

IVY GERANIUM PRODUCTION

Pelargonium peltatum (L.) L'Herit.

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INTRODUCTION: The popularity of ivy geraniums continues to grow. Ivy geranium sales increased from 30.1 million in 1996 to 30.9 million dollars in 1997 (+3%). In Minnesota, ivy geranium sales increased 20% from 1996 to 1997. The increase of the ivy geranium sales is due, in part, to consumer and grower recognition of the relative heat and drought tolerance of this group of geraniums compared to other geranium types. In addition, breeding efforts have greatly increased the variety of colors and leaf shapes available in ivy geraniums and introduced new types with increased heat tolerance. This article outlines basic

efforts in England resulted in the first semi-double and double flowering forms of ivy geraniums in 1875. The first seed propagated ivy geranium was produced in 1986 by Blair Winner of Denholm Seeds. Although there are seed propagated ivy geranium types available, most ivy geranium cultivars are propagated from cuttings (asexually). In total, cutting propagated ivy geraniums constitute approximately 20% of the geranium cutting market.

CULTIVARS AND CLASSES: There are four classes/groups of ivy geraniums:

1) **Traditional Types** – these types have large, thick leaves with large semi-double or double flowers. Inflorescences are few, but showy. Examples of this type include the cultivars Harvard, Yale, and Tavira.

2) **Balcony Types** – these types originated from European breeding efforts, have small, thin leaves, numerous single flowers, branch profusely, and are more heat and drought tolerant than most ivy geraniums. Examples of this type include Balcons, Cascades and Decoras line.

3) **Dwarf Types** – these types resemble the Balcony types except they are dwarfed, i.e. have a smaller plant form and flowers. An example of this

"Ivy geranium wholesale value increased 20% in Minnesota between 1996 and 1997."

practices associated with growing ivy geranium stock, propagation of ivy geranium cuttings and finishing an ivy geranium crop.

History: Ivy geraniums were first discovered in South Africa in the Cape Province and were first grown commercially in England in the 1700's. Initial breeding

Table 1. Ivy geraniums currently on the market.

Cultivar	Source	Color	Earliness	Zone	Type	Cycoce/Florel
Acapulco compact cascade	Fischer	Pink/White	Early	None	Single	Medium
Amethyst	Fischer	Dark Lavender	Early	Medium	Semi-double	Medium
Balcon Pink Star	Oglevee	Pink/White			Single	
Balcon Royale	Oglevee	Scarlet			Single	
Barock	Fischer	Dark Red	Early	Light	Semi-double	Little
Beach	Fischer	True Red	Medium Early	Light	Semi-double	Med./Freq.
Beauty of Eastbourne	Oglevee	Red			Semi-double	
Belladonna	Fischer	Pink	Early	None	Semi-double	Medium
Belle	Oglevee	Red			Semi-double	
Blanche Roche	Fischer	Early	Early	Light	Semi-double	Little
Blue Blizzard	Fischer	Lavender	Medium	Dark	Single	Medium
Bright cascade	Fischer	Red	Medium	None	Single	Med./Freq.
Butterfly	Fischer	Light Lavender	Early	Light	Semi-double	Little
Colorcade Burgundy	Ball FloraPlant	Dark Burgundy			Semi-double	
Colorcade Lavender	Ball FloraPlant	Medium Lavender			Semi-double	
Colorcade Lilac	Ball FloraPlant	Lavender			Semi-double	
Colorcade Pink	Ball FloraPlant	Rose Pink				
Comedy	Fischer	Violet	Medium Late	Dark	Semi-double	Medium
Cornell	Oglevee				Semi-double	
Evka	Oglevee	Pink			Single	
Flair	Fischer	Deep Salmon	Early	Light	Semi-double	Medium
Global Bright Purple	Oglevee	Purple			Semi-double	
Global Light Lilac	Oglevee	Light Purple			Semi-double	
Global Merlot	Oglevee	Dark Purple			Semi-double	
Global Neon Cherry	Oglevee	Bright Pink			Semi-double	
Global Rich Red	Oglevee	Red			Semi-double	
Global Rose	Oglevee	Pink			Semi-double	
Global Ruby Red	Oglevee	Dark Red			Semi-double	
King of Balcon	Oglevee	Light Pink			Single	
Lambada	Fischer	Dark Pink	Early	Medium	Semi-double	Medium
Lila compact cascade	Fischer	Lavender	Early	None	Single	Med./Freq.
Lila mini cascade	Fischer	Lilac	Medium	None	Single	Little
Luna	Fischer	White	Medium Early	Medium	Semi-double	Little
Mandarin	Fischer	Orange	Early	Medium	Semi-double	Medium
Matador Burgundy	Oglevee	Dark Purple			Semi-double	
Matador Light Pink	Oglevee	Light Pink			Single	
Mexicana	Fischer	Red/White	Medium	Light	Semi-double	Med./Freq.
Minicascade Lavender	Oglevee	Pink			Single	
Minicascade Pink	Oglevee	Pink			Single	
Minicascade Red	Oglevee	Red			Single	
Molina	Fischer	Salmon Pink	Medium	Dark	Semi-double	Med./Freq.
Nicole	Oglevee	Pink			Semi-double	
Peppermint Candy	Oglevee	Red/White			Semi-double	
Pink Blizzard	Fischer	Pink	Medium	Light	Single	Med./Freq.
Princess of Balcon	Oglevee	Pink			Single	
Red Blizzard	Fischer	Red	Very Early	Dark	Single	Med./Freq.
Red mini cascade	Fischer	Red	Medium	None	Single	Little
Saint Malo	Oglevee	Red			Semi-double	
Sofie cascade	Fischer	Light Salmon Pink	Medium	None	Single	Med./Freq.
Sybil Holmes	Fischer/Oglevee	Pink	Medium	None	Semi-double	Little
Taj Mahal	Fischer	Burgundy	Medium Early		Semi-double	Medium
Tornado Cherry Red	Novartis					
Tornado Rose	Novartis					
Tornado Orchid	Novartis					
Vinco	Oglevee	Bright Pink			Semi-double	
White Blizzard	Fischer	White	Medium	Light	Single	Medium

