Hanging Basket Production In Northern Climates

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Introduction:

Hanging baskets have been grown for centuries. Yet, little information dedicated to hanging basket production. A new publication that I would recommend to anyone who grows a significant number of hanging baskets is the Ohio Florists' Association's 'Tips on Growing and Marketing Hanging Baskets' (see references). This publication can be ordered through PPGA (1-800-647-PPGA).

In recent years, there has been a significant increase in the variety of plant material grown for use in hanging baskets. Traditionally, ivy geraniums, impatiens, fuchsia, petunias, and foliage baskets were grown in hanging baskets. Recent popularity of New Guinea impatiens has led to a tremendous increase in New Guinea impatiens baskets of this plant alone. Recent breeding efforts emphasized development of new vigorous, yet heat resistant plants, ivy geraniums. In addition to ivy geraniums, a variety of new plant materials that are heat and drought tolerant cultivars have been introduced such as Bacopa, Sunlover petunias or Supertunias, a variety of new multiflora petunias, Diplodenia, and Mandevilla, etc. etc.

This article was written to provide a single general reference for the basics of scheduling and growing hanging basket crops. I tried to include as many new plant materials as possible. Recommendations are based on production procedures in the upper midwest but are often applicable to growing in northern climates. Information was drawn from a variety of sources including existing publications and growers (see literature cited). In particular, Steve Maslowski from Malmborg's and Cheryl from Linder's are acknowledged for their practical advice and opinion.

Selection of Plant Material:

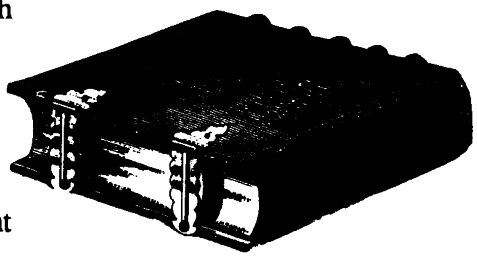
Too often selection of hanging basket plant material is based on the appearance of a basket when it leaves the retail outlet. Our industry would serve itself better by selecting hanging basket plant material based on performance of a basket at the consumer's home. Such selection occurs, to some extent, de facto when a consumer has a bad experience with a hanging basket and does not purchase the same type of hanging basket crop or does not purchase a basket at all the following season. It is in all of our best interest to

"Select hanging basket crops based on performance at the consumer's home."

Table 1. Identification of hanging basket crop heat and drought tolerance and level of maintainence.

