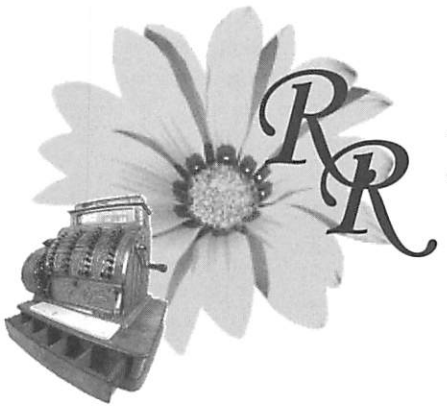

Retail Reflection$: Post-production Fertilization

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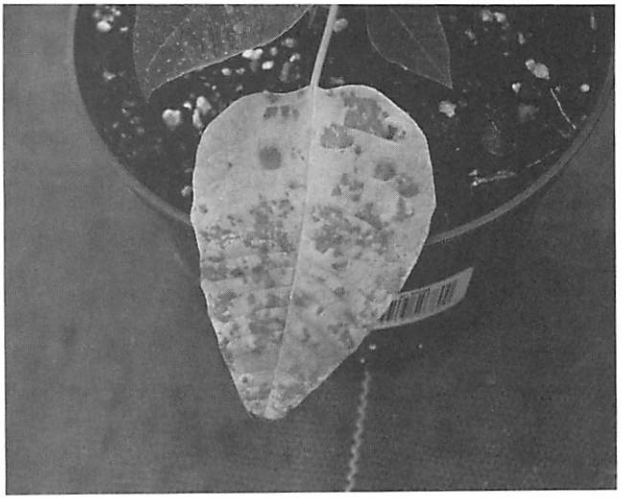
The Reality

It is late May, you have just sold the majority of your second turn, and your third turn is in flower and ready for June sales. By now, like all greenhouse growers, the muscles are a little sore and you are finding it hard to get up in the morning. You feel good about spring sales and are ready for a break. But....the weather is still cool, rainy nights along with warm days have boosted plant sales and the customers are still flocking in. The third turn has been on display for about a week and you begin to observe customers selecting only the finest material from flats of bedding plants; sales are dropping rapidly. You yourself are beginning to see why they're being so selective. The lower leaves are turning yellow, the plants are slightly stretched, and the flowers are spent. What you are experiencing is what many other growers encounter every year– improper management of plant nutrition in the retail setting.

Why establish a fertility program in the garden center or retail location? There are several reasons:

- It helps to maintain a quality crop through the dog days of summer, because landscapers and homeowners are always installing new gardens and demanding healthy materials.
- Fertilization can help tone plant foliage and promote the life of the plant through the increased production of flowers.
- Managing nutrition (ceasing, reducing, continuing, or increasing) at the retail location can extend shelf life on display racks and benches.
- Early to late-summer sales can boost revenue if the plants look good.
- Plants continue to grow in retail environments with high light, thus plants demand nutrients.
- Knowing how to manage fertilization during the later stages of growth will increase your awareness of specific species' requirements.
- Environmentally conscious growers are praised (especially in today's world). Displaying a sign that states, "Fertilization is reduced to avoid excessive nutrient runoff" is a very powerful statement.

The ultimate advantage you have over garden centers or mass market chains is that you still have total control over the crop's nutrient requirements. You know how the crop was fertilized from potting to market date and hopefully you have monitored the pH and electrical conductivity (EC) over time. The plant problems that garden centers or chain stores may have are numerous. For instance, will the plants receive any fertilizer or water on display benches? If employees provide water, how well will they irrigate? I once witnessed a young man watering a group of plants with an oscillating lawn sprinkler at night! How knowledgeable about plant nutrition are the employees of



a big chain? These problems can make customers travel to your business and convince them that you produce the finest material. If you are recognized as being a reputable establishment, then you have created a niche for yourself. You are a retailer who has healthy material in the summertime, and not just during the busy weekends of Mother's Day and Memorial Day!

Monitoring

It is important to remember that fertilizers are not medicine. Overcoming deficiencies, especially in the retail area, will take longer because nutrient uptake is not as rapid in the post-production stage. More importantly, monitoring the crop so that deficiencies never occur should be the common practice for growers with retail centers.

