Irrigation With A Twist

Subirrigation systems help growers save water, fertilizer, and labor, while producing more uniform crops than other irrigation methods.

Subirrigation affects growing conditions differently than more traditional irrigation systems.

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LITTLE doubt exists that water management in the new millennium greenhouse will incorporate automated irrigation systems that minimize or eliminate fertilizer and pesticide runoff. Water is becoming an increasingly precious commodity. The public and lawmakers are becoming more vocal in expressing their concerns about limited water resources and possible contamination of existing water sources. The water amount used and the fertilizer amount allowed in runoff from greenhouses is under increasing scrutiny and is already regulated in some parts of the country.

The floriculture industry will have to show it is concerned about these issues and use water as efficiently as possible, while minimizing runoff. Zero runoff can be achieved by implementing closed subirrigation systems, such as ebb-and-flow. In addition to environmental benefits, zero-runoff systems save labor, water, and fertilizer, while producing more uniform crops than overhead or drip irrigation.

Nutrition Guidelines

Subirrigation affects the growing conditions differently than more traditional irrigation systems. Because excess nutrients are not removed by leaching, the electrical conductivity (EC, a measure of the amount of salts in the growing medium) of the growing medium of subirrigated plants often increases during production. Therefore, fertilizer guidelines developed for overhead irrigation systems cannot be used for subirrigation. Besides fertilizer rate, the type of growing medium is another factor that can affect growth of subirrigated plants. Since coconut coir has been considered as a possible replacement for peat in soilless media, we wanted to determine its suitability for use in subirrigation systems.

As more growers incorporate zero-runoff irrigation systems in their greenhouses, there is a need for better production guidelines. Since bedding plants are the mainstay of the floriculture industry, we chose to develop grower-friendly guidelines for two important bedding plant crops – petunias and begonias. This includes optimal fertilizer rates, type of soilless medium, and optimal ranges for the leachate EC and pH of the growing medium.

Media And Methods

We grew petunia 'Dreams Mix' and begonia 'Ambassador Scarlet' in three soilless media — Metro-Mix 220, MetroMix

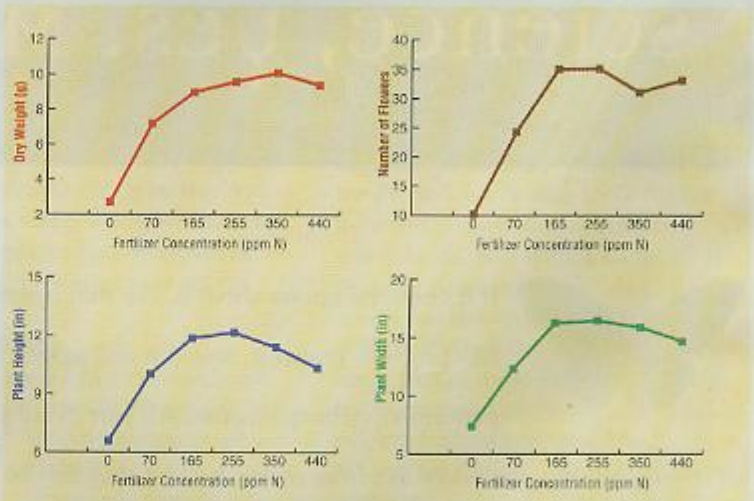

Figure 1. Nitrogen concentration of the fertilizer affects the dry weight, height, width, and number of flowers of petunias after five weeks of growth. Petunias generally preferred higher nitrogen concentrations than begonias. Note that these data were collected after five weeks of growth. The plants had reached a saleable size after only three weeks.

366 ScottsCoir, and MetroMix 500. The three growing media differ in their water-holding capacity (MetroMix 200 holds the most water and MetroMix 500 the least). Another important difference is that MetroMix 366 ScottsCoir contains coconut coir instead of peat. All plants were grown in 4-inch pots, placed on ebb-and-flow benches, and fertigated with 20-10-20 fertilizer solutions with 0, 70, 165, 255, 350, or 440 ppm N (60% nitrate and 40% ammonium). Plants were irrigated as needed, ranging from twice a week at the beginning to daily at the end of the experiment. Periodically, we measured leachate EC and pH using the pour-thru method, by pouring about five fluid ounces (fl. oz.) oz of water on the surface of the growing medium and collecting the first 2.5 fl. oz. of leachate.

We used the aboveground plant parts (shoots) to measure the effects of fertilizer and growing medium on plant growth. One of the most accurate indicators of plant growth is dry weight, which is measured by weighing plants after drying them in an oven. Shoot dry weight tells us how much "substance" or mass (cell components, cell walls, etc.) the plant has accumulated and how it is affected by the treatments. We also measured indicators of plant appearance, such as weight, height, width, and number of flowers (see Figure 1, page 30). At regular intervals throughout the experiment, we recorded all of the above factors. Although begonias and petunias reached a saleable size after five and three weeks, respectively, we collected measurements for two more weeks to see the long-term treatment effects.

Fertilizer Rates

Begonias grew best when fertilized with 165 or 255 ppm N. A nitrogen concentration of 70 ppm resulted in tall plants with a relatively low dry weight, indicating that the plants were leggy. Using more than 255 ppm N decreased the width and flowering of the begonias. Petunias, a faster growing crop, preferred higher nitrogen concentrations than begonias. The plants grew fastest with 255 to 350 ppm N, but plant growth and quality was affected little by nitrogen concentrations ranging from 165 to 440 ppm. At lower nitrogen levels, growth and width of petunias were reduced. Based on our results, we recommend nitrogen concentrations of 150 to 250 ppm N for begonias and 200 to 350 ppm N for petunias. The lower part of these ranges is preferred because the possibility of fertilizer burn is reduced.

