nutrition

Soil Fertility

for Field-grown Cut Flowers

Field-grown cuts can be a great bridge between spring bedding plants and holiday specialty crops, providing much-needed revenue during the slow summer months.

By Douglas Cox

Top: Zinnia and other direct-seeded annuals benefit from a small amount of starter fertilizer at sowing and a larger application of fertilizer when plants are about one foot tall. Bottom: Gladiolus should receive a portion of its fertilizer requirement as the flower spikes develop. (All photos courtesy of Tina Smith)

Growing annual and perennial flowers for cutting during the summer is becoming a popular way for greenhouse operators to bridge the spring bedding plant and holiday potted crop seasons. In many respects, outdoor flower crops, particularly annuals, require similar soil fertility management practices as vegetables and other outdoor field crops.

An effective fertility program begins with fall and early spring soil management practices, but right now, with the 2002 crop already planted, the most important practices involve providing adequate nutrition to the plants as they grow and flower.

The major goals for an outdoor cut flower fertilizer program are to provide adequate levels of nutrients for vegetative growth early in development, promote the development of strong stems and encourage a consistent yield of good flowers throughout the cutting season. In addition to producing a good crop, another important goal is to use fertilizers in a responsible manner to maintain soil health and avoid environmental contamination.

FERTILIZING CUT FLOWERS AFTER PLANTING

Generally, nitrogen fertilizer for cut flowers should be applied on the basis of 1-2 lbs. of actual nitrogen per 1,000 sq. ft. Some large and fast-growing annuals like sunflowers may need more, and a slightly higher rate may be needed on sandy soils or where irrigation or rainfall rates are high. Generally, nitrogen fertilization involves split applications or applications targeted at the main growth period.

Adequate nitrogen is critical for cut flower production. A nitrogen deficiency will result in poor plant growth, a reduction in flower yield and the appearance of foliar chlorosis. Too much nitrogen may result in too much vegetative growth, cause weak stems and delay flowering.

Unfortunately, nitrogen is required in the greatest amount by plants and is easily lost from the soil by leaching or in the form of a gas. For these reasons, nitrogen fertilizer must be applied each year to maintain adequate levels for production. Leaching of nitrogen as nitrate can be a serious problem not only as a way of losing nitrogen for the crop, but also because it can pollute groundwater and surface bodies of water. Too much nitrogen fertilizer, high rainfall or excess irrigation, and sandy soil are all factors favoring nitrate leaching.

Nitrogen fertilization also affects soil pH. Over time, the continuous use of ammonium or urea fertilizers tends to lower pH, and limestone may be required to neutralize the acidity.

FERTILIZATION FOR ANNUALS

Germinating seeds and young seedlings are very sensitive to fertilizer injury, so initial fertilizer applications should be very small. Starter fertilizer should be applied at a rate of about 1/4-1/2 lb. of actual nitrogen per 1,000 sq. ft. at seeding either by broadcasting or banding. Bands should be placed about two inches below and to the sides of the seeds.

For annual species started from seed in the field, fertilizer should be applied after the young plants are well-established, according to the following recommendations for annual transplants.

When transplants from the greenhouse are used to start the crop, about 20-30 percent of the total nitrogen requirement should be applied in a preplant application made just before planting, assuming the transplants are healthy and have been hardened-off. Another 20-30 percent of the total should be applied as a sidedress application when the transplants are about 8-10 inches tall.

Sometimes, one application of fertilizer at planting can grow a good crop of annual cuts. However, split applications of nitrogen fertilizer are more efficient in fields receiving heavy irrigation or rainfall or that have sandy, well-drained soil. Split application provides a more consistent supply of nutrients than one large application made at planting and comes closer to meeting the actual needs of annuals as they develop.

Table 1. Approximate amount of limestone needed to change soil pH.