type of ivy geranium is the cultivar Mini-Lila series.

4) Ivy Zonal Hybrids – leaves and

"Pinch/spray Florel 2-4 weeks after planting when the roots reach the edge of the pot."

flowers of these types resemble those of zonal geraniums but the plant has a vining habit. Flowers are fewer, and a semi-double to double. Examples of this type include the cultivars Pascal, Genchen, and Madeline Crozy. A list of the currently available cultivars and some of their characteristics is shown in Table 1.

STOCK PLANT PRODUCTION: The objective in stock plant production is to grow stock plants that produce as many high quality cuttings as possible per square foot per week. In order to achieve this we need to 1) receive plants early enough to build sufficient plant size, 2) have a high rate of leaf unfolding during cutting production, 3) have a high rate of photosynthesis and a low rate of respiration to increase cutting size/dry weight and 4) control stem elongation. Cutting dry weight is important because



the weight of the cutting is often associated with good quality by the customer and the rootability of a cutting generally increases and early cutting growth is better as cutting dry weight increases.

Plant Number Per Pot: In general, you should receive and pot rooted cuttings for stock plants use from December 1 to January 15. The earlier cuttings are potted, the more cuttings that plant will likely produce. Most growers plant 3-5 cuttings in a 10-12" hanging basket pot (without the hanger) for later sales. Alternatively, some growers pot rooted-cuttings in smaller pots (6-8" azalea pot) and transplant to larger containers later to minimize the space plants initially require.

Initial Pinch and Florel: Pinch cuttings/apply Florel after roots reach the edge of the pot (2-4 weeks after potting) to induce early branching. Florel application should occur at the same time that you would pinch. Do not pinch/spray

Florel too early as this can initially stunt plants. Spray Florel (350 ppm) on plants until foliage is wet in the morning on a cloudy day. Application of Florel on sunny, warm days at a higher rate (500 ppm) can cause leaf burn. Harvest cuttings from stock plants when a tip cuttings are 1 ½ - 2 ½" long and

have a single fully expanded leaf and a few small leaves. Repeat Florel applications on a monthly basis to stimulate continued branching.

