

# Producing High-Quality Geraniums

## I. Getting Started

### KEY IMPORTANT POINTS

- Try to be proactive in your management decisions, whether it is height, fertilization, insect or disease control.
- Don't wait for problems to dictate your crop strategy.
- Read this culture information before you start the crop.

### 1. VARIETY SELECTION

For the best possible performance, you need the best varieties for your specific needs. The importance of variety selection is often underestimated. Selecting the right variety will help you manage the crop more easily and will save you a considerable amount of money in the long run. The main characteristics of good varieties should be:

#### Habit:

- Excellent branching for maximum flower power even under tight (economical) spacing.
- Even vigor across the varieties.
- Round mounding habit.

#### Leaves:

- Small to medium-sized leaves with zone; preferred dark leaves.
- High edema resistance for ivy geraniums.
- Heat tolerance.

#### Flowers:

- Bold and clear colors.
- Beautiful round flower heads.
- Shatter resistance.
- Early flowering across varieties.
- Continuous flowering throughout the summer.
- Large amount of flowers.
- Resistance to high light and heat scorch.

#### Zonal Geraniums:

Fischer zonal geraniums are categorized in our catalog into either compact, medium, or vigorous varieties. Use these categories to help you match the appropriate variety to the pot size you're using.

**Compact varieties** are more suited for smaller 4" and 5" pots and are usually early flowering. They can also be used for larger containers and baskets, but the grower should allow more crop time for the plants to develop marketable size. Compact varieties need little chemical growth regulation and are ideal for fast growing and early-flowering production. Compact varieties include many from our dark-leaved Tango™ and Eclipse® series, along with several medium-green-leaved types.

**Vigorous varieties** are especially suited for 6" and larger containers. These varieties generally have larger flowers, larger leaves, and are a bit later flowering than compact varieties. They fill in containers relatively quickly and have outstanding landscape performance when planted outside. Vigorous varieties can be grown in smaller size containers; however, the grower will need to apply several applications of growth regulator and/or pinch the plants to keep them under control.

Vigorous varieties consist of primarily medium-green-leaved types, including our line of Rocky Mountains and some vigorous Americana® types. As mentioned earlier, these plants do especially well in the landscape.

**Medium varieties** are intermediate in vigor between compact and vigorous, and include a range of dark-leaved and medium-green-leaved types. Medium varieties are flexible in that they are suitable for a wide range of containers including baskets. They generally need moderate chemical growth regulation to keep them bushy and mounded. Many of the Americanas and some dark-leaved Eclipse® varieties (Goldsmith-bred) are in this category.

The Americana® series consists of medium-green-leaf varieties with medium-vigorous to vigorous growth habits. Its most vigorous-growing varieties should be managed similarly to Rocky Mountain™ varieties. The Eclipse® varieties are all dark-leaved and are comparable to Fischer's Tango™ series. They vary in vigor from compact to very vigorous.

#### Exotics:

Fischer's collection of exotic geraniums includes several upright varieties offering a range of leaf colors and flower types. Exotics can be grown like zonal types and attention should be paid to growth regulator applications since they differ significantly in vigor. Several varieties in the exotic line are late flowering (i.e. Wilhelm Langguth, Appleblossom, Tricolor, Happy Thought and Crystal Palace Gem) and will take several more days to show good flower color compared to most other Fischer zonals.

#### Ivy Geraniums:

Fischer ivy geraniums lead the market and offer the latest in habit and form. Our catalog lists our entire line of ivy geraniums, including our single-flowering Blizzard and Cascade varieties. Sometimes called "alpine" geraniums, blizzards and cascades are very heat tolerant and make fantastic displays in window boxes, baskets and combination planters. They are also gaining recognition as being very suitable for landscape beds because of their spreading/mounding nature, and self-cleaning flowers.

Fischer also has Goldsmith-bred Freestyle® and Caliente™ series in their ivy geranium line. Freestyles are traditional ivies with trailing to semi-trailing habits and a range of beautiful flower colors. Calientes are ivy/zonal crosses that would be similar in leaf type and habit to the Fischer Reggae ivy varieties. Like our Reggae varieties, they have good edema resistance and can be grown similar to our other ivy geraniums.

When selecting ivy geraniums from our catalog, pay special attention to our growth regulator information. Because of the large selection of varieties, growers should become familiar with this information to help them maintain nicely mounded plants and to group the plants accordingly. We also list the relative heat tolerance of the plant based on its ability to flower and prevent leaf tip yellowing under extremely warm temperatures (highlighted in chart).

## 2. TIMING

#### Zonals:

If grown under optimum conditions, in northern climate zones, the time from potting of the rooted cuttings (one cutting per pot) to finishing:

RC Pot Size	# Weeks
4"	7 – 8
5"	9 – 10
6"	11 – 12
7"	14 – 15
10" (3 plants/pot)	11 – 12

Under warmer southern conditions, the time can be reduced by 1–2 weeks.

In case of direct sticking, 3 weeks should be added using unrooted cuttings and 2 weeks with callused cuttings.

These are general guidelines; vigorous varieties will fill out containers more quickly than compact varieties, but might be slightly later in flowering than compact varieties. We recommend using vigorous varieties (for example, Rocky Mountains) for 10" and larger containers.



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## For Ivies:

If the cuttings are pinched 2–3 weeks after planting rooted cuttings (one cutting per pot):

RC Pot Size	# Weeks
4"	10 – 11
5"	12 – 13
6"	14 – 15
7"	16 – 17
10" (4-5 plants/pot)	13 – 14
12" (5 plants/pot)	13 – 14

Under warm southern conditions, the times can be reduced by 1–2 weeks.

In case of direct sticking, 3 weeks should be added using unrooted cuttings and 2 weeks with callused cuttings.

Subtract about 1 week if Florel is applied early followed with a soft pinch 2–3 weeks after planting a rooted cutting. (This method will produce the best-branched, most even crop.)

Subtract about 2 weeks off the schedule if only Floral is applied early and no pinching is done.

(For more details, see section III. "Finishing High Quality Ivy Geraniums.")

## 3. URC (UNROOTED CUTTINGS) VS. CC (CALLUSED CUTTINGS) VS. RC (ROOTED CUTTINGS)

The decision should not be based on price, but rather what fits best for your company regarding facilities, experience and crop time.

**URC:** Requires the most sophistication, especially when direct sticking. The key elements are the need for bottom heat, a good shade system, excellent mist set up, experienced growing staff, and a moist media (especially for direct sticking) at time of sticking, otherwise losses due to Botrytis can be high and result in an uneven crop.

**CC:** The perfect alternative to unrooted cuttings for direct sticking, usually requiring less attention, mist, and shade than URC. The other advantages are reduced losses and a more even crop. Nevertheless, bottom heat (70°F in the soil), careful misting, and a barely moist media at time of sticking (the top third of the pot should be moist, the bottom dry) are very important prerequisites for good success.

**RC:** The safest way to go if there is no mist system, no bottom heat available, and if providing slightly moist media at the time of sticking cannot be accomplished. Rooted cuttings are probably the best alternative for growers who don't have much experience, are new to geranium production, or would like to get a later start with their production, possibly saving on heating costs.

## REQUIREMENTS FOR MANAGING URC

**Upon arrival:** Unrooted cuttings should be unpacked and stuck immediately. If that is not at all possible, opened boxes should be stored at 36–38°F for no longer than 24 hours to prevent excessive yellowing or high losses. If a cooler is not available, the bags should be opened, laid out on the bench, and misted well. Do not store cuttings in closed boxes. Contact your broker immediately if there appear to be any problems with the cuttings.

**Soil and air temperature:** On the first night, the temperature should be 68–70°F. Then it should be raised to 72°F (air and soil). After the plants reach their final height and leaf expansion, the temperature can be dropped to 66–68°F. If plants need to be held in propagation for a while, 500–750 ppm Cycocel alone, or for a stronger effect, combined with 1,000 ppm B-Nine (Dazide), can be applied weekly if needed.

**Rooting hormones:** Fischer does not recommend the use of rooting hormones on geraniums. Too high of rates or immersing the stem in the hormone can cause burning and subsequently lead to plant losses. This is especially true with small or soft cuttings. With good warm bottom heat, hormones are generally not needed.

