Getting to the Root of It

Find out how to work best with media, water and fertilizer when growing perennials.

By Paul Pilon

Top: Many growers utilize surface water as their primary source of irrigation water. Shown above is one of two ponds at Sawyer Nursery in Hudsonville, Mich. Pond water is the only source of water used to irrigate their perennial crops. Bottom: By understanding growing media, irrigation water and fertility, growers can more successfully produce uniform and consistent crops. Shown here is Ajuga 'Chocolate Chip'. (Photos courtesy of Paul Pilon)

With the advancement of perennial production, many operations are looking at their current fertility programs only to discover the traditional practices used with greenhouse crops aren't always sufficient with many perennial crops. With a shift in production practices, it is often helpful to review the basics of crop fertility and apply these principles to meet the needs of new crops.

Fertility, by definition, is the capacity of a soil to supply nutrients to plants in adequate amounts and in suitable proportions. This definition was derived largely to represent field-grown situations, not that of container production. With greenhouse production, fertility involves an interaction of the media, water and fertilizer.

GROWING MEDIA

The media used to produce containerized plants must have several properties to provide adequate plant development. All media contains aggregates, or components, which consist of different materials and particle sizes. Some of the most commonly used aggregates include peat moss, bark, bark ash, coir, perlite and vermiculite. Many other materials have been used or are being developed for use in potting media. Mixing different components often provides the physical properties necessary for optimum plant growth. Components such as peat moss provide a media with excellent water-holding characteristics. Other aggregates, such as bark and perlite, promote aeration and drainage. The components themselves are not nearly as important as the environment they create, namely the water, air and nutrient content.

Porosity is a measurement of the pores, or the spaces between the aggregates, and represents the volume of a media available for air, water and the roots. Most soilless media contains 40-70 percent total pore space. After irrigating, the air portion of the total porosity is usually between 10-30 percent. For perennial production, look for a media with a total porosity of 50-60 percent, which contains 20-25 percent air after irrigating. Establishing a balance between the water-holding capacity and aeration is key to optimum plant growth.

WATER QUALITY AND IRRIGATION PRACTICES

Any producer of containerized plants must know the characteristics of the irrigation water applied to their crops. The availability of various nutrients essential for normal plant growth is determined through complex interactions between water, media and fertilizer. Alkalinity, pH and hardness are the key components of water quality that growers need to understand.

Irrigation water used for greenhouse production usually consists of groundwater, surface water, drainage/runoff ponds, rain or municipal water. Groundwater is essentially rainwater drained through the upper soil surface that has reached a saturated zone called an aquifer. Streams, creeks, rivers and large lakes are all sources of surface water. Drainage/runoff ponds are usually a combination of rainwater and drain tile runoff. Collection of rainwater from roofs with no ground contact is becoming a popular source of irrigation water. Several operations use water from a city, county or other municipality to supply their watering needs. Each source of water has its own set of strengths and weaknesses. Growers must research and become very familiar with all the characteristics of their water source.

pH. The pH of a solution is the balance of the hydrogen ions and the hydroxides in it and measures the strength of an acid or base. The range of pH is from 0 (most acidic) to 14 (most basic). For optimum perennial production, the pH of the media usually ranges 5.6-6.3, and the pH of the irrigation water is generally 5.4-7.0. The solubility (availability)

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of nutrients in the root zone is strongly affected by the media pH. As the pH of the media increases, certain nutrients, such as iron and phosphorous, become less available for plant roots to uptake. At low pH levels in the media, certain micronutrient toxicities could occur. The media pH is directly related to the quality of water being applied to the crops.

Alkalinity. By far, the most crucial factor to know about the water source is alkalinity. Alkalinity is a total measure of the substances in the water that have "acid-neutralizing" ability. It is attributed mostly to calcium and magnesium carbonates and bicarbonates, which are major components of limestone (limestone is often used to increase pH levels). While the pH of a solution measures the strength of an acid or base, the alkalinity reflects the solution's power to react with acid and keep the pH from changing (buffering capacity). With irrigation water of high alkalinity (over 150 ppm), each time water is applied to the crop we are increasing the carbonate and bicarbonate ions, which react with the substrate acidity. This causes the pH of the media to rise over time.

Hardness. Hardness is a measure of the combined content of calcium and magnesium carbonates in water. Hard water is generally associated with alkalinity. However, it is possible to have high levels of calcium and/or magnesium chlorides (often considered "hard") in the water and not have high alkalinity. If your water is hard, it is important to look at the ratio of calcium to magnesium. For crop production, a ratio of 5 parts calcium to 1 part magnesium is usually

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Alkalinity, pH and hardness are the key components of water quality that growers need to understand.

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Many growers successfully feed their crops using water-soluble fertilizers injected into the irrigation water. Above is an example layout of an H.E. Anderson injection system.

acceptable. Calcium levels higher than these can interfere with the uptake of magnesium, causing magnesium deficiency within the plant.

Efficient irrigation. There are several methods growers use to distribute irrigation water over their crops. Overhead irrigation applied either by hand or with sprinklers is probably the most common method of irrigating crops. Despite its popularity and effectiveness, overhead irrigation is extremely inefficient. Depending on crop spacing, plant canopy and volume of irrigation applied, as much as 80 percent of the water delivered to a crop is lost to leaching and runoff. For growers who pay for every gallon of water they use, this inefficient application of water becomes problematic.

Applying water through various forms of drip irrigation is another method growers have adopted to water their crops. Drip systems are much more efficient than overhead irrigation. However, to get uniform watering, it is often common to have up to 25 percent of the water applied lost to leaching.

The most efficient method of watering crops is subirrigation. Most of these systems are closed systems and involve collecting and reusing the irrigation water. Each form of irrigation practice has an effect on the overall fertility levels within the container.

FERTILITY CONCEPTS

Before entering the realm of fertility, growers must understand a few key concepts. Most fertility programs consist of using either water-soluble fertilizers, controlled-release fertilizers (CRF) or some combination of the two. Growers need to choose a fertilizer formulation, or whatever combination of nutrients they will apply to their crops. When using water-soluble fertilizers, a rate must be determined, often expressed in parts per million (ppm), to distribute these nutrients. Growers using controlled-release fertilizers calculate the ➧

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rate in terms of pounds-per-yard incorporated or grams-per-pot top-dressed.

The frequency at which fertilizers are applied can have an impact on plant growth and nutrition. Several growers have adopted the practice of "constant liquid feed," or applying a low rate of fertilizer with every watering. Other growers apply a higher rate of fertilizer at weekly or biweekly intervals. As long as adequate, but not excessive, amounts of nutrients are applied to the plants, crop nutrition is usually kept in check.

The volume of irrigation water applied, with or without fertilizers, will affect the quantity of nutrients and salts that are retained in the growing medium. The "leaching fraction" is the proportion of irrigation water or nutrient solution that is lost from the container by leaching. For example, 10 ounces of water is applied to the growing medium of a 5-inch pot, and after the irrigation one ounce of water is collected from the pot. This represents a 10-percent leaching fraction. With low leaching fractions, there are more nutrients and salts retained in the growing media. It is often beneficial to increase the leach fraction to flush excessive salts from the media before they rise to dangerous levels.

All growers should monitor both the fertility level of the crop and the irrigation water being applied. The electrical conductivity (EC) is a measurement of the salt levels in a solution and is used by most growers to monitor their crop's nutritional status. High EC levels can severely stunt plant growth, burn foliage and even cause plant death. To determine the fertility level of the crop, the most common method for in-house testing used to measure the pH is the

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