

Tensiometers or Watermarks for Scheduling Irrigation

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Tensiometers are the major devices used to measure soil tension and aid in scheduling microirrigation. However, there can be a large variation in readings from unit to unit requiring constant maintenance. A major problem can be the proper functioning of the vacuum gauge. The watermark, an electric resistance granular matrix sensor of recent introduction, eliminates in-field maintenance while providing accurate soil tension measurements in the 10-200 kPa range.

We evaluated tensiometers (irrometers) and watermarks(both from Irrometer Co., Riverside, CA) at the Western Iowa Research Farm (silt loam with AWC of 2.6 inch/foot), Castana; and the eastern Iowa location (Muscatine Farm, Fruitland - coarse sand soil with 0.5 inch/foot). Sweet corn was the test crop at Castana and the deep rooted asparagus at Fruitland. The moisture devices were set at 3 soil depths: 6, 12, and 24 inches. There were 4 replications for each depth.

The devices were placed between 2 plants and were within 12 inches from each other. The devices were soaked in water for 24 hours prior to setting in the field. Air was expelled from the irrometer with a hand vacuum pump. The installation procedure involved adding a small amount of water to the bottom of the hole before inserting the moisture sensor. The depth was measured accurately with a marked soil probe.

A microirrigation system was used with the sweet corn at Castana. Trickle irrigation tubing (T-tape 508, delivering 0.34 gpm/100 feet) was placed down the center of each bed of two rows or 9 inches from each row. At Fruitland, a solid set overhead sprinkler irrigation system was used for the asparagus crop.

Figures 1 - 3 represent the moisture tension readings for the sweet corn at Castana. As in 1999, the correlation between tensiometer and watermarks was very good. For the three soil depths of 6, 12, and 24 inches, the correlation coefficients were $r = .53, .65, \text{ and } .72$, respectively. However, there were periods where the watermarks failed to detect a rain event. For example, in early July tensiometers rose rapidly from 5 kPa to 25 kPa reflecting a drying condition while watermarks only moved from 3 to 5 kPa over the same time period (Fig. 1 and 2). We have observed in the past that watermarks are slow in responding to a drying event after a low tension (high moisture) period.

At Fruitland on the coarse sand soil we noticed that the watermarks were slower to respond to a rain/irrigation event than the tensiometers. Thus, readings were taken every 2-3 days to allow the instruments to stabilize (figure 4). During the study period the asparagus received enough water (rain/irrigation) to average 0.19-inch per day. The weather station recorded the PET at 0.19-inch per day for the same period. The correlation between

the devices at the 6 and 12-inch depths was $r = 0.98$ and 0.92 , respectively. The watermarks worked well in this soil type where large differences occurred in soil moisture. We have noted in past reports that on the heavier, higher soil water content silt loam soils the watermarks were slow responding and did not always detect initial changes in soil moisture conditions. Also, grower experiences indicate a preference for the tensiometers. The main reasons given were the ease of direct reading (did not have to hook up a meter to the wires), and tensiometers required considerably less effort to remove from the field in the fall.

