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Ornamental Pepper Production
Avoiding Top Poinsettia Problems

Maximizing Fertilizer Use and Minimizing Runoff

Even if you're a small grower with a limited budget, the Integrated Fertilizer and Irrigation Management system can help you decrease runoff while improving plant quality.

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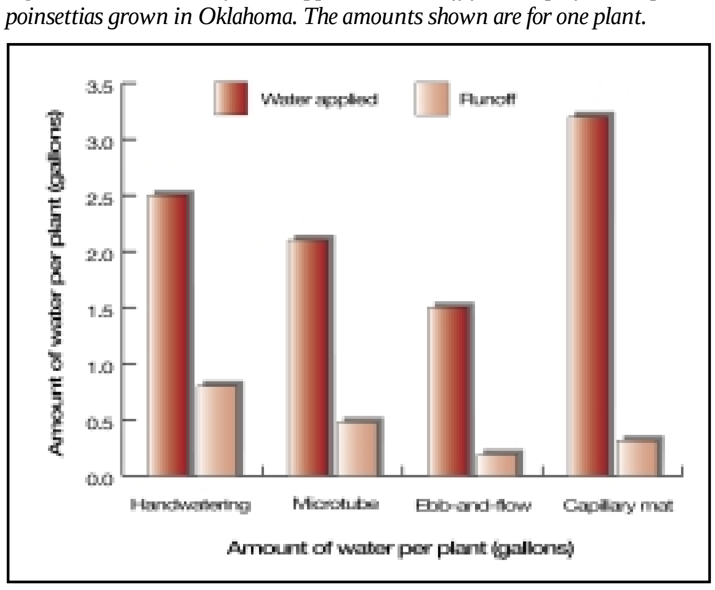
Controlling fertilizer and water use and runoff is a necessity for some businesses due to their proximity to environmentally sensitive natural areas or water sources. Reducing water and fertilizer use for many businesses, however, is becoming increasingly important to control expenses. Research at North Carolina State University and Oklahoma State University is shedding new light on how to manage fertilizer and water use.

The Integrated Fertilizer and Irrigation Management (IFIM) system is a comprehensive approach to runoff control from container plant production. IFIM is similar to IPM, the integrated pest management system already being used by the nursery and greenhouse industries. Through the use of IFIM, runoff from container nurseries and greenhouses can be eliminated while maintaining or improving plant quality. IFIM recommendations have been arranged in levels of increasing sophistication of water and nutrition management and runoff control. In addition, higher-level practices will often require more experience in growing practices or increasing cost. The following is a list of actions you can take to control fertilizer and water use and runoff.

LEVEL I

Secure the highest-quality water source possible. The most important consideration in setting up an irrigation plan is water quality. Water should be tested prior to selecting a site for a new business and periodically, over time and different locations, after the business is established because the quality can change seasonally. Electrical conductivity (EC), a measure of the soluble salt level or salinity of water, is one of the most important factors. Water with a low EC — 0.1 to 0.5 dS / m — will give the grower the greatest number of irrigation options and will reduce future problems caused by high-soluble salts accumulating in the medium. Plant species vary in their tolerance to soluble salt levels, which can stunt plant growth and cause marginal leaf burn. High salt levels frequently can be managed by leaching, which, unfortunately, increases water use.

Figure 1. The amount of water applied and runoff for a crop of 6-inch potted poinsettias grown in Oklahoma. The amounts shown are for one plant.



Using ebb-and-flow irrigation, these 6-inch potted geraniums were grown using either 260 ppm nitrogen from 20-10-20 (CLF), 5.3 grams/pot Osmocote 14-14-14 plus 130 ppm nitrogen from 20-10-20 (CRF and CLF) or 11.7 grams/pot Osmocote 14-14-14 (CRF). While plant growth was similar, the plants grown with the controlled-release fertilizer lost only 1.7 percent of nitrogen applied through runoff. The plants fertiligated with 260 ppm nitrogen lost 34 percent of nitrogen through runoff.

