Department of Horticultural Science

Horticulture Information Leaflet 521
Revised 6/98

COMMERCIAL PANSY PRODUCTION

Douglas A. Bailey, Professor

Pansies have become the most popular annual for mid-fall to late-spring color in the Southeast. Intensive breeding programs that have selected for unique flower colors, large flower size, greater flower number, and temperature tolerance have led to many new and exciting cultivars to select from for use in the landscape. This leaflet was written to give growers production advice for pansies.

History

The modern pansy, *Viola × wittrockiana*, is thought to have derived from *Viola tricolor*, a native of central Europe. Although pansies are a perennial in cooler climates, they are grown as a cool season annual in the Southeast and rarely survive our summer heat.

In the past 50 years new pansy colors such as shades of pink, rose, and orange have become available. Modern pansy breeding is largely concentrated in Germany, the United States, and Japan. From the late 1970's up to today, pansy breeding has concentrated on aspects of quality such as vigor, heat tolerance, and free flowering.

Flower Color Types

Pansies have single blooms, each with five petals that are rounded in shape. There is a wide color range for pansy flowers. Colors include red, purple, blue, bronze, pink, black, yellow, white, lavender, orange, apricot, and mahogany.

Pansies can be divided into pure-color flowers and multicolored flowers. Pure-color varieties have a single color on the flower and are called 'clear.' Multicolored flowers that have a very dark blue/black centers are called 'blotched' or 'faced.' Some blotched pansies may have a different color blotch than the usual dark blue/black face. Other multicolored pansies have white or light colored edges or have petals of differing colors; most of these two or three color pansies also have a dark face.

Varieties and Flower Sizes

There are three main categories of pansies, based on flower size:

Large—$3\frac{1}{2}$ to $4\frac{1}{2}$ inch-diameter blooms
Medium—$2\frac{1}{2}$ to $3\frac{1}{2}$ inch-diameter blooms
Multiflora—$1\frac{1}{2}$ to $2\frac{1}{2}$ inch-diameter blooms

There are well over 300 pansy cultivars available today. Most cultivars come in series (Table 1). A series has similar plant qualities such as plant size and heat tolerance. The individual members of a series each have different flower colors and sometimes have color patterns that differ from each other.

Propagation

Plugs or Seed. Pansy producers must decide whether to purchase pansy plugs or pansy seed. Seed may be grown as pansy plugs or in open seed trays, depending on time of marketing, labor availability, the number of pansies produced, and equipment and facilities available. For small operations and / or growers just starting into pansy production, purchasing plugs and concentrating on production of finished flats is a wise step. Only after gaining expertise in finishing seedlings should new growers consider purchasing seed rather than purchasing plugs.

Pansy propagation for the fall market must occur during July and August, months not conducive to optimum pansy seed germination and seedling development in North Carolina. A germination chamber and an efficient cooling system are needed for fall pansy production. There are many plans available for germination chambers (Bartok, 1992; Carlson, 1990; King, 1992; Polking et al., 1990). Many small and medium-sized greenhouse operations find it more feasible to purchase plugs for the early fall market rather than investing in a germination chamber or to tackle pansy germination in the summer heat. For late-

North Carolina Cooperative Extension Service
NORTH CAROLINA STATE UNIVERSITY
COLLEGE OF AGRICULTURE & LIFE SCIENCES

Table 1. Major pansy series and cultivars with flower type, flower size, and number in each series.