Common Name	Latin Name	Heat Tolerance	Drought Tolerance	Maintainence
African Daisy	Dimorphotheca sinuata	Yes	Yes	Low
Alyssum	Lobularia maritima	Yes	No	Medium
Anagallis	Anagallis monelli	Yes	No	High
Artemisia	Artemisia stelleriana	Yes	No	Medium
Bacopa	Sutera diffusus	Yes	No	Medium
Begonia	Begonia semperflorens	Yes	Yes	Low
	Begonia tuberhybrida	No	No	High
	Other	No	No	High
Bougainvillea	Bougainvillea sp.	Yes	Yes	Low
Brachycome	Brachycome melanocarpa	No	No	High
Bridal Veil	Gibasis pellicida	Yes	No	Medium
Browallia	Browallia speciosa	No	No	High
Cigar Plant	Cuphea ignea	Yes	No	Medium
Chrysanthemum	Dendranthema grandiflorum	No	No	High
Coleus	Coleus x hybrida	No	No	High
Cuphea	Cuphea hyssopifolia	Yes	Yes	Low
Diascia	Diascia sp.	No	Yes	Medium
Diplodenia	Diplodenia sp.	Yes	Yes	Low
Evolvulus	Evolvulus sp.	Yes	Yes	Low
Fuchsia	Fuchsia x hybrida	Yes	Yes	High
Globe Amaranth	Gomphrena globosa	No	No	Low
Helichrysum	Helichrysum bracteatum	Yes	No	Medium
Impatiens	Impatiens walleriana	No	No	High
Ivy Geranium	Pelargonium peltatum	Yes	Yes	Low
Lantana	Lantana camara	Yes	No	Medium
Lobelia	Lobelia erinus	No	No	Medium
	Lobelia ricardii	Yes	No	Medium
Lotus	-	Yes	Yes	Low
Lysmachia	Lysmachia procumbens	No	No	High
Mandavilla	Mandevilla sp.	Yes	Yes	Low
Marguerite Daisy	Argeranthemum frutescens	Yes	No	Medium
Marigold	Tagates patula	Yes	Yes	Low
Nasturtium	Tropaeolum majus	Yes	No	Medium
New Guinea Impatiens	Impatiens hawkerii	No	No	High
Nierembergia	Nierembergia hippomanica	Yes	Yes	Low
Osteospermum	Osteospermumsp.	No	No	High
Passion Vine	Passiflora sp.	Yes	No	Medium
Pentas	Pentas lanceolata	Yes	Yes	Low
Petunia	Petunia x hybrida	Yes	Yes	Low
Portulaca	Portulaca grandiflora	Yes	Yes	Low
Russelia	Russelia equisetiformis	Yes	Yes	Low
Rhodochiton	Rhodochiton atrosanguineum	No	No	Medium
Sanvitalia	Sanvitalia procumbens	Yes	No	Medium
Scaevola	Scaevola aemula	Yes	Yes	Low
Shizanthus	Schizanthussp.	No	No	High
Seed Geranium	Pelargonium hortorum	Yes	Yes	Low
Swedish Ivy	Plectranthus australis	No	No	High
Thunbergia	Thunbergia alata	No	No	High
Thyme	Thymus sp.	Yes	Yes	Low
Verbena	Verbena hybrida	Yes	No	Medium
	Verbena speciosa	No	Yes	Medium
Vinca	Catharanthus roseus	Yes	Yes	Low
Vinca Vine	Vinca sp.	Yes	Yes	Low
Wishbone Flower	Torenia fournieri	No	No	Medium
Zinnia	Zinnia angustifolia	Yes	Yes	Low

insure in as many ways as possible that baskets continue to perform well at the consumer's home. Peter Konjoian of Konjoian's Floriculture Education Services Inc. (Andover, Mass.) has emphasized this for years and is a leader in selling for postproduction performance. An excellent article of factors affecting postproduction performance by Argo and Biernbaum (1994) appears in the before mentioned OFA publication.



Clearly the two biggest problems with postproduction performance are 1) flower and leaf loss due to water and/or high temperature stress, and 2) nutrient deficiencies due to lack of fertilization by the consumer and/or high pH problems. The single biggest criteria of a grower when selecting hanging basket types should be heat and drought tolerance. Fertilization of baskets can be accomplished by application of a slow release fertilizer when the plant leaves the retail outlet or by educating the consumer to fertilize regularly with liquid fertilizer. Table 1 identifies heat and/or drought tolerant plant materials grown in hanging baskets and a general rating of the degree of difficulty in maintaining these crops throughout the growing season in the upper midwest.

As mentioned before, Peter Konjoinian is a model for consumer education with respect to post production care of bedding plant baskets. He not only informs the consumer of the special needs of the basket they are purchasing but also sells equipment to insure that baskets are adequately watered and fed throughout the season. Dr. Konjoinian can be contacted at (508-683-6962). Unfortunately most consumers are not as diligent as Dr. Konjoinians customers nor do most retailers educate the consumer about postproduction care. Clearly, detailed information on a 'care' tag should be sold with hanging baskets.

Scheduling:

Scheduling of hanging basket crops is dependent on 3 things: expected sale/ship date, final desired size, and growing temperature. The schedules in Table 4 are based on 10" basket crop for mid-May sales date and a constant 68°F growing temperature.

Containers:

Clearly the size of the container is directly related to the amount of water is retained in a basket after watering. Greater water holding capacity reduces the frequency of watering required and the potential for drought stress. For instance, Argo and Biernbaum (1994) relate that a an 8" basket holds 45% and a 6" basket holds only 15% of the media contained in a 10" basket. Obviously, the potential for water stress is least in a 10" basket and greatest in a 6" basket.