	Pounds of limestone per acre by soil type (1 acre = 43,560 sq. ft.)				
Change in pH desired at 6-8" depth	**Sand**	**Sandy loam**	**Loam**	**Silt loam**	**Clay loam**
4.0 to 6.5	2,600	5,000	7,000	8,400	10,000
4.5 to 6.5	2,200	4,200	5,800	7,000	8,400
5.0 to 6.5	1,800	3,400	4,600	5,600	6,600
5.5 to 6.5	1,200	2,600	3,400	4,000	4,600
6.0 to 6.5	600	1,400	1,800	2,200	2,400

FERTILIZATION FOR PERENNIALS

After flowering or harvest, most perennials continue to grow, building the root system and expanding the crown or other overwintering structures. So some perennials may benefit from a second fertilizer application after flowering. About 1-2 lbs. of actual nitrogen per 1,000 sq. ft. is required by peony. One-half should be applied at emergence, one-fourth just after flowering and one-fourth at dormancy. Asiatic and Oriental lilies grown as perennials should be fertilized by sidedressing with 2-3 lbs. of 10 percent nitrogen fertilizer per 100 ft. row as the shoots begin to emerge from the soil and again at the same rate right after flowering. Late-season fertilizer applications to perennials are somewhat controversial. Some feel that fertilizing in the fall may disrupt the plants' normal preparations for dormancy and make them susceptible to cold injury, while others think there is a benefit to the roots and crowns. I recommend using caution and avoiding high nitrogen applications; however, applying phosphorus may be beneficial to root and crown development. Also, it would be safe to apply limestone if it is needed to adjust pH.

What about phosphorus and potassium? Just like in the greenhouse, complete nitrogen / phosphorus / potassium (NPK) fertilizers are applied to outdoor cut flowers according to the nitrogen requirement. Ideally, however, phosphorus and potassium should only be applied if their need is indicated by a soil test. So rather than using 10-10-10, a grower could use single element carriers such as ammonium nitrate, preplant superphosphate and potassium chloride to fulfill the exact needs according to a soil test.

The effects of phosphorus on cut flower production are less obvious than those of nitrogen. A phosphorus deficiency may result in smaller plants and shorter flowering stems, but foliar symptoms may not be apparent.

Less phosphorus than nitrogen is needed by plants, and phosphorus is more stable in the soil than nitrogen. Some agricultural soils test "very high" or "excess" in phosphorus because of the regular use of NPK fertilizers over many years. Generally, the potential harm caused by high phosphorus is not to the plants but to the environment. Too much phosphorus can lead to runoff to surface bodies of water. This encourages excess growth of algae and other aquatic plants, which leads to a serious decline in water quality. Ideally, nutrients should be applied based on need as determined by a soil test. Unlike nitrogen, an application of phosphorus may not be needed every year.

Superphosphate is a soluble phosphorus fertilizer and is best used to correct a low-phosphorus condition before planting. Rock phosphate is very insoluble and is best used for the long-term maintenance of phosphorus in the soil.

Potassium deficiency causes marginal chlorosis and burning on the lower leaves first. Unless the deficiency is severe, it may not affect the leaves on the ➧

Cultivation for weed control is important because weeds compete with cut flowers for nutrients, water and light.

harvested stems, but it could reduce overall yield. Potassium deficiency is most likely to occur on sandy soils low in clay and organic matter.

It may not be necessary to apply potassium fertilizer to some clay soils and soils high in organic matter every year. There is no harm to the environment from excess potassium and no direct harm of high potassium to most plants. However, too much potassium can depress the uptake of calcium and magnesium, sometimes to the point that deficiencies of these elements develop.

COVER CROPS AND ORGANIC FERTILIZERS

Once a cut flower crop has been harvested, there may be some growing time left in the late summer and early fall in regions having cold winters. Rather than leaving the soil fallow, this would be a good time to grow a cover crop. Cover crops absorb residual nutrients left in the soil, add organic matter, may add nitrogen to the soil and may help protect the soil from erosion over the winter. In New England, winter rye, oats and hairy vetch are popular cover crops; however, different species may be recommended in other parts of the United States. Hairy vetch is a legume cover crop that fixes nitrogen from the atmosphere and may add as much as 100 lb. of nitrogen per acre when planted in August and plowed down in the spring.

Mulching with black plastic or a thick layer of organic mulch controls weeds, conserves water and reduces the movement of nutrients out of the root zone.

