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RE: Research Report on Aquasorb Project Conducted in 2016

2016 Aquasorb Greenhouse Study

Brief Description of Project Methods

This study was carried out at the UGA Ornamental Horticulture Greenhouse Complex in Athens, GA. Greenhouse conditions included temperature settings of 23°C (day) and 20°C (night). *Hibiscus acetosella* plants were grown in a SunGro Nursery Mix (including starter charge) with 1.25 Kg/m^3 Harrell's 18-6-8 (plus minors), 90 day controlled release fertilizer incorporated. Irrigation was calculated based on determining the field (water) capacity of each treatment and attaining a 0% or a 10% leaching fraction for each treatment daily (one irrigation event a day was applied). Based on the field capacity of each treatment, the associated volumetric water content to attain field capacity could be programmed into an automated irrigation system that precisely irrigated daily and corrected for plant size as plants grew in the study. Lysimeters were also employed, to double check soil moisture sensor readings, as weight of the container is an accurate measure of water held in the soil. Ten plants per rep, with three reps per treatment, were grown in 6.1L (Trade 2-gallon) containers for 45 days, at which time irrigation was stopped and dry-down longevity onserved. Treatments included a control, Aquasorb at 3lbs/yd^3, and Aquasorb at 4lbs/yd^3. Important results are described below, with associated figures.

Results

Result 1: In the below figure, whereby volumetric water content was maintained at 25% to afford a 0% leaching fraction, cumulative irrigation volume decreased significantly as Aquasorb was added and Aquasorb rate increased. In the control, 12.8 L of irrigation was required during the production cycle. At 3lb/yd^3 of Aquasorb, 10.1 L was required. At 4lb/yd^3 of Aquasorb, 7.7 L was required. Interestingly, plant size was significantly larger when comparing the control (no Aquasorb) and treatments with Aquasorb. However, there was no difference between plant dry weight between 3lbs/yd^3 and 4lbs/yd^3 treatments. This suggests

that for maximizing benefit while maintaining cost effictiveness, the lower rate of 3lbs/yd^3 may be more appropriate to recommend.
It should be noted that a 0% leaching fraction is generally not recommended as a BMP. However, this is because when the BMPs were written, technology did not exist that could maintain irrigation at a volumetric water content with such precision. Histroically, timers controlled irrigation – which is very inefficient compared to soil moisture sensors. However, with the ever increasing importance of water and increasing irrigation efficiency, we wanted to include a 0% leaching fraction to show that plants could be grown in this situation - and to see if Aquasorb could improve a system with 0% leaching fraction.