The material a basket is made of effects the ability of that basket to retain water. Clearly, moss or fiber lined baskets will require more watering that plastic baskets. Similarly, new basket types with holes on the sides of the basket will require more water than containers without holes. It is critical that consumers understand the additional maintainance requirements of plant materials grown using some of these pot types prior to sale. I encourage you not to grow 6" baskets that have side holes; they are a formula for disaster for the consumer.

The average number of baskets that can be filled with a given volume of media is shown in Table 3.

Table 2. Hanging basket crop schedules for mid-May sale date for upper midwest production. Growth regulators are identified on crops in which they are sometimes applied.

Common Name	Plant Date	Pinch Number	Last Pinch	Cutting Number/Pot	Growth Regulator
African Daisy	3/25	0		5-7	B-Nine (2,500ppm)
Alyssum	3/25	0		5-7	B-Nine (2,500ppm)
Anagallis	2/1	1-2	3/23	5	Unknown
Artemisia	2/1	1-2	3/23	5	None/B-Nine (2,500 ppm)
Bacopa	3/25	0/Florel		4-5	B-Nine (2,500ppm)
Begonia fibrous	3/25	0		5-7	Cycocel (500-1500)
'Charm'	2/25	1-2	4/7	5	Cycocel (500-1500)
'Richmondensis	2/25	1-2	4/7	5	Cycocel (500-1500)
tuberous	2/15	0	-	5	Cycocel (500-1500 ppm)
Bidens	3/14	Florel	3/23	5	None Needed
Bouganvillea	2/1(4")	0		3-5	Bonzi/Florel (?)
Brachycome	3/25	0		5	B-Nine (2,500ppm)
Bridal Veil	3/25	0		5	None Needed
Browallia	3/25	0		5	B-Nine (2,500ppm)
Cigar Plant	3/25	0		5	None Needed
Coleus	3/25	1	4/14	5	B-Nine (2,500 ppm)
Cuphea	2/1	2	3/23	5	None Needed
Diascus	3/1	0		5	B-Nine (2,500 ppm)
Diplodenia	12/1	2	3/25	5	None Needed
Evolvulus	2/1	1-2/Florel	3/16	5	Florel/B-Nine (2,500 ppm)
Fuchsia	2/25	2-3/Florel	3/14	4-5	Florel/A-Rest (25 ppm)
Helichrysum	3/25	0		5	B-Nine (2,500 ppm)
Impatiens	3/25	0		5	Bonzi/Sumagic (2-5 ppm)
Ivy Geranium	2/1	1-2	3/23	5	Cycocel (500-1500)
Lantana	2/21	1-2/Florel	3/23	5	Florel/B-Nine 2,500 ppm)
Lobelia erinus	3/25	0		5	B-Nine (2,500 ppm)
ricardii	2/1	2	3/23	5	B-Nine (2,500 ppm)
Lotus	2/25	0-1	3/23	5	None Needed
Lysmachia	2/25	1-2/Florel	3/23	5	Florel/ B-Nine (2,500 ppm)
Mandavilla	12/1	as needed	3/1	3	Unknown
Marguerite Daisy	3/25	0		3-5	B-Nine (2,500 ppm)
Marigold	3/25	0		5	B-Nine (2,500 ppm)
Nasturtium	4/1	0		3-5	B-Nine (2,500 ppm)
N. G. Impatiens	2/1-3/25	0/Florel		4-5	Florel/None Needed
Nierembergia	3/25	0		5	B-Nine (2,500 ppm)
Osteospermum				5	B-Nine (2,500 ppm)
Passion Vine	2/25	1	3/25	3-5	Florel/B-Nine (?)
Pentas	2/1	1-2	3/23	5	B-Nine (2,500 ppm)
Petunia Most	4/5	1	4/23	5	B-Nine (5,000ppm)
Purple Wave	3/1	1/Florel	3/25	3-5	B-Nine (5,000ppm)
Portulaca	3/25	0		5	B-Nine (2,500ppm)
Russelia	2/1	1-2	3/23	5	Unknown
Rhodochiton	2/1	2	3/25	5	None Needed
Sanvitalia	3/25	0	-	5	B-Nine (2,500 ppm)
Scaevola	2/25	0-1	3/25	5	B-Nine (2,500 ppm)
Shizanthus	3/25	0		5	B-Nine (2,500 ppm)
Seed Geranium	3/25	0-1		5	Cycocel (500-1500 ppm)
Swedish Ivy	3/1	1	3/25	5	None Needed
Thunbergia	3/12	0		5	B-Nine (2,500 ppm)
Thyme	3/25	0		5	None (Food crop)
Verbena	2/21	1-2	4/14	5	B-Nine (2,500ppm)
Vinca	3/25	0	-	5	B-Nine (2,500 ppm)
Vinca Vine	2/1	Florel	3/14	5	Florel/None Needed
Wishbone Flower	3/25	0		5	B-Nine (2,500 ppm)
Zinnia	3/25	0		5	B-Nine (2,500 ppm)
Zonal Geranium	3/14	0-1	4/7	5	Cycocel (500-1500)

