# 1984 CORNELL GERANIUM GUIDELINES

## PART 2

**GROWTH RETARDANT TREATMENT FOR RAPID FLOWERING AND HEIGHT CONTROL.** Research studies have shown that 2 growth retardant chemicals, Cycocel and A-REST, when properly applied, causes earlier flowering by 5-7 days in some experiments and 0 to a few days in other tests, depending on cultivar. Retardants have shown good control of height and "stretching" especially in treatment of plants in packs and in small pots crowded together. B-Nine has not been an effective growth regulator for geraniums. **None of these retardants is registered by EPA for use on geraniums.**

The research studies show that a Cycocel spray application of 1500 ppm should be applied when the plants have 4-6 leaves and have nearly covered container soil area. This occurs 2-4 weeks after transplanting. Use 1¾ oz (50 ml) Cycocel to 1 gal of water. This is a 1500 ppm spray. A wetting agent such as B-1956 or Z-77 at ½ teaspoonful per final gal of solution insures good coverage. Spray the plants on cloudy days or early or late in the day when relative humidity is high. Uniformly wet the leaves. The spray may be repeated in 7 to 10 days. Two sprays are usually sufficient. Cycocel spray causes slight yellowing of leaf edges. Plants slowly grow out of this condition.

**To insure success,** plants should be in a thoroughly turgid condition and not wilting. Wilted plants do not absorb growth retardants and are also more susceptible to injury. Water plants several hours before spraying so leaves dry before treatment. Do not water plants for 24 hours after treatment.

**A-REST spray**—A 200 ppm solution is applied in the same manner as outlined for Cycocel. To make 1 qt of solution, mix 24 fl oz (706 ml) of A-REST with 8 fl oz (232 ml) of water. This is a 200 ppm spray. **Do not add wetting agents.** An easy method is to put the 24 fl oz of A-REST in a qt measure and add water to the qt level. Use a fine spray to thoroughly and lightly wet leaves.

**SECOND TRANSPLANTING.** Plants in plug trays or 1½-2- in. packs for 3½-4- in. flowering pot production are shifted to the finishing pot 7 to 11 weeks before flowering, when roots have filled the growing medium of the packs or plugs. Avoid potting plants deeper than originally planted.

**SPACING.** Newly transplanted pots can be spaced pot-to-pot initially: 105 3½- in. or 72 4-in. pots on each square yard of bench area. When the leaves begin to touch, respace 3½-in. plants to 5 x 6-in. on centers (43 per sq. yd) and 4-in. plants to 6 x 6-in. on centers (36 per sq. yd).

**FINISHING TEMPERATURE.** Starting 2-3 weeks before sales, night temperaturres can be gradually lowered to about 55°F (13°C) to harden plants and intensify flower color. Temperatures below 55°F (13°C) will delay flowering seriously. Maintain a day temperature 10°F (5.6°C) **above night temperature.**

**PURCHASED SEEDLINGS OR STARTED PLANTS.** By purchasing started seedlings, growers can simplify geranium production. Cultural practices are the same as for any seedling geranium.

Growers also can purchase direct seeded plugs or transplanted "started plants", which come in flat cells up to 2 x 2- in. and are planted directly into finishing 4-in. pots. This permits late winter-early spring greenhouse space to be used for holiday crops. "Started plants" are about 7-10 weeks old when received and can be finished in 6 to 9 weeks at 62-65°F (16-18°C) if potted in early April.

Well established seedlings in ⅝ x ⅝- in. clels about 4 weeks old are good for transplanting to packs and are ready for sale after 7 to 9 weeks at 60-64°F (16-18°C). For flowering plants in 4-in. pots, transplanting is completed earlier.

**CONTROL OF FLORET SHATTER.** Floret petals of many seed geranium cultivars drop when plants are moved, during overhead irrigation or spraying, etc. Research has shown that floret shattering is minimized during marketing by application of an inhibitor of ethylene production, STS (silver thiosulfate). Because the chemical is unstable a fresh mixture must be made for each application, as follows:

1. Dissolve 50 milligrams silver nitrate in 0.5 liter distilled water;
2. Dissolve 292 milligrams sodium thiosulfate in 0.5 liter distilled water;
3. Slowly mix the 2 solutions by stirring the silver nitrate solution into the sodium thiosulfate solution;
4. Spray approximately 10 ml of the mixture onto the foliage of each plant (one liter of solution treats 100 plants).

