FERTILIZER for subirrig

THE WATER USED AND THE FERTILIZER ALLOWED IN RUNOFF FROM GREENHOUSES IS ALREADY REGULATED IN SOME PARTS OF THE COUNTRY. NO DOUBT WATER MANAGEMENT IN THE NEW-MILLENNIUM GREENHOUSE WILL INCORPORATE AUTOMATED IRRIGATION SYSTEMS THAT MINIMIZE OR ELIMINATE FERTILIZER AND PESTICIDE RUNOFF.

Closed subirrigation systems, such as ebb-and-flow benches, can provide zero runoff, labor, water and fertilizer savings and production of more uniform crops than other irrigation systems.

Zero runoff can be achieved by using closed subirrigation systems, such as ebb-and-flow. But this is not the only benefit from using these closed systems. Growers who have been using these systems realize additional benefits: labor, water and fertilizer savings and production of more uniform crops than with overhead or drip irrigation systems.

With a subirrigation system, benches, troughs or greenhouse floors are flooded with a fertilizer solution pumped from a holding tank. The solution is taken up by the growing medium through a wicking action. After 15 to 20 minutes, the remaining fertilizer solution on the bench or floor is drained back into the holding tank, where it is stored until the next fertigation (usually the next day). There is no runoff with this irrigation system.

Changes in growing conditions

Subirrigation affects growing conditions differently than traditional irrigation systems. Because excess nutrients are not removed by leaching the growing medium, the electrical conductivity (EC) of the medium (the measure of salts in the medium) can increase. Since excess fertilizer is not leached from the growing medium, the medium EC for subirrigated plants often increases during production. Therefore, fertilizer guidelines developed for overhead irrigation systems don't apply for subirrigation.

Changes in fertilizer rates

As a result of the differences in subirrigation and overhead or drip irrigation, nutrition guidelines for these systems are also different. Research at the University of Georgia has shown that instead of using the conventional parts per million rate of nitrogen in a fertilizer solution, growers need to maintain a growing medium EC in a specific range. This can be done by regularly performing a leachate analysis throughout the growing cycle of a crop and monitoring EC of the leachate solution. Our previous research with subirrigated bedding plants

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showed the growing medium EC is a much better measure than fertilizer concentration to determine whether fertilizer applications are adequate.

PourThru determines EC

Growers need not be concerned that use of subirrigation systems will require sending a lot of soil samples to testing labs to determine EC levels. The PourThru testing method enables growers to quickly and accurately determine the medium EC in house. This technique is simple, non-destructive and fast.

The PourThru method requires pouring a specific volume of distilled water (2.5 ounces per 4-, 5- and 6-inch pot and 3.5 ounces per 6½-inch pot) over the growing medium. The first 2 ounces of leachate is collected and the salt level is determined with an EC meter. (For more details on the PourThru method, see **GM***PRO* March 2000, Page 28, or the North Carolina State University, Department of Horticultural Science Web site, http://www.ces.ncsu.edu/depts/hort/floriculture/.)

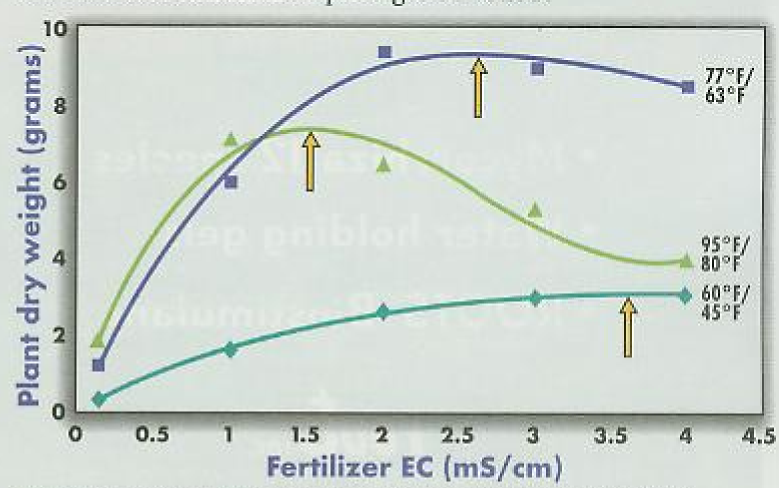
Determining optimal fertilizer rates

We set out to determine if optimal fertilizer concentrations depend on water use and therefore on environmental conditions in which plants are produced. Plants use more water and take up more nutrients when grown at high temperatures than at low temperatures. We wanted to know if fertilizer rates should be adjusted according to the water to nutrients' usage ratio, and if different fertilizer concentrations should be applied under different environmental conditions.

'Dreams Red' petunias were grown in 4-inch square pots filled with a soilless medium for 9½ weeks. The initial medium EC was 2.1 mS/cm measured with the saturated media extract method. Plants were separated and placed in three rooms with different temperature settings. The first room simulated early spring growing conditions (60°F days, 45°F nights), the second room was maintained at 77°F days, 63°F nights and the last room simulated late spring/early summer growing condition at 95°F days, 80°F nights. All plants were subirrigated with one of five fertilizer solutions made from a 20-10-20 fertilizer. The EC levels were 0.15 (no fertilizer), 1, 2, 3 and 4 mS/cm, which correspond to 0, 135, 290, 440 and 590 ppm of nitrogen, respectively.