**Mist:** The best way to mist zonal geraniums is to have some of the bigger leaves rolling, not wilting, especially at noon. Ivies will not roll their leaves, but will be OK with about 20% less mist than the zonals. Spraying a spray adjuvant, such as Capsil 30 (3–4 ounce per 100 gallons) a day or two after sticking helps in water penetration into the cutting and prevents water from beading up on the leaves. The Capsil can be combined with an early fungicide spray or alone. The mist should be adjusted daily according to changes in the weather and the conditions of the cuttings. It is crucial that there is no water standing on the leaves, there is limited air movement during the first 7–10 days, and no mist is applied in the night after the first 1–2 nights. The mist should be gradually reduced between day 5–10, depending on the weather conditions. Too much mist can severely damage a crop and lead to foliar diseases. Not enough mist can delay a crop and make it uneven. If the leaves get a dull, grayish green color, and there is no Botrytis, the misting should be increased.

**Media and moisture level:** The ideal growing media has a pH of 5.8–6 (6.1–6.3 in a saturated media extract), high air volume, and should be easy to stick the cuttings. Although we feel that Oasis is a very good media, it is important to make sure it never dries out completely, as it can be hard to re-wet. Fischer prefers to use Fertiss from the Oasis company. It offers a good combination of water holding and aeration, and provides excellent growth after transplant. It is also very reasonable in cost. Other good propagation media include the Wedge from Oasis, IHT, Preforma, Ellepot and Jiffy Pellets. Each has its own particular advantages and nuances of use. If peat is used, it should be coarse and mixed with 40–50% perlite. As peat is usually too wet in the beginning, it should be either watered in very carefully, or sit on the bench for a couple of days before sticking so it can dry out somewhat. As mentioned above, if direct sticking is preferred, watering the pots initially in such a way that only the upper third of the pot is moist and the bottom portion is dry is very important to minimize losses.

**Fertilizer:** Start feeding with 150–200 ppm nitrogen of a balanced fertilizer (20–10–20 or 15–15–15 for softer growth and 15–5–15, 13–2–13, or 14–0–14 for harder growth) after all the cuttings start to root. Some varieties root slower than others and, if possible, feeding should begin on a variety by variety basis. Under optimal conditions, day 8–10 would be a starting time for the fertilization to begin. Constant foliar feeding with the mist at 50 ppm nitrogen might be appropriate if conditions are very cloudy and humid, resulting in reduced leaf transpiration and nutrient uptake from the soil. Try to avoid fertilizing during the very hottest time of the day, since rapid drying and fertilizer residue on the leaves can cause damage. If growers begin to see fertilizer burn, they should reduce rates or wash the fertilizer off after fertigation.

**Light:** The ideal light conditions for the first two weeks after sticking are 2,000 foot candles, although light intensities between 1,500 and 3,000 foot candles are acceptable. These lower light levels help reduce the stress on the cutting and reduce the amount of misting needed. Reduced misting leads to less disease problems and leaching of nutrients from the leaves. After rooting, 3,000–4,000 foot candles of light are ideal.

**Plant protection:** The main problem is Botrytis on the stem and on the leaves. The steps that should be taken to greatly reduce chances of infection are: careful misting (especially under poor light conditions), sufficient spacing (25–30 plants per sq. ft.), cleaning of severely infected leaves, and good light conditions. Decree (1 pound per 100 gallons) alternated every 5–7 days with a combination spray of Daconil + Chipco 26019 both at three-quarters the regular rate work well in preventing Botrytis and is our recommended procedure at Fischer rooting stations. The chemicals should be applied as a "srench," so they get into contact with the stem of the cutting. Newer chemicals like Heritage (6 ounces per 100 gallons), Compass (3 ounces per 100 gallons), and ZeroTol (1:300 dilution) are also labeled for Botrytis and appear to be effective in controlling the disease. ZeroTol at 1:100 dilution can also be used as a spray on benches and floors for algae control. It is always a wise idea to alternate chemical sprays with other fungicide classes to prevent resistance. Avoid heavy sprays and drenches of Medallion as phytotoxicity can occur.

## 4. REQUIREMENTS FOR MANAGING CC

**Upon arrival:** They should be unpacked and stuck immediately. If that is not possible, opened boxes should be stored at 36–38°F for no longer than 24



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hours, to prevent excessive yellowing or high losses. If a cooler is not available, the bags should be opened and the cuttings laid out on the bench and misted well.

**Soil and air temperature** should be at least 70°F for maximum root development and to keep the losses at a minimum.

**Mist:** The mist should be applied lightly to avoid wilting for the first 3–5 days depending on light, humidity, air movement, and temperature. The misting can be done by hand.

**Media and moisture level:** The ideal growing media has a pH of 6–6.3 (6.2–6.5 in a saturated media extract) for zonals, 5.5–5.8 (5.8–6.1 in a saturated media extract) for ivies, and high air volume. Coarse peat with 30–40% perlite is ideal.

**It is very important to initially water the pots in such a way that only the upper third of the pot is moist and the bottom two thirds dry.** By keeping the moisture level in the pot as low as possible, the chances for Botrytis on the petioles and stem are greatly reduced.

**Fertilizer:** Feed with 200 ppm nitrogen of a balanced fertilizer (20–10–20 or 15–5–15 as described earlier for URC) after all the cuttings of one variety started to root.

**Light:** The ideal light intensities until root development are around 2,500 foot candles. After rooting, cuttings should be given 3,500–4,000 foot candles.

**Plant protection:** Subdue Maxx at 3/4 of an ounce per 100 gallons, right after sticking will prevent any possible problems with Pythium. This disease could otherwise be a problem, as some of the first roots might be damaged during handling and shipping. Other chemicals to help prevent Pythium are Truban, Terrazole, Alliette, and Banrot (a broad spectrum fungicide).

## 5. REQUIREMENTS FOR MANAGING RC UNTIL THE PLANT STRUCTURE IS BUILT

(For the finishing part of the crop, please see sections II. and III.) A good start is extremely important for growing high quality, well-branched plants.

**The key factors are:**

**Upon arrival:** Rooted cuttings should be unpacked and planted immediately. **The pots should be prepared and the greenhouse warmed up to 72°F.** If immediate planting is not possible, the rooted cuttings should be spread out on the bench (if they arrived in strips) and should be watered and shaded if necessary. If this can't be done, the opened boxes should be stored in a cooler at 45–50°F.

**Media:** Use the best mix you possibly can. A 55–70% high-quality coarse peat, 20–25% perlite, 5–10% vermiculite (for heavier mixes), and 5–10% calcined clay (mainly for increased cation exchange capacity) are ideal. Many media manufacturers provide medium to high drainage mixes that work well for geraniums.

**pH:** The pH should be at 5.5–5.8 (5.8–6.1 in a saturated media extract) for ivies and at 6–6.3 (6.2–6.5 in a saturated media extract) for zonals. Many growers work with media manufacturers to customize potting mixes for their geranium production (i.e. customized high lime mixes for zonals). Media tests should be performed before planting and every two weeks after that, and the pH adjusted by using appropriate basic (calcium nitrate) or acidic (ammonium nitrate) fertilizers. Sulfuric acid or liquid lime can also be used for a quicker pH adjustment. **We highly recommend growers to try using the “Pour Thru” technique promoted by N.C. State University to monitor pH and EC on a weekly basis. Using the Pour Thru is very cost effective and can be done on a regular basis in-house. For step-by-step details, check out their website at [www.pourthruinfo.com](http://www.pourthruinfo.com).**

**Water:** Get a water analysis every year before planting and make sure that the fertilizer and acid injectors are working properly. The alkalinity after the acid injection should be between 80–120 ppm bicarbonates.

**Fertilization:** A complete media analysis should be done at the beginning of the crop and every two weeks after. All these tests are expensive and time consuming, but by far cheaper and less problematic than costly mistakes.

For ideal media, the analysis at the beginning should read around:

150 ppm nitrogen	1 ppm iron
20 ppm phosphorus	0.7 ppm manganese
200 ppm potassium	0.3 ppm zinc
100 ppm calcium	0.15 ppm copper
50 ppm magnesium	0.3 ppm boron
30 ppm sulfur	0.05 ppm molybdenum

Growers might want to try saturating the media before planting with 400 ppm nitrogen of a balanced fertilizer to help “jump-start” the plants once they are transplanted. Otherwise, the first feeding with 250–300 ppm nitrogen should be done as the initial “watering in” of the cuttings after planting (in combination with 3/4 of an ounce Subdue Maxx per 100 gallons). This will protect the roots from Pythium and supply the plants with enough fertilizer until the next fertilization. Avoid waterlogged conditions early on.

**Temperature:** The ideal temperature for the first 4–6 weeks of the crop (depending on pot size) is 70–72° F for optimum root development, overall growth, and branching, regardless of light conditions. The usual 68–70°F day and 63–65°F night, will result in increased stretching, reduced branching, and reduced overall plant and root development. **Growing geraniums cool and dry is a waste of time and money, especially during the first part of the crop.**

**Light:** The ideal light conditions for the first two weeks after planting are 2,500–3,000 foot candles. After that, light can be increased to 3,500–4,500 foot candles.