Note that either a highly sensitive balance is required for measuring the chemicals or large amounts of stock solution can be made for each chemical and stored. Amounts of the 2 solutions are mixed together as needed. Treatment is most effective when applied 5-10 days before marketing.

Trials with STS continue, but until the chemical receives EPA and New York State clearance for use on geraniums, treatment cannot be recommended.

### PLANT PRODUCTION FROM CUTTINGS

We recommend purchase of cuttings from specialist propagators who are using the latest culture-indexing and virus-indexing techniques to insure disease-free plants.

You may purchase unrooted, callused or rooted cuttings or small plants. The more developed the plant root system, the faster a 4- in. flowering plant can be finished.

Regardless of the type of young plant obtained, geraniums require pathogen-free cultural conditions. All propagation benches, flats, media, pots and anything that is used for geranium production should be either steam pasteurized or chemically treated to prevent introduction

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of disease. See *Cornell Recommendations for Commercial Floriculture Crops, Part II.*

**UNROOTED CUTTINGS.** For early spring sales and for the 2 for 1 propagation method (page 6), order to arrive between Jan. 1 and Feb. 15. Unrooted cuttings stuck at this time can be potted directly to 4-in. finishing pots. They will flower about 10 weeks later.

Under ideal greenhouse conditions, unrooted cuttings for Memorial Day flowering plants may be stuck as late as March 15 (rooted cuttings planted in early April). They also are planted directly to 4-in. pots.

The propagation medium may be peat and vermiculite, peat and perlite, peat-lite mix or any commercially available material used for propagation. Do not heavily compress propagation bench medium as this reduces aeration and drainage.

Some growers have successfully rooted cuttings directly-stuck in 4-in. pots of peat-lite mix. This method requires more space than if cuttings are rooted in a propagation bench and then potted, but saves labor.

Use bottom heat of 75°F (24°C) to hasten root development. Air temperature should be not less than 65°F (18°C) at night with day temperature 70°F (20.5°C) or higher if days are sunny. Air temperatures below 65°F (18°C) significantly slows rooting and is not recommended.

Rootone, Hormodin #1 or similar rooting hormone may be dusted lightly on bases of cuttings. Adding 1 part of benomyl or ferbam to 9 parts by volume of rooting hormone has shown beneficial results.

To avoid spread of disease, **DO NOT DIP THE BASES OF GERANIUM CUTTINGS IN EITHER LIQUID OR POWDER ROOTING HORMONE.** Never return unused rooting hormone compound to the original container.

Do not allow cuttings to lie around the headhouse. Stick them immediately into propagation medium. Immediately after sticking, water cuttings well. Low pressure intermittent mist should be used on a decreasing cycle of application as geraniums root. (See Table 5). Less mist is needed for geraniums than for poinsettia or chrysanthemum cuttings. If disease fungi or bacteria are present in plants, mist encourages the development of symptoms.

Table 5. Proposed Misting Schedule

| Days from cutting insertion | Duration and frequency of misting | |
|---|---|---|
| | Duration (seconds) | Frequency (minutes) |
| 3-4 | 15 | every 6 |
| 5-7 | 10 | every 12 |
| 8 until removed | 5 | every 18 |

Geranium cuttings should be rooted sufficiently for potting 10 to 14 days after sticking. Roots ¼-in. long are large enough to insure successful establishment after transplanting.

## PRODUCING ONE'S OWN CUTTINGS

**Stock Plant Production.** Growers who choose to propagate cuttings from their own stock plants should set up a **mother block system.** Mother blocks are established by purchasing disease-free cuttings from reliable propagators in late spring or summer. Grow plants in 5 gal containers using a pasteurized growing medium. Follow a thorough sanitation program. Do not place the stock plants outside; grow them under glass or plastic. Discard plants that show leaf spot, yellow leaves, dieback or other abnormal growth symptoms. Take cuttings by breaking out soft tops or using a sterilized knife or razor blade (dip the knife in alcohol and flame). Do not dip cuttings in liquid solution. Maintain good cultural conditions and ventilation. Avoid excessive crowding. Follow recommended disease and pest control procedures as outlined in *Cornell Recommendations for Commercial Floriculture Crops, Part II.*

There are 3 major approaches to stock plant development.