Fertilizer guidelines for subirrigated plants commonly call for using half the fertilizer concentration used with overhead irrigation with leaching. Our results show that these guidelines will not result in optimal plant growth. Although excess fertilizer does not get leached out of the containers when subirrigation is used, it tends to end up out of harm's way nonetheless. In subirrigation, excess fertilizer salts accumulate in the top half-inch of the growing medium. Subirrigated plants normally have few if any roots in this part of the container and the salt buildup does not affect the plants.

EC and pH Ranges

Our research on subirrigated begonias, geraniums, and petunias has shown that growing medium EC is a much better measure than fertilizer concentration to determine whether fertilizer applications are adequate. Growing medium EC is a measure of the amount of fertilizer and other salts in the growing medium. We measured growing medium EC with the pour-thru method and found that plant growth was not very sensitive to EC. Begonia growth was reduced when the EC was lower than 1.5 or higher than 4 mS/cm. Petunias grew best when the EC was within 2.3 to 5.2 mS/cm. However, subsequent research has shown that both species grow best when the EC is kept in the lower part of these ranges. Therefore, we recommend an EC of 1.5 to 2.5 mS/cm for begonias and 2 to 3 mS/cm for petunias. Both species can withstand higher EC (up to 5.5 mS/cm) for brief periods without much effect on the plants. But if the EC becomes higher than recommended, the fertilizer concentration should

be reduced to minimize salt buildup in the growing medium.

The EC of the growing medium is affected not only by the fertilizer concentration, but also by the quality of the irrigation water. The water in our greenhouse has very few salts in it and has an EC of only 0.15 mS/cm. If your irrigation water has a higher EC (measure it before adding any fertilizer!), the recommended growing medium EC will have to be adjusted accordingly. For example, if your irrigation water has an EC of 0.95 mS/cm, the recommended growing medium EC for begonias is 2.3 to 3.3 mS/cm.

Growing medium pH ranged from 5.1 to 6.8 for petunias and 4.6 to 7.0 for begonias. pH decreased during the growing period and was lower with high fertilizer concentrations. This is normal with an acidic fertilizer like 20-10-20 and irrigation water that is low in bicarbonates. The recommended pH range to prevent micronutrient deficiencies is 5.5 to 6.5. Although leachate pH in some of the treatments became lower than recommended, this had no obvious negative effect on the plants and there were no micronutrient deficiencies or toxicities.

Growing Medium Type

The type of growing medium had little effect on plant growth or quality. Petunias grown in MetroMix 220 were slightly taller than those grown in MetroMix 366 ScottsCoir or MetroMix 500, which may be related to the greater water-holding capacity of MetroMix 220. In some cases, growing medium also affected the width of the plants, but these effects were not consistent throughout the experiment. In general, growing medium had much less effect on the plants than the fertilizer concentration.

However, the different growing media affected growing medium EC. The EC of MetroMix 220 was higher than that of MetroMix 366 ScottsCoir or MetroMix 500 (Figure 2). This emphasizes the importance of monitoring the EC of the growing medium

and suggests that plants grown in MetroMix 220 can be fertilized with lower concentrations of nitrogen than plants grown in MetroMix 366 ScottsCoir or MetroMix 500.

Conclusions

High-quality, subirrigated petunias and begonias can be grown with a range of fertilizer concentrations and in different growing media. Fastest growth occurs when begonias and petunias are grown with 240 and 400 ppm N, respectively. But instead of managing a fertilizer program by applying constant fertilizer concentrations, it is better to measure the growing medium EC on a weekly basis and to make sure that the EC stays within the optimal range (1.5 to 2.5 mS/cm for begonias and 2 to 3 mS/cm for petunias, when using water with a low EC). A growing medium pH between 5.5 to 6.5 will assure adequate availability of micronutrients. **GG**

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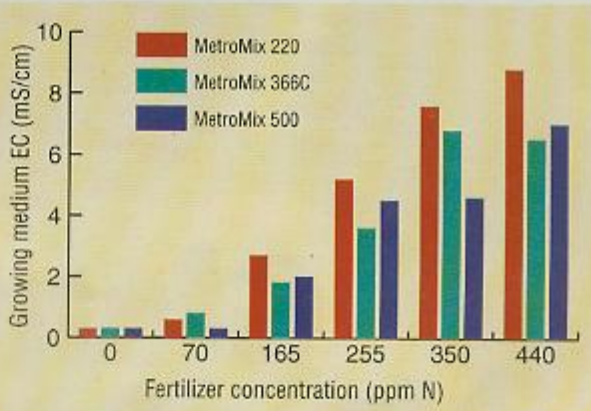

Figure 2: Fertilizer concentration and composition of the growing medium affect the EC of the growing medium. Growing medium EC increases rapidly when the fertilizer concentration increases, while MetroMix 200 has a higher EC than the other two media. Data were collected after growing begonias for five weeks.

Recommendations for growing medium EC and pH ranges for begonias and petunias grown in subirrigated systems

Growing Medium EC	Begonias	Petunias
PourThru (mS/cm)	1.5–2.5	2.0–3.0
Saturated Medium Extract (mS/cm)	0.9–1.5	1.2–1.8
Growing Medium pH	5.6–6.5	5.6–6.5