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Retaining Water For Healthy Plants

Superabsorbent gels and media mix can make a big difference in keeping plants hydrated.

by BILL ARGO, PH.D. and PAUL FISHER, PH.D

YOUR choice of growing medium and its water release characteristics are important for your customers' success with their patio containers and baskets. The key concept is that available water-holding capacity is not the only factor in influencing how long plants go between watering. Materials such as finer, more degraded peats, clays and superabsorbent gels can slow the release of water by the media back to the plant, resulting in a crop that requires less maintenance to survive.

Understanding Water Release Characteristics

The ability of a medium to retain and release water depends on the particle size of the materials used to produce the media. Spaces in between particles are termed pore spaces, and the size of the pore spaces influences whether air or water is retained after an irrigation.

Soil water can be further divided into easily available, water-buffering capacity, and unavailable water fractions. Only the easily available and water-buffering capacity fractions are "available" for use by the plant for growth and transpiration. Larger water-filled pores retain the water in an easily available form for the plant. As the size of the water-filled pores decreases, the water held in the smaller pores is more difficult to extract (held at a higher tension) and is therefore less available (sometime called water-buffering capacity). The extremely small pores retain the water so tightly that the plant can not extract it and this is termed unavailable water.

In a medium where larger water-filled pores (easily available water) predominate, plant water use would be relatively constant until it ran out, and then the plant would wilt. For example, available water-holding capacity of 18 corn mercial media was measured in mature 10-inch impatiens baskets. The baskets were thoroughly watered and allowed to drain, then placed in a low-light environment under fluorescent lights and allowed to dry until severely wilted (foliage collapsed onto the pot). On average, the plants took up about the same amount of water per day until visible wilt was observed. When visible wilt was observed, only about 5 percent of the total amount of available water was left.

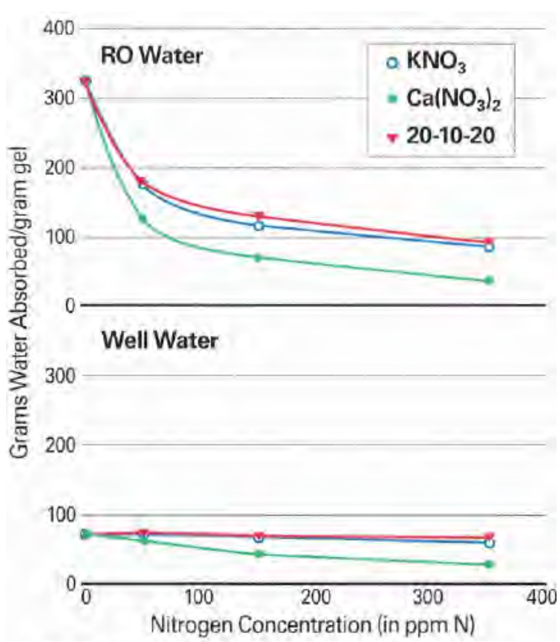

Figure 1. Effect of water quality and fertilizer salt type and concentration on the absorption of water by Supersorb C gel. The well water contained 60 ppm calcium and 30 ppm magnesium. Research by Bill Argo and John Biernbaum.

In media that held a larger percentage of the available water in smaller pores (water-buffering capacity), plant water use would decrease over time because the remaining water would become more difficult to extract as the media dried, thus extending the time between irrigation compared to plants grown in media from the example above. Examples of materials that contain a large percentage of fine particles or have small internal pores are older, more degraded peats, clays (like calcined clay or zeolite) and sandy, loam field soil.

In evaluations of impatients grown in 10-inch hanging baskets, three peat/component blends were compared to the same media containing a fine zeolite (similar to calcined clay) incorporated at 50 pounds/yard^3 (<2 percent by volume). While the available water-holding capacity was unaffected, average days between watering for plants grown in media containing the zeolite was increased by 25 percent compared to the non-zeolite treatments over the 11 weeks of the experiment.

In a separate experiment also using 10-inch impatiens baskets, the available water-holding capacity of a coarse sphagnum peat/perlite/vermiculite blend was 16 fl. oz. greater than a similar media that contained a finer, more degraded peat. Even though the plants were the same size, over the 11 weeks of the experiment, the average days between watering was the same for plants grown in the two media. This indicates that the finer, more degraded peat medium released the water to the plant slower than the coarse sphagnum peat medium.

It is important to remember changing the water release of the media by adding fine particles will also decrease aeration. A medium with high water-holding capacity and slow water release is good for the customer but runs the risk of overwatering during greenhouse production.

Superabsorbent Gels

Another way to retain more water in a less available form is to use superabsorbent gels. Originally formulated in the early 1960s for water purification, these materials are available in horticultural grades and are marketed to increase the water-holding capacity of the root media and therefore extend the time between watering, decrease water and fertilizer runoff, increase plant quality and extend shelf life. However, published research has not shown a consistent benefit in these criteria when gel is incorporated at the recommended rate.