**CO<sub>2</sub>:** 1,500 ppm for the first four weeks promotes optimum growth.

**Control of Pythium:** Geraniums generally are not prone to fungal root rot, although Pythium can be a problem under wet and cold conditions. A drench of 3/4 of an ounce of Subdue Maxx every three to four weeks, depending on watering frequency and amount of leaching, should avoid any Pythium problems, even at high feed levels. Other chemicals to help prevent Pythium are Truban, Terrazole, Alliette, and Banrot (a broad spectrum fungicide). RootShield (a biological pesticide) is also effective against Pythium. We have also heard favorable comments from growers using newer biological products, such as Companion and Actinovate SP, for Pythium control.

**Growth regulation:** To build a rounded, well-branched plant structure, it is absolutely necessary to regulate the growth of geraniums early, first with Florel at 350 ppm (**500 ppm very often is too high and we commonly see toxicity from using this high rate**) and afterward with Cycocel at 750–1000 ppm. For stronger effects, B-Nine at 1,500–2,500 ppm combined with Cycocel at 750–1,000 ppm work very well. Dazide 85 WSG is a new product with a similar active ingredient as B-Nine and can be used instead of B-Nine. Bonzi or Piccolo can also be sprayed at 2–5 ppm to maintain compact growth. Some growers have had good luck using Sumagic sprays at 1–2 ppm after the early Florel spray(s). Current research is being conducted with TopFlor, a new growth regulator with activity similar to Sumagic. Compact varieties should receive 1–2, medium vigorous varieties 2–3, and vigorous varieties 3–4, Florel applications every 7–10 days after the newly transplanted cuttings have established. This is for crops grown in 6” or larger pots (longer crop times). For geraniums grown in 4” or smaller pots, usually one Florel spray is all that is used to prevent significant flower delay. Cycocel, Cycocel + B-Nine (Dazide), Bonzi (Piccolo), or Sumagic can be applied similarly; **however, because of the cost effectiveness of Florel and its ability to promote branching, we recommend Florel as the best choice for early growth regulator treatments.**

For maximum branching, rooted cuttings can be applied with 150–200 ppm Florel either before or immediately after transplanting; however, the cuttings must be healthy, well-rooted, and under no moisture stress. In order to achieve the full effect, Florel applications have to be done in combination with high soil temperature and good feed. Florel is more effective at warm temperatures (70°F) versus cooler temperatures (60–65°F). The assessments for growth regulator treatments need to be done about once per week, depending on how the plants are growing. Again, only soft and actively growing plants should be



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treated. If the new leaves look too dark, hard, and small, delay the treatment a week. Geraniums should not be treated with Florel a minimum of 6–8 weeks before sale. Cycocel or B-Nine (Dazide) or both combined can be applied as a spray until buds show color. Avoid late sprays of Cycocel, Bonzi (Piccolo), Sumagic, or Cycocel + B-Nine (Dazide) or flowers will be relatively small and down into the foliage. With Cycocel and Florel, it is very important that the **plants are actively growing**, have good roots, the soil is moist, and the sun does not hit the leaves as long they are wet from the spray, other wise they might get burned. Spraying in the evening will avoid this possible problem. Florel toxicity on young plants shows up as overall yellowing of older, bottom leaves. Subsequent Florel applications (at possibly lower rates) should be delayed until plants have recuperated. A drench of Cycocel (1,000–3,000 ppm) works especially well on ivy geraniums after they are on drip irrigation above the benches. Bonzi or Piccolo drenches at 0.25–0.5 ppm can also be used in these situations or to hold a crop that is mature.

## II. Finishing High-Quality Zonal Geraniums

### 1. ASSESSMENT OF THE CURRENT CROP

It is *very important* to take the time and make a detailed assessment of all aspects of the crop. Determine where the crop currently is and where it ideally should be. Make a list of all the changes that should be made for next year, mainly regarding varieties, timing, early Florel and Cycocel treatments, temperature, media, and fertilization.

**The ideal conditions for the first part of the crop are:** 70–72°F day and night, 300 ppm nitrogen feed, high soil moisture level, 1–3 applications of 350 ppm Florel depending on vigor of varieties, and weekly applications of 750–1,000 ppm Cycocel (or Cycocel + 1,500–2,500 ppm B-Nine (Dazide) for a stronger growth retarding effect) on an “as needed” basis.

The idea is to promote branching, establish a strong root system, and at the same time prevent big leaves, long petioles and overall stretchy plants. Very vigorous zonal varieties (like Appleblossom, Wilhelm Langguth, Rocky Mountain™ White, Rocky Mountain™ Scarlet, Rocky Mountain™ Violet, Americana® Dark Red, etc.) or compact varieties that do not branch evenly (like Tango™ Violet and Tango™ Dark Red) might benefit from a soft pinch at the main growing point about 4 weeks after planting and after the first Florel application. **However, pinching zonals is generally not necessary when using Florel sprays.**

Florel should be applied 10–14 days after planting and then every 5–8 days as long as the plants are actively growing. If the new leaves are small and look dark green, Florel (or other growth retardants) should not be applied until they are actively growing again.

The lower the pH and bicarbonates of the water, the more effective Florel will be. Adding phosphoric or sulfuric acid to the water to drop the pH to below 5.5 before adding Florel will increase its effectiveness. The soil should be moist and the application done early morning so the leaves dry before the sun can burn them. To be on the safe side, Florel can be sprayed in the evening.

**Florel applications should stop 6–8 weeks before the sale.** (For quick 4” crops, this might mean applying only one Florel application either very early after transplant or possibly even in propagation.) Afterwards Cycocel, or in warmer climates, Cycocel + B-Nine (Dazide) combinations or other stronger growth regulators (like Bonzi (Piccolo) at 4–5 ppm or Sumagic at up to 3 ppm) should be applied to keep the plants bushy and under control. Ideally, growth regulators should be applied in combination with negative DIF and cool morning strategies. To “hold” plants, Bonzi (Piccolo) can be drenched at 0.5 ppm. Always make several trials with Bonzi (Piccolo) drenches (especially at higher rates) before large-scale applications and be extra careful in measuring out solutions.

**Stunting of plants** can occur when either Bonzi (Piccolo), Sumagic, and B-Nine (Dazide) + Cycocel are either over-applied or applied at very high rates. If this occurs, then the temperatures should be raised to encourage growth. Growers can also apply either Pro-Gibb or Fascination at 3–4 ppm to give a boost to the plants and help them grow out of the chemical retardant. The increased growth

response can be seen in about 7–10 days. A second application can be done if needed at the same rate if the growth increase is not enough.

### 2. ENVISION YOUR PERFECT PLANTS

Have a clear mental picture in mind of how the geraniums should ideally look. Based on the current plant structure, this mental picture will be extremely helpful for making the right decisions at the right time on a daily basis. At the same time it is very important to envision the perfect plant depending on pot size, spacing, and method of shipping. Be sure to make exact notes for every variety regarding future adjustments. Taking digital pictures or regular photographs of several representative plants periodically throughout the crop is a good way of documentation and will be useful when making comparisons from year to year. Sharing these pictures with trusted specialists is also a good way to get instant feedback in case of problems. Using these tools should bring you close to perfection in the years to come. Raise your perceived limits of how good your perfect crop can look and you will be surprised and very proud of the outcome. You will (and should) receive more money for these “perfect” plants.

### 3. ATTENTION TO ALL THE DETAILS MAKE A PERFECT CROP

Reading the plants on a daily basis and making the necessary adjustments of all the variables involved is crucial. The right combination of temperature, humidity, light, soil moisture, feeding level, and growth regulation is a balancing act, which has to be evaluated and corrected constantly. To ideally achieve top-quality geraniums, the plants should be pushed with 70–72°F day and night, high feeding, proper moisture, and light levels. At the same time they should be kept from stretching and “forced” to maximize their potential branching and flower power with growth regulators, cool morning drop, and negative DIF (day temperature is lower than night temperature).

Variety selection is extremely important and very often underestimated in its implications for branching, early flowering, leaf size, flower power, space requirements, shattering, longevity, and overall beauty and shape of the flower. Otherwise, minor price differences when purchasing your cuttings would not be a reason for switching from one series to another. For optimum performance, you need the best varieties for your specific needs. (See section I. “Getting Started—Variety Selection.”) Once you have made the best possible selection, then study the varieties’ individual traits to enhance their positive attributes and overcome their shortcomings. By selecting one variety or breeding line over another, a considerable amount of money can be made when you get the results you want. Furthermore, grouping similar varieties together makes temperature, irrigation, and growth regulator management a lot easier.