I. **Conventional Stock Plants.** Rooted cuttings are planted in the summer and all shoots are pinched regularly to induce branching, making available a large number of cuttings in winter and spring. The winter cuttings may be used for aditional stock plants. Stock plants by this method tend to stay short and stocky and become crowded. This greatly reduces air circulation and light and thereby creating conditions conducive to disease development. Often some inner leaves are removed to promote air circulation through the plant canopy.

After cutting production January to March, these plants are sometimes are pruned to an aceptable form and sold in flower as large "patio" plants during the April-June marketing period.

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II. **Tree-Form, Single-Stem, or Totem Pole Stock Plants.** Disease-free cuttings are planted but **not** pinched; plants will grow vertically. Insert a 30 to 36-in. stake for support. Pinch side shoots as they appear, or take the side cuttings for use as additional conventional stock plants. This can be done every 2-3 weeks. But, when cuttings are removed, be sure that 2 or 3 leaves remain for further growth. In December remove the terminal cutting (top of plant) to induce more growth of side shoots from which cuttings are harvested as they appear. At the last propagation, the entire plant can be used for various types of cuttings. Research at the University of Missouri has shown 80 top or terminal cuttings plus additional leaf-bud or stem cuttings, producing 214 finished plants in 4-in. pots from each stock plant. A commercial grower has reported 22,500 plants from 300 tree-form stock plants (75 finished 4-in. pots per stock plant.)

III. **The 2/1, 5/1, 12/1 and 40/1 Method.** This system, sometimes called the logarithmic method, was proposed by Yoder Brothers in the June, 1969 *Grower Circle.* The technique is based on planting "clean" geranium cuttings. By proper scheduling and handling of the cuttings, one can get either 2, 5, 12 or 40 saleable plants in May from each of the original cuttings and its progeny. For this technique, you must have mist propagation, bottom heat, a minimum night temperature of 65°F (18°C) for good rooting and rapid growth, and you must keep the growing medium moist and well fertilized. Examples:

1. **The 2 for 1 program**
   **Mid-February**—plant 100 purchased "clean" cuttings in 4-in. pot set at 6 x 6-in. spacing.
   **Mid- to late March**—take 100 top cuttings and root directly in 4-in. pots under mist at 6 x 6-in. spacing. In May you have for sale 200 plans from the original 100 cuttings.
2. **The 5 for 1 program**
   **Early January**—plant 100 cuttings in 5-in. pots with automatic watering, or in bench, at 6 x 8-in. spacing.
   **Mid-February**—take as many top cuttings as possible, probably 80. Stick directly in 4-in. pots under mist. After 4 weeks space at 6 x 6-in. This finishes 80 plants in May.
   **Mid-March**—take 120 terminal cuttnigs and stick directly in pots under mist. After 4 weeks, space at 6 x 6-in. This finishes about 120 plants.
   **Late-March**—take 200 terminal and heel* cuttings. Stick directly in 4-in. pots under mist. Space at 6 x 6-in. This finfiishes 200 pots.
   **Late-March**—also, pot 100 stubs** in 4-in. pots. Space at 6 x 6-in. This finishes 100 plants. Thus, there is a total of 500 plants from the original 100 cuttings.

*Heel cutting—really a 2-in. terminal cutting from a side shoot taken back to the stem, as contrasted to leaving several leaves (mentioned under the tree-form procedure).

**These are really the original stock plants which, if planted in a bench, will be lifted and potted in a 5-in. pot. If originally the stock plant was planted in a 4-in. pot, it may be large enough to warrant being shifted to a 5-in. pot.

The **12 for 1** and **40 for 1** programs are based on similar principles. Detailed schedules can be obtained from the Penn State *Geranium Manual,* from your Cooperative Extension Agent, or from the Department of Floriculture and Ornamental Horticulture at Cornell University.