Series	Plant type	Flower type	Flower size	No. in series or cultivar color
Accord	F_1	both	medium	9
Alpenglow	O.P.*	blotch	large	Red
Atlas	F_1	clear	medium	2
Azure Blue	F_1	blotch	medium	Blue
Berna	O.P.	clear	large	Purple
Bingo	F_1	both	large	7
Characters	F_1	both	medium	14
Clear Sky	F_1	clear	medium	8
Color Festival	F_2	blotch	large	Mix
Coronation Gold	O.P.	clear	large	Golden Yellow
Crown	F_1	clear	medium	12
Crystal Bowl	F_1	clear	multiflora	11
Delft	F_1	blotch	medium	Blue & White
Delta	F_1	both	medium	16
Faces	F_1	both	medium	16
Fama	F_1	both	medium	12
Giant Forerunner	?	both	medium	16
Happy Face	F_1	blotch	medium	7
Imperial	F_1	both	medium	15
Joker	F_2	blotch	multiflora	5
Lyric	F_1	blotch	medium	6
Majestic Giant	F_1	blotch	large	8
Maxim	F_1	blotch	multiflora	14
Medallion	F_1	blotch	large	6
Melody	F_1	both	multiflora	16
Padparadja	F_2	clear	multiflora	Orange
Paper White	O.P.	clear	large	White
Premiere	F_2	both	medium	6
Presto	F_1	clear	medium	8
Rally	F_1	both	medium	11
Regal	F_1	blotch	medium	13
Rhinegold	O.P.	blotch	large	Yellow
Roc	F_1	both	medium	11
Skyline	F_1	blotch	medium	8
Springtime	F_1	both	medium	18
Super Majestic Giant	F_1	blotch	large	9
Swiss Giants	O.P.	both	large	Mix
Ullswater	O.P.	blotch	large	Blue
Ultima	F_1	both	medium	4
Universal Plus**	F_1	both	multiflora	21

*O.P. = open pollinated variety.
**Replaces the Universal series.

autumn through early spring markets, pansy propagation is much easier due to cooler temperatures.

Germination Requirements. **Seed selection** is the first decision in pansy propagation. There are two basic types of pansy seed available, traditional seed that is not treated to enhance germination, and primed seed that has been physiologically treated to start the germination process. The advantages of primed seed include higher percentage germination, faster germination, and less sensitivity to high temperatures during germination. Primed seed cost more, but given the high temperatures in the Southeast during pansy propagation for autumn sales, primed seed should be used by growers lacking a temperature-controlled germination chamber.

Substrate physical properties for pansy germination include adequate aeration and good moisture retention. Germination substrates should be composed of finer (smaller particle size) components than substrate used for finishing bedding plants. A finer mix affords more moisture retention, but increases the possibility of overwatering and poor aeration (see the section on moisture that follows).

Substrate chemical properties are as important as physical properties. A substrate pH of 5.4 to 5.8 is best for pansy production. Avoid substrates containing a large nutrient starter charge as pansy seedlings are sensitive to high concentrations of soluble salts. A substrate containing dolomitic lime for pH control (as well as to supply Ca and Mg), micronutrients, and a small amount of superphosphate is ideal. Phosphorus (P) levels in the germination substrate should be very low; high P levels cause seedling stretch.

Fertilization using a liquid feed program should begin after stem and cotyledon emergence. Use a fertilizer relatively low in phosphorus and low in ammoniacal nitrogen to prevent excessive stretch. Formulations with nitrogen derived from potassium nitrate [KNO_3], calcium nitrate [$Ca(NO_3)_2$], and magnesium nitrate [$Mg(NO_3)_2$] such as the basic-residue fertilizers listed in Table 2 are recommended. These formulations have the added benefit of supplying calcium and magnesium. Using these base residue fertilizer formulations allows pansy propagators to minimize the liming charge in the substrate

Table 2. Quantities (ounces) of fertilizer or fertilizer salts to dissolve in 100 gallons of water to make solutions containing 50 to 250 ppm each of nitrogen (N) and potassium (K_2O). Select concentrations based on production phase and recommendations given in the text.

Fertilizer or salts	Concentration of N and K_2O (ppm)			
	50	75	100	250
Acid-residue sources	oz/100 gallons			
20-10-20*	3.34	5.0	6.7	16.7
20-9-20*	3.34	5.0	6.7	16.7
ammonium nitrate	1.23	1.85	2.5	6.15
+ potassium nitrate	1.50	2.25	3.0	7.5
+ monoammonium phosphate (20-10-20)*	0.54	0.81	1.1	2.7
Basic-residue sources	oz/100 gallons			
13-2-13 (-6Ca-3Mg)*	5.13	7.7	10.3	25.65
14-0-14 (-6Ca-3Mg)	4.76	7.14	9.5	23.8
15-0-15 (-9.5Ca-1Mg)	4.45	6.68	8.9	22.25
15-5-15 (-5Ca-2Mg)*	4.45	6.68	8.9	22.25
15-3-20 (-3.8Ca-1.9Mg)*	4.45	6.68	8.9	22.25
17-0-17 (-4Ca-2Mg)	3.92	5.88	7.83	19.6
potassium nitrate	1.51	2.28	3.03	7.58
+ calcium nitrate	1.76	2.64	3.52	8.8
+ magnesium nitrate (13-0-13-6.6Ca-3.3Mg)	1.8	2.7	3.6	9.0

*These formulations also contain phosphorus (P_2O_5).

and to use the fertilization program to maintain the appropriate pH.