### 4. GREENHOUSE CLIMATE MANAGEMENT

Generally, it can be said that even under low light conditions the temperature should not be lowered as this would result in reduction of growth, impaired root development, and a higher chance of root and foliage diseases, the latter mainly caused by higher humidity. Growing a good crop with lower temperatures, (especially night temperatures) is definitely possible, but will result in smaller, less branched plants provided the same crop time. Under low light and high humidity conditions, plenty of air movement and if necessary, “heat and vent strategies,” are extremely important for disease control. This will also supply sufficient transpiration for the plant, which is absolutely necessary for good growth and edema management in ivies (See section III. “Finishing High-Quality Ivy Geraniums,” for more tips on edema control.)

**Temperature:** The ideal temperature for optimum growth rate, habit, and flower formation is 70–72°F day and night for building the plant structure between the first 5–10 weeks of the crop (depending on the pot size). An average temperature of 68°F is good for a slower grown crop. The higher the day temperature as compared to the night temperature (positive DIF), the more stretching of internodes and petioles, the bigger the leaves, and the greater reduction in branching. A temperature regime of high day temperatures and low night temperatures will save fuel, but will result in a more difficult-to-grow crop and a less-than-ideal plant.

A negative DIF regime can be started in the “finishing part of the crop,” which, depending on the pot size, can be the last 3–7 weeks of the crop. By keeping the night temperature at 70°F, the amount of negative DIF applied will determine the internode length (stretch rate). Temperatures of 62–65°F day would be the ideal range for compact growth. In contrast, the higher the positive DIF and the



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lower the light conditions, the more growth regulation is needed, especially under high-density spacing.

Cool morning drop can be started 3–6 weeks before the sale depending on pot size and growth rate. Dropping the temperature to 50°F starting at first light for two hours can strongly diminish the far-red-light-induced stretching in the early morning hours and acclimate the plants to cold night temperatures in May (for plants being sold in early spring). To further harden off the plants, the average temperature can be dropped a few degrees several days before shipping, as long as there is enough air movement and no danger of Botrytis infection.

**Light:** Optimum light levels for production of zonals are 3,500–5,000 foot candles (ivies around 3,500–4,000 foot candles). Zonal geraniums can tolerate up to 6,500 foot candles of light if the day temperature is below 75°F. Hanging other crops above zonals can reduce light levels and significantly reduce their growth and flowering. It is also very wise to not hang geraniums above other geraniums below because of the chances of bacterial disease contamination from the dripping baskets.

**Humidity:** Keeping the humidity low with sufficient airflow is the most important strategy in fighting Botrytis. High night temperatures as well as venting while heating are expensive, but are very effective strategies to reduce the incidence of Botrytis and for growing high-quality geraniums. Ideally the humidity should be lower than 75%.

## 5. PH, FERTILIZATION AND FEEDING SCHEDULE

It is extremely important to constantly monitor and correct the pH to be around 6–6.3 (6.3–6.6 in a saturated media extract, SME) for zonals. (Ivies prefer a pH of 5.5–5.8.) Media analysis should be performed every 2 weeks and the pH adjusted by using appropriate basic (calcium nitrate) or acidic (ammonium nitrate) fertilizers, sulfuric acid, liquid limestone (Limestone F), or even by topdressing the media with finely ground limestone (start with about 1 tsp per 6" pot) and watering in well. Low pH on zonals leads to iron toxicity while high pH on ivies leads to iron deficiency (tip yellowing). Check with your media manufacturer to see if they can customize a geranium mix that is in the ideal pH range.

The salt level (EC) should be adjusted every week and ideally a complete soil analysis should be performed every 2 weeks. Excellent crops are grown when the EC is maintained around 2 or slightly higher (using SME procedures). If using the Pour Thru procedure, EC readings should be slightly higher. This is commonly achieved by using fertilizer rates between 225–300 ppm nitrogen on a continual basis. Maximum nutrient readings 4 weeks after planting until the end of the crop should be around:

250 ppm nitrogen	2 ppm iron
30 ppm phosphorus	1 ppm manganese
300 ppm potassium	0.4 ppm zinc
150 ppm calcium	0.2 ppm copper
70 ppm magnesium	0.4 ppm boron
50 ppm sulfur	0.06 ppm molybdenum

**We highly recommend growers try using the "Pour Thru" technique promoted by N.C. State University to monitor pH and EC on a weekly basis. Using the Pour Thru is very cost effective and can be done on a regular basis in-house. For step by step details, check out their web site at [www.pourthruinfo.com](http://www.pourthruinfo.com).**

A few clean water leaches before shipping, and if possible with a drench of Subdue Maxx (or other appropriate fungicides), will help reduce chances of root disease infection should the plants dry out during shipping, in the store, or until the customer is able to plant them.

To prevent salt buildup, the feeding should be performed such that 15–20% of the applied solution drips out of the pot. Different formulations have different effects on the soil pH and the softness of the plant. For example, 15–15–15, 20–9–20 and 20–10–20 (relatively high ammonium nitrate and ammonium phosphate types) can be used for soft growth and for lowering pH while 15–0–15, 14–0–14, 15–5–15 or 13–2–13 (high calcium nitrate and potassium nitrate types) produce more toned (harder) growth and can be used to slightly raise the pH.

Many of bedding plant plug formulas, such as the 14–0–14 and 13–2–13 listed above, also contain a significant amount of Mg from magnesium nitrate. Excellent crops of zonals can be grown by alternating between soft feeds and hard feeds to maintain ideal growth and media pH. For zonals, we generally prefer to use Cal-Mag (calcium nitrate plus magnesium nitrate) types as the main feed, with periodic applications of 20–10–20. In sub-irrigation systems, the fertilizer rate should be reduced around 40–50% compared to overhead irrigation 4–5 weeks after planting to avoid salt buildup.

Depending on the soil analysis, additional magnesium, calcium, and minor nutrients might need to be applied throughout the crop cycle. Epsom salts (MgSO<sub>4</sub>) is an excellent source of magnesium.

If any nutritional problems should appear, a good recommendation is to leach the crop heavily with fertilizer solution or plain tap water. **(When in doubt, leach out!) Call for advice and get the potting media analyzed immediately.**

If EC (soluble salt level) in the soil is high (>3.0 mS/cm in a SME), don't let plants dry out. Leach them well with plain tap water and drench with Subdue Maxx at 3/4 ounce per 100 gallons every 4 weeks to help prevent further root damage.

If newly developing leaves become yellow under hot conditions (most common with certain ivy geranium varieties) drench with 3–4 ounces of Sprint 330 or Sprint 138 per 100 gallons periodically in the early morning or evening hours. The leaves should be rinsed off immediately after the treatment with tap water to avoid any chances of burning. Higher rates can be used (8 ounces per 100 gallons) in severe situations; however, be aware that zonals are susceptible to iron toxicity, especially when the pH begins to drop below 6 (see section on bronze speckling).

**Feeding schedule:** Ideally, geraniums should not be waterlogged in the beginning, as to quickly establish a healthy root system. After that they prefer to be evenly moist (not wet) for ideal performance. In general, geraniums should be watered after the weight of the pot is about half of the saturated weight. Many experienced growers have a good feel for proper moisture in the pot just by lifting up the pot with their hand. Trying to keep geraniums compact by growing them on the dry side will slow down growth and reduce branching and overall flower production. The irrigation and feeding schedule has to be adjusted to changes in light, temperature, humidity, and plant age on a daily basis.

**Troubleshooting:** The most common nutritional problems we encounter are: **1) upper leaf cupping and 2) bottom leaf necrosis and bronze speckling.** Both symptoms show up mainly on zonals, but can also occur on ivies.

**Bronze speckling, necrotic spots, and leaf edge necrosis** on bottom leaves are caused by too much iron and manganese in the leaves. This commonly comes about when the pH drops to below 5.5 and iron and/or manganese are taken up in excess by the plant. Some varieties are more susceptible than others. To prevent this iron/manganese toxicity, avoid continuous use of very acidic fertilizers (20–20–20, others), monitor the pH regularly (keep above 6) and adjust as needed with limestone additions or basic fertilizers, and avoid excess micronutrient applications. Some varieties, like Rocky Mountain™ Dark Red and Americana® Bright Red, are good indicator plants for low pH-induced iron toxicity.