The 12 for 1 program starts in early November and the 40 for 1 program starts in early September.

## INCREASED BRANCHING OF STOCK PLANTS WITH A GROWTH REGULATOR

Lateral branching of stock plants has been increased by application of ethephon (Florel). Since flowering is severely delayed, treatment must **not** be made during forcing of plants for sale in the spring.

Effectiveness of treatment is affected by cultivar, water quality, temperative, light energy and nutrition. Research has shown that a 500 ppm Florel spray (1.6 fl oz or 47 ml per gal of water) starting in August, two weeks prior to pinching and applied every 3 to 4 weeks until the end of December is effective. Use freshly mixd solutions.

Because of variation in response under different conditions, a grower should experiment on her/his own by spraying small groups of plants to run-off using several concentrations (350, 500, and 750 ppm) every 3 to 5 weeks with 3 to 5 repeated applications. The results should serve as a guideline for the following season.

Some reports indicated that Florel treatment is effective with Dark Red 'Irene', 'Pink Camellia', 'Cherry Blossom', 'Madam Langguth', 'Picardy', 'Sincerity', 'Snow Mass', and 'Springtime' **but** is ineffective on many others.

**4-IN. GERANIUMS IN 8-9 WEEKS.** Saleable flowering plants can be produced in 8-9 weeks through scheduling and timing.

"Geraniums in 6 Weeks" steps recommended by the late Dr. Kenneth Post in the *NYSEG Bulletin* 10 in 1946 still hold true. Actually from an April 1 planting of rooted cuttings about 50% were in flower by May 15 and another 40% by the end of May. With newer virus-free plant material, growth should be faster. The 2 for 1 method is good for this April planting.

Pot healthy, well-rooted cuttings directly to 4-in. pots 8 weeks before required sales date. Use peat-lite medium and a constant fertilization program at 200 ppm N-P-K. (Table 4.) Grow on at minimum 65°F (18°C) night tem-

## Welcome to New Member

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perature. Keep soil moist. **Do not pinch.** Grow in full sunlight spaced 6 x 6-in. on centers. Apply a growth retardant as required to control leaf and plant size. Any deviation from the program results in delayed blooming and less than high quality plants.

**POTTING MEDIUM.** The Cornell peat-lite mixes have been shown to be a superior growing medium for geraniums. (See Table 2.)

**Soil Mix (1 soil: 1 peat: 1 perlite by volume).**

Some growers may choose to use soil in their mix. A 1:1:1 by volume combination of peat moss, perlite and soil has been successful. Nutrient and pH levels should be adjusted before planting based on soil analysis.

Old greenhouse bench soils should be tested for nutrient and soluble salt content before being used as a component of geranium potting soil.

**FERTILIZATION.** The following nutrient levels for geraniums have been determined by Cornell Floriculture Soils Lab using Spurway procedures:

Table 6. Nutrient levels for Geraniums.

| | |
|---|---|
| Nitrate ($NO_3$) | 30 to 50 ppm |
| Phosphorus (P) | 4 to 6 ppm |
| Potassium (K) | 25 to 35 ppm |
| Calcium (Ca) | over 150 ppm |
| pH | 5.8 to 6.8 |
| Total soluble salts | less than 150 mhos* |

*Using 1:2 ratio for soluble salts in soil; soluble salts levels may be higher in peat-lite mixes.

These levels can be maintained by fertilizing at every watering with the merials listed in the **Fertilization** Table 4.

Osmocote 14-14-14 incorporated at 12 lb per cu yd of medium has been used successfully to produce high quality geraniums. No liquid fertilization of these crops is needed.

Geraniums are sensitive to potassium deficiency which causes yellow leaf margins that eventually die and turn brown. Low nitrogen, low phosphorus and low temperature make leaves turn red. Maintain adequate fertility levels until the crop is sold. Boron deficiency has been reported in New England and Pennsylvania with fast-crop geraniums and slow-release fertilizers.

