Bedding Plant Nutrient Management

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The first things that come to mind when I hear "nutrient management" are fertiliser rates, pH, and electrical conductivity (EC); however, it is important to consider other things that affect nutrient management decisions. Let's first take a look at what might affect the type of fertiliser chosen.

Water Quality. Water quality is probably the most important factor to consider and alkalinity is the component of water quality that is generally the most influential. Alkalinity is the measure of water's ability to counteract (neutralise) acids. High alkalinity can cause substrate pH levels to rise too high and cause nutrient disorders such as boron and iron deficiency. When you submit a water sample for testing, the alkalinity is generally reported in parts per million (ppm) calcium carbonate ($CaCO_3$).

Alkalinity can be combated by choosing an acidic fertiliser such as 20-10-20 or similar product; however, if alkalinity levels are too high (>200 ppm $CaCO_3$) consider acid injection (the type of acid and rates can be determined from the alkalinity calculator located at www.floricultureinfo.com, follow the links to floriculture software). If producing plugs, the maximum threshold may be even lower (~ 100 ppm $CaCO_3$).

Low alkalinity can also be a factor in nutrient management. When alkalinity values are below 75 ppm $CaCO_3$, substrate acidification can occur rapidly. Acidification causes to the pH to drop too low, which can cause iron and manganese toxicity. Consider using a basic fertiliser such as 13-2-13 or 15-5-15, which tends to increase substrate pH and counteract the acidification. If persistent low pH problems are not easily solved by fertiliser choice, investigate the use of liquid lime or potassium bicarbonate to prevent pH drop. Also, a common practice used is the rotation of an acidic (i.e. 20-10-20) and a basic (13-2-13) fertiliser on a weekly basis. This rotation is also beneficial in providing an extra boost of calcium, which is generally found in basic fertilisers.

Another component of water quality is EC. This is a measure of the total concentration of salts (the good and bad) in the water. Salt concentration is important because too much salt can inhibit plant growth. Correcting high EC irrigation water can be handled by growing more salt tolerant crops, increasing the leaching fraction (more on that later), using periodic “clear” watering, or installing a reverse osmosis system to purify the water.

Micronutrient levels can also cause problems in bedding plant nutrition. Keep in mind that nutrients in your water (be it municipal, surface, or well) can change and adapting a biannual testing system may prevent nutrient problems. Knowing what the micronutrient levels are in the water is important because micronutrient toxicities can be enhanced from a complete fertiliser (which has additional micronutrients) or supplemental micronutrient applications. Many micronutrient supplements contain multiple nutrients; use caution not to create a toxicity of “micronutrient A” when trying to correct a deficiency of “micronutrient B”. Keep in mind that most micronutrient disorders are caused by improper pH. Checking the substrate pH should be the first step when a micronutrient disorder is suspected.

Fertiliser Components. Generally a “complete” fertiliser helps to ensure a quality crop. A complete fertiliser contains the macronutrients: nitrogen, phosphorus, potassium, and others as well as the micronutrients: iron, manganese, copper, boron, and zinc – in short everything nutritionally a plant needs to survive – almost.

I have mentioned the acidic fertiliser 20-10-20. Most acidic fertilisers don’t contain calcium, and plants need calcium to survive. A common problem in greenhouses that have low alkaline water is that calcium deficiency occurs when crops are produced that tend to push up the substrate pH (such as pansy and vinca). Why? Generally, low alkaline water has little calcium; therefore, when an acidic fertiliser is used to combat high pH, plants are not supplied sufficient calcium from the fertiliser or water. This is where using acid injection to keep the pH low and a basic fertiliser with calcium to push up the pH may be preferred.

Other considerations should be made for the nitrate (NO3) to ammoniacal (NH4 or urea) ratio. A good rule of thumb is no more than 30 percent of the nitrogen should come from an ammoniacal source. Excessive ammoniacal-nitrogen can damage roots, cause distorted growth, and inhibit flowering, especially during cloudy and cool conditions.

A low phosphorus fertiliser can help prevent plant stretch and is environmentally friendly. In most situations, we are trying to avoid plant stretch (hence PGRs and HID lighting). Several researchers have noted that less than 10 ppm phosphorus (saturated media extract test) is needed for healthy plant growth. So, if a 20-10-20 fertiliser at 100 ppm nitrogen is used, more than 20 ppm phosphorus is being supplied (remember the amount of phosphorus is the middle number x 0.44), which is much more than a typical bedding plant needs. With this in mind, fertilisers such as 20-20-20 and 15-16-17 are not the most efficient due to the nutrient balance.

But remember when choosing a fertiliser, first consider if it is acidic or basic. A product like 13-2-13 has very good attributes (low ammoniacal-nitrogen and phosphorus) but may not be suitable if you have high alkaline water (unless acid injection is used).

Crops. Most growers in the U.S don’t have the luxury of growing just a few crops. Our markets demand diversity. So how does one go about managing the multitude of nutritional requirements? I suggest grouping crops by pH and EC requirements. Divide crops into high, moderate, and low categories for each pH and EC and make a table (Table 1). This visual tool can help plan production and eliminate some of the guesswork.

The values and crops that I selected for Table 1 are not magical. I used my experience along with information from textbooks and production guidelines provided by the seed and cutting companies. The truth is that you know your production system better than anyone else, so tailor the concept to best fit your needs.