**Upper leaf cupping** of zonals and sometimes ivies has been a more recent problem over the years and appears to be related to all or some of the following:

- low limestone charges in the potting media,
- low water alkalinity,
- fertilizers containing low amounts of phosphorus,
- high levels of micro nutrients,
- generally sub-optimum nutrient levels,
- often, but not always combined with low pH.

The edges of newer leaves begin to cup upwards (a lily pad look), are reduced in size, and do not expand properly. The symptoms generally appear during the middle to later half of the crop and after the crop has begun to put on growth. The worst cases reported to us have been associated with low media pH. Sometimes the same look can also be caused by organic compounds in the water or certain fungicides. Although it is not yet clear what exactly causes these symptoms (and there might be a variety of reasons), the problem can be prevented or corrected. We have found that adding Limestone F (begin with 32 ounces per 100 gallons)



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or top-dressing the media with finely ground limestone and watering in well helps relieve the problem. Switching over to softer feeds, with higher phosphorus levels that allow better leaf expansion, like a general purpose 20–10–20 (non-peat-lite special) ideally combined with the limestone application helps subsequent new leaves expand normally. There is on-going research at several institutions to try to understand exactly what is causing the leaf cupping.

## 6. DISBUDDING AND GROOMING

In order to achieve the best possible branching and overall growth, mature flower buds can be removed up to 4 weeks (depending on temperature and light conditions) before shipping. If buds are small, they can be pinched off; if they are more mature, they should be removed at the base of the peduncle. Disbudding towards the end of the crop time should be staged depending on at what time certain batches of particular varieties are sold. Their last disbudding should be done at least 4 weeks before shipping. That way the plants are always “fresh” and ideally about 50% open at the time of sale. This will ensure less shattering during transport and enough flower power after planting. Another big advantage of weekly bud removal up to 4 weeks before the sale is that the plants will have a higher bud and flower count that will develop in one flush.

## 7. SPACING

The ideal spacing will be determined by whether it makes more financial sense to produce a “top notch” big (11–13” diameter), medium (8–10” diameter), or small (6–7” diameter) plant. Regardless, the idea is to produce as many well-branched plants as possible per square foot through proper use of growth regulators and temperature and without having them grow into each other. As the crop is being sold, the plants should be constantly spaced in order to get bigger, fuller, and hopefully more valuable. This also creates a more conducive buying environment if the plants are sold out of the greenhouse.

## 8. INSECTS

It is absolutely mandatory to have a tight insect-scouting program in place so that late insecticide applications can be avoided. Having to spray blooming plants can ruin a beautiful crop. Extra care has to be taken to control thrips, as they have to be controlled both on the plants and in the soil. (DuraGuard works well as a drench for thrips pupae.) The pesticides Conserve, Mesuro, Pedestal, and Orthene + pyrethroid (Talstar, Tame, etc.) do a good job controlling thrips. There have been reports of increasing thrips resistance to Conserve, so be sure to rotate with other chemicals. Be on the lookout for thrips as the crop begins to develop flowers. Aphids can also be a problem on zonals and ivies and cause small, distorted leaves and black sooty mold. They are best controlled using early Marathon drenches or granular top-dresses. Flagship, Celero, Safari, and Tristar are relatively newer chemicals with similar properties as Marathon and can offer long-term control of aphids. There are also several other biological options for controlling aphids. Spider and cyclamen mites (mainly on ivies) are especially challenging to detect early. Avid, Thiodan, Pylon, Sanmite, Shuttle (new), and Floramite work well for mites. A relatively new miticide, TetraSan, work well on eggs and immatures and should be explored if mites are a consistent problem. With all pesticide sprays, it is critical to rotate between different classes of pesticides (i.e. pyrethroid versus organophosphate versus insect growth regulator, etc.) to avoid chemical resistance by the insect.

**Budworms:** Geraniums (along with Petunias and Calibrachoas) can be affected by budworms once plants have entered the landscape. Budworm moths lay eggs on the plants during the summer months and the eggs develop into small worms. These worms can devastate geraniums by tunneling into young flower buds and basically eliminating their flower show. Consumers with plants in the home landscape and growers who grow in open greenhouses or on outside flats should look for flying moths and inspect plants periodically for budworms. Sprays of Orthene, Conserve, or pyrethroids (Talstar, Tame, etc.) usually will control the worms.

## 9. DISEASES

The most important diseases to watch out for are: *Xanthomonas campestris* pv. *pelargonii* (Xcp) (wilt and spots), *Ralstonia* (wilt), *Pythium*, *Botrytis*, geranium rust, and *Alternaria*. *Ralstonia* and *Xanthomonas* bacterial wilts can definitely be the most devastating diseases because they spread quickly and there is no known chemical cure.

**Xanthomonas:** Besides ordering cuttings from a “clean” reputable source that goes through all of the culture and virus indexing steps (as all major producers do), it is extremely important to provide and keep an absolutely clean greenhouse environment. (Restrict visitors from other greenhouses, install foot baths, disinfect hands and knives between at least every bench, etc.) The disease can quickly spread from plant to plant through splashing water (common with overhead irrigation) and by cleaning and handling the plants. Avoid hanging geraniums above other geraniums (including seed geraniums) because of the risk of contamination from the plants above. Do not overwinter old geranium plants in the greenhouse from year to year. These plants have a greater chance of harboring the disease without showing symptoms versus newly supplied culture-indexed cuttings. In addition, if you grow perennial or fancy-leaf geraniums, make sure you are getting these from a supplier who has culture-indexed the plants. **There is no known cure for Xanthomonas once the plant has been infected.**

The best line of defense is to scan the crop weekly for any symptoms that look suspicious of the disease. Obtaining as many pictures of the disease as possible—in books, magazines or through extension services—will help immensely to properly identify the disease. Fischer USA can provide you with detailed literature and pictures of the disease if you need further information. The earlier *Xanthomonas* is detected the better the chance to minimize the damage. Quick test kits by AGDIA work very well in diagnosing the disease

as long as symptomatic tissue is tested. If the quick test does not give you a clear diagnosis, then samples should be sent to a commercial disease lab.

Under most circumstances it is possible to save a crop and avoid a catastrophe by early detection and the right course of action. Suspicious looking plants should be immediately sent to a reputable lab. Symptoms are multiple and may include:

- Wilting plants or individual leaves, with root systems still appearing healthy,
- Small (1/15–1/8”), coffee-brown, water-soaked spots within a tan-purple colored bigger spot (often a sign of transmission by water),
- Yellowish or olive-green wedges between the veins,
- Olive-green wedges between veins with the neighboring tissue becoming yellowish green; dark green veins shining through yellowish tissue,
- Upward (later downward) curled edges of leaves (often in conjunction with the appearance of wedges), usually only on one side of a leaf exhibiting symptoms.

In case of a positive result, a second sample should be sent to a different lab to be confirmed. At the same time the supplier should be contacted and an action plan should be established as to what plants should be discarded, the proper procedure for discarding, and how the greenhouses should be disinfected for next year’s crop.

**Ralstonia:** *Ralstonia* is a bacterial wilt disease that can be transmitted through soil, contaminated irrigation water, cutting knives, or personnel. Until recently, it had shown up primarily in southern states. The race 3 biovar 2 type of *Ralstonia* has recently gathered significant attention in the industry because it can also attack several agricultural crops (i.e. potatoes) and is deemed an economic threat if the disease infects important edible crops. This strain is currently listed as a bioterrorism organism by the U.S. government because it can survive cold temperatures (overwinter) and possibly infect potato and tomato crops. *Ralstonia* causes wilting symptoms similar to Xcp; however, it does not cause spotting on the leaves. It’s containment and clean-up should be handled similarly as Xcp and the supplier/broker should be contacted immediately if *Ralstonia* is suspected. There are also new quick test kits offered by AGDIA for testing *Ralstonia*. Fischer USA has invested literally millions of dollars in facilities and laboratory tools to prevent *Ralstonia* (and Xcp) from infecting their stock plants and cuttings.

**Pythium:** *Pythium* fungal root rot can be avoided to a large extent by using coarse peat, not letting the plants dry out, especially when salt levels are high (consistent pH and EC tests!), and by not over-watering the plants. Good sanitation goes a long way in helping to prevent *Pythium*. To be on the safe side, Subdue Maxx at 3/4 ounces per 100 gallons every 3–4 weeks is an excellent way of minimizing or eliminating *Pythium* problems. Truban, Terrazole, Banrot, and Alliette also do a good job preventing *Pythium*. Biological fungicides, such as RootShield, Companion, and Actinovate SP also appear to be working well for many growers.