Apply 50 ppm nitrogen feed every three to five days until the development of the first true leaves. At that point, increase the concentration to 100 ppm nitrogen, still applying every three to five days. Water with clear water in between feedings as needed.

Monitor the substrate pH during seedling production to assure it stays in the 5.4 to 5.8 range. A substrate pH above 5.8 can result in boron and iron deficiency; and high pH may lead to an increased incidence of black root rot, caused by the fungus *Thielaviopsis basicola*. If the substrate solution pH rises above 5.8, drench seedlings at 10 day intervals with 1 to 3 lb per 100 gallons of either iron sulfate [$FeSO_4 \cdot 7H_2O$] or aluminum sulfate [$Al_2(SO_4)_3 \cdot 18H_2O$] to help lower the pH. Lightly mist seedlings after application to prevent foliage injury from the drenches. If your irrigation water has a pH above 5.8, acidify it (at each watering and feeding) with 35% sulfuric acid to a pH of 5.4 to help lower the substrate solution pH. Continue these corrective treatments until the substrate pH drops and stays in the 5.4 to 5.8 range.

Temperature is an important factor for pansy germination and seedling growth. Optimum germination (fastest and greatest percentage) occurs at a constant 68 °F for both primed and non-primed pansy seed. After radicle (root) emergence (about 4 days after seeding) and during stem and cotyledon emergence, maintenance of cool temperatures (between 60 and 70 °F) is best for pansy seedling growth. Pansies do respond to DIF (difference between day and night temperature), so try to maintain a constant day / night temperature such as 68 °F rather than a positive (day warmer than night) DIF to reduce stretch. After the first true leaf appears (about 14 days after seeding) up to transplant into the finishing flat (approximately 6 weeks after seeding), temperatures should be reduced (if possible) to a constant 58 to 62 °F.

Light is not required for germination (during the first two to four days), but is needed after radicle (root) emergence to prevent excessive stretching. Between 1,500 and 3,500 footcandles of light are recommended after radicle emergence. Upon radicle emergence, many growers move seedlings from the germination chamber to the greenhouse, if they do not have adequate lighting in the germination chamber.

Moisture must be controlled during germination. Keep the relative humidity around the seed and seedling very high, but do not soak the substrate. Placing a thin layer of vermiculite over the seed will increase humidity around the seed during germination. Though relative humidity should be high during germination, excessive moisture in the substrate reduces oxygen, reduces germination, and reduces root growth. Frequent, light mist or fog applications are better than less frequent but heavier waterings that saturate the substrate. Reduce misting frequency and relative humidity as seedlings develop to 'harden' growth.

Seedling growth regulation is possible through DIF, as mentioned early. If a zero DIF (equal day and night temperature) does not control stretching adequately, apply a 5 to 10 °F negative DIF (night temperature of 64 to 68 °F and day temperature of 58 to 62 °F) for height control. When this level of temperature control is impossible, (often the case in the Southeast), consider using chemical growth retardants that are labeled for pansies to control

Table 3. Chemical growth retardants labeled for use on pansies in the greenhouse.