Medium:

Criteria when selecting a medium for

media. The remainder of the media should be composed of equal parts of

peat

is

containing

$CaCO_3$ and from 7.0-9.3, respectively. The typical consumer repeatedly waters plants with this water resulting in a steady increase in medium pH. High media pH results in iron and/or magnesium deficiency. Soil 'buffers' the media resulting in a slower increase in media pH through the growing season compared to a soilless media. In addition, soil containing media retains more nutrients compared to

Table 4. Coefficients for calculating the amount of acid needed (milliliters/gallon) to neutralize 1 ppm bicarbonate

Acid	Specific Gravity	Coefficient
75% Phosphoric	1.381	0.0041
85% Phosphoric	1.579	0.0037
93% Sulfuric	1.835	0.0019
61% Nitric	1.381	0.0062

season

Table 3. Average number of hanging baskets filled from a given volume of growing media.

Pot Size (inches)	Number/ Cubic Foot	Number/ Cubic Yard
6	17	459
8	10	270
10	5	135
12	4	108

program. If you incorporate soil in your basket mix, make sure you sterilize the soil prior to use and never use soil from previously farmed land; atrazine (herbicide) residue may be present.

Mix approximately 10-15% soil with your

nated when irrigation water pH/alkalinity is adjusted prior to application to crops. Alkalinity is a measure of the ability of irrigation water to neutralize an acid. In other words, the higher the water alkalinity the higher the ability of that water to increase media pH. Treated water (softened in most towns) often has an alkalinity between 40-120 ppm $CaCO_3$/$MgCO_3$. In contrast, well water in rural Minnesota (outside the beltway) can often have an alkalinity level between 250-550 ppm $CaCO_3$/$MgCO_3$. Ideally, water alkalinity should be adjusted to 100-120 ppm $CaCO_3$ (calcium carbonate) for

Molbak's Greenhouse and Nursery, Woodinville, Washington

Crop	Planting Date	Plants/Basket	Pinch Date(s)	Finish Date
Mixed Baskets	2/27 - 6/12	6 - 11	No Pinch	5 weeks
Impatiens	3/15 - 6/12	4	At Planting	5 weeks
Ivy Geraniums	11/7	5	12/12, 2/6	20 weeks
	1/9	5	2/6, 3/15	20 weeks
Fuchsia	11/4	4	12/5, 2/15	21 weeks
Non-Stop Begonias	1/15 - 4/15	4	No Pinch	12 weeks
Zonal Geraniums	3/13 - 7/17	3	No Pinch	4 weeks
Petunias	3/13 - 5/8	4	No Pinch	4 weeks
Begonia 'Richmondensis	11/28	4	1/1	16 weeks
Browallia	3/20 - 5/17	6	No Pinch	6 weeks
Heliotrope	3/20 - 4/17	4	At Planting	6 weeks

hanging basket production. Water alkalinity is best decreased by injecting acid into the irrigation water.