**Botrytis:** *Botrytis* can be prevented with good air movement, keeping the plants clean, maintaining humidity below 75% (by raising the night temperature or “heating



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and venting” under rainy, damp conditions), and by watering early in the morning. Combination sprays of two or three chemicals work best against Botrytis. An excellent combination is Daconil + Chipco 26019 (or Dithane) at 75% rate each. Decree also works very well and has a different mode of action against the disease. We have also received several reports of excellent Botrytis control using ZeroTol (hydrogen dioxide) in the mist system (used continuously at a dilution rate of 1:2,500). ZeroTol can also be applied periodically as a spray at a dilution rate of 1:250–300. Other products registered for Botrytis control are Heritage, Compass, and Spectro. Some growers have also had luck using PlantShield, Rhapsody, Actinovate SP (all biologicals) as a plant spray to prevent Botrytis. As with insecticides, it is wise to rotate between classes of fungicides to prevent disease resistance. **Avoid using Medallion as a heavy spray or drench on geraniums since toxicity can occur.**

**Geranium Rust:** As Rust spores appear on the under side of the leaf, they easily can go undetected for quite a while. Rust is hard to manage if it is not detected early. Dithane (mancozeb) once a week at 24 ounces per 100 gallons prevents the onset and the spread of the disease. An excellent cure is Strike at 4 ounces per 100 gallons every week for 3 weeks in a row. Be aware that Strike (also Terraguard) can act as a growth retardant when used repeatedly. Heritage and Systhane (Eagle 20 EW) also work well for geranium rust. Scouting the crop weekly for 0.1” yellow spots on the upper side of the leaf or the dark brown 0.1–0.2” big pustules (spores) on the under side of the leaves is critical for fighting the disease early. In later stages the dark brown pustules also appear on the upper side of the leaves and large concentric rings form on the under sides of the leaves.

**Alternaria:** This fungal disease can be found more in the warmer southern climates and in geranium beds during rainy summers across the states. The appearance is somewhat similar to Xanthomonas leaf spot, although the spots are more evenly distributed, have a more tan color, exhibit concentric rings in the later stages, and exhibit no wilting wedges within the leaves. Chemicals that work against Botrytis also work well against Alternaria.

**Other bacterial diseases:** *Pseudomonas cichorii* (mainly in Florida) and *Pseudomonas syringa* develop leaf spots that are generally larger than those from *Xanthomonas*. The diseases should be identified in a lab. As mentioned earlier, *Ralstonia solanacearum* (also in northern climates) causes wilting symptoms similar to *Xanthomonas* but does not cause leaf spotting. Like *Xanthomonas*, it is a serious disease and can come into greenhouses from infected cuttings. *Pseudomonas cichorii* and *Ralstonia solanacearum* can also infect other ornamental crops.

## 10. ORGANIZATION AND CLEANLINESS PAY OFF

The **wow factor** of a well organized, clean greenhouse and overall facility can't be emphasized enough. Nobody will doubt that a clean and orderly grocery store (and especially the fruit, vegetable, and meat department) is an absolute necessity for customers to feel good enough to purchase the products wholeheartedly. Because of a good and often subliminal perception, the customers value the products higher than the same products from an unorganized, poorly maintained store.

Aside from having less disease problems, it definitely pays to hire extra labor, mainly for peak times, just to keep the whole facility clean and organized. If that is not done, there will most probably not be enough time to take care of those important issues. Customers will put a higher value on plants that are clean and look healthy coming from an organized and clean environment than the ones coming from environments of algae, slippery and muddy walkways, hoses on the floor, and general disorder. The excellent greenhouses that provide their visitors and customers with a good buying experience know how important organization and cleanliness are for their success.

## 11. DETAILED CARE INSTRUCTIONS

Even the most beautiful geraniums are only partially finished until the customer is happy with their performance. They will promote the product and company by word of mouth and will likely return the following year. If you're a retail grower, having a well-written, detailed care instruction guide will reduce claims, staff time required for the sale, and will make the customer feel cared for and much more comfortable with their purchase.

The care instruction guide should be perceived as the “geranium bible.” It should be annually improved, which will prove your dedication to the customer. The instructions should be part of the sale and should include a description of the

product you grow and sell and why it is different and better as compared to other products. Proper care instructions should cover the specifics of the most frequent customer concerns. The following topics should be addressed:

- 1) Immediate care (frost, light, water, storage, and flower bud abortion) and
- 2) Extended care, depending on pot size (replanting, planting depth, disinfecting pots, soil amendments, drainage, light, water, fertilizer requirements, grooming, pest and weed control, etc.).

On a final note, finishing high-quality geraniums is (as with all other plants) all about commitment to excellence, attention to detail on a daily basis, proper knowledge, and customer satisfaction. The best indicator for success is if the customer thinks that the value he or she receives exceeds the price paid.

## III. Finishing High-Quality Ivy Geraniums

Producing great looking ivy geraniums can be very rewarding in regards to your customer's satisfaction and your company's profitability. Fischer continues to expand and improve their ivy geraniums in regard to flowering and growth habit. These new and improved varieties are generally earlier flowering, have more flower power and better branching, have dramatic and improved colors, and are more edema resistant. This makes growing ivy geraniums much easier and generates a lot more appeal to customers.

The price difference and customer satisfaction between OK and excellent baskets can be enormous, and are the best incentive for trying hard to grow the best money can buy.

### 1. VARIETY SELECTION

The main characteristics for great performing ivy varieties in pots and baskets are:

- Excellent branching for maximum flower-power and ease of transportation,
- Earliness for good overall appearance at time of sale,
- Bold and clear colors,
- Attractive, edema-resistant foliage,
- Resistance to flower shattering, and
- Resistance to leaf tip yellowing under high temperatures.

**For hot and humid climates,** cascades and blizzards are the best choice. They are very sun and heat tolerant and perform well in all pot sizes and applications. They are becoming more popular for use in combination containers and baskets because of their cascading habit and self-cleaning flowers. Cascades and blizzards are excellent for use in baskets, window boxes, and in landscape beds. They should be grown like vigorous ivies and started a bit earlier than traditional ivies since they usually don't exhibit a lot of color in their early stages of development.

### 2. TIMING AND CUTTINGS PER POT

In general, ivies take about 2–3 weeks more production time versus zonals to reach a marketable product. If the cuttings are pinched 2–3 weeks after planting rooted cuttings (one cutting per pot):

RC Pot Size	# Weeks
4"	10 – 11
5"	12 – 13
6"	14 – 15
7"	16 – 17
10" (4-5 plants/pot)	13 – 14
12" (5-7 plants/pot)	13 – 14

Under warm southern conditions, the times can be reduced by 1–2 weeks.

In case of direct sticking, 3 weeks should be added using unrooted cuttings and 2 weeks with callused cuttings.



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Subtract about 1 week if Florel is applied early followed with a soft pinch 2–3 weeks after planting a rooted cutting. (This method will produce the best branched, most even crop.) Subtract about 2 weeks off the schedule if only Florel is applied and no pinching is done.

Usually the worst mistakes many growers make are:

- Not enough cuttings per pot,
- Not enough plants in the center of the pot, which results in openness,
- Not enough growing time when fewer cuttings are used,
- Not enough growth regulating, and
- Not enough attention to the details in the first part of the crop.

Ten–12" baskets should have 4–5 (preferably 5) cuttings with at least 1 cutting in the center and the outer rim cuttings 2 1/2" from the edge of the pot. For May sales, specimen baskets should be started with rooted cuttings in the beginning of February and compact baskets for the mass market at the end of February. With 3 cuttings per pot (10" basket), the plants should be potted about 3–4 weeks earlier and given more Florel applications (or pinches). For high-quality plants and better prices at retail, we recommend using 6–7 cuttings in a 12"–14" pot. The cuttings should be arranged with 4–5 around the outside approximately 2 1/2" from the edge of the pot and 2–3 cuttings in the center.

There is still a wide open market for 4–5" ivies planted with one cutting the middle of March, (with Florel, not pinched) and for 6–7" pots with 2 cuttings per pot planted in the beginning of February. These are gaining popularity for use in large containers, window boxes, and also landscape beds. With this high density cropping, new customers can be won by growers who can offer a new product form at more competitive prices, which can also be planted together with other bedding plants.

## 3. MEDIA, PH AND FERTILIZATION

**Media:** Ideal media should contain 25% perlite, 60% good coarse peat, and 10–15% vermiculite or clay for better water retention and buffer capacity.

**pH:** A pH between 5.5–5.8 (5.8–6.1 in a SME) is ideal for ivies and important in maximizing growth and reducing edema and leaf tip yellowing (zonals prefer 6–6.3). To maintain a pH in this range, the soil should be tested every two weeks and appropriate adjustments be made with the application of basic (calcium nitrate) or acidic fertilizers, sulfuric acid, or limestone additions.