Environment: Temperature has a direct effect on leaf unfolding rate, photosynthesis, respiration and stem elongation. Photosynthesis is the process where dry weight is accumulated by harvesting light. Respiration is the process where dry weight is lost to maintain existing tissue. The rate that leaves unfold on a plant is dependent on the average daily temperature that an ivy geranium is grown at. The warmer the average daily temperature, the higher the leaf unfolding rate up to approximately a 76-86°F average daily temperature. I have found the single most limiting factor in cutting yield with most ivy geranium propagators is insufficiently warm temperatures.

Dry weight gain on plants increases as day temperature increases up to approximately 76°F and as night temperature decreases to approximately 50°F. We do not grow crops with a 76°F day and a 50°F night temperature, however, because such a temperature regime would increase stem elongation (see paragraph below) and reduce the average daily temperature thus reducing leaf unfolding rate or yield. Instead, we grow at temperatures to maximize yield while achieving sufficient cutting dry weight and controlling stem elongation.

As with dry weight gain, as the day temperature ivy geraniums are grown at increases relative to night temperature (the higher the DIF) stem elongation increases. Also, during a 24-hour period, stem elongation is most sensitive

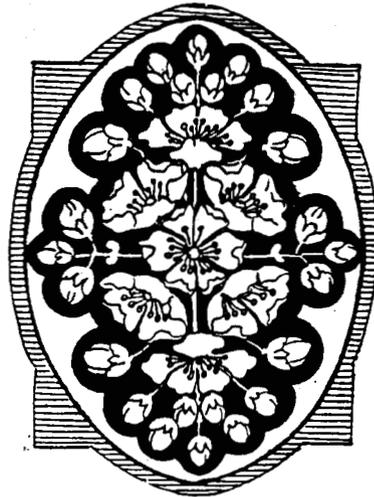
to temperature during the first part of the morning. Dropping temperatures early in the morning will reduce stem elongation. Conversely, increasing temperatures early in the morning will increase stem elongation.

"Stock plants should be grown with a 70-74°F day temperature and a 64-68°F night temperature to promote leaf unfolding and dry weight gain."

tion. A good way to maintain leaf unfolding rate but reduce stem elongation is to drop the temperature early in the morning to approximately 50-55°F to minimize stem elongation but not affect the average daily temperature significantly and, therefore, cutting yield.

Based on the information presented above, stock plants should be grown

with a warm average daily temperature to promote leaf unfolding. Stock plants should be grown with a day warmer than the night to promote dry weight gain. Stock plants should be grown with as little difference between day and night temperature as



possible and with a cool morning drop in temperature to minimize stem elongation. We therefore, recommend a stock plant temperature regime of 70-74°F day temperature, 64-68°F night temperature

and a cool morning drop (first 3 hours of the morning) in temperature to 58-60°F to minimize stem elongation.

Light: Remember that there must be bright light ($>200 \mu\text{mol m}^{-2} \text{s}^{-1}$; 1000 footcandles) in addition to warm temperatures if photosynthesis is going to occur and result in good cutting dry weight. Low light conditions combined with warm temperatures will reduce cutting weight by reducing photosynthesis and increasing respiration, and reducing stem caliber and subsequent rooting. If light levels are low either 1) decrease temperature to maintain cutting quality by reducing leaf unfolding rate and accept that your cutting yield will decrease or 2) increase light by turning on supplemental lighting (preferably high pressure sodium). Most growers will turn lights on ($50-75 \mu\text{mol m}^{-2} \text{s}^{-1}$; 250-375 footcandles) at 5-6 p.m. and off at 2 a.m. each day to take advantage of off-peak rates.

Cutting Yield: Projected cutting yields per plant are as follows if cuttings are planted on December 15 and recommended temperatures are used. Harvest 1-2 cuttings per plant on January 26. Harvest 1-2 cuttings per plant on February 9. Harvest 2-3 cuttings per plant on February 23. Harvest 2-4 cuttings per plant on March 8. Harvest 3-6 cuttings on March 22. Harvest 3-6 cuttings per

plant on April 5 for late sales. After April 5, stock plants should be shaped immediately to allow baskets to finish for Mother's Day sales. In summary, you can harvest 12-23 cuttings per plant depending on the environment and cultivar.