Alkalinity should be between 40 and 100 ppm, and pH should be 6.0-8.5. Typically, water pH determines if the media pH will change after potting, while water alkalinity determines how quickly the media pH will change. At an excessively high or low pH, some plant nutrients will be unavailable for the roots to absorb. For growers who use basic fertilizers, such as calcium and potassium nitrate, water pH and alkalinity should be at the low end of the recommended range to prevent media pH from climbing during production. Growers who use acidic fertilizers, especially in the southeast, can readily use water with pH and alkalinity at the center or upper end of the recommended range.

Finally, the nutrient content of the water should be checked. While low levels of some nutrients can be beneficial, high levels of one or more nutrients may indicate that the nutrition program should be adjusted. If the water has high levels of nitrogen, calcium or magnesium, less of these nutrients can be added as fertilizers. High nitrogen levels can be especially prevalent in areas with sandy soil, shallow wells or intensive agriculture. Unfortunately, high levels of calcium, magnesium and iron can be antagonistic to other nutrients such as manganese or boron and reduce their uptake. Also, very high boron levels, greater than 1 ppm, can be toxic.

Use media with a high water- and nutrient-holding capacity. Using a media that retains the maximum amount of water, yet retains sufficient aeration, will reduce the frequency of irrigation required. Commercial premixed media vary in water-holding capacity. For self-mixed media, the percentage of peat moss can either be increased, or a water-absorbent material can be incorporated. Remember, increasing the time needed between irrigations will also help customers better maintain the plants in the retail environment or in the home. Note that too much water retention may reduce aeration and increase the likelihood of root rot.

Fertilize at or below recommended rates. Relative to other costs, such as labor, fertilizer is inexpensive. However, in highly competitive markets, every penny may be necessary to obtain a profit. Plants are often fertilized at unnecessarily high levels as insurance against substandard growth. Lower rates may be used in many cases. For example, if several crops are being grown with only one injector, use constant liquid fertilization rates set for the lowest-nutrient-requiring species, and supplement those species requiring higher rates with controlled-release fertilizers. In addition, many bedding plant species may grow too tall if given high fertilizer rates. Excessive fertilizer rates can also cause foliar damage, increased susceptibility to root rot and stunting.

Growers should vigilantly monitor the nutritional status of their crops. The natural variations in weather, irrigation frequency, leaching, water quality, media nutrient content and plant growth will combine to make each crop unique. The simplest monitoring method is to visually assess the crop. This is best done by an experienced grower. Visual monitoring is not, however, effective by itself in the long term. By the time symptoms are noted, damage has already occurred to the crop, resulting in reduced quality and decreased sales. The best monitoring method is to track media pH and EC levels using pH and EC meters. A variety of pH and EC meters are available from greenhouse supply firms.

Reduce water and nutrition at the end of the crop cycle. This will "harden" plants and increase post-harvest life. For many potted flowering plants, such as poinsettias, fertilization should be reduced or terminated 1-3 weeks prior to sale. For bedding plants, such as petunia, marigold and ageratum, the fertilizer rate should probably be reduced by one-half at visible bud. Completely eliminating fertilizer applications is not advisable for bedding plants because the small amount of media provides little reservoir for the plants. Also, bedding plants often dry out rapidly in retail areas and are watered frequently, leading to much nutrient leaching.

Use mechanized irrigation systems. Systems such as drip or micro-tube deliver water directly to the ➧

plants and eliminate runoff between them. Research at Oklahoma State University showed that in poinsettia production, 32 percent of water applied using handwatering was lost as runoff compared with only 23 percent for microtube (drip) irrigation (see Figure 1, page 36) Over two years of poinsettia production, hand-irrigated plants required 2.5 to 5.3 gallons per plant while microtube irrigation required 2.1 to 4.8 gallons per plant, respectively. In-line drippers should provide similar water savings. Other irrigation systems, such as ebb-and-flow, are even more water- and nutrient-efficient and are included under level II.

Grow cultivars or species that require the least water and nutrients. This recommendation is easy to suggest but hard to practice, as customers dictate most of the species and cultivars grown. However, floriculture crop species vary greatly in their water and fertilizer requirements, and high water- and fertilizer-requiring crops may be avoided in some cases. For example, chrysanthemums require much water and fertilizer, while Easter lilies have lower requirements.