**Fertilization:** A complete potting media analysis should be done at the beginning of the crop, then every 2 weeks thereafter. These tests take time and money, but are worth it in the end when the crop has had no nutritional problems and is looking great. Without periodic media analysis, the grower has little idea of the nutrient status of the crop. The analysis should read around:

### In the beginning:

150 ppm nitrogen	1 ppm iron
20 ppm phosphorus	0.7 ppm manganese
200 ppm potassium	0.3 ppm zinc
100 ppm calcium	0.15 ppm copper
50 ppm magnesium	0.3 ppm boron
0.05 ppm molybdenum	

### Six weeks after planting, until the end of the crop:

220 ppm nitrogen	3 ppm iron
30 ppm phosphorus	1.5 ppm manganese
250 ppm potassium	0.4 ppm zinc
150 ppm calcium	0.2 ppm copper
80 ppm magnesium	0.4 ppm boron
0.06 ppm molybdenum	

**Fertilization of ivies is similar to zonals. (See section II. "Finishing High-Quality Zonal Geraniums—pH, fertilization and feeding schedule".)** As with

zonals, plants should be thoroughly irrigated with moderate leaching. Using "soft" feeds alternated with "hard" feeds generally produces the best crops and helps to maintain the media in an ideal pH range. Monitor the EC and try to maintain a level of around 2 mS/cm (using SME technique) or slightly higher after the plants are established and actively growing. If using the pour thru procedure, EC readings should be slightly higher. Micronutrients (especially iron), magnesium sulfate, and calcium nitrate should be applied periodically based on media and/or tissue analysis.

Ivies are particularly prone to iron deficiency (yellowing of new leaves), especially when the pH gets into the mid 6 range or when the temperatures in the greenhouse get above 80°F. Some varieties of ivies are worse than others (see our catalog listing of heat tolerance of ivies). If newly developing leaves begin to yellow under hot conditions, apply 4 ounces per 100 gallons of Sprint 330 or Sprint 138 (chelated iron) every 3 weeks in the early morning hours. Leaves should be rinsed off immediately after treatment to avoid any chances of burning. If the yellowing is severe and a quick correction is needed, then the rate can be increased to 8 ounces per 100 gallons. Iron sulfate can be used also at similar rates as described above, but is generally not as effective as an iron chelate.

**Feeding schedule:** One of the most common problems with ivies is that they are grown too wet in the first part of the crop cycle and too dry in the second part. (See also edema control.) Ideally ivies should be grown on the drier side in the beginning and generally fed after the weight of the pot decreases to 50% of the saturation weight. Ivies like it evenly moist (not wet!) for ideal performance. The feeding schedule has to be adjusted to the light, temperature, and plant age on a daily basis.

## 4. TEMPERATURE

The ideal temperature to reach optimum growth rate, habit and flower-formation is an average of 68–70°F (68–70°F day and night results in compact growth). The higher the positive DIF, the longer the stem internode length and more stretching. With a 75°F day and 63°F night, good quality can be achieved, although Botrytis might be a problem due to the low night temperatures. An acceptable temperature regimen is a 72°F day and a 65°F night. An early cool morning drop for two hours at 50°F (DIP), starting before first light, should begin 6 weeks after planting for more compact plants. A regime of 66°F days and 70°F nights results in excellent, compact, and well-branched plants with little, if any, Botrytis. The higher the positive DIF, the more growth regulating will become necessary, especially on the more vigorous varieties.

Hanging ivies in the air above the benches, especially in the second part of the crop, very often exposes them to too much light, heat, and humidity for proper growth and edema control.

## 5. GROWTH REGULATING AND FLOREL

**Florel** should be applied at 350 ppm to avoid stunting or bottom leaf yellowing; 500 ppm can be too drastic.

Compact growing varieties (Picasso, Blanche Roche, Shiva, etc.) need fewer treatments (1–2) than more vigorous varieties (Beach, Mandarin, blizzards, cascades) which need 3–4. Medium vigorous varieties (Taj Mahal, Chirocco, etc.) are in between these two. Our catalog lists the relative vigor (growth regulator frequency) of each of our varieties.

Plants should be well-established (2 weeks after planting), actively growing, and moist with no sunshine for up to 2 hours after application. For maximum branching, rooted cuttings can be sprayed with 150–200 ppm 1 week before planting.

For most even habit the plants should be sprayed with Florel about 2 weeks after planting, then followed with a soft pinch (around 3 weeks after planting).

Ideally Florel should be applied up to 6–8 weeks before sale, after that, Cycocel should be applied to keep plants compact, depending on temperature regimen, variety, and overall appearance. Remember that plants should be actively growing and be under no environmental stress when the Florel is applied, otherwise stunting and bottom leaf yellowing will occur.

**Cycocel** should be sprayed at 750–1,000 ppm to avoid yellowing. Frequent (weekly) applications at low rates result in a more even crop than less frequent applications at high rates. Compact varieties will need fewer applications than more vigorous varieties.

Cycocel can be drenched at 1,000 up to 3,000 ppm through drip irrigation. This is



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fairly costly, but is useful for hanging baskets or pots which are in areas that are hard to spray. (See also Bonzi drenches.)

Cycocel should be sprayed very early in the morning or early evening, and the soil should be moist. In warmer climates Cycocel (750–1,000 ppm) can be combined with B-Nine (or Dazide) at 1,000–3,000 ppm and sprayed 1–3 times.

**Bonzi or Piccolo** can be sprayed at 4–5 ppm (depending on growth habit and temperature) 1–4 times after the initial Florel treatments. In very warm climates, this is a good alternative to Cycocel.

Bonzi (Piccolo) drenches should be done only after sufficient tests. The rate should be 0.5 ppm, with the soil moist and the plants actively growing. Make several trials before using Bonzi drenches and measure out solutions carefully and accurately.

As mentioned earlier, Sumagic has been used with some success by some growers as a spray at 1–2 ppm following the early Florel sprays. TopFlor is another new growth regulating chemical that is currently being evaluated on geraniums.

## Water stress

Trying to keep ivies compact by growing them “dry” will slow down the overall development and very often results in severe edema. Water stress is not recommended as a means of growth control.

## 6. BRANCHING, DISBUDDING, AND LEAF REMOVAL

### Branching

Good branching, rounded habit, and flower power is a result of combining: variety characteristics, DIF, light, temperature, feeding schedule, EC in media, Florel, growth regulation, spacing, and pinching. All of those factors combined wisely will result in excellent plants.

### Disbudding

If possible, taking all of the buds off up to 4 weeks before sale will result in a higher bud count, improved branching, and more compact plants at the time of sale. Many times, however, this is not convenient because of labor considerations and difficult access to hanging baskets.

### Leaf removal

If needed, taking big and yellow leaves out in the beginning of April will result in a more even and healthy basket. If Florel is applied sufficiently, this usually is not necessary.

## 7. LIGHT

Ivies prefer light levels between 3,500 and 4,000 foot candles. Hanging in the air above benches, ivies can receive more light, heat and humidity than is good for them. Good air circulation, an optimum feeding schedule, and even moisture in the soil are extremely important conditions in order to minimize edema and other cultural problems like root loss or subsequent malnutrition. On drip irrigation, compact varieties should be on separate drip lines than the more vigorous varieties.

## 8. EDEMA CONTROL

Edema is a physiological disorder mainly in ivies. It is caused by too much water uptake into the plant without sufficient water loss from the leaves.

Initially, the symptoms appear as “water blisters” on the bottom sides of the leaves. Under water, light, and pH stress conditions, these “blisters” (cells) burst, resulting in small to large corky spots on the under side of the leaves. Symptoms can resemble spider mite damage. Edema can be controlled by following all, some or all, of the following steps:

- Make sure plants don't dry out, especially under hot conditions,
- Plants should not be overwatered in January and February when they are small and light levels are low,
- Remove saucers from hanging baskets and snap them on later for sale,
- Make sure there is sufficient air circulation,
- Keep relative humidity below 75% and avoid hanging ivy baskets right next to wet cooling pads; heat and vent under high humidity,

- Shade if sudden high light conditions occur,
- Keep pH between 5.6–5.7 and make sure iron is sufficiently supplied (zonals might show iron toxicity if pH is lower than 5.7),
- Feed early morning and provide calcium nitrate regularly throughout production, and
- If on drip irrigation, separate compact from more vigorous varieties.