Media – The ideal media for ivy geranium stock plants should have a pH of 5.5 to 6.2, be well drained/aerated, and have a high water and nutrient holding capacity. Since stock plants are grown for cuttings and then finished for sale, it is critical that plants be planted in a media that will maintain its structure until the following fall to insure good garden performance. For this reason, we recommend bark, coir, coarse peat, or rice hulls as amendments to a media to maintain porosity throughout the growing season. Media



water holding capacity is increased compared to standard peat blends by adding rockwool, rice hulls or sterilized soil. Nutrient holding capacity is increased compared to standard peat media by adding vermiculite, calcine clay or sterilized soil. If rockwool or coir are added, test each material first to make sure that sodium, potassium and/or soluble salt levels are not elevated. The best root development I have seen occurred when we grew plants in coir-based media.

Fertility – Since ivy geranium stock plants are grown during low light/cooler temperature periods of the year, we recommend using primarily nitrate-based fertilizers as opposed to ammonium- or urea-based fertilizers to avoid ammonium toxicity. Symptoms of ammonium toxicity include a reduction in growth along with yellowing along the leaf edges.

Media nutrient levels should be brought up to optimal levels as quickly as possible (Table 2). Therefore, we recommend that you fertilize with 400-600 ppm nitrogen from a balanced fertilizer the first 2-3 you fertilize. After this, reduce ppm nitrogen to 100-200 ppm. You should make sure that stock plants also receive regular applications of calcium, magnesium, and micronutrients. All of these materials can be low or nonexistent in commercial fertilizer blends.

If you are growing your stock plant crop in a humid environment (polyhouse with a

non-concrete floor, plants may not take up adequate amounts of micronutrients/calcium because the plant is not using very much water. As a result, the youngest leaves may turn yellow/white and become deformed because they are deficient in calcium or some micronutrient (often boron).

Therefore, we recommend fertilizing with a calcium nitrate based balanced fertilizer and that you apply magnesium sulfate monthly along with additional micronutrients. In addition, if plants are not using much water, make sure you fertilize foliage periodically (overhead water) in the morning to foliar feed stock plants to insure that they have adequate calcium and micronutrients. Always, always do soil tests every 2-4 weeks. Most nutritional problems can be diagnosed using a soil test, however, tissue tests are valuable in that they identify what the plant is actually taking up. Recommended media and tissue levels of nutrients are shown in

Table 2. Media and tissue standards for ivy geranium (*Pelargonium peltatum* L.) production in a soilless medium. Tissue test standards are in percentage data except where noted.

Nutrient Levels	Media		Tissue (%)
	Spurway	Saturated Paste	
PH	5.5 – 6.0	5.5 – 6.0	
Soluble Salts	120 – 180	2.0 – 4.0	
Nitrate	150 – 180	100 – 199	3.4 – 4.4
Ammonium	2 – 8	2 - 10	
Phosphorus	5 – 10	10 – 15	0.4 – 0.7
Potassium	50 – 60	150 - 250	2.8 – 4.7
Calcium	120 – 180	200 – 300	0.9 – 1.4
Magnesium	40 – 60	50 – 125	0.4 – 0.6
Iron	0.25 – 0.50	0.3 – 3.0	115–270 ppm
Manganese	0.25 – 0.50	0.3 – 3.0	40-175 ppm
Zinc	0.25 – 0.50	0.3 – 3.0	10-45 ppm
Boron	0.25 – 0.50	0.1 – 0.5	30-100 ppm
Copper	N/A	0.1 – 0.5	5-15 ppm

Table 2. Additional nutritional information can be found in the 'Most Common Problems' section below.

CUTTING ROOTING: Harvest cuttings first thing in the morning to insure cuttings are turgid (have as much water in them as possible). Dip/talc cutting ends of difficult to root cultivars in an IBA talc (Homodin #1) prior to 'sticking' cuttings to encourage rooting. Many ivy geranium cultivars will root freely and not require an IBA application. Cuttings are typically rooted in a deep-celled plug tray. Root cuttings in a soilless media that contains a polymer if rooted cuttings will be shipped in the tray to minimize breakage during the shipping process. If cuttings will not be shipped, most commercial soilless media are satisfactory for rooting.