Brain Biermeijer (Biermeijer Greenhouses, Cottage Grove, Minnesota) called the other day to find out how much sulfuric acid he needed to inject into his water to decrease his water alkalinity from 260 to 100 ppm. He has a 1:100 injector, 5 gallon stock tank, and wanted to use phosphoric acid. The easiest way to determine how much acid to add to water that I know of is to use the following equation:

(Actual Alkalinity - Desired Alkalinity) x (Coefficient from Table 5) x (Gallons in Stock Tank) x (Injector Ratio) = Milliliters Needed

In our example Brian should add:

(260-100=160) x (0.019) x 5 gallon stock tank x 100 injector ratio =1520 mls of phosphoric acid to his 5 gallon stock tank.

Weidner's Gardens, Encinitas California

Crop	Planting Date	Plants/Basket	Pinch Date	Finish
Fuchsia	3/1	1	4/1, 5/5, 6/10	20 weeks
Supertunia	2/14 - 3/1	2	after 2 weeks	9 weeks
Ivy Geraniums	2/14 - 3/1	4	after 2 weeks	10 weeks
Streptocarpella	2/14 - 3/1	3	after 2 weeks	12 weeks
Brunfelsia	6/1	3	8/15, 1/1	38 weeks
Dipladenia	3/1	3	after 3, 8, 14	20 weeks
Helichrysum	2/14 - 3/1	3	No Pinch	10 weeks
Brachycome	2/14 - 3/1	3	No Pinch	8 weeks
Russelia	12/15	3	after 4-6 weeks	30 weeks

Stacy's Greenhouse, York, South Carolina

Crop	Planting	Plants/Basket	Pinch Date(s)	Finish
Impatiens	3/15	4	No Pinch	7 weeks
N.G. Impatiens	2/1	4	3/1	13 weeks
Geraniums	2/15	3	3/15(Florel)	11 weeks
Sunlover Petunia	3/1	3	3/21	9 weeks
Scaveola	2/14	3	3/15	13 weeks
Vinca	3/15	6	No Pinch	9 weeks
Lantana	2/15	4	3/15	13 weeks
Portulaca	3/15	6	No Pinch	9 weeks
Fibrous Begonia	3/15	4	No Pinch	7 weeks

Planting:

Planting dates obviously vary in different locations in the United States. Stephen Carpenter assembled schedules from a variety of locations around the

US and published them in the publication OFA Hanging Baskets Tips (see references). These tables are shown on the next 2 pages. Obviously he overlooked getting information from the horticultural mecca of Minneapolis/St. Paul. Upper midwest schedules are found in Table 2.

Konjoian's Greenhouses, Andover, Massachusetts

Crop	Planting Date	Plants/Basket	Pinch Date(s)	Finish
Begonia				
'Richmondensis'	2/15	4-5	3/1	15 weeks
Brachycome	2/25	4-5	3/15	14 weeks
Double Impatiens	3/15	4 -5	No Pinch	10 weeks
Evolvulus	1/15	5-7	2/15	19 weeks
Fuchsia	2/15	4-5	3/1	15 weeks
Hiemalis Begonia	2/1	4-5	3/1	17 weeks
Impatiens	4/1	4 -5	No Pinch	8 weeks
Ivy Geranium	2/22	5 -6	3/8	14 weeks
Lantana	3/1	4 -6	3/8	13 weeks
Lysimachia	3/15	4-5	No Pinch	10 weeks
N.G. Impatiens	2/10	3 -4	No Pinch	16 weeks
Scaevola	3/1	3-5	3/15	12 weeks
Supertunia	3/15	3-4	4/1	10 weeks

Schedules change considerably with growing temperature. Sunny springs result in earlier flowering and atainment of marketing size. In contrast, cloudy springs tend to result in crops that are 'behind'. Always remember that these schedules are based on a typical spring that contains a mix of sunny and cloudy days. Prolonged cloudy weather means that air temperatures will need to be increased to compensate for the loss of plant heating resulting from direct sunlight. Direct sunlight heats plants approximately 5-8°F above the air temperature.

