Scheduling Methods for Bell Pepper Irrigation on Sandy Soils

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The research was conducted at the Muscatine Research Farm (eastern Iowa along the Mississippi river). This site is an excessively drained coarse sand (sandy, mesic Entic Hapludoll) with 93% sand, 1-5% clay, organic matter of 1-3% and an available water content (AWC) of 0.5-0.7 inch/foot.

Sweet bell peppers grown in twin-rows on black plastic mulch was the test crop to evaluate 3 irrigation scheduling methods using 2 in-line emitter spacings. The trickle tubing was placed in the bed center approximately 2 inches deep. The trickle line was Chapin, turbulent twin-wall, 10 ml cane tubing. Water source was a deep-well. Five-week old pepper transplants, cv. Brigadier, were set May 27. Planting arrangement was twin rows, 16 inches apart, on 4-foot wide plastic, with plants spaced 17 inches in-row. Weather data collection included daily max/min temperature, wind speed, solar radiation, and relative humidity. The irrigation methods were:

1. Soil tension = irrigation event triggered when daily readings of a 6-inch tensiometer reached 10-12 cbars. Water amount to apply determined as 50% depletion of AWC and brought back to field capacity.
2. Smittle crop coefficient = daily ET (modified Penman equation) X Smittle crop coefficient (developed in GA under similar soil type and planting arrangements) determined daily amounts of water to apply.
3. Crop canopy = daily ET X percent crop canopy cover (never < 0.4 and never exceeded 1.0).

The 2 in-line emitter spacings were 6-inch and 12-inch Chapin twin wall cane tubing that delivered 0.3 gpm/100 ft. The water amount called for by the methods was applied twice daily, at 8 am and 2 pm. Normal crop culture and pest management practices for the area were followed. Additional N, as 32% urea, was applied through the irrigation at 10 lbs N/acre/week. The irrigation treatments were initiated June 20th and continued until August 9.

Results

Table 1 indicates that watering via the 6-inch tensiometer setting of 10 to 12 cbars resulted in 32.6% more total fruit produced compared with the Smittle crop coefficient method. Further, the marketable yield was double that of the other two treatments. But cull fruit accounted for 67% of total fruit indicating none of the watering methods were suitable for commercial production. Cull fruit were mostly small and misshapen. By the second harvest significant root plugging of the trickle emitters was evident.

Tensiometer readings in all plots reflected the water amounts applied, i.e. the Smittle and crop canopy methods (both based on ET measurement) tended to run drier than the tensiometer based
method, particularly after July 8 (Fig. 1 and 2). The reference ET for the period was 12.24 inches. The crop ET for the crop canopy treatment (No. 3) was 9.6 inches and the Smittle method (No. 2) 10.88 inches. Over an inch of rainfall occurred July 8, bringing the soil water content of all treatments to field capacity. Even though total water quantity was similar among treatments, the tensiometer method applied 383 gallons/plot more water prior to July 8, compared to 270 gals/plot for the crop canopy and Smittle methods, which resulted in more plant branching and flower development. There was no difference in yield between the two emitter tape spacings. Marketable fruit size and fruit shape was similar in all treatments at 5.7 ounces each and a 0.99 length/diameter ratio, respectively.

A tensiometer demonstration trial was conducted with Amish growers of greenhouse grown tomatoes in SE Iowa. Their growing medium was field soil which was previously cropped with alfalfa. Although they installed microirrigation tubing they lacked information when to water or how much to apply. Two equipment stations, each containing a 6-inch and 12-inch tensiometer, were established in each greenhouse and growers instructed on their use. Results indicated considerable soil moisture tension variability among greenhouse growers (Fig. 3 and 4). Grower A was able to maintain the 6-inch moisture tension at the target of 30 cbars throughout the season. His 12-inch depth tensiometer indicated uniform moisture without over watering. Grower B, on the other hand, applied water erratically and placed the plants under water stress during the heavy fruiting period. Also, acceptance of this water scheduling method differed among growers.

Table 1. Water applied and pepper fruit produced for the growing season of June 17 to August 9. Yield results are the sum of two harvests, Aug. 1 and Aug. 11, 2003.

<table>
<thead>
<tr>
<th>Irrigation Method</th>
<th>Water used, gals/plot</th>
<th>Total</th>
<th>Marketable</th>
<th>Cull</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensiometer</td>
<td>1021</td>
<td>700 A↑</td>
<td>287 A</td>
<td>413</td>
</tr>
<tr>
<td>Crop Canopy</td>
<td>903</td>
<td>607 AB</td>
<td>170 B</td>
<td>437</td>
</tr>
<tr>
<td>Smittle</td>
<td>978</td>
<td>528 B</td>
<td>135 B</td>
<td>385</td>
</tr>
</tbody>
</table>

↑ Mean separation within columns by DMRT, 5% level.
Fig. 1. Tensiometer readings at the 6-inch depth for the three irrigation scheduling treatments on coarse sand soil, Muscatine, IA.
Fig. 2. Tensiometer readings at the 12-inch depth for the three irrigation scheduling treatments on coarse sand soil, Muscatine, IA.

Fig. 3. Tensiometer readings at the 6-inch soil depth for a greenhouse tomato crop.
Fig. 4. Tensiometer readings at the 12-inch soil depth for a greenhouse tomato crop.