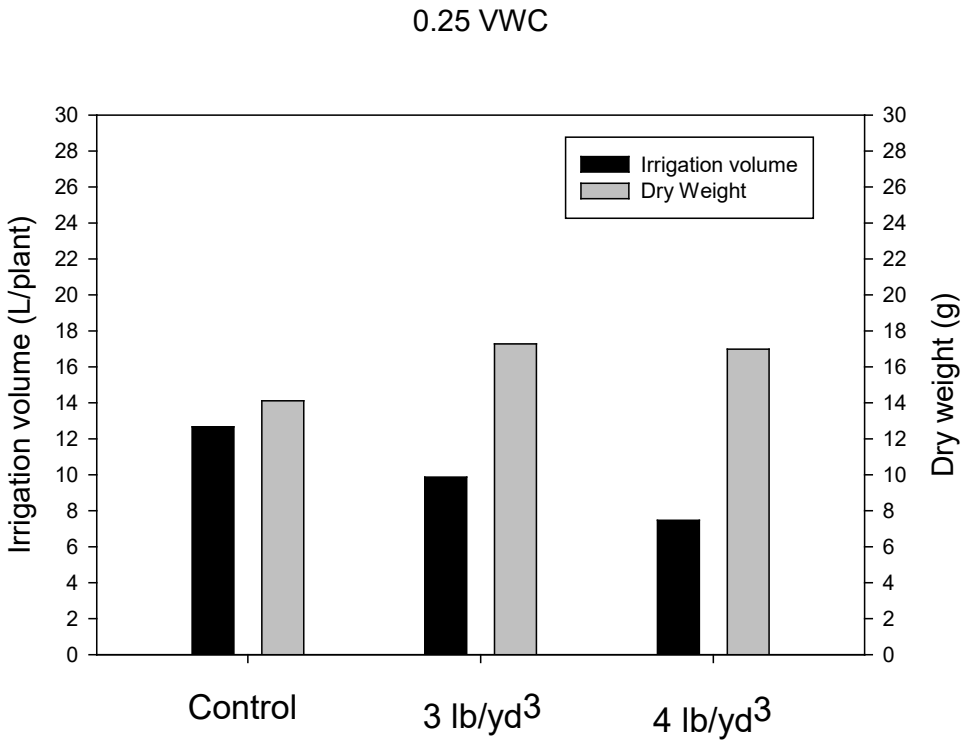

Figure 1. Total irrigation volume and dry weights of Hibiscus acetosella 'Panama Red' plants grown in SunGro nursery mix in 6.1L (Trade 2-gallon) containers with aquasorb incorporated at 0, 3, and 4 lb/yd^3. Plants were precision-irrigated to maintain a 0.25 m^3/m^3 substrate volumetric water content (0% leaching fraction). Average of 10 plants per treatment.

Result 2: In the below figure, whereby volumetric water content was maintained at 32.8% to afford a 10% leaching fraction, cumulative irrigation volume decreased significantly (reduced by more than half) as Aquasorb was added; but did not differ between Aquasorb rates of 3lb/yd^3 and 4lb/yd^3. In the control, 26.3 L of irrigation was required during the production cycle. At 3lb/yd^3 of Aquasorb, 11.2 L was required. At 4lb/yd^3 of Aquasorb, 9.6 L was required. Interestingly, there was no difference between plant size among any of the treatments. This indicates Aquasorb could be used to reduce irrigation volume by more than half, while growing a similar sized plant; if growing using currently accepted best management practices.