Nutrition:

In general, it is desirable to promote

Possum Run Greenhouses, Inc., Bellville, Ohio

Crop	Planting Date	Plants/Basket	Pinch Date(s)	Finish
Acalypha	Jan-Feb	4-5	Some	16 weeks
Begonia				
'Richmondensis'	2/20	3	Little or no	11 weeks
'Non-Stop'	3/1	4	No Pinch	10 weeks
'Reiger'	3/1	3	By 3/15	12 weeks
Brachycome	March	5	Some	8 weeks
Diascia	Dec-Jan	3	every 2 weeks	20 weeks
Evolvulus	Feb	5	Some	12 weeks
Fuchsia	Oct-Jan	4-5	Florel	14 weeks
Helichrysum	Feb	4	No Pinch	14 weeks
Ivy Geranium	Jan-Feb	3-4	Florel	15 weeks
Impatiens (Double)	Jan-Feb	1-3	every 2 weeks	18 weeks
Impatiens (New Guinea)	Jan	4	No Pinch	15 weeks
Lobelia 'Ricardii'	Jan-Feb	4-5	every 2 weeks till vern.	17 weeks
Lysmachia	Dec-Jan	3	every 2-3 wks	22 weeks
Scaevola	Jan-Mar	4-5	every 2-3 wks	10 weeks
Purslane/Verbena Mix	Jan-Mar	4-5	Verb. - every 2	11 weeks

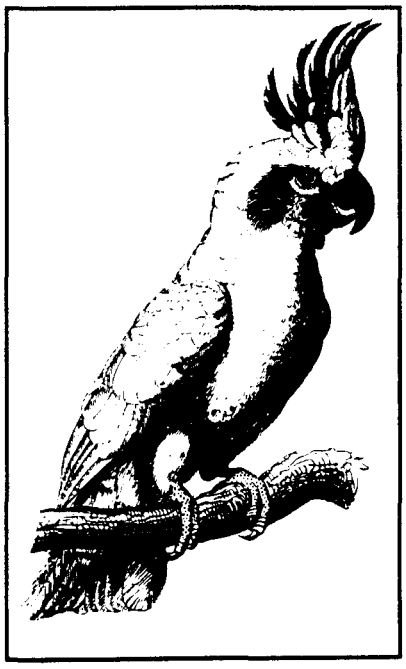
branching and lush growth early in basket production and 'harden' the basket crop off prior to sale. This can be done to some extend by altering your nutritional regime over time.

"We recommend fertilizing with 400-600 ppm N and K when plants are first watered."

A common mistake when growing any plant material in larger containers that are not watered frequently during the first month is to under fertilize. Optimal fertility levels are often not reached until the plant is 1-2 months old. Therefore, we (at the University of Minnesota) recommend that baskets receive an application of fertilizer delivering 400-600 ppm nitrogen (balanced N-P-K) after planting when the baskets are watered in. In this way initial growth is optimized by supplying adequate nutrition. It is important that cuttings have had a chance to 'harden off' prior to this stronger fertilizer application rather than applying the fertilizer immediately after cuttings are removed from the propagation bench.

A premixed fertilizer such as a (20-20-20) is recommended for the first fertilizer application. A significant amount of the nitrogen in this fertilizer is in the ammonium and/or urea form (often >60%). High ammonium/urea fertilizers tend to give lush growth and increase branching compared to nitrate based fertilizers. You should continue to use ammonium based fertilizers if your growing conditions are sunny and warm. Application of ammonium/urea based fertilizers under cloudy and/or cool growing conditions can result in ammonium toxicity. The basis for ammonium toxicity is not well understood but may be related to induction of calcium deficiency. Symptoms of ammonium toxicity include a reduction in growth, yellowing along the leaf margin, and reduced and/or burnt roots. The solution for ammonium toxicity is to leach to attempt to wash out the excess ammonium. Ammonium toxicity is more prevalent and difficult to control with media that contain soil versus soilless media.