By maintaining the proper pH and electrical conductivity (EC), growers will avoid many nutritional problems in the greenhouse. The pH directly influences nutrient availability. The general pH range for most floriculture crops is 5.4 to 6.8, but maintaining the pH between 5.6 and 6.2 is recommended. Soluble salts are measured by electrical conductivity, a measure of all of the dissolved salts in the substrate solution. Some salts provide nutrients while others are not essential for plant growth. Refer to **Table 1** for pH and EC ranges for popular floriculture crops in the post-production stage.

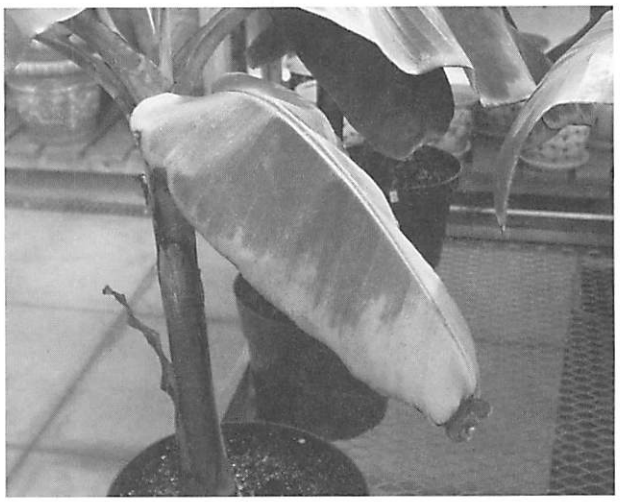
Sales may slump in the retail area due to abnormal weather patterns or the regional economic situation. You may be concerned with delays in sales that may sometimes lead to cutting back plants or manipulating the environment constantly. Both actions require a tremendous amount of labor. Knowing the pH and EC values of a crop can help regulate the amount of fertilizer applied without causing damage to plants. Maintaining compact growth while avoiding nutrient deficiencies should be relatively easy by simply monitoring the substrate EC levels. In most cases, conducting one analysis one to two weeks after displaying the crops will provide pH and EC values to take action.

The most practical means of attaining pH and EC values is by using the PourThru method. For detailed information about the PourThru method visit *www.pourthruinfo.com*. Principles behind pH and EC and information about pH and EC meters can also be found at this site.

Principles of Fertilization

It has been suggested that for most floricultural crops at visible flower bud, fertilization be discontinued or reduced significantly because plants require less nutrients for growth during flowering. Most growers apply liquid fertilizer on a constant liquid feed program, and reduce the rate by half when the plant begins to show flower buds. When the crop is marketed, nutrients should still be applied at an appropriate level. Perhaps a once weekly application should be adopted to continue a nutrient charge in the substrate.

Root development will be significant in the retail setting, if pathogen infection and high EC levels have not damaged the root system. Water demand will be great, especially in late spring/ early summer, and irrigation may be required daily in the retail setting if temperatures and light intensity are high. Therefore, multiple fertilizations each week may be required for crops, especially vigorous growing plants like petunias and combination plantings of vegetative annuals.



Certain questions should be answered before displaying plants in the retail setting:

• What are the pH and EC requirements for my plants?
This will establish the target pH and EC levels to keep plants healthy and looking their best on display.

• What is my water quality?
This determines if a basic or acid fertilizer should be used, if there is calcium and magnesium in the irrigation water, and if a fertilizer with micronutrients will be required. A basic water test will provide the grower with pH, EC, and alkalinity levels. Depending on the alkalinity levels, two fertilizers will serve as the nutrient sources during the post-production stage. They are 20-10-20, an acidic fertilizer for battling high to moderate levels of alkalinity, and 15-5-15, a basic fertilizer for low alkaline water conditions.

• Did I use slow release fertilizers?
This will indicate if more clear water can be applied to crops because the slow release fertilizer is providing nutrients to plants in the retail area.

Avoiding Excessive Growth

The ultimate goal in retail is to sell the product rapidly. Unfortunately the mindset sometimes is to give the crop one final application of highly concentrated fertilizer before marketing, and this practice can severely affect quality. Applying too high of a rate can cause undesired growth which will lead to leggy plants. Although the plants are at the end of their production cycle, growth still occurs, nutrients are still required, so provide minimal amounts of fertilizer to keep them healthy and toned.