Mist cuttings frequently during the first 4 days (approximately 10-15 seconds every 15 minutes). Reduce misting frequency to once or twice every day. Media temperature should be maintained at 75-77°F. Media pH should be between 5.5-6.0. It may be necessary to

"Apply a 200 ppm Florel spray to rooted cuttings 1 week before planting into final pots."

1) amend the water to maintain media pH during the rooting period, and 2) fertilize cuttings after they root with a weak nitrate-based fertilizer (100-150 ppm N-P-K). See the section below on how much acid to add to water to minimize the impact of irrigation water alkalinity on

media pH.

Rooting starts within 2 weeks. Complete rooting will take 3-5 weeks. For maximum cutting rooting and branching after cuttings are planted in the finished container, apply 200 ppm Florel to cuttings 1 week before planting.

FINISHING IVY GERANIUM:

Traditionally, ivy geraniums are sold in hanging baskets. However, alternative uses for ivy geraniums such as mixed baskets, window boxes or ground covers have greatly expanded the potential sales of this crop. Therefore, growers are experimenting with growing ivy geraniums in packs, 4", and 6" and 8" pots as well as baskets. Recommendations below are based on hanging basket produced ivy geraniums but apply, in most cases, to other finished products as well.

Planting: Plant 4-5 rooted cuttings per hanging basket. Plant 1-2 cuttings in the center and 3 cuttings 2 ½" from the edge of the pot. Plant 5-7 cuttings in a 12" pot/basket. Plant 2-3 cuttings in the center of the pot and 3-4 cuttings 2 ½" from the edge of the pot. Specimen baskets should be started the beginning of February. Compact baskets should be started the end of February. If 3 and 5 cuttings are used for the 10 and 12" pots, respectively, start plants an additional 3-4 weeks earlier. Alternatively, if more than the recommended cutting numbers are used, plants can be started later.

If selling ivy geraniums as a 4" potted crop, pot rooted cuttings in mid-March and apply Florel to promote branching rather than pinching. If selling ivy geraniums as a 6" crop, pot 2 cuttings per pot in the beginning of February-March

depending on the final size of the desired product.

Media: Ideal media for ivy geraniums should have a pH of 5.5 to 6.0, be well drained/aerated, and have a high water and nutrient holding capacity. The

optimal pH for ivy geraniums is below that for seed geraniums. Do not grow

seed geraniums at pH's below 6.0 as manganese/iron toxicity will occur! Other issues related to media can be read in the section above on media considerations in stock plant production.

pH: Media pH generally is 5.0-6.0 when it arrives. After a crop is planted, media pH generally changes. In what way media pH changes depends on the components in the media, the water alkalinity and the makeup of the fertilizer. Pine bark in the media tends to decrease media pH. In contrast, coarse lime in the media tends to increase media pH over time.

The most common factor that affects media pH is the irrigation water. Irrigation water often contains carbonates that will increase media pH over time. A measure of the amount of carbonates in water is the alkalinity of the water expressed in milliequivalents or ppm of

calcium carbonate. If your water alkalinity is high you essentially are essentially adding a significant amount of lime to your media every time you water! We minimize the impact of irrigation water on media pH by adding acid to the water to neutralize the alkalinity. How much acid

you need to add depends on the alkalinity of your water and the acid that

Table 3. Amount of acid in milliliters to be added per gallon of water for each ppm bicarbonate when adjusting alkalinity level. The initial ppm bicarbonate from a water analysis minus the desired ppm (100 or 120 ppm for example) will provide the ppm bicarbonate to be neutralized.

Acid (%)	Milliliters
75 Phosphoric	0.0041
85 Phosphoric	0.0037
93 Sulfuric	0.0019
61 Nitric	0.0062

you want to use. In general, we recommend decreasing water alkalinity to 100-120 meq using sulfuric acid. Water alkalinity in the U.S. varies from 70 to 550 meq. The exact amounts of acid needed for your water can be calculated from Table 3 or by calling me (612-624-9703).