In northern climates nitrate based fertilizers (calcium + potassium nitrate) are recommended after the initial ammonium based fertilizer application until April 1. In addition, we feel nitrate based fertilizers at the end of production aid in the 'hardening off' process compared to ammonium based fertilizers.



It is very important that soil tests are conducted regularly on hanging basket crops. The production time is generally longer than other bedding plants and the nutritional balance has a greater oportunity to get 'out of wack'. Recommended soil test values for both Spurway and saturated paste extraction procedures are shown in Table 5.

The most common nutritional problems in

order of occurance in the upper midwest are:

1) High soluble salts
   Soluion - Leach
2) Ammonium toxicity
   Solution - Leach
3) High pH induced iron and magnesium deficiency.
   Solution - leach with acidified water and use acid based fertilizers.
4) Lack of fertility
   Solution - Increase fertilization.

Branching:

Baskets are pinched to induce branching, to obtain cuttings, or to regain control of plant growth. Plant growth should never get out of control! Pinching off growth to regain control is simply throwing away material that you paid money to grow! Soft pinching plants should be done whenever possible to maximize the amount of plant material that is left behind and minimize the length of the production schedule. Manage growth with scheduling, pinching, temperature and growth retardants/regulators.

Late planting and pinching is a common problem in hanging basket production especially among pot plant producers in the northern U.S.; Frequently, Easter can interfere with hanging basket production in our area. It is possible to hasten growth at the end of production by growing plants at warmer temperatures but this typically reduces overall plant quality. Do not cheat on scheduling. It is especially important to follow schedules with photoperiodic plants (daylength sensitive) such as fuchsia.

Not all plants respond to pinching with increased branching (Table 6).

Recent research by Konjoian has demonstarted that it is possible to produce excellent hanging basket crops without pinching at all; the chemical pinching agent/branching promoter Florel can substitute for a pinch. A spray application of 500 ppm Florel to foliage can eliminate the need for pinching on ivy geranium, fuchsia, lantana, begonia, and many other hanging basket crops. Konjoian suggests that Florel be applied at the time a crop would normally be pinched.

In addition to inducing branching, Florel application results in flower bud abortion. Therefore, more plant growth is directed towards vegetative development to build plant size and the need for old flower removal is eliminated until late in the season. Less dead flowers also decreases the amount of Botrytis is a greenhouse as well. Florel application also decreases internode elongation and leaf size.

Normal flowering will occur 6-8 weeks after the last Florel application. Therefore, Florel should not be applied any later than mid-March when baskets will be marketed for Mother's Day.

Growth Retardants:

Hanging basket crop stem elongation, as with many other plant species, is directly related to the difference between the day and night temperature. Stem elongation increases as the difference between the day and night temperature increases. We recommend that initial growth after pinching be controlled as much asd possible by growing baskets at 0oF DIF. Growing baskets at low DIF levels often results in 'fuller' growth.

Often, baskets are grown above benches in the greenhouse where they receive high day temperatures and low night temperatures (high +DIF) because there is not enough bench space. As a result, stem elongation is often promoted more on hanging basket crops than on those crops growing on the benches in the same greenhouse. Growth retardant applications are recommended on many bedding plant crops to limit internode elongation to maintain compact 'full' growth.

B-Nine, Cycocel, A-Rest, Sumagic and

Bonzi are applied to hanging basket crops for elongation control. Elongation control is achieved when B-Nine, Cycocel and A-Rest are applied to the foliage. In contrast, elongation control is only achieved using Sumagic and Bonzi when the retardant comes in

Table 5. Recommended media nutrient levels as determined by Spurway and saturated paste extraction procedures or hanging basket production.

	pH	SS	NO3	P	K	Ca	Mg	Fe	Mn	Zn	B
Spurway	6.5	100	180	7	60	150	40	0.25	0.25	0.25	0.15
Sat. Paste	6.5	1.0	100	7	100	150	40	0.40	0.40	0.40	0.15

contract with the stem and/or media. It is therefore, difficult to achieve uniform elongation control with these materials when applied as sprays. Therefore, drench applications of Sumagic or Bonzi are recommended for hanging basket crops. Because drench applications are labor intensive, these materials are usually only used on plant materials in which other growth retardants are not very effective such as impatiens.