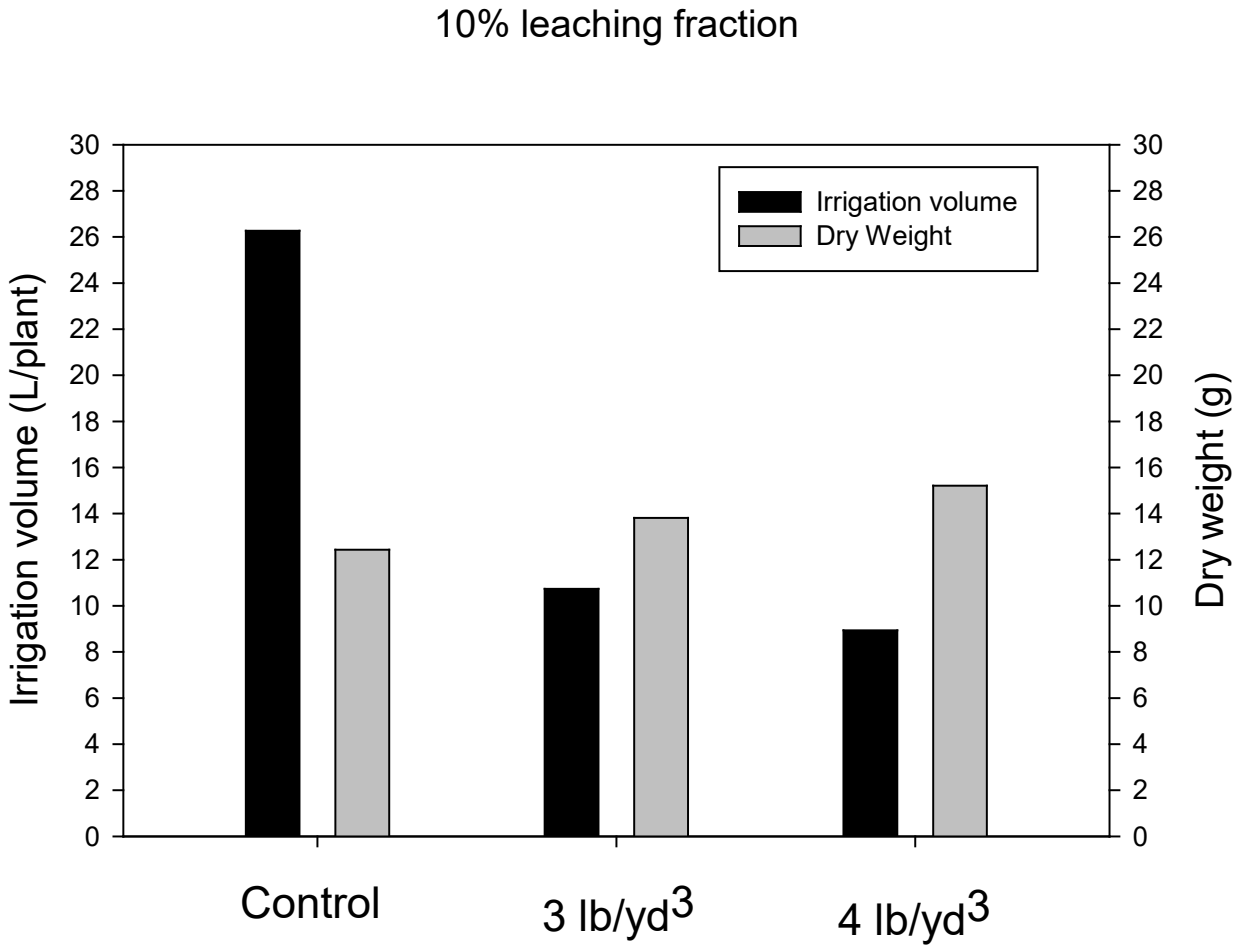

Figure 2. Total irrigation volume and dry weights of Hibiscus acetosella 'Panama Red' plants grown in SunGro nursery mix in 1-gallon containers with aquasorb incorporated at 0, 3, and 4 lb/yd^3. Plants were irrigated once daily to a 10% leaching fraction. Average of 10 plants per treatment.

Result 3: As part of this study, we wanted to investigate how Aquasorb altered the physical properties of the soilless substrate. As you can see in the figure below, the primary change in physical properties as Aquasorb was added and rate increased was an increase in water holding capacity of the soil. In this study, field capacity of the substrate (look to the far left of the graph) was increased from 30.8% (control) to 33.7% (3lb/yd^3) to 36.4% (4lb/yd^3).
Plant stress in containers is related primarily to cyclically (daily) minimum soil moisture, with physiologic stress occurring when soil moisture drops below 20-25% volumetric water content (based on taxa) and wilting/damage/death occurring below 12-18% volumetric water content (based on taxa). The point here, based on preliminary research, is that regardless of Aquasorb rate, volumetric water content rarely drops below 30%. In the control, with no Aquasorb, volumetric water content is frequently at 25% VWC. A 5% increase in water holding capacity of the soil is significant.