Fertilizer also affects media pH. In general, fertilizers that have nitrogen in the ammonium nitrate or urea form tend to decrease media pH. In contrast, fertilizers that have nitrogen in the nitrate form tend to increase media pH. Whether a fertilizer is acidic (will reduce pH) or basic (will increase pH) can be assessed by looking at the fertilizer bag. In most cases there will be a term acidity or basicity on the bag. Acidity refers to the pounds of calcium carbonate limestone required to neutralize the acidity caused by applying one ton of the specified fertilizer. The basicity of a

fertilizer identifies how many pounds of

fertilizing with every watering. Nitrogen levels can often be reduced to 150-250 ppm after this to maintain nutrient levels in the desired range. Always base how much you fertilize on your soil tests which you should conduct every 2-4 weeks. Also remember that the fertility within a pot will vary with the grower. Each grower differs in how they water and will, therefore, apply different amounts of fertilizer to a pot!

Table 4. Amount of ammonium nitrate + urea as a percentage of the total nitrogen in the fertilizer (%NH4) and the acidity and basicity levels for common fertilizers. A backslash denotes that there are two formulations of this fertilizer.

Fertilizer	% NH4	Acidity	Basicity
21-7-7	90	1,700/1,560	-
20-20-20	69	583/474	-
20-10-20	38	393	-
15-15-15	52	261	-
15-16-17	47/30	215/165	-
20-0-20	25/69	40/0	-
15-5-15	28	-	135
15-0-15	13	-	319
15.5-0-0	6	-	400
13-0-44	0	-	460

In northern climates, it is critical to fertilize with fertilizers that have the nitrogen in the nitrate form during cool temperature/low light periods of the year, i.e. February and early March. The amount of ammonium nitrate/urea in a fertilizer can increase as the season progresses from winter to

calcium carbonate limestone that the application of one ton of the specified fertilizer is equivalent to. These terms have little relevance to us except that they give us some indication of how acidic or basic a fertilizer is. In general, fertilizers >400 acidity or basicity will have a significant and rapid impact on a media pH. The closer the acidity or basicity is to 0, the less of an effect that the fertilizer will have on your media. Some acidity and basicity levels for common fertilizers are shown in Table 4.

spring. In general, we recommend fertilizing with a 'high nitrate' fertilizer during January and February (15-0-15 Dark Weather Feed), an Excel based fertilizer (15-0-15 Cal-Mag) during March and a Peat-Lite type fertilizer during April and May (20-10-20). Although we have had good experience with these materials, there appear to be some alternative fertilizers that we will look at this season including the Greencare fertilizers. Suggested media and tissue nutrient levels are shown in Table 2.

Nutrition: Nutrient levels should be increased initially to the recommended levels as quickly as possible. Too often, media nutrient levels are below recommended levels early in production when proper nutrition is critical. For this reason, we recommend fertilizing ivy geraniums with 400-600 ppm N (nitrogen) from a balanced fertilizer early in production (first 2-3 fertilizations) to bring nutrient levels up to the recommended levels. We also recommend

PH affects the availability of nutrients to the plant. High media pH will 'tie up' iron, manganese, boron and phosphorus in the media. In other words, you can have adequate nutrient levels in the media but the plant will express a deficiency symptom because those nutrients are not available to the plant. In contrast, low pH will 'tie up' calcium and magnesium. For this reason you should, as recommended before, conduct regular soil tests

to maintain pH between 5.5 and 6.0.

Last Pinch – The last pinch should occur no later than 4-6 weeks prior to the anticipated sales date. Remember, in most cases, an application of Florel can substitute for a pinch. Apply Florel at 350 ppm on a cloudy day to minimize the possibility of foliage damage. Also remember that there is considerable variation in the response of different cultivars to a Florel application.

Temperature: Goals to have when establishing the environment for an ivy geranium crop include rapid development, numerous flowers, and compact growth. To achieve rapid development, growers must maintain minimal average daily temperatures. As was mentioned above, the rate at which a plant develops increases as the average daily temperature a plant is grown at increases to approximately 76-80°F.

Flower number on ivy geraniums is also dependent on the average daily temperature plants are grown at. Ivy geranium flower number per inflorescence increases as the temperature plants are grown at decreases to approximately 50°F. For instance, flower number per inflorescence decreased from 9 to 3.8 flowers on the cultivar 'Nicole' as average daily temperature increased from 54 to 84°F.