Product	Stage of production	Application rate and method	Comments
A-Rest® (ancymidol)	plugs or seedlings	3 to 9 ppm spray (1.5 to 4.4 fl oz per gallon) for plugs; 8 to 19 ppm spray (3.9 to 5.8 fl oz) after transplant	apply to plugs beginning after the first true leaf is present
B-Nine® (daminozide)	plugs or seedlings	2,500 ppm spray (0.39 oz per gallon)	apply beginning after the first true leaf is present; weekly applications may be needed
B-Nine® (daminozide) + Cycocel® (chlormequat--chloride)	plugs or seedlings	1,000 ppm B-Nine (0.16 oz per gallon) + 1,000 ppm Cycocel (1.08 fl oz per gallon) applied as a tank mix spray	apply beginning after the first true leaf is present
Bonzi® (paclobutrazol)	plugs or seedlings	1 to 5 ppm spray (0.032 to 0.16 fl oz per gallon)	use 3 ppm when two true leaves are present or use multiple spray at 1 ppm
Bonzi® (paclobutrazol)	plants in flats	5 to 15 ppm spray (0.16 to 0.48 fl oz per gallon)	use the higher rate in warmer weather; make the first application when plants are 2" in diameter or height; avoid late applications due to flowering delay and slow growth in the landscape after transplant
Sumagic® (uniconazole)	plugs or seedlings	1 to 3 ppm spray (0.26 to 0.77 fl oz per gallon)	use 3 ppm when three true leaves are present or make a 1 ppm spray when two true leaves are present
Sumagic® (uniconazole)	plants in flats	3 to 6 ppm spray (0.77 to 1.54 fl oz per gallon)	see comments for Bonzi

seedling stretch (Table 3). Many plug growers report that multiple applications at low concentrations offer more control in programming plug size than a single application at a high concentration.

Scheduling. Scheduling during seedling production depends on the environment and the production system used. Pansy plug production is a 5 to 7 week cropping period whereas seedlings produced in open flats are usually ready for transplanting 4 to 5 weeks after sowing.

Finishing Pansies

Scheduling. Timing for finished flats and pots of pansies should be based on a target market date and anticipated environmental conditions. Finished flats can be ready for sale in 5 to 9 weeks from transplant (total cropping time of 11 to 14 weeks). Count back from your projected market date to determine when you should have material ready for transplanting.

For autumn markets, many growers have plants available from mid-September through early December. In the piedmont and coastal regions of North Carolina, pansies are difficult to establish in the landscape prior to mid-October. However, given that customers are willing to purchase plants in September, growers usually target plant sales rather than survival.

The Finishing Environment. **Substrate** characteristics that are recommended for the finishing containers are similar to those described for propagation. The major difference between the two is the degree of porosity; ‘looser’ mixes with a higher degree of aeration and more rapid drainage than germination mixes are recommended for finishing pansies.

The substrate should contain liming sufficient to result in a pH of 5.4 to 5.8. Micronutrients and a small starter charge of phosphorus are also recommended.

Fertilization during the finishing stage of pansy production is similar to that of the germination phase: do not overfeed pansies. A constant feed program of 125 ppm nitrogen is sufficient for pansies, if leaching is minimal. If leaching is excessive (such as outdoor production subject to heavy rains), increase the constant feed to 175 to 200 ppm nitrogen. A weekly feed program of 225 to 275 ppm nitrogen can also be used instead of a continuous feed program. Rotate between a basic-residue fertilizer such as 15-3-20-3.8Ca-1.9Mg and an acid residue fertilizer such as 20-10-20 to assure adequate supplies of macronutrients and to help maintain a constant substrate pH (Table 2).

Temperatures for finishing pansies are similar to those used in seedling production. Best growth and development is best achieved with a daily average temperature of 58 to 62 °F. As mentioned earlier, pansies do respond to DIF, and a zero or negative DIF is preferred for height control over a positive DIF. Pansies can be grown at even cooler temperatures (night temperature of 48 °F) without damaging the plants, but development will be slower.

Light levels should be as high as possible, but temperature control usually requires shading of about 30 to 50% during late summer and autumn to reduce the heat load on the plants. Remove shading and increase irradiance as soon as ambient temperatures allow to promote better plant growth and flower development.

Water plants prior to wilting, but allow the substrate to dry out between waterings. Excessive moisture results in poor root growth and could increase the incidence of root rots. However, allowing the substrate to dry to the point of plant wilting could concentrate salts around the roots, resulting in root damage. When watering, try to minimize leaching (maximum of 15% leaching fraction) to reduce nutrient runoff from your crop.