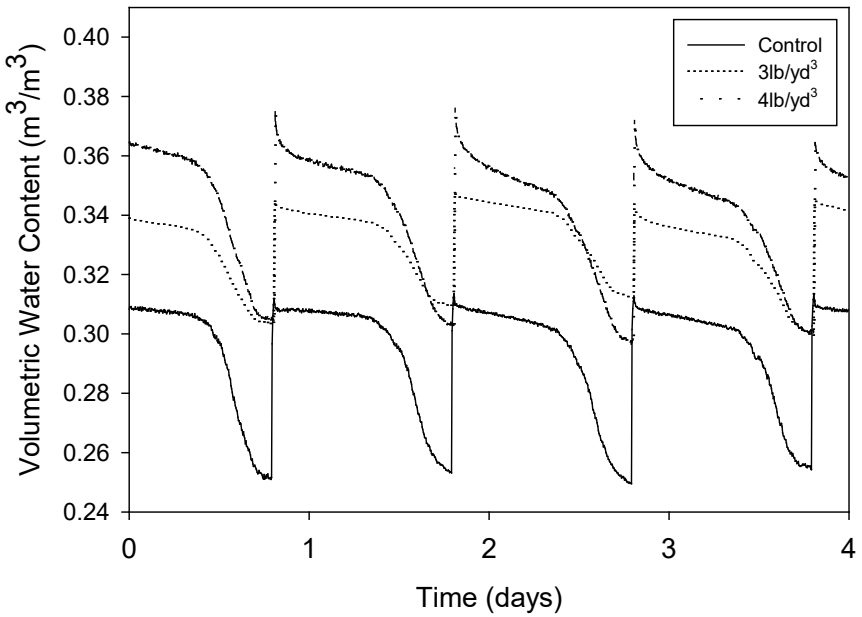

Figure 3. Diurnal fluctuations in substrate volumetric water content for plants watered once daily to a 10% leaching fraction – over the 4 days prior to to the termination of the study when plants were ready for sale. Hibiscus acetosella 'Panama Red' plants were grown in SunGro nursery mix in 1-gallon containers with aquasorb incorporated at 0, 3, and 4 lb/yd^3. Average of 3 containers per treatment.

Result 4: Although not part of the formal study, we decided to add a component to this project looking at drydown rates when irrigation was turned off. This mirrors what happenes when a plant leaves the nursery/greenhouse, is transported long-distance and is placed in a landscape or garden center environment; where irrigation is not frequent or reliable. It also mirrors what happens when there is an irrigation system failure (e.g. power outage) in a production facility. Previous research with this plant (hibiscus) indicated that the perminant wilting point, whereby the plant cannot recover and dies, occurs at 15% volumetric water content. Control plants reached the permamnet wilting point 3 days after irrigation ceased. However, both 3 and 4 lb/y^3 treatments extended shelf life of plants significantly - to 5 days. What we find interesting is that it appears 15% volumetric water content may be close to the point whereby the osmotic potential of Aquasorb particles is equal to the osmotic potential of this taxa (which we already know – based on previous studies). This is evident as the 3 and 4 lb/y^3 treatments converge at 15% volumetric water content. Alternatively, this could be the point at which this substrate outcompetes Aquasorb and the plant for moisture, based on adhesion pressure and/or capillary pressure.

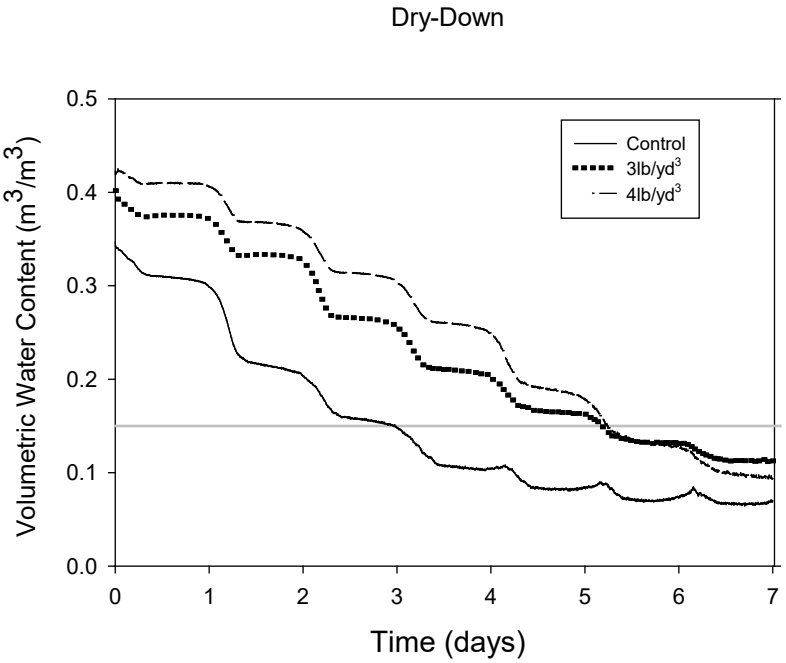

Figure 4. Time to dry down for Hibiscus acetosella 'Panama Red' plants grown in nursery mix in 1-gallon containers with aquasorb incorporated at 0, 3, and 4 lb/yd^3. Average of 4 containers per treatment. The grey line represents a VWC of 0.15 m^3/m^3, the estimated permanent wilting point.