As with managing stock plants, you should try to minimize the difference between day and night temperature to minimize stem elongation. This can be difficult since ivy geraniums are traditionally hung high in the greenhouse where day temperatures are warmest and night temperatures can be cool. Therefore, maintain baskets on the benches for as long as possible and apply Florel to

promote compact early growth and apply light applications of Cycocel (500-750 ppm) later in production to control stem elongation.

Based on the above relationships, we recommend growing ivy geraniums with a 68-72°F day temperature and a 58-63°F night temperature with a cool morning drop in temperature to 50-55°F.

Light: Ivy geraniums vary in their light requirements. In many cases, they are exposed to more light in a greenhouse than is optimal for growth. Excessively high light levels will decrease growth possibly by increasing temperature. In general, ivy geraniums prefer light levels between 2,500 to 3,500 footcandles (500-700 $\mu\text{mol m}^{-2} \text{s}^{-1}$). Cultivars vary

"The last pinch should occur no later than 4-6 weeks prior to the anticipated sales date."

somewhat in their light preference with 'Sugar Baby' preferring approximately 2,000 footcandles and 'Amythest', 'Cornell' and 'Pascal' preferring 3,000-4,000 footcandles.

Diseases: There are 4 diseases that attack ivy geraniums: 1) *Botrytis*, 2) Rust, 3) *Rhizoctonia* and 4) *Pythium*. *Botrytis* is a foliar fungal disease that will establish itself on damaged tissue first and then on living tissue. *Botrytis* spores can only germinate when they are on a wet surface for an extended period of time (4-6 hours). Two cultural ways to

control *Botrytis* are to 1) remove and dead or damaged leaves from the plants, benches and below the benches to remove the spore source, and 2) water plants in the morning only and reduce

"The best ways to insure good garden performance are to 1) educate the consumer about regular fertilization and 2) to apply a slow release fertilizer to the plant when it is sold."

humidity to maintain dry foliage to inhibit *Botrytis* spore germination.

Rust is caused by the fungus *Puccinia pelargonii zonalis*. Symptoms appear first as small circular yellow spots on the undersides of the leaves that develop and increase in size and get a brown spot in the center. Avoid your chances of Rust by not carrying plants over, reducing overhead watering, do not take cuttings from plants that have been grown outside.

Rhizoctonia and *Pythium* are fungal diseases that attack primarily the roots. *Rhizoctonia* can attack the stem/leaves when conditions are very wet. Both root rots are water molds and therefore require wet/moist conditions to proliferate. *Rhizoctonia* tends to proliferate most in warm, moist conditions and *Pythium* tends to proliferate most in cool, moist conditions. Culturally manage these diseases by not overwatering plants. Chemically manage these diseases by drenching monthly with fungicides alternating between a

Subdue+Cleary's 3336 or a Banrot application.

Insects: There are few insects that infest ivy geraniums. Thrips are probably the most problematic lately. The most obvious symptoms of thrip infestation are white/necrotic streaks on the flower petals/foliage. Since thrips are so difficult to control late in production, take extra time to control them early in production. Apply Azatin + Mavrik, Duraguard, Talstar + Orthene, Tame or Sanmite to control thrips. Remember to rotate among three families and spray every 5 days for a minimum of 4 times in a row.

Red spider mites can also be a problem in ivy geranium production. The most obvious symptoms of red spider mite infestation are necrotic spots on the foliage and webbing around the shoot tips. Control red spider mites by applying Avid, Pentac and/or Sanmite. Apply to the entire plant making sure that the underside of the foliage is sprayed. Spray every 5 days. Repeat treatments for a minimum of 4 spray applications (about 3 weeks).

