IRRIGATION RESEARCH CONTINUES AT SWMREC

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Irrigation is a necessity for economic production of many vegetable crops. The ability to supplement rainfall is important to meet modern market demands. Michigan averages 30 to 36" inches of moisture per year. Only six to eight occurs during June, July and August when shallow rooted vegetables need an inch or more weekly. Not only is there insufficient rainfall during the growing season, but also what rain occurs is sporadic with potential dry periods between events. Most vegetable growers have enough experience with weather that they have invested in irrigation systems.

Drip irrigation research began in 2002 at the Southwest Michigan Research and Extension Center (SWMREC). Early efforts were geared toward efficient delivery and application. Recent activity has investigated critical plant stage/s, water amounts and affects on nutrient movement. Commercial fields have also been surveyed to determine adequacy of grower practices. This article reports on some of the 2003 results.

SWMREC Trials

One 2003 SWMREC trial investigated affect of moisture levels on tomato and cucumber. Six levels (10, 15, 20, 25, 30, and 35 cb) were maintained using tensiometers hard wired (Figure 1) to solenoids which allowed treatments to be irrigated one hour when the tensiometer reached the determined level. Tensiometers measure amount of force needed to remove water from soil - the drier the soil the higher the number. To measure soil moisture affects, each treatment was monitored weekly and continuously. Weekly readings tracked seasonal trends while continuous readings observed daily fluctuations. Water use for each treatment was measured from flow meters. All trials were conducted on Spinks loamy fine sand.

Figure 1. Tensiometer showing hard wire leading to solenoid valve. Tensiometer is set for 35 centibars

No difference was found in fruit yield and quality in either cucumber or tomato for the 10, 15 and 20 cb treatments. However there was a large difference in the amount of water used. The 10 cb treatment averaged 3.66 inches of water per week while the 20 cb treatment applied only 1.55 inches weekly. The 10 cb treatment used over twice as much water as the 20 cb, without producing added benefit in yield or quality. This represents a significant savings in water and production expense.

Significant yield loss for both cucumber and tomato occurred at 25 cb which received 0.42 inches of water/week. At 25 cb cucumber produced 347 bushels/acre compared to 797 bushels/acre from 15 cb. Significant wilting was observed on cucumber at 25 cb. Tomato yield at 25 cb averaged 2877 twenty-five pound cartons compared to 3483 at 15 cb. No plant wilting was observed on tomatoes. However,

tomato fruit size and quality was significantly affected. Thirty-eight percent of the fruit from 25 cb was small or culled compared to 24% for 10 cb, 26% for 15 cb and 21% for 20 cb. Only 48% of fruit from 25 cb were graded No. 1 compared to 64%, 62% and 64% for 10, 15 and 20 cb, respectively.

Figure 2 shows a typical seasonal moisture pattern observed for the 10 and 25 cb treatments in tomatoes. In both cases moisture levels are adequate early in the season. However, the 25 cb treatment drops starting late July and continuing into September - a time directly corresponding with the harvest period.

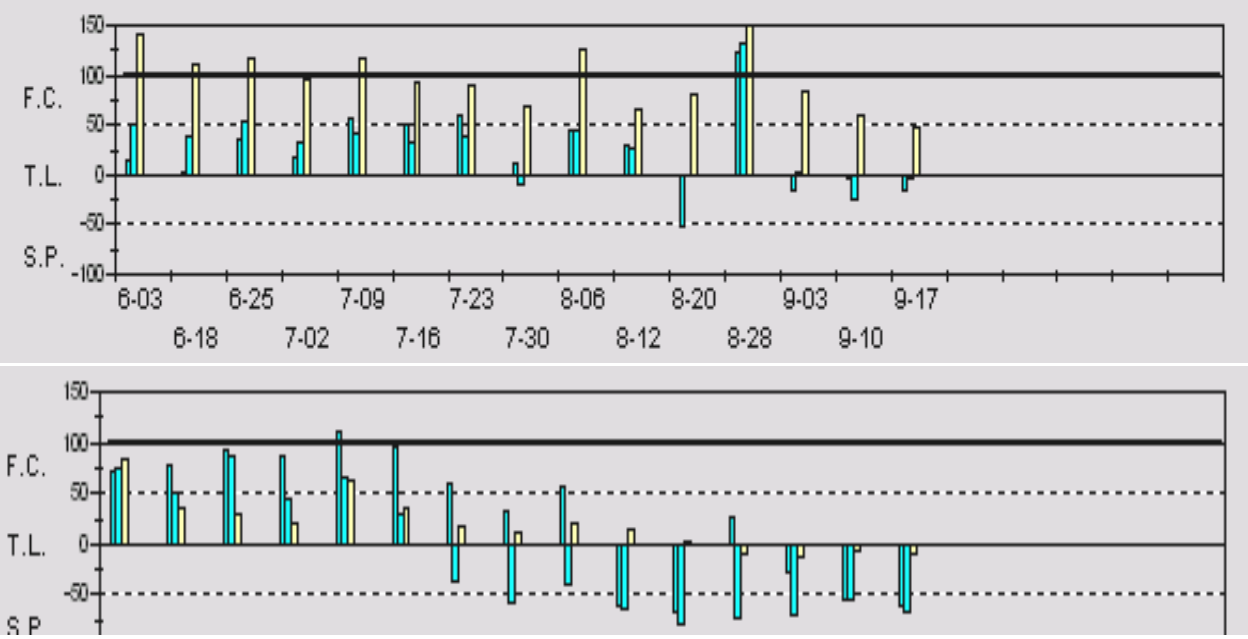

Figure 2. Typical seasonal soil moisture trends observed in tomatoes from a sand-based soil at 10 centibars (top) and 25 centibars (bottom). F.C. (100) is the Field Capacity of the soil. T.L. (65% F.C.) is the trigger level at which irrigation should begin. S.P. is the stress point. The three bars for each date are readings taken at the 1, 2 and 3 foot levels (left to right, respectively).