Table 1a. Post-production fertilization strategies for moderate to heavy feeding bedding and pot crops.

Common Name	Botanical Name	Crop Type	pH	EC*	Estimated Fertilization**	Comments
Begonia (Rieger)	*Begonia* x *hiemalis*	Pot	5.5-6.5	0.5	100 ppm N weekly	Superphosphate supplement may be necessary
Bouganvillea	*Bouganvillea spectabilis*	Hanging basket	5.5-6.1	0.5-0.75	100 ppm N weekly	2 tsp. Osmocote/ basket is optional
Cabbage/Kale	*Brassica* spp.	Pot	5.8-6.5	0.5-0.75	100 ppm N weekly	
Chrysanthemum	*Chrysanthemum grandiflora*	Pot	5.7-6.2	0.5-0.75	100 ppm N weekly	1 tsp. Osmocote / 6" pot is optional
Combination Containers	Various	Pots/Hanging baskets	5.8-6.2	0.5-0.75	100 ppm N weekly	Many plants (with various requirements) are in the same container; consider individual plant needs.
Easter Lily	*Lilium longiflorum*	Pot	6.5-7.0	0.5-0.75	100 ppm N weekly	1.0 tsp. Osmocote / 6" pot is optional
Firecracker Flower	*Crossandra infundibuliformis*	Pot	6.2-7.0	0.5-0.75	100 ppm N weekly	1 tsp. Osmocote / 6" pot is optional
Flowering Maple	*Abutilon* spp.	Hanging basket	5.5-6.5	0.5-0.75	100 ppm N weekly	1 tsp. Osmocote / 6" pot is optional
Fuchsia	*Fuchsia* spp.	Hanging basket	5.8-6.2	0.5	100 ppm N weekly	1.5 tsp. Osmocote / 6" pot is optional
Geranium	*Pelargonium* x *hortorum*	Pot	6.0-6.5	0.5-0.75	100 ppm N weekly	
Geranium (Regal)	*Pelargonium* x *domestica*	Pot	6.0-6.5	0.5-0.75	100 ppm N weekly	1 tsp. Osmocote / 6" pot is optional
Hibiscus	*Hibiscus rosa-sinensis*	Pot	5.8-6.5	0.5	100 ppm N weekly	1 tsp. Osmocote / 6" pot is optional
Hydrangea (blue)	*Hydrangea macrophylla*	Pot	5.1-5.6	0.5	100 ppm N weekly	1 tsp. Osmocote / 6" pot is optional
Hydrangea (pink/red)	*Hydrangea macrophylla*	Pot	6.0-6.2	0.5	100 ppm N weekly	1 tsp. Osmocote / 6" pot is optional
Jerusalem Cherry	*Solanum pseudocapsicum*	Pot	5.8-6.2	0.5	100 ppm N weekly	
Kalanchoe	*Kalanchoe blossfeldiana*	Pot	5.8-6.5	0.5	100 ppm N weekly	
Lantana	*Lantana* spp.	Pot	6.0-6.5	0.5-0.75	100 ppm N weekly	
Petunia (vegetative)	*Petunia* x *hybrida*	BPF/Hanging basket	5.5-6.0	0.5-0.75	100 ppm N weekly	
Poinsettia	*Euphorbia pulcherrima*	Pot	5.6-6.2	0.5	100 ppm N weekly	1 tsp. Osmocote / 6" pot is optional; Magnesium supplement may be required
Torenia	*Torenia fournieri*	Pot/hanging basket	5.8-6.2	0.5-0.75	100 ppm N weekly	
Tropical Bleeding Heart	*Clerodendrum thomsoniae*	Hanging Basket	5.7-6.3	0.5	100 ppm N weekly	1 tsp. Osmocote/ basket is optional

* Based on PourThru sampling, for further information visit: www.pourthruinfo.com
** Recommendations based on a comple fertilizer.

Table 1b. Post-production fertilization strategies for medium feeding bedding and pot crops.