Postharvest: Limitations for continued performance of ivy geraniums once they leave the greenhouse are petal shattering immediately after shipping, drying out plants, and insufficient fertilization. Flowers can shatter or fall off plants after shipping. To avoid flower shattering you can spray silver silver thiosulfate (STS) 2 weeks prior to shipping. SILVER THIOSULPHATE IS NOT REGISTERED FOR USE ON IVY GERANIUMS. Only apply STS to ivy geraniums if plants are free of *Pythium* root rot. We recommend that plants be drenched with Subdue + Cleary's 3336 2 weeks prior to an STS application. To make STS:

- 1) Dissolve 0.42 grams of silver nitrate in ½ liter of water.
- 2) Dissolve 2.48 grams of sodium thiosulfate in ½ liter of water in a separate container.
- 3) **Add the silver nitrate solution to the sodium thiosulfate solution while stirring. NOT THE REVERSE!**
- 4) Dilute the solution with water by adding 9 liters of water to yield a total of 10 liters of final solution.
- 5) Spray plants using a plastic sprayer to wet foliage. 10 liters should cover approximately 1,000 plants.
- 6) STS solution can be stored in a refrigerator for 1 month.

The best way to alleviate future nutrient deficiencies is to 1) educate the consumer to fertilize and 2) to apply a slow release fertilizer when the plants are sold. Apply a table-spoon of Osmocote (14-14-14) to the surface of the media when plants are sold to provide some nutrition to plants after they leave the greenhouse.



MOST COMMON PROBLEMS:

The most common problems in ivy geranium production and their solutions are shown below.

Iron deficiency – The symptom of iron deficiency is interveinal chlorosis (yellowing between the veins) on leaves near the shoot tip. Iron deficiency is caused by insufficient iron in the media or high media pH. If you have high media pH (>7.0) decrease pH by applying 3.5 ounces 85% phosphoric acid per 100 gallons of water OR 1.8 ounces of sulfuric acid AS A ONE TIME APPLICATION. This amount will generally decrease media pH by 0.5 pH units. Reapply acid if necessary after conducting a soil test. Overhead watering with a fertilizer that contains iron is a quick and easy way to alleviate this problem temporarily.

Magnesium deficiency – A symptom of magnesium deficiency is interveinal chlorosis on leaves near the bottom of the stem. Low pH or insufficient magnesium in the media causes magnesium deficiency. Increase pH by leaching with water with a high alkalinity or with a basic fertilizer. If magnesium levels are low

in the media, drench with 8 ounces magnesium sulfate (Epsom salts) per 100 gallons of water. In most cases, it is helpful to do a monthly drench of Epsom

salts as a preventative since many fertilizers do not contain magnesium.

High Soluble Salts – Symptoms of high soluble salts include burning of the leaf edges on lower leaves, burning of root

will stay wet on the foliage for an extended period. Florel application will also decrease stem elongation but can not be applied during the last six weeks prior of production.

Odema – Odema is a physiological disorder believed to be caused by fluctuations in temperature, humidity and water status. Solutions to this problem include maintaining a constant growing environment, maintaining a pH between 5.5-6.0, maintaining relative humidity below 75%, and feeding with fertilizers with nitrogen in the nitrate-based forms. Irrigate only in the morning.

"Ivy geraniums are sensitive to calcium deficiency in Eastern Minnesota and Western Wisconsin."

tips, slight wilting on sunny days even when the media is moist, and a general slowing of growth. Solve by leaching media with clear water for 10-20 minutes. Prevent this problem in the future by either leaching slightly every time you water or conducting periodic leaches. Regardless, the easiest way to avoid this problem is to monitor your media soluble salt levels to insure that they do not get too high (see Table 2).

Excessive Stem Elongation – Stem elongation varies with cultivar. Excessive stem elongation occurs when the difference between the day and night temperature is high and/or when no growth retardants are applied to plants. Solve this problem by 1) reducing day temperatures, 2) dropping day temperatures the first 3-4 hours of the morning, 3) apply Cycocel at a rate of 750 ppm or 1-4 ppm Bonzi. Cycocel may have to be applied weekly. Do not spray more than 750 ppm Cycocel as leaf edge burning can occur. Regardless if you use Cycocel or Bonzi, apply these materials early in the morning when the material

No/Few Flowers – Lack of flowering is usually caused by 1) high temperature, 2) late application of Florel, or 3) overwatering/water stress. Temperatures should not exceed 76-80°F if possible. In most cases, an inflorescence will form but the number of flowers in that inflorescence will be greatly reduced. Florel should not be applied during the last 6 weeks of the production cycle.

Botrytis – *Botrytis* (grey mold) can be a problem when conditions are humid, plants are dense, and plants are watered late in the day. See section above on *Botrytis* for cultural controls.