Figure 3 shows how plant water demand increases dramatically during July and August. Not maintaining moisture during this time may significantly affect yield and quality.

The 10 cb treatment had highest moisture at the three foot level as indicated by readings near and above 100. The goal in water management should be to keep moisture (and nutrients) in the top two feet where most roots are growing. High levels at three feet indicates too much water is moving beyond the root zone and potentially beyond reach of the plant.

Continual measurements found a similar pattern across treatments. Soil moisture was highest from 3:00 to 9:00 a.m., decreasing 9:00 a.m. to 5:00 p.m., lowest 5:00 to 8:00 p.m. and increasing 8:00 p.m. to 3:00 a.m. (Figure 4). This pattern is expected since 9:00 am to 5:00 pm corresponds to greatest plant water demand. Recovery time for soil moisture begins at 8:00 pm when the plant shuts down for the day and then reaches a maximum from 3:00 to 9:00 am.

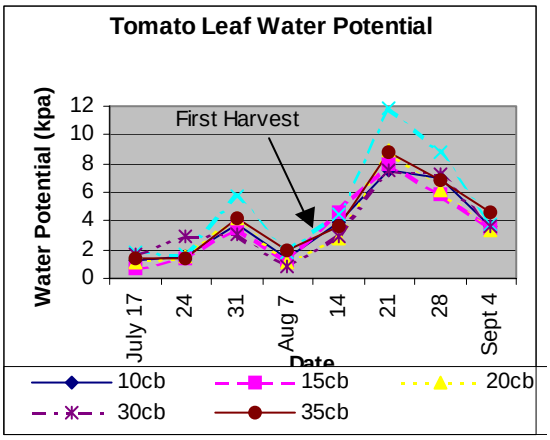

Figure 3. Tomato leaf water potential. Higher numbers indicate greater water demand

Some growers purposely limit irrigation during harvest thinking it improves eating and shipping quality. This may be true for some but not all crops and growers may be sacrificing yield as a result. Another contributing factor to the decrease may be by early August most growers are busy harvesting, packing and shipping, and irrigation becomes a secondary activity.

Research Continues In 2004

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Commercial Filed Survey

The 2003 effort included monitoring several commercial sites. The sites represented several growers, soil types and crops. Wide variation in patterns was observed with soil type the most significant variable. Figure 5 shows a typical seasonal pattern from a sand-based soil. There is sufficient to high moisture levels early, progressing to near the stress point later in the season. This pattern is somewhat concerning since it resembles the pattern from the poor performing 25 cb treatment (Figure 2). The affect this pattern had on yield was not determined.

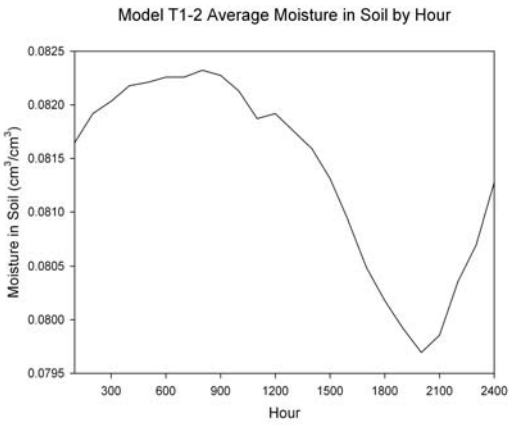

Figure 4. Daily soil moisture pattern for tomato grown in sandy soil.

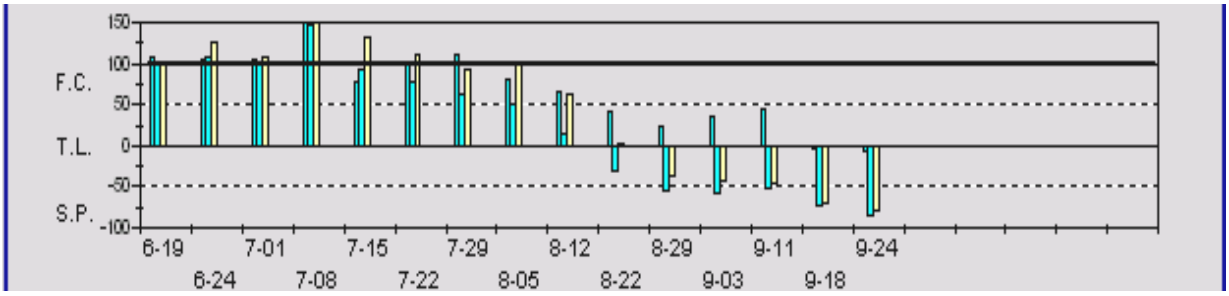

Figure 5. Seasonal soil moisture pattern from a commercial vegetable planting. F.C. (100) is the Field Capacity of the soil. T.L. (65% F.C.) is the trigger level at which irrigation should begin. S.P. is the stress point. The three bars for each date are readings taken at the 1, 2 and 3 foot levels (left to right, respectively).

continue the research into 2004. Trials planned in 2004 will investigate the best time for water inputs during the diurnal soil moisture cycle. Trying to answer questions like; Does it matter to the plant if water is added as soil moisture is being depleted or is it best to add water during the natural recovery time? Will the plant require less water when irrigated at different times? Does flattening the curve have any effect on yield? A trial is also being designed to determine if limiting irrigation during harvest improves shipping quality while not hurting yield. Monitoring commercial fields will also be continued but with an emphasis on advising growers on irrigation scheduling.