Plant growth regulation is best achieved through a zero or negative DIF. A day / night temperature regime of 55 °F / 65 °F is very effective in reducing excessive stretch, but is a rarity during autumn in the Southeast. If chemical growth retardants are needed, follow guidelines in Table 3. Do not apply growth retardants to transplants until they exhibit active growth. Avoid late applications of growth retardants (especially of Bonzi and Sumagic), as they may delay flowering and slow growth once plants are transplanted into the landscape.

Production Problems

Insect and Related Pests. There are a variety of pansy pests, some of them with the potential to be serious problems (Table 4). Growers should contact their County Extension Centers to request the suggest Insect Notes dealing with each pest. These insect notes and the current edition of the "N. C. Agricultural Chemicals Manual" will offer the most up-to-date control measures for each pest.

The major pests listed in Table 4 that growers should be scouting for are printed in bold type. The other pests listed have the potential to become production problems, but are usually not as serious.

Diseases. Pansies are susceptible to a number of serious diseases in both production greenhouses and in landscape beds. Listed below are some of the more common pansy diseases in North Carolina along with prevention and control measures. Consult the current edition of the "N.C. Agricultural Chemicals Manual" for the most up-to-date listing of fungicides labeled for use on pansies.

Damping-off of seedlings: During production of pansies, damping-off by *Pythium* spp. can be a major disease problem. The best control of any disease is to completely avoid its occurrence. Every bedding plant grower should thoroughly understand damping-off, factors that favor its development, and potential sources of contamination. Damping-off must be avoided through a complete, continuous sanitation and cultural program. Fungicides should be used to control damping-off only

Table 4. Insect and related pest problems of pansies during production, their botanical name, and NCSU Department of Entomology Ornamentals and Turf Insect Notes that address each pest.

Pest	Botanical name	Insect note(s)
Black cutworm	*Argotis ipsilon*	#7
Foxglove aphid	*Aulacorthum solani*	#38, #103, #104
Fungus gnats	*Lycoriella* spp. & *Bradysia* spp.	#29, #103
Green peach aphid	*Myzus persicae*	#38, #103, #104
Greenhouse whitefly	*Trialeurodes vaporariorum*	#10, #103, #104
Pansyworm	*Euptoieta claudia*	#7
Shore flies	*Scatella* spp.	#103
Silverleaf whitefly	*Bemisia argentifolii*	#83, #103, #104
Slugs	*Deroceras* spp. & *Lehmannia* spp.	#22, #91
Variegated cutworm	*Peridroma saucia*	#7
Western flower thrips	*Frankliniella occidentalis*	#72, #103, #104
Yellow woollybear	*Spiosoma virginica*	#7

as a last resort. Most fungicides used to control damping-off also cause some injury to seedlings. The younger the seedling, the more severe the injury. Fungicide rates higher than recommended must be avoided. If damping-off is a continual problem, much effort should be made to determine the source of the pathogen and correct the sanitation or cultural problems rather than continue to use or increase the use of fungicides. Fungicides effective in controlling damping-off due to *Pythium* spp. include etridiazole (Truban) and metalaxyl (Subdue).

Black root rot: Black root rot, caused by the soilborne fungus, *Thielaviopsis basicola*, can also be very serious on pansy. This fungus attacks the fine feeder roots. Infected roots are black due to the presence of the fungus. *Thielaviopsis basicola* also causes a root rot on Helleri holly and vinca.

This fungus is common in soils across North Carolina and it is active over a very wide temperature range. The fungus infects the feeder roots and gradually kills the entire root system.

Black root rot has been a serious problem in pansy production in the Southeast for the past five to seven years. It appears to be related to production in August and September when it is too hot for pansy plants and they are "stressed."

Control measures for black root rot during production include:

❶ Avoid excessive heat stress, especially on young seedlings.

❷ Avoid other stresses, such as high substrate pH that can lead to micronutrient deficiencies (mainly boron and iron), excessive soil moisture, or excessive salts.

❸ Preventative drenches with labeled fungicides such as 1-[1-[[4-chloro-2-(trifluoromethyl) phyenyl]imino]-2-ropoxyethyl]-1H-Imidazole (Terraguard 50 WP) and thiophanate methyl products such as Domain or Cleary's 3336 may help.