Shade greenhouses promptly. Reducing the light intensity in the warmest part of the year will decrease temperature and irrigation needs. Delaying installation of shading will increase water demand and irrigation needs in the spring. There are two common ways to reduce the light intensity in a greenhouse: shade cloths and shading compounds. External shading is more effective than internal shading because in the latter case, the light has already entered the greenhouse and is absorbed by the screen, raising the internal greenhouse temperature. However, internal shading can be automated and allows growers to regulate light levels by opening the shade cloth during cloudy days and closing it during sunny days.

Another type of shade cloth is made of spun fiber, such as Remay or Vispore, which are white and lightweight. Spun fiber cloths are not strong enough to be used externally and are often used to cover specific benches. The cloth is so lightweight that it can be laid directly on the plants for a temporary light screen, such as immediately after transplanting cuttings or after cutting back plants.

Shading compounds can also be used to reduce light intensity. The white-colored compounds can be applied to the outside of the glazing in one heavy layer or 2-3 thin layers.

Repair leaking hoses and water lines promptly. Leaking lines can waste large amounts of water and fertilizer if connected to the injector. Conduct regular maintenance checks to detect and repair leaks. Look for wet areas on the greenhouse floor that might indicate leaking pipes underground.

Use water shut-offs on all hoses. This straightforward recommendation can save a lot of water, especially in retail operations where irrigation may be interrupted frequently by customers.

Optimize plant production. Improper production practices may slow plant growth, delay harvest and increase total water and nutrients applied. Delayed production typically adds to production expenses and should be avoided. Optimize production temperatures and other practices to ensure that the highest-quality crops are produced in the shortest period of time. In particular, growing crops at lower-than-optimum temperatures can greatly increase the production time of some species and may be more costly in the end than using extra heat to get a shorter crop time.

LEVEL II

Reduce or eliminate leachate. Leaching is frequently used to prevent the build-up of soluble salts in the media and to ensure that all plants are well-watered. Leachate can be readily reduced by not irrigating too long. Train and retrain employees regularly on how to properly irrigate. Plants can be grown with no leaching, but high-quality water, low fertilizer rates and an experienced grower are required. Using a no-leach production system on hanging baskets also eliminates water dripping on crops below the baskets. For no-leach production, low constant liquid fertilizer rates or controlled-release fertilizers are used to prevent excessively high media EC.

Use fertilizers that release low levels of nutrients in the runoff. Typically, a greater percentage of the nutrients in controlled-release fertilizers are absorbed by the plants and not lost as leachate. The nutrient efficiency (retention) of greenhouse irrigation systems was increased if 50 or 100 percent of fertilizer was supplied by controlled-release fertilizers as compared with 100 percent constant liquid fertilization. Fertilizing with 100 percent constant liquid fertilizer caused higher concentrations of nutrients to be released to the environment with no increase in growth or quality (pictured on page 36). The nutrient retention of controlled-release fertilizers was greatly increased with the use of ebb-and-flow irrigation, which produced large, high-quality plants and released small volumes of runoff with low nutrient content.

Reuse water and nutrients. In work with potted poinsettias, ebb-and-flow systems produced only 12 percent runoff compared to 32 percent for hand-watering and 23 percent for drip irrigation (see Figure 1, page 36). Overall, poinsettias grown with ebb-and-flow irrigation also required only two-thirds the water of hand irrigation and only three-fourths the water of microtube irrigation. Not surprisingly, recirculatory ebb-and-flow irrigation had the highest water-use efficiency; recirculatory subirrigation systems produce the greatest amount of plant material per gallon of water compared with hand watering, drip irrigation and capillary mats (see Figure 2 below).

Use high-humidity chambers to reduce water used during propagation. Tents and propagation chambers have become popular for seed germination and cutting rooting. High-humidity tents are generally preferable to misting systems because tenting eliminates over-misting, algae growth on floors and concerns over malfunctions, and it ensures a uniform propagation environment. High-humidity tents also reduce leaching of nutrients from the leaves, free moisture on the foliage and disease incidence compared to misting. Tenting eliminates the need for a mist or fog system, which can make direct propagation in the final container more feasible.

The major drawbacks of tent propagation are the additional labor ➧

Figure 2. The amount of plant material produced with each gallon of water applied and each gallon of runoff.