; maintain 70°F. Grow seedlings at 60° NT to develop some plant size, or at least as cool as possible in summer. Then in the fall and winter, grow plants cold (45-50° NT) to stimulate flower bud initiation; usually need 6-8 weeks. Then raise temperature to 55° and plants should flower in 6-7 weeks.

a) **Primula malacoides**—Sow seed June to September for January-April flowering; thus a 7-8 month crop. For example, for an early February crop, sow seed in early July; after transplanting to pots, grow at 60° NT until late October and then at 48-50° to initiate flower buds until mid-December. Then raise night temperature to 55°.

However, studies in England have shown that 'Christmas Rose' sown in mid-August and 'Fire Globe' in mid-July flowered for Christmas marketing when grown with natural daylength and 55° NT—except for a period of 50° and short days (black clothing) from mid-September to mid-October.

b) **Primula polyanthus and acaulis types** — These make an attractive cold crop in 4-inch pots for everyday sales but at 50° NT, plants require 5-6 months from seeding to bloom. For instance, an August seeding blooms in February-April.

A new Extra Early Christmas series is reputed to bloom within 90 days of sowing. Available in red, rose, blue and yellow. Worth trying.

Now let's look at the traditional triple-C group of cold potted crops, Calceolaria, Cineraria and Cyclamen.

6. **CALCEOLARIA:** A usual schedule is to sow seed July-early August and grow plants at 60° until early November; then at 50° to help initiate flower buds. In January raise the night temperature to 55° for flowering in late March; thus a crop time of 8 months.

However, breeding has changed the genetics of calceolaria. Some grow faster at warm temperatures; some respond favorably to long photoperiods. Not all cultivars need the traditional cold temperature for flower initiation.

Swedish research shows that a seeding of certain cultivars in late July, with plants grown at 60° until late October, followed by 55° and 18-hour long days (12 watts of incandescent light per square meter) will flower in mid to late January, a crop time of 6 months.

In another approach, based on studies in Germany and Pennsylvania with 5 cultivars, seed is sown in late September; seedlings are transplanted into flats in mid-October and grown at 65-70° NT. When transplanted into final size 5-inch pots in mid-November, start short days with 60-65° NT. In late December, start long day treatment with 55° and continue until late January. This would be a 4½ month crop **but** would be a cold crop for only the last month. Perhaps the shorter growing time will offset the fuel requirement of the higher temperature.

Cultivar selection is an important factor. In Ithaca with an early cultivar 'Brite 'n Early', from seed sown in mid-August, plants grown with 60° NT until mid-November, and then switched to 50°, were ready for sale in mid-January, about a 4¾ month crop, but only 2 months cold.

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COLD POTTED CROPS (cont.)

It would be interesting to know how other cultivars would react to these various adjusted schedules.

A factor to keep in mind for calceolaria and cineraria is that the final size of the plants is governed greatly by the period of growth at warm temperatures before flower initiation at cool temperatures or with long days.

Recently I read about Calceolaria Anytime, with clear rose, red shades, and yellow spotted flowers. Apparently does not need a cooling period to bloom due to its genetic characteristics. Reported to bloom in 4 to 4½ months. Plants of rose and red shades are very dwarf and compact. Sounds excellent for 4½- and 5-inch pots.

7. **CINERARIA:** Here is another plant to grow warm in early stages; then give about 6 weeks below 60° to initiate flower buds, and another 8 weeks at 55° to bloom. Sow seed in July for Valentine's Day sales, and in August-September for Easter. For example, sow seed in mid-July, transplant in August and grow at 55-60° til the first week of November. Then switch to 50-55° for early February flowering. Some recommendations are to grow at 45-50° but growth is very slow below 50°. Because of the high water loss from Cineraria leaves, select cultivars that tend to have smaller leaves and compact habit of growth.

With both Calceolaria and Cineraria, to keep the entire crop in the "cold" category, consider buying started plants and after shifting to final pot size, grow them cool.

8. **CYCLAMEN:** Most growers think of it as a traditional cold potted crop. But is it? Yes, if you want to consider the 13-15 month schedules for large plants in 6½- and 7-inch pots. But I favor cyclamen as a warm crop with the 8-9 month "fast-crop" method. Thanks to the plant breeders, we have cultivars that give excellent flowering and wonderful keeping quality in the office and home.

A major factor in "fast-crop" technique is warm temperature but explore it in relation to the energy requirements. For the Christmas crop, much of the warm temperature is at a time when natural heat is available. And again one must consider the energy requirement per square foot or per plant.

For the 8-month Christmas crop of cyclamen in 5-inch pots, printed guidelines are available. Seed is sown in April. The warm month for germination in the dark is in an insulated room. These seedlings are at 3 by 3 inch spacing for 3 months, potted and grown pot to pot 2 months, then 2 months at 60-62° with wider spacing. This is not a cold crop by my definition but one must consider the space per plant and shorter crop time span in relation to the slower cold-crop of cyclamen.

This does not rule out one's growing cyclamen completely as a cold crop but one must consider the balance between the fuel saving per day in relation to the greatly extended crop production period.

And of course there is the possibility of purchasing "started plants" and finishing them with 65-68° for 1-2 months after potting and then 62-64° to flowering.

SUMMARY

Specific crops grown as cold crops (50-55° NT) for nearly all, or part, of the crop production period have been discussed. There has been emphasized the need to recognize that fuel costs per plant for the production period is a better measure than only the yearly fuel cost per square foot at warm and cold temperatures.

An area of research needed for cold potted crops, and also other crops not considered in that category, is the relationship between day and night temperatures. Cornell research with poinsettias has shown that higher day temperatures, when one gets the benefit of natural heat, can offset lower night temperatures. With 9-hour photoperiods, plants with 50° NT and 80° DT flowered at the same time as plants with 60° NT and 70° DT, and 5 days earlier than with 60° NT and 60° DT.

More recently research at the University of Maryland showed an application of daylength control for potentially growing poinsettias cool. The crop was started earlier than usual and given short days by application of black cloth from September 10 to October 5, and grown with 54° NT and 64° minimum DT and natural DT rise to 76°.

Annette Hegg Diva with this treatment had bract maturity November 23, one month earlier than similar plants under natural daylength, and 64° NT. A. H. Dark Red, Mikkel Super Rochford, and Mikkel Fantastic showed similar earlier bloom with 3½ weeks of short days and then 54° NT as compared to 64° NT and natural daylength. Thus the black cloth treatment in September reduced the fuel requirement for the poinsettia crop. With a light-proof heat blanket, giving short days should be easy.

Additional research with various potted plants may show that some plants can be grown with cooler air temperatures if the soil or other root medium can be kept warmer than usual. Perhaps control of other environmental factors in addition to air and soil temperature levels can be used to convert some of our standard warm potted plants into cold potted plants.