Botrytis blight: Botrytis blight is a common but only slightly damaging disease of pansies caused by *Botrytis cinerea*. *Botrytis cinerea* is an airborne fungus that attacks almost any flower and dead, dying or damaged plant tissue. During production, the greatest losses due to botrytis occur late in production. Occasionally, this fungus also can attack germinating seed or seedlings, particularly if they are injured or excessively crowded. High rates of fertilization, death of lower leaves, low light intensity, frequent watering, early flower production, and crowded plants all favor botrytis blight development. The development of botrytis blight is also favored by warm temperatures and high humidity. Most growers try to manage botrytis blight with a combination of cultural practices, sanitation, and timely fungicide applications. Some effective management tools include:

❶ Keeping the relative humidity below 85%, particularly at night.

❷ Keeping the spore load down in the greenhouse through good sanitation.

❸ Good air movement in the greenhouse to reduce humidity pockets.

❹ Proper ventilation of the greenhouse.

❺ Greenhouse covers that reduce spore production.

❻ Sunny weather with lower relative humidity.

❼ Crop mix made up with plants less susceptible to botrytis blight.

❽ Ship plants at their peak of quality.

❾ Timely applications of effective fungicides. Fungicides with potential resistance problems include: thiophanate methyl (Cleary's 3336 and Domain), iprodione (Chipco 26019), and vinclozolin (Ornalin). Fungicides with no resistance problems include: chlorothalonil (Daconil 2787 and Exotherm Termil) and mancozeb (Manzate 200).

Leafspot diseases: Pansies are susceptible to several leafspot diseases, but the most common ones in North Carolina are anthracnose (caused by the fungi *Colletrotichum gloesosporiodes* and *Colletrotichum violae-tricoloris*) and scab or spot anthracnose (caused by *Sphaceloma violae*). The leafspots vary in color from white to brown to black and often have a water-soaked margin. The spots may or may not have concentric rings

Table 5. Recommended foliar nutrient concentrations for pansies.*

Nutrient	Adequate range
Nitrogen (N)	2.5 to 4.5%
Phosphorus (P)	0.25 to 1.0%
Potassium (K)	2.5 to 5.0%
Calcium (Ca)	0.6 to 3.0%
Magnesium (Mg)	0.25 to 0.75%
Sulfur (S)	0.2 to 0.7%
Sodium (Na)	0 to 0.5%
Iron (Fe)	30 to 300 ppm
Manganese (Mn)	25 to 300 ppm
Zinc (Zn)	20 to 100 ppm
Copper (Cu)	5 to 40 ppm
Boron (B)	20 to 80 ppm

*Ranges are averages from three commercial analysis laboratories.

and spore producing structures. While leafspot diseases are fairly common on pansy, they seldom cause much damage. These diseases are best controlled through proper sanitation, such as removal of plant debris.

Additional diseases of pansy: Three rust diseases (caused by *Puccinia ellisiana*, *Puccinia violae*, and *Uromyces androponis*) plus a seed smut (*Urocystis kmetiana*) have been reported on pansy, but rarely are a major problem (Jones, 1993). Other diseases reported on pansy include root rot caused by *Aphanomyces cladogamus*; leafspot diseases caused by *Alternaria violae*, *Cercospora violae*, *Phyllosticta rafinesquii*, *Ramularia agrestis*, and *Ramularia lactea*; downy mildew caused by *Peronospora violae*; damping-off caused by *Rhizoctonia solani*; Southern blight caused by *Sclerotium rolfsii*; powdery mildew caused by *Sphacerotheca humuli*; and root knot nematodes, *Meloidogyne* spp.

Prior to treating for these or any disease, it is essential to have the disease organism properly identified. Contact your County Extension Center for sample submission procedures.

Nutritional Disorders. Pansies are relatively free from nutritional disorders, when grown at the proper pH. However, when the substrate pH is allowed to climb above 5.8, micronutrient deficiencies can be a problem.

Magnesium (Mg) deficiency can also be encountered, if the pH falls too low, or if calcium levels are too high with respect to Mg levels.

Routine foliar analysis should be conducted to assure that nutrient content in the foliage is within recommeneded ranges (Table 5).