***CARBON DIOXIDE* ($CO_2$).** Geraniums respond well to supplementary carbon dioxide giving more rapid rooting of cuttings and a more prolific habit of self-branching and large leaves. The latter may be a disadvantage in propagation stock. Maintenance of 750 to 1000 ppm $CO_2$ from 8 a.m. to 4 p.m. has been reported beneficial.

**GROWTH RETARDANTS.** Cycocel applications prevent plants from becoming too leggy or from occupying excessive bench area. Apply as a foliar spray to runoff at 1500 ppm (1¾ oz per gal of water) when cuttings are well established or when new breaks on pinched plants are 1 to 1½-in. long. Do not apply less than 4 weeks before anticipated sale, to allow yellow leaves to regain good green color and to allow the flower to expand fully. Yellowing of foliage does not occur with a drench treatment; apply 4 fl oz (100 ml is enough) of the 1500 ppm solution to each 4-in. pot. The soil should be only moderately moist so that growth retardant solution will not run out of the bottom of the pot. Again, application should not be made less than 4 weeks before selling.

A-REST as a 200 ppm foliar spray may be used in the same manner as outlined for Cycocel. (Refer to the retardant section for additional information).

**SPACING.** Excessive plant spacing reduces production per sq ft and dollar returns to the grower. Too close spacing causes lanky growth and poor plant quality. The following shows the number of 4-in. plants that can go on 100 sq ft of bench area:

| | | |
|---|---|---|
| pot tight | 700 | (poor quality) |
| 6 x 6-in. on centers | 400 | (profit—normal spacing) |
| 6 x 8-in. on centers | 300 | (quality) |
| 8 x 8-in. on centers | 225 | (high quality—demand premium prices for profit) |

Spacings greater than this are uneconomical and not recommended.

## GIBBERELLIC ACID FOR INCREASE OF FLOWER SIZE

A spray of 1-2 ppm gibberellic acid ($GA_3$) and two drops of wetting agent per gallon applied when 2 to 3 florets are just beginning to show color will increase flower head size and will make the flower last longer. Apply in fine mist until flower buds become wet. No harm is done if a little of the material gets on other parts of the plant. The increased inflorescence size is due mainly to increased length of floret pedicels. Not all cultivars respond alike. Growers should try it on a few plants of their cultivars to observer response before spraying more plants.

## TREE GERANIUMS

Research at Michigan State University indicates that a tree-type geranium can be produced in 4 months with 5 weekly applications of a 250 ppm gibberellic ($GA_3$) solution. Spray regular 4-in. geraniums and remove all lateral growth until desired height is obtained. The weak stem will need staking. After the fourth $GA_3$ application, shift from 4-in. to 8-in. pots for finished product.

To produce the plant crown, pinch terminals at desired height, and pinch resulting breaks several times as needed. Remove flower buds until desired size is achieved. Also remove lower leaves when crown starts to develop.

Fertilize well with 15-16-17 fertilizer. Grow warm: 62°F (17°C) night and 70°F (20.5°C) day temperatures.

## References Cited on "Peperomia" Research

*by Gloria W. Shen and John G. Seeley*

EDITOR'S NOTE: These references were omitted in the article "The Effect of Shading and Nutrient Supply on Degree of Variegation of Variegated Peperomia," by Gloria Shen and Dr. Seeley, which appeared in the February issue of the Bulletin. Because there are references within the article, the research references used are listed here.)


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2. Conover, C.A. and R.T. Poole. 1974. Influence of shade, nutrition, and season on the growth of Aglaonema, Maranta, and Peperomia stock plants. Proc. Trop. Reg. Amer. Soc. Hort. Sci. 18:283-287.
3. Conovar, C.A. and R.T. Poole. 1980. Interior quality of *Dracaena angustifolia* Roxb. 'Honoriae' as influenced by light and fertilizer during production HortScience 15:24-26.
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# 1984 CORNELL BEDDING PLANT GUIDELINES

## (END OF SERIES)

### BEDDING PLANT PEST CONTROL

Control of insects, mites and slugs attacking bedding plants is complicated by the wide array of cultivars of different kinds of plants generally grown as intermixed plantings or in close proximity to one another within the greenhouse. These may include both ornamental and food crop types.