Common Name	Botanical Name	Crop Type	pH	EC*	Estimated Fertilization**	Comments
Ageratum	*Ageratum* spp.	Bedding Plant Flat (BPF)	5.5-6.5	0.5-0.75	75 - 100 ppm N weekly	
Alyssum	*Lobularia* spp.	BPF	5.5-6.5	0.5-0.75	75 - 100 ppm N weekly	
Asiatic and Oriental Lily	*Lilium* spp.	Bulb	6.0-6.5	0.5-0.75	75 ppm N weekly	
Balloon Flower	*Platycodon grandiflorus*	Pot	6.0-6.5	0.5-0.75	75 - 100 ppm N weekly	
Begonia (wax)	*Begonia* spp.	BPF	5.5-6.5	0.5-0.75	75 - 100 ppm N weekly	
Cockscomb	*Celosia* spp.	BPF	5.5-6.5	0.5-0.75	75 - 100 ppm N weekly	
Coleus (shade)	*Solenostemon scutellarioides*	BPF	5.5-6.5	0.5-0.75	75 ppm N weekly	
Coleus (sun)	*Solenostemon scutellarioides*	Pot	5.5-6.5	0.5-0.75	75 - 100 ppm N weekly	
Cosmos	*Cosmos bipinnatus*	BPF	5.5-6.5	0.5-0.75	75 - 100 ppm N weekly	
Cyclamen	*Cyclamen persicum*	Pot	5.0-6.0	0.5	75 ppm N weekly	1/2 tsp. Osmocote / 6" pot is optional
Dahlia	*Dahlia* spp.	BPF	5.5-6.5	0.5-0.75	75 - 100 ppm N weekly	
Dianthus	*Dianthus* spp.	Pot/BFF	6.2-6.8	0.5-0.75	75 - 100 ppm N weekly	
Gerbera Daisy	*Gerbera jamsonii*	Pot	5.5-6.0	0.5-1.0	75 - 100 ppm N weekly	Magnesium supplement may be required
Globe Amaranth	*Gomphrena globosa*	BPF	5.5-6.5	0.5-0.75	75 - 100 ppm N weekly	
Impatiens	*Impatiens wallerana*	BPF	5.5-6.5	0.5-0.75	75 - 100 ppm N weekly	
Petunia (seed)	*Petunia* x *hybrida*	BPF	5.5-6.0	0.5-0.75	75 - 100 ppm N weekly	
Primrose	*Primula* spp.	Pot	5.5-6.0	0.5	75 ppm N weekly	Magnesium supplement may be required
Salvia	*Salvia* spp.	BPF	5.5-6.0	0.5-0.75	75 - 100 ppm N weekly	
Snapdragon	*Antirrhinum majus*	BPF	5.5-6.5	0.5-0.75	75 - 100 ppm N weekly	
Sunflower	*Helianthus annuus*	Pot	6.0-6.5	0.5-0.75	75 ppm N weekly	
Zinnia	*Zinnia elegans*	BPF	6.0-6.5	0.5-0.75	75 - 100 ppm N weekly	

Table 1c. Post-production fertilization strategies for light feeding bedding and pot crops.