Plant Growth. Besides knowing the target EC and pH values for crops, think about the crop development stage. When plants are young, they need only a small amount of nutrition. The nutrient requirement then increases during the stage of "rapid vegetative growth" and generally decreases once the reproductive stage of growth (flowering) has started (Figure 1). Following a low-high-low fertility regime can prevent disorders, save fertiliser and water, and increase postharvest life. Generally, when a fertility rate or EC is recommended, this is for the rapid vegetative growth stage so consider this while designing a nutrient management strategy.

Irrigation. Irrigation systems should also be a factor when deciding how to manage plant nutrition. It has been suggested to reduce the fertiliser rate approximately 30% if using subirrigation versus overhead. This is because subirrigation does not facilitate the flushing of excess salts that build up in a container. This can also occur with drip-tube irrigation depending upon your substrate and rate/volume of water supplied to the container.

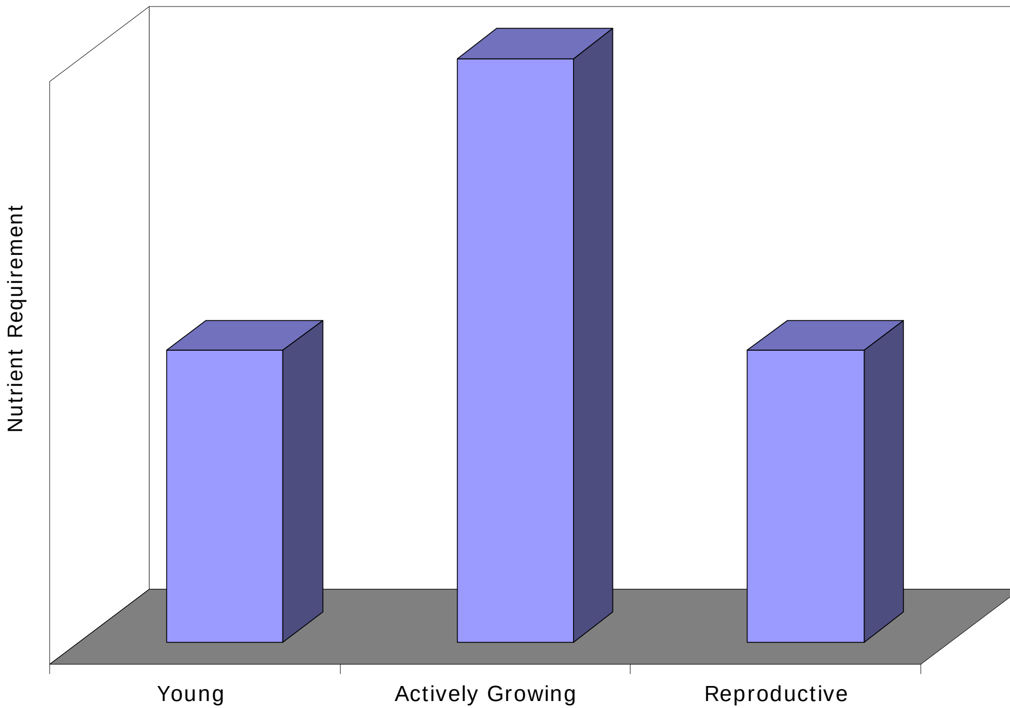
When using drip-tube or overhead watering, monitor the leaching fraction. Leaching fraction is a term used to describe the amount of water that is leached out of the bottom of the container as a percentage of what was added to the top. Generally, a 10 percent to 20 percent leaching-to-input volume is recommended. This amount helps to flush out salts that may have built up in the substrate.

If the leaching fraction exceeds 20 percent, fertiliser and water are likely being wasted. If leaching frequently to keep EC values acceptable, then consider lowering the

	Low pH (5.7 - 6.0)	Moderate pH (6.0 - 6.3)	High pH (6.3 – 6.6)
Low feed	coleus, lantana, pansy, snaps, vinca	ageratum, begonia, celosia, impatiens, New Guinea impatiens	calendula
Moderate feed	evovulus, portulaca, salvia, scaevola	bracteantha, dianthus, heliotrope, verbena	argyranthemum, campanula, geranium, marigold, pepper, sunflower, tomato
Heavy feed	petunia		

Table 1. Divide crops by pH and EC requirements to help categorize them by nutrient requirements and simplify nutrient management.

Fig. 1 Relative nutrient requirements at three growth stages.



fertiliser rate or periodically using clear water. One can lower the fertiliser rate and leaching fraction simultaneously and still produce a healthy crop.

When switching irrigation systems, reevaluate the nutrient management program. Switching to labor-saving methods such as drip-tubes and subirrigation is practical, financially rewarding, and advantageous to the environment. But, keep in mind that different irrigation methods require different nutrient management strategies. If recapturing runoff, remember recaptured water must be monitored carefully for pesticide and PGR contaminants as well as pH and EC values.

Other factors. Container size affects nutrient management. The smaller the container, the more difficult it becomes to manage watering and fertilising. The small substrate volume has a lower buffering capacity and holds less water, so pH, EC, and water contents may fluctuate rapidly.

Controlled release fertilisers (CRF) for bedding plants are generally not economical. However, if profit margins are sufficient, some “value added” large bedding plants (such as 6” pansies or geraniums) may accommodate the added cost and labor associated with CRF applications. If using CRF, remember to reduce the liquid feed concentration so the EC does not get too high.

Testing. There are many dynamics to nutrient management and it is very likely that what works for one situation may not work for another. So, the only way to know what will work for you and your crops is to test nutrient parameters. It is wise to occasionally send tissue and substrate samples to a lab for complete analysis; however, routine on-site pH and EC testing is an easy way to monitor crop performance. Proper pH and EC management (yes, just these two factors) can eliminate approximately 90% of nutritional disorders that occur in floriculture production.