Because bedding plants require a relatively short growing period before reaching marketable stage, serious problems generally do not have a chance to develop. However, this does not preclude the possibility of occasional serious infestations. Most of the injurious pests of bedding plants are capable of very rapid development. Of major importance are the aphids, spider mites, whiteflies, mealybugs, thrips and fungus gnats. "Worms" (caterpillars of moths and butterflies) generally have a longer life cycle, but because of the nature of their feeding habits may be very destructive in a short time in the closely packed plantings of bedding plants. Slugs, snails and ants may be troublesome as well.

Good sanitation is an essential component of a successful bedding plant operation. The growing area within, and the area on the exterior, immediately adjacent to the greenhouse should be kept free of weeds which may serve as reservoirs for insect and mite populations. Plant debris may also harbor pests and should not be permitted to accumulate within and around the growing site. It is also essential that all plants are thoroughly inspected for the presence of insects prior to their placement in the greenhouse.

Avoid applying treatments during periods of plant stress, usually associated with high temperatures or water deficiency. Wilting is a clear example of the existence of stressful conditions. It is best to treat plants when the foliage is dry. In many instances, there is an optimum range of temperatures suggested during which insecticidal treatment may be made safely. Outside of this range, treatment may cause plant injury or be ineffective. It is also desirable to terminate chemical treatments before the flowering phase because the blossoms of many varieties are prone to spotting, discoloration or shattering when thus exposed.

The pesticide label should be carefully read not only for suggested recommendations and directions for specific uses but also to be certain that all precautions for personal safety and protection of the environment are understood. It must also be emphasized that growers are obligated to maintain accurate accounts of pesticide use for the records of the New York State Department of Environmental Conservation (DEC) where restricted insecticides are involved.

Pesticide recommendations for specific ornamental crops may be found in the current edition of *Cornell Recommendations for Commercial Floriculture Crops, Part II: Pest Control—Diseases, Insects and Weeds.*

### WEED CONTROL

The main weed control strategy is to safely control weeds around the greenhouse in order to avoid bringing difficult to control weeds into the greenhouse.

Diquat is the only non-selective contact herbicide labeled for use in a greenhouse containing a crop. It is used under and between benches, but must be kept off the foliage of desirable plants. There is no soil residue. Repeat applications are needed to kill perennial weeds.

Roundup is an excellent systemic herbicide used to control perennial weeds around a greenhouse. It has no soil residue in normal soils so it can be used to kill weeds in a bed 7-10 days before setting out pots or before planting into the soil.

The label restricts the use of Roundup in greenhouses. It may be used only in a structure free of desirable plants and with the ventilating fans off. There is considerable evidence that Roundup used under the benches is no hazard to crops not directly in contact with the spray. If Roundup is sprayed in an empty greenhouse, make sure that any plastic or concrete side wall that may contact desirable plants is washed after a few days to prevent the Roundup on the walls from damaging plants that are later brought into the greenhouse.

Do not let weeds in a greenhouse go to seed. Keep the walks free of *Oxalis* and bittercress or they will shoot seeds onto the soil surface in benches or pots. Use weed free soil in containers.

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possible tremendous industry progress worldwide.

Similarly, Boodley's contributions in extension have been legion. He was regularly sought by Extension agents throughout the State as a speaker and trouble-shooter for commercial florist audiences. His knowledgeable recommendations and his expertise as a diagnostician stood him in good stead with growers everywhere. He was appreciated by industry persons for his production knowledge, experience and savvy.

As a teacher and an advisor of both undergraduate and graduate students in floriculture, Professor Boodley had a significant impact on young people with horticultural interests. Many today hold important positions in the floriculture industry.

Professor Boodley is the author of the book, *The Commercial Greenhouse*, and numerous scientific and commercial publications.

He served as Chairman of the Department July 1, 1970 through June 30, 1975.

Professor Boodley continues his interest in commercial horticulture research in his new responsibilities in developmental horticulture with the Smithers-Oasis Corporation in Kent, Ohio. He coordinates and directs research and development in plant-growing media formulations, post-harvest physiology, and related areas. He also travels to meet and work with growers and university researchers in these programs.