Common Name	Botanical Name	Crop Type	pH	EC*	Estimated Fertilization**	Comments
African Violet	*Saintpaulia ionantha*	Pot	5.8-6.5	0.5-0.75	50 ppm N weekly	
Amaryllis	*Hippeastrum* spp.	Bulb	6.0-6.5	0.5	None	
Azalea	*Rhododendron* spp.	Pot	4.5-5.5	0.5	50 ppm N weekly	Use an acid-special fertilizer
Caladium	*Caladium* spp.	Tuber	5.5-6.5	< 0.5	None	
Calceolaria	*Calceolaria crenatiflora*	Pot	6.0-6.5	0.5	50 ppm N weekly	1/2 tsp. Osmocote / 6" pot is optional
Calla Lilly	*Zantedeschia* spp.	Pot	5.5-6.0	0.5	50 ppm N weekly	
Cape Primrose	*Streptocarpus* x *hybridus*	Pot	5.5-6.0	0.5	50 ppm N biweekly	
Christmas Cactus, Easter Cactus	*Schlumbegera buckleyi*, *Rhipsalidopsis gaertneri*	Pot	5.7-6.5	0.5	None	
Cineraria	*Pericallis* spp.	Pot		0.5	50 ppm N weekly	
Crocus	*Crocus* spp.	Bulb	6.0-7.0	<0.5	None	
Daffodil	*Narcissus* spp.	Bulb	6.0-7.0	< 0.5	None	
Dahlia	*Dahlia* spp.	Tuber	6.5-7.0	< 0.5	50 ppm N weekly	
Exacum	*Exacum affine*	Pot	6.2-6.8	0.5	50 ppm N weekly	1/2 tsp. Osmocote / 6" pot is optional
Flowering Onion, Garlic	*Allium* spp.	Bulb	6.0-7.0	< 0.5	None	
Foliage	Various species	Pot	6.0-6.5	0.5	50 ppm N weekly	
Freesia	*Freesia* x *hybrida*	Bulb	6.2-6.8	0.5	None	
Gloxinia	*Sinningia speciosa*	Pot	5.5-6.0	0.5	None	
Heather	*Erica* spp.	Pot	5.5-6.0	0.5	50 ppm N weekly	
Hyacinth	*Hyacinthus*, *Hyacinthoides*, *Muscari*	Bulb	6.0-7.0	0.5	None	
New Guinea Impatiens	*Impatiens hawkeri*	Pot/Hanging basket	5.8-6.2	0.5	50 ppm N weekly	Darker leaf cultivars are more sensitve to high EC.
Pansy	*Viola* x *wittrockiana*	BPF	5.5-6.0	0.5	50 ppm N weekly	
Perennials			5.5-6.5	0.5	50 ppm N weekly	1 tsp. Osmocote / 6" pot is optional (active growth stage)
Pot Rose	*Rosa* x *hybrida*	Pot	5.5-6.5	0.5	50 ppm N weekly	
Ranunculas	*Ranunculas* spp.	Pot	6.0-7.0	< 0.5	None	
Shamrock, Four-Leaved Clover	*Oxalis* spp.	Bulb	6.0-7.0	< 0.5	None	
Tulip	*Tulipa* spp.	Bulb	6.0-7.0	< 0.5	None	
Venus Fly Trap	*Dionaea muscipula*	Pot	3.5-4.9	0.5	None	

A low phosphorus/ammoniacal-nitrogen fertilizer should be used in the retail setting. High levels of both nutrients have been shown to increase stem elongation, and ammoniacal-nitrogen causes lush growth with less flowering. Use fertilizers like 15-0-15 and 15-5-15 (if a basic fertilizer is needed) or 20-10-20 (if an acidic fertilizer is needed) in the retail sales area weekly at concentrations of 50 to 100 ppm N.

Also excessive watering with or without fertilizer can cause undesired growth in crops such as exacum and impatiens. Flowering can be increased by reducing the amount of water applied to exacum.

Slow Release Fertilizers

Use of slow release fertilizers in the retail setting is minimal because producers wish to have more control over plant growth. Nutrients can be released quickly due to higher temperatures, which may introduce undesired levels of ammoniacal-nitrogen in the substrate, a causal agent of lush and leggy growth. Heavy feeders like garden mums and poinsettias are mainly given a slow release fertilizer application after potting or the fertilizer is premixed with the root substrate, but rarely are they treated again before marketing. Most bedding plant species will not require the extra boost of fertilizer during the late stages of production as nutrient demand decreases. A liquid fertilizer program is popular amongst retail growers. If growers decide to use a slow release fertilizer, fertilizers that contain both ammonium and nitrate are recommended, such as Osmocote and Nutricote. Clear water applications can be more routine in the retail setting as minimal release periods for these fertilizers are 3 to 4 months. Generally, the cost is too high to incorporate slow release fertilizers into bedding plant substrates.