## 9. INSECTS

Ivies are not a main target for insects. The most important pests are thrips and aphids. Several chemicals and chemical cocktails will help control thrips. These include Conserve, Mesurool, Azatin + Avid, Talstar + Orthene, Tame, Decathlon, and the new Pedestal. Under severe insect pressure, plants should be treated every 5 days 4 times in a row. Duraguard as a drench is very important to break the lifecycle of the thrips in the potting media. There have been reports of increasing thrips resistance to Conserve, so be sure to rotate with other chemicals. Aphids can be controlled with various pyrethroid sprays (Talstar, Tame, etc.) or by using long-term systemic neonicotinoids (Marathon, Safari, Celero, etc.). Cyclamen mites and Red Spider mites can be a severe problem if they are not detected early enough. Avid, Sanmite, Akari, Floramite, Pylon, Shuttle, or TetraSan used every 5–7 days 3–4 times in a row can eradicate these pests. Try to rotate between chemicals to avoid insect resistance to the chemicals.

## 10. DISEASES

Botrytis and Pythium are the main disease problems. Botrytis can be prevented with good air movement, cleaning dead blooms, high night temperatures, early watering, and “heating and venting” under humid conditions. Decree (1 pound per 100 gallons) is an excellent chemical for controlling Botrytis. Combination sprays with Daconil plus Chipco 26019 alternated with the Decree does a very good job controlling Botrytis outbreaks. Spectro is also a good choice for control. ZeroTol (1:300 dilution), Heritage (6 ounces per 100 gallons), and Compass (3 ounces per 100 gallons) are also labeled for Botrytis control.

Pythium can be reduced by using coarse peat and not allowing plants to dry out, especially when high salt levels are present. Overwatering, especially with cold soil temperatures, can also cause Pythium to flourish and move in on roots. The best prevention and cure of Pythium is good sanitation and a drench with Subdue Maxx at 3/4 of an ounce per 100 gallons (or other appropriate fungicides or chemicals) every 3–4 weeks. Very often, if Subdue Maxx does not seem to work, all that is needed is a slightly higher rate or rotating with another chemical for controlling Pythium. Always read the label directions and never go above the recommended label rate.

### Technical Assistance:

For further technical assistance on growing geraniums, please contact: Karl Trel-linger (karl.trellinger@syngenta.com), or Harvey Lang (harvey.lang@syngenta.com) or by calling Syngenta Flowers at 800-344-7262.



# Producing High-Quality Geraniums

## FUNGICIDES

Product Name	Active Ingredient
Actinovate SP	0.03% Streptomyces lydicus
Alliette WDG	80% aluminum tris
Alude	45.8% potassium salts of H <sub>3</sub> PO <sub>4</sub>
Banrot 40WP	15% etridiazole+ 25% thiophanate-methyl
Camelot	58% copper salts
Cleary's 3336 50WP	50% thiophanate-methyl
Cleary's 3336 F	41.3% thiophanate-methyl
Compass O 50WDG	50% trifloxystrobin
Companion	0.03% Bacillus
ConSyst WDG	50% chlorothalonil+ 16.7% thophanate-methyl
Contrast 70WSP	70% flutolanil
Cygnus 50WDG	50% kresoxim-methyl
Daconil Ultrex	82.5% chlorothalonil
Daconil Weather Stik	54% chlorothalonil
Decree 50WDG	50% fenhexamid
Dithane M-45	85% mancozeb
Dithane T/O	75% mancozeb
Eagle 20 EW	19.7% myclobutanil
Exotherm Termil	20% chlorothalonil
Fungo Flo	46.2% thiophanate-methyl
Heritage	50% azoxystrobin
Medallion	50% fludioxonil
Milstop	"85% carbonic acid, monopotassium salt"
OHP 6672 4.5L	46.2% thiophanate-methyl
OHP 6672 50W	50% thiophanate-methyl
Phyton 27	21.4% fixed copper
Pipron	84.4% piperalin
Protect T/O	80% mancozeb
Rhapsody AS	1.34% Bacillus subtilis
Root/Plant Shield	Trichoderma fungus
Sextant	23.3% iprodione
Spectro 90WDG	72% chlorothalonil+ 18% thiophanate-methyl
Strike 50WDG	50% triadimefon
Subdue Maxx	21.3% mefenoxam
Terraclor 400FL	40% quintozone
Terraclor 75WP	75% quintozone
Terraguard 50WP	50% triflumazole
Terrazole 35WP	35% etridiazole
Truban 25EC	25% etridiazole
Truban 30WP	30% etridiazole
Zero Tol	27% hydrogen dioxide

Note: These suggestions are only guidelines and may have to be altered to meet individual grower's needs. Check all chemical labels to verify registration for use in your region.

## INSECTICIDES

Product Name	Active Ingredient
Akari 5SC	5% fenprothimate
Attain TR	4.0% bifenthrin
Avid 0.15EC	2% abamectin
Azatin XL	3% azadirachtin
Botanigard ES	11.3% Beauveria bassiana GHA
Celero 16 WSG	16% clothianidin
Citation WP	75% cyromazine
Conserve SC	11.6% spinosad
Decathlon 20WP	20% cyfluthrin
Distance	11.2% pyriproxyfen
Duraguard ME	20% chloropyrifos
Endeavor	50% pymetrozine
Enstar II	65.1% S-kinoprene
Flagship 25WG	25% thiamethoxam
Floramite SC	22.6% bifenazate
Gnatrol	0.6% B. thuringiensis var. israelensis
Hexygon DF	50% hexythiazox
Judo	45% spiromesifen
Marathon 1% G	1% imidacloprid
Marathon 60WP	60% imidacloprid
Marathon II	21.4% imidacloprid
Mesuroil 75W	75% methiocarb
Naturalis-O	72% Beauveria bassiana ATCC 74040
Orthene TT&O WSP	75% acephate
Ovation SC	42% clofentezine
Pedestal	10% benzoylurea
Preclude TR	4.8% fenoxycarb
Pylon	21.4% chlorfenapyr
Safari 20SG	20% dinotefuran
Sanmite 75WP	75% pyridaben
Talstar FL	7.9% bifenthrin
Tame 2.4EC	31% fenprothrin
TetraSan	5% etoxazole
Thiodan 3EC	33.7% endosulfan
Thiodan 50WP	50% endosulfan
Tristar 70WSP	70% acetamiprid
Ultra Fine Oil	98.8% paraffinic oil

## CHEMICAL EQUIVALENTS

A-Rest (0.0264% ancymidol):	5 ppm = 2.5 fl ounces/gallon or 19 ml/liter
B-nine or Dazide (85% daminozide):	1500 ppm = 0.23 ounce/gallon or 1.76 gallons/liter
Bonzi or Piccolo (0.4% paclobutrazol):	5 ppm = 0.16 fluid ounce/gallon or 1.25 milliliter/liter
Cycocel (11.8% chlormequat):	1000 ppm = 1.1 fl ounces/gallon or 8.5 milliliter/liter
Fascination (1.8% GA4+7+1.8%BA):	2 ppm = 0.015 ounce/gallon or 0.12 milliliter/liter
Florel (3.9% ethephon):	350 ppm = 1.2 fluid ounces/gallon or 9.5 milliliter/liter
Sumagic (0.055% uniconazole):	1 ppm = 0.26 fluid ounce/gallon or 2 milliliter/liter
TopFlor (0.38% flurprimidol):	1 ppm = 0.033 fluid ounce/gallon or 0.25 milliliter/liter
Pro-Gibb (4% GA3):	4 ppm = 0.013 fluid ounce/gallon or 0.11 milliliter/liter

## PLANT GROWTH REGULATORS

Product Name	Active Ingredient
A-Rest	0.0264% ancymidol
B-nine	85% daminozide
Bonzi or Piccolo	0.4% paclobutrazol
Cycocel	11.8% chlormequat 1 ounce = 28.35 gm
Fascination	1.8% GA4+7+1.8% BA
Florel	4% ethephon ProGibb T&O 4% GA3
Sumagic	0.055% uniconazole
TopFlor	0.38% flurprimidol
Capsil 30	nonionic organosilicate

## CONVERSION TABLES

### Temperature

To convert Fahrenheit to Celsius:  
Subtract 32 and multiply by 0.55; thus 68°F = 20°C.

To convert Celsius to Fahrenheit:  
Multiply by 1.8 and add 32; thus 30°C = 86°F

### Dry Weight

1 pound = 454 grams = 16 ounces

### Liquid Weight

1 ounce = 29.6 milliliters = 2 tablespoons

1 teaspoon = 0.1667 ounce

33.78 ounces = 1000 milliliters = 1 liter

1 gallon = 3.78 liters