The amount of water absorbed by a gel is dependent on the water quality and fertilizers used to grow the crop. The more salt contained in the water, the less water the gel will absorb. In addition, divalent ions like calcium or magnesium will chemically bind to the gel, further reducing its ability to absorb water. For example, Supersorb C absorbed about 330 times its weight in water when hydrated in reverse osmosis purified water, but only 75 times its weight in water when hydrated with well water containing 60 ppm calcium and 30 ppm magnesium. In a solution of calcium nitrate at up to 350 ppm N (400 ppm Ca), the gel absorbed about 30 times its weight in water (Figure 1).

To put some numbers on it, Supersorb C had a recommend-

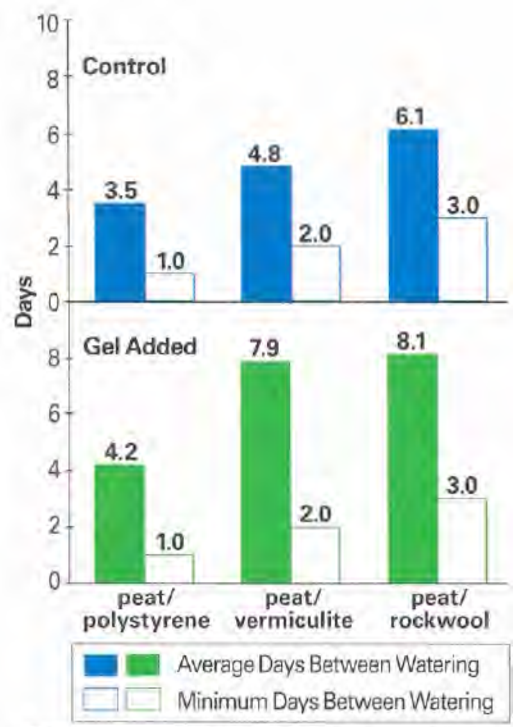

Figure 2. Effect of incorporating a superabsorbant gel (Supersorb C) on the average days between watering and minimum days between watering impatiens grown in three 60 percent sphagnum peat/40 percent component blends. The water contained 60 ppm calcium and 30 ppm magnesium and the fertilizer used was 20-10-20. Research by Bill Argo and John Biernbaum.

BETTER BASKETS

MEDIA MATTERS

ed incorporation rate of 1.5 pounds (680 grams) per cubic yard. A typical 10-inch hanging basket has a volume of about 1.3 gallons, which yields about 160 baskets per cubic yard of mix. At that rate, you would expect to have about 4.25 grams of gel incorporated into each 10-inch basket.

With pure water, 4.25 grams of gel would absorb about 47 fl. oz. of water. In water containing moderate concentrations of calcium and magnesium, the amount of water absorption would be about 10 fl. oz. of water, and if high rates of calcium-based fertilizers were used to grow the crop, then as little as 4 fl. oz. of water would be absorbed by the gel.

It also takes a long time (up to eight hours or more) for gels to fully hydrate. Consider the amount of time water is applied to most large containerized plants, ranging from less than a minute (hand watered with a hose or an Echo watering system) to tens of minutes with low-volume emitters. There is simply not enough time for the irrigation water to directly cause the gel to hydrate. Rather, it is the water left in the media after the irrigation has finished that the gel uses for hydration.

In evaluations of impatiens grown in 10-inch hanging baskets, several peat/component blends containing Supersorb C superabsorbent gel at an incorporation rate of 1.5 pounds per cubic yard were compared to the same media without gel for available water-holding capacity, as well as average and minimum days between watering over an 11-week period. The irrigation water used for the experiment contained 60 ppm calcium and 30 ppm magnesium, and the fertilizer used was 20-10-20 at 300 ppm N applied once every two weeks.

On average, neither the available water-holding capacity nor the minimum days between watering (high water-use days) were affected by the incorporation of the gel. Thus, when water use by the plant was high, the gel was ineffective because it did not increase the water-holding capacity of the media.

However, the average days between watering was increased by the incorporation of the gel, with the greatest benefit coming to plants grown in media that already had high water-holding capacities (Figure 2). When the water use of the plant was low, the portion of available water absorbed by the gel was released back to the plant slower than to plants in the unamended media. So incorporating a superabsorbent gel into a medium did reduce the amount of maintenance required to keep the basket alive, just not during periods of high water use.

Changing the way water is released by the media to the plant can reduce the maintenance required to keep the plants alive. Next month, we will discuss water absorption, and we will do a cost analysis of components and amendments talked about in the first three parts of this series. GG

About the authors: Bill Argo (bargo@blackmoreco.com) is technical manager at the Blackmore Company and Paul Fisher (pfisher@u 11.edu) is an Associate Professor in the Environmental Horticulture Department at the University of Florida. The authors thank John Biernbaum at Michigan State University. The authors acknowledge support from the Michigan Agriculture Experiment Station, Western Michigan Bedding Plant Association, The Bedding Plant Foundation, The American Floral Endowment, Partek Inc. and greenhouse growers throughout the state of Michigan.