Because of differences in the amount of water lost through transpiration at different temperatures, plants grown at higher temperatures were watered (and fertilized) more often than those grown at lower temperatures. Leachate EC and pH were measured at regular intervals using the PourThru method.

Plant shoots were used to measure effects of fertilizer concentration on plant growth. Shoot



Fertilizer concentrations affect plant growth differently at different temperatures. Experiment results show that optimal fertilizer concentration (indicated by arrows) is lower at higher temperatures.

dry weight can tell how much mass (cell components, cell walls, etc.) a plant has accumulated and the impact of treatments. Number of flowers and flower size were used as indicators of plant appearance.

Impact on plant growth

Petunias in the coldest growing room (60°F days, 45°F nights) accumulated the most dry weight when fertilizer EC was 3.5 mS/cm. In the second room (77°F days, 63°F nights) plants grew best with a fertilizer EC of 2.6 mS/cm. Petunias in the warmest room (95°F days, 80°F nights) accumulated the most dry weight with a fertilizer EC of 1.6 mS/cm.

Maximum growth rate correlated more with the medium EC than with fertilizer EC. The largest plants were produced with a final medium EC of 3 to 4 mS/cm, regardless of the temperature. However, throughout most of the growing period, growing medium EC was lower than this (2 to 3 mS/cm).

At the low end of the growing medium EC range (below 2 mS/cm), plant growth was slow, probably because of insufficient nutrients. At the high end of the growing medium EC range (above 4 mS/cm), plant growth also was slow, probably because of too much nutrients causing salt stress.

Impact on flowering

At the highest temperatures (95°F days, 80°F nights), petunias flowered earliest but had smaller flowers. At these high temperatures, flower size decreased with increasing growing medium EC. This was not the case at lower temperatures, where the EC had no effect on flower size. Even though petunias flowered earliest at the higher temperatures, at the end of the study plants grown at 77°F days and 63°F nights produced the most open flowers.

Impact on medium EC

Our measurements showed that growing medium EC increased as fertilizer solution EC and temperature increased. We recommend that subirrigated plants be grown with more dilute fertilizer solutions at higher temperatures because of the interactive effect of fertilizer concentration and temperature on medium EC.

Other environmental conditions may affect optimal fertilizer concentrations as well (see Impact of environmental conditions, Page xx). It is important to realize that medium EC is affected not only by fertilizer concentration, but also by quality of irrigation water.

The water in our greenhouse has very few salts in it and has an EC of 0.15 mS/cm. If your irrigation water has a higher EC (measure it before adding any fertilizer), be sure to add

Impact of environmental conditions

Our research showed that plants grow better with lower fertilizer concentrations at higher temperatures. Other environmental factors may affect optimal fertilizer concentrations as well. It all depends on how they affect water use and growth of plants.

When plants use a lot of water but grow slowly, they benefit from lower fertilizer concentrations than when plants grow fast, but use fairly little water. Here is how different environmental conditions affect optimal fertilizer concentrations.

Light level. Both the growth and water use of plants increase with increasing light levels. These effects tend to cancel each other out and optimal fertilizer concentrations are probably not affected much.

Temperature. Because plants use more water at higher temperatures, plants will benefit from more dilute fertilizer rates under warmer conditions.

Humidity. Plants use less water when humidity is high, but humidity has little effect on growth of the plants. Therefore, plants will need higher fertilizer concentrations when humidity is high.

Wind speed and air movement. Air movement generally has little effect on plant growth, but it increases the amount of water the plants use. When there is a lot of air movement, fertilizer concentrations should be lower than when there is no air movement.

Monitoring EC. Light, temperature, humidity and wind can affect optimal fertilizer concentrations. Unfortunately, it is difficult to predict exactly what the optimal fertilizer program is in a specific greenhouse. However, by monitoring growing medium EC you can determine whether there is enough fertilizer in the medium for your plants. For petunias and many other bedding plants, we recommend a PourThru EC of 2-3 mS/cm.

this number to the recommended growing medium EC range.

Nutrition guidelines

During the early, cooler months of the spring, subirrigated petunias should be grown with higher fertilizer rates. In the late, warmer spring months, subirrigated petunias should be grown with lower fertilizer rates.

Regardless of temperature, growers should measure the growing medium EC on a regular basis. We recommend weekly measurements. Medium EC should be kept within an optimal range of 2 to 3 mS/cm when using water with a low EC.

Bodie V. Pennisi *is extension floriculture specialist, University of Georgia, Rural Development Center, 15 RDC Road, Tifton, GA 31793; (229) 386-3687; fax (229) 386-7374; e-mail bpennisi@arches.uga.edu.* ***Jong-Goo Kang*** *is a visiting scientist, Sunchon National University, South Korea, e-mail jgkang@griffin.peachnet.edu.* ***Marc van Iersel*** *is associate professor of floriculture, University of Georgia, Department of Horticulture, 1109 Experiment St., Griffin, GA 30223; (770) 412-412-4766; fax (770) 412-4764; e-mail mvanier@griffin.peachnet.edu.* GM