There are many “organic” alternatives to chemical fertilizers that can be used to fertilize outdoor cut flowers. Composts, animal manure, dried blood, bone meal, rock phosphate and seaweed products can all be used successfully, keeping in mind that most of these have much lower nutrient analyses and lower solubility than commercial fertilizers. With an organic fertilizer, a much larger weight of material must be applied to supply the same amount of nutrients compared to a chemical fertilizer. For example, to supply 2 lbs. per 1,000 sq. ft. of actual nitrogen using horse manure (0.6-0.3-0.5) 333 lbs. would be needed versus 20 lbs. of 10-10-10. In theory, assuming that all the nitrogen in the manure is soluble, plant response to nitrogen from both materials should be about the same.

A successful organic fertilization program for outdoor cut flowers requires a multi-pronged approach to maintain fertility and organic matter. The program should include cover crops for the times when the soil is fallow; materials to build fertility and/or organic matter in the long-term such as rock phosphate, bone meal, composts, limestone and manure; and more soluble fertilizers like dried blood (12-1.5-0.5) to meet the immediate needs of the crop.

TRICKLE IRRIGATION

A trickle irrigation system can be used to efficiently provide water and nutrients through injection to annual or perennial cut flowers. Depending on the size of the field and the type of injection equipment in use, cut flowers are fertilized either on the basis of pounds nitrogen per acre (large fields) or ppm nitrogen (small fields). Using a trickle system and a conventional greenhouse injector, 20 percent nitrogen water-soluble fertilizer (e.g., 20-10-20 or 20-20-20) can be applied at either 300-400 ppm nitrogen weekly or 150-200 ppm nitrogen at every watering (constant liquid feed). In the absence of a trickle system, these rates could be applied on a small scale through a hose using a simple injector like a “Hozon.” Avoid fertilizers that contain calcium or sulfate because these could clog emitters or other parts of the system.

SOIL TESTING

An annual soil test for pH and nutrient levels should be made in either the fall or spring. Since phosphorus, potassium, calcium and magnesium are fairly stable in the soil, a fall test gives a good reading on the status of these elements for the following spring. If needed, limestone or rock phosphate can be applied in the fall, giving these materials a head start on reacting with the soil before spring. Since the status of nitrogen is very changeable, a spring test or one right before a planned fertilizer application or planting is best.

Soil should be collected from about 10 randomly selected spots in the cut flower field and from a depth of about 6-8 inches. The 10 subsamples should be mixed together into one sample to send to a lab.


A well-maintained bed of celosia ready for harvest.

LIME REQUIREMENT

Checking pH and adjusting it by liming is an important practice in many parts of the United States. For most cut flowers, a pH range of 5.5-7.0 is best, but some species may have particular optimum pH levels for best performance. A soil's pH affects the availability of trace elements and the activity of many beneficial soil microrganisms. Phosphorus availability is highest between pH 6 and 7, so liming an acid soil may help free some plant-available phosphorus.

In addition to raising the pH of acid soils, limestone serves as fertilizer for calcium and magnesium. As a soil becomes acid, it also supplies less and less calcium and magnesium. Use finely ground dolomitic limestone or calcitic limestone containing 5-10 percent magnesium to get both elements.

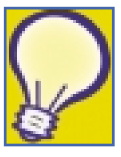
When the pH is not in the desired range, a lime requirement test can be run to determine how much lime is needed. In some cases, pH may be too high, and an acidifying material like elemental sulfur may be required. Lime requirement tests take into account the soil texture — sandy soils need much less limestone to cause a pH change than soils high in clay or organic matter. Table 1 on page 24 gives a rough estimate of the amount of lime needed based on the desired pH change and the texture of the soil.

PREPARING THE SOIL FOR NEXT YEAR

Some fertilizer materials are best incorporated prior to planting. These would include limestone and superphosphate (fall or spring), a starter fertilizer (spring) and any compost or other organic material that must decompose to release nutrients.

Superphosphate should not be applied if the soil tests "high" or "very high" for phosphorus. Generally, limestone and preplant fertilizers are broadcast on the soil surface and then worked into the top 6-8 inches of the soil by disking or rototilling. Banding phosphorus or starter fertilizers close to the rows may be preferable to broadcasting when the soil fertility is low. Banding puts the fertilizer close to the root systems of the plants as they begin to grow. GPN

Douglas Cox is an associate professor in the department of Plant and Soil Sciences at University of Massachusetts, Amherst, Mass. He can be reached by phone at (413) 545-5214 or E-mail at dcox@pssci.umass.edu.



LearnMore!
For more information related to this article, go to www.onhort.com/LM.CFM/gp080203