Nutrient Management

During the post-production stage there usually are 4 to 5 common nutrient deficiencies that can occur when the pH is too high or the EC is too low. Iron deficiency (interveinal chlorosis of the upper growth) can occur when the pH rises above 6.6. Low salts can result from too many clear water irrigations in the retail sales area. Deficiencies like lower leaf yellowing (nitrogen), lower leaf purpling (phosphorus), lower leaf marginal chlorosis (potassium), and lower leaf interveinal chlorosis (magnesium) are common when PourThru EC values are below 0.5 mS/cm. Calcium is an essential nutrient that serves as a constituent of cell walls. Because calcium demand is less in the post-production stage when plants are at their mature stage (less cell division and elongation), calcium in the irrigation water should be adequate. The demand for calcium will increase, however, when plants are cut back because of stretchy growth in the retail sales area and a new plant canopy is forming. Micronutrients like boron, copper, manganese, and zinc are generally provided by the breakdown of organic substrate components or from the irrigation water. One application of a complete fertilizer like 20-10-20

Table 2. Corrective procedures for pH and EC problems.

High pH	Apply 21-7-7 or 20-10-20 to decrease the pH, or apply iron sulfate at a rate of 2 lbs. per 100 gallons, or inject acid if alkalinity levels are greater than 200 ppm N.
Low pH	Apply 15-0-15, 15-5-15, or flowable lime (Apply potassium bicarbonate if the pH remains lower than 5.5)
High EC (>1.0 mS/cm PourThru)	Reduce the rate of fertilizer or apply more clear water to the crop.
Low EC (<0.5 mS/cm PourThru)	Increase the rate of fertilizer or decrease the amount of clear water applied to the crop.
Nitrogen deficiency	One application of calcium nitrate + potssium nitrate, 20-10-20, or 15-5-15 at a concentration of 200 to 300 ppm N.
Phosphorus deficiency	One application of 20-10-20, 15-5-25, or 15-5-15 at a concentration of 200 ppm N.
Potassium deficiency	One application of potassium nitrate or 15-5-25 at a concentration of 300 ppm N.
Magnesium deficiency	One application of 15-5-15 Cal-Mag at a concentration of 300 ppm N or magnesium sulfate at a rate of 2 lbs. per 100 gallons.
Iron deficiency	Apply 21-7-7 or 20-10-20 to decrease the pH, or apply iron sulfate at a rate of 2 lbs. per 100 gallons, or inject acid if alkalinity levels are greater than 200 ppm N.

should provide micronutrients until plants are planted in garden soils. Deficiencies may occur if the pH is close to neutral. **Table 2** provides corrective procedures for some of the more common nutrient disorders mentioned above.

External Factors Affect Plant Quality

Although nutrition plays a major role in how plants appear in the retail setting, several other external factors contribute to plant quality in the post-production stage. Because this article mainly focuses on nutrient effects on plant quality, these factors will not be discussed extensively, but greenhouse growers should never underestimate them.

- Irrigation—Water should be reduced at the visible bud stage, and the growing substrate should be allowed to dry more thoroughly.
- Light—Levels should be reduced in the retail setting. Provide shade to plants when temperatures are ≥68°F. Tiered shelving is highly recommended in the display area as the bottom and top shelves will receive similar light levels.
- Temperature—It has been suggested to reduce temperatures by 5 to 8°F during the post-production stage. Lowering temperatures will also enhance flower color.
- Ventilation—Maintain airflow in the retail setting to avoid disease and air pollutant accumulation.
- Substrate Selection and Container Size—Select a mix that provides proper aeration and good water holding capacity. Large containers (greater than packs) will help reduce the frequency of wilting.
- Propagation and Potting Times—Late season production should be kept to a minimum because it may lead to discarding final product due to slower sales, even if plants are looking their best in the retail area.
- Plant Growth Retardants (PGRs)—PGRs will keep plants more compact in the sales area. They also reduce water demand and enhance foliage color with some chemicals.
- Employee Competence and Education—Train employees to handle plants responsibly.

Conclusion

Fertility is just one component of plant production that affects flower and foliage longevity. Cultural factors including production temperature, irrigation, light, substrate, and container size also affect post-production longevity. If these factors are ideal for plant growth then fertilization is not a large issue, but the reality is many retail environments are not perfect. Maintaining proper pH and EC values for specific crops is the best management tool growers can use. Fertilizing at the appropriate growth stage, along with applying the right rate and concentration of nutrients, prolongs the visual quality of plants displayed and will establish retail growers as producers of quality material.