Boron deficiency: The symptoms of this deficiency are very specific. The younger, developing leaves are small, thickened and puckered. In many instances, the main shoot will stop growth completely (abort), and lateral shoots will attempt to expand, developing the thick, puckered leaves mentioned above.

The first stage of treatment should involve reducing substrate pH (if above the recommended range) to 5.4 to 5.8 to make boron more available to the plant. See the earlier section on nutrition for methods to lower substrate pH.

The second step in treating boron deficiency would be to apply a substrate drench of borax at $^1/_2$ oz per 100 gallons or use solubor at $^1/_4$ oz per 100 gallons. Lightly mist off foliage after the application, as boron solutions can burn leaves.

Prior to the boron drench, check the levels of calcium and magnesium in the substrate. Calcium tends to tie up boron, especially when the calcium to magnesium ratio is too high (greater than about 5 : 2, Ca to Mg). If Ca is out of proportion to Mg, include 1 lb per 100 gallons of Epsom salts ($MgSO_4 \cdot 7H_2O$) in your boron drench.

Do not apply more than two boron drenches during production, as excessive boron will also cause problems on pansies. Unfortunately, plant recovery from boron deficiency is a slow process. It may take two to three weeks before normal growth is resumed after a boron application.

Iron deficiency: Symptoms of iron deficiency are interveinal chlorosis (yellowing) of primarily the youngest leaves, followed by marginal burning in severe cases. As with boron deficiency, the first step in treating iron deficiency is assuring the substrate pH is within the recommended range. If the pH is too high, follow the recommendations given earlier to lower it to 5.4 to 5.8 using iron sulfate. Not only will this treatment lower the pH, it will also increase the iron supply in the substrate solution. If further treatment is needed, use a foliar spray of 10% iron chelate (Sequestrene 330 Fe) at 4 oz per 100 gallons.

Magnesium deficiency: Symptoms of magnesium deficiency on pansy are interveinal chlorosis of the newly matured (not the youngest, still expanding) leaves followed by general yellowing of the leaves beginning at the margins. Marginal necrosis can follow in severe cases.

If magnesium deficiency is suspected, check the Ca to Mg ratio, as mentioned above. If it is greater than 5 : 2, apply a substrate drench of 2 lb Epsom salts per 100 gallons of water. Do not make applications more than once every four weeks. If multiple applications are needed, be sure to monitor both foliar and substrate levels of Ca to assure that the Mg applications do not cause Ca to become deficient.

Summary

The demand for pansies appears to some growers to be continuously increasing. However, many other growers feel that the market is leveling off. Before investing in production, carefully consider markets, how to start the crop (seed or plugs), and the exacting need for the correct environment for a high-quality finished product. Remember, well-grown, high-quality pansy crop is profitable only with good customer contacts and an assured a market for your product.

Suggested Readings

Bartok, J. 1992. Build your own germination unit. Greenhouse Grower 10(11):21, 23.

Behe, B.K. 1991. Pansy production and marketing. Ala. Coop. Ext. Serv. Circular ANR-596.

Carlson, W.H. 1990. How to build a germination room. Greenhouse Grower. 8(11):16–17.

Derthick, S., W.H. Carlson, and L. Ewart. 1990. Producing pansies for profit. Mich. State Univ. Coop. Ext. Serv. Bull. E-2239.

King, P. 1992. Once upon a mattress: a tip for growing your own plugs. GrowerTalks. 56(8):55, 57, 59, 61.

National Garden Bureau. 1993. Pansy fact sheet. Natl. Garden Bur. Downers Grove, IL.

Polking, G., D. Koranski, R. Kessler, and M. Khademi. 1990. Germination chambers guarantee success in the plug tray. GrowerTalks. 54(8):62–63, 65, 67, 69.

Recommendations for the use of chemicals are included in this publication as a convenience to the reader. The use of brand names and any mention or listing of commercial products or services in this publication does not imply endorsement by the North Carolina Cooperative Extension Service nor discrimination against similar products or services not mentioned. Individuals who use chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Be sure to obtain current information about usage and examine a current product label before applying any chemical. For assistance, contact an agent of the North Carolina Cooperative Extension Service in your county.