Recommended materials for elongation control and method of application for upper midwest hanging basket production are outlined in Table 2.

ProGibb is an elongation promoter. I have only seen Pro-Gibb applied to bedding/basket crops to overcome ecessive inhibition of stem elongation resulting from too much growth retardant being applied; usually, Sumagic or Bonzi. If you overapply growth retardant, apply 10 ppm Pro-Gibb as a spray.

Flowering:

Most hanging basket crops are day-neutral. In other words, the length of the day does not affect when the plants flower. However, most day-neutral crop flowering is enhanced by increasing the total amount of light that a crop is exposed to. Enhancement in flowering is usually expressed by earlier flowering and/or more flowers per inflorescence.

In contrast to day-neutral plants, some plants such as Fuchsia are photoperiodic.

Table 6. Some effects of photoperiod on annual crops used as hanging basket crops.

Crop	Short Days	Long Days
Basil	Hasten flowering	Delay flowering
Tub. Begonia	delay flowering	induce flowering
Bougainvillea	promote flowering	less flowering
Coleus	induce flowering	delay flowering
Gaillardia	delay flowering	induce flowering
Morning Glory	induce flowering	delay flowering
Nicotiana	delay flowering	induce flowering
Pansy	strengthen stems	increase flower #
Perilla	induce flowering	delay flowering
Petunia	delay flowering	hasten flowering
Verbena	delay flowering	induce flowering
Zinnia	hasten bud dev.	delay bud dev.

Flowering of photoperiodic plants is affected by the length of the photoperiod or daylength. Fuchsia flowering is stimulated when the daylength exceeds the night length. Therefore, flowering of fuchsia can be hastened with night interruption lighting (mum lighting; 10 footcandles applied from 2200-0200 hr) or delayed by pulling cloth to provide a shorter day than night. Although most crops grown in baskets are not photoperiodic with respect to flowering, the morphology of many is affected by photoperiod. Table 6 shows some of the known effects of photoperiod on common annual basket crops. The degree of photoperiod effects on many annual crops has been reduced through breeding efforts but some persist.

Light intensity (irradiance) affects flowering of many crops. In specific, flower number per inflorescence typically increases proportionally with intensity up to 600 μmol s^{-1} m^{-2} (3000 footcandles). Higher irradiance usually does not increase flowering.

Finishing:

In some cases slow release incorporation of fertilizers when media is mixed is recommended. I do not recommend this. You simply lose too much control of the nutrient level in the pot. I have seen too many high soluble salt problems when slow release fertilizers are incorporated in media.

In addition, the difficulty in interpreting soil tests increases greatly because the total amount of nutrient is reported in the results rather than the actual available to the plant. For this reason, I recommend top dressing with slow release fertilizers prior to shipping baskets or informing the retailer that he/she should do this prior to sale. One-two tablespoons of resin-coated fertilizer (18-0-18) per basket is usually enough when the fertilizer has a 4 month release rate.

Baskets should be 'hardened-off' prior to sale. Plants are hardened off by reducing temperature and fertilizer. In general, nitrate based fertilizers tend to produce 'harder' growth that can withstand outdoor conditions more easily. Therefore, only nitrate based fertilizers should be used late in basket development.

Shipping seed geaniums can cause petal shattering after they are removed from the truck at the retailer's. Therefore, silver thiosulfate is commonly sprayed on seed geraniums 1-2 weeks prior to shipment to inhibit petal shattering. A 0.2 mM concentration solution of STS is recommended to control shattering in many crops. To make this solution:

1) add 8.8 milligrams of silver nitrate to 500 milliliters of distilled water.

2) add 35.2 milligrams of sodium thiosulfate to another 500 milliliters of distilled water.

3) Pour the silver nitrate solution into the sodium thiosulfate solution. DO NOT DO THE REVERSE.

4) Spray on plants until foliage is moist.

5) Store mixed solution at 35°F in an opaque container.

Literature Cited:

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