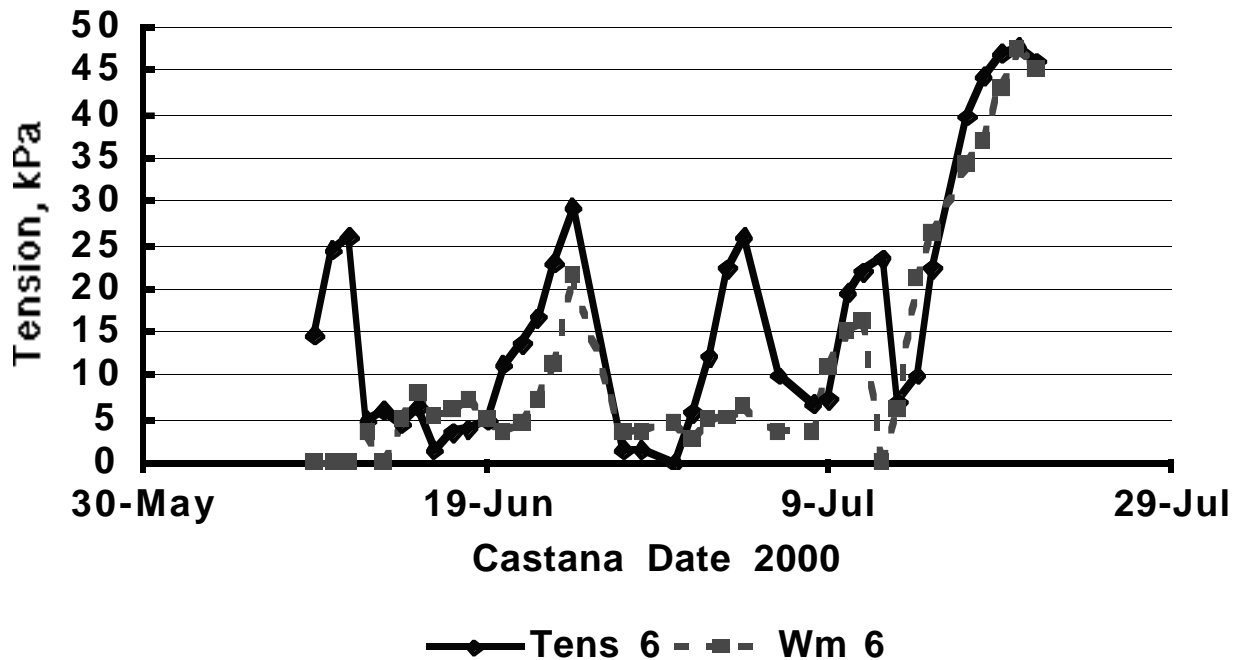


Figure 1. Tensiometer (Tens 6) and watermark (Wm 6) soil moisture tension readings from a sweet corn crop grown on a silt loam soil at Castana, Ia., 2000. The devices were placed at the 6-inch soil depth and the correlation over the time period measured was $r = .53$.

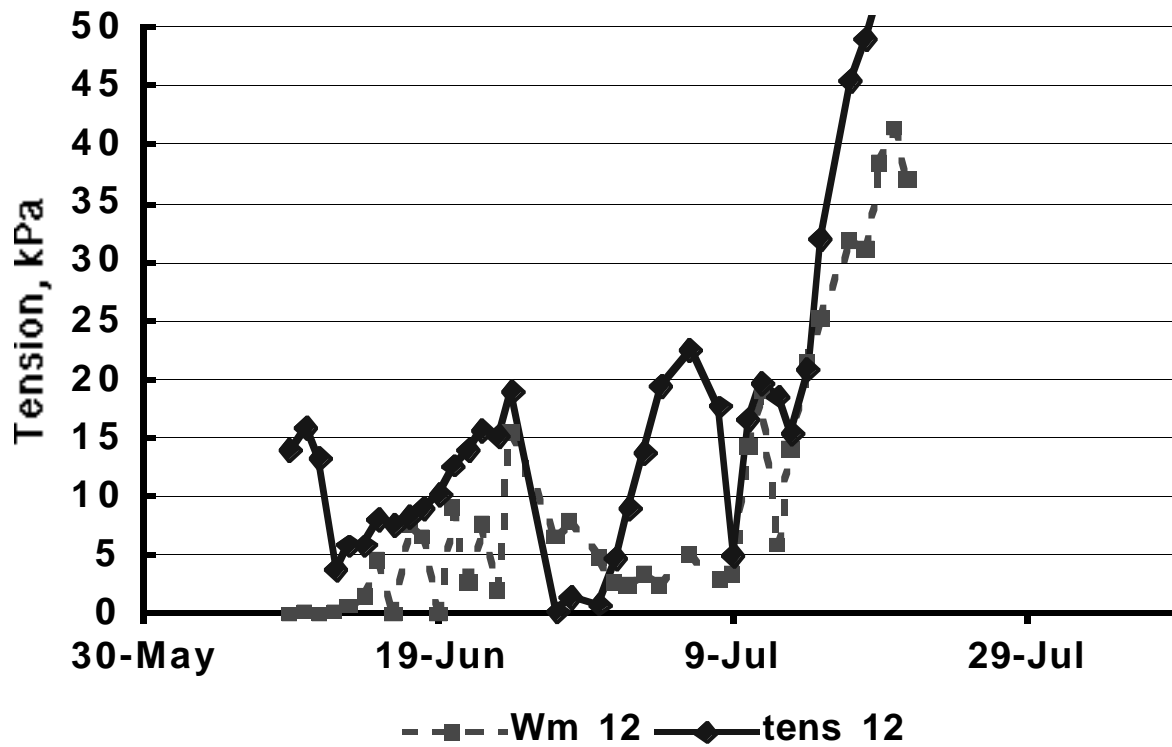


Figure 2. Tensiometer (Tens 12) and watermark (Wm 12) soil moisture tension readings from a sweet corn crop grown on a silt loam soil at Castana, Ia., 2000. The devices were placed at the 12-inch soil depth and the correlation over the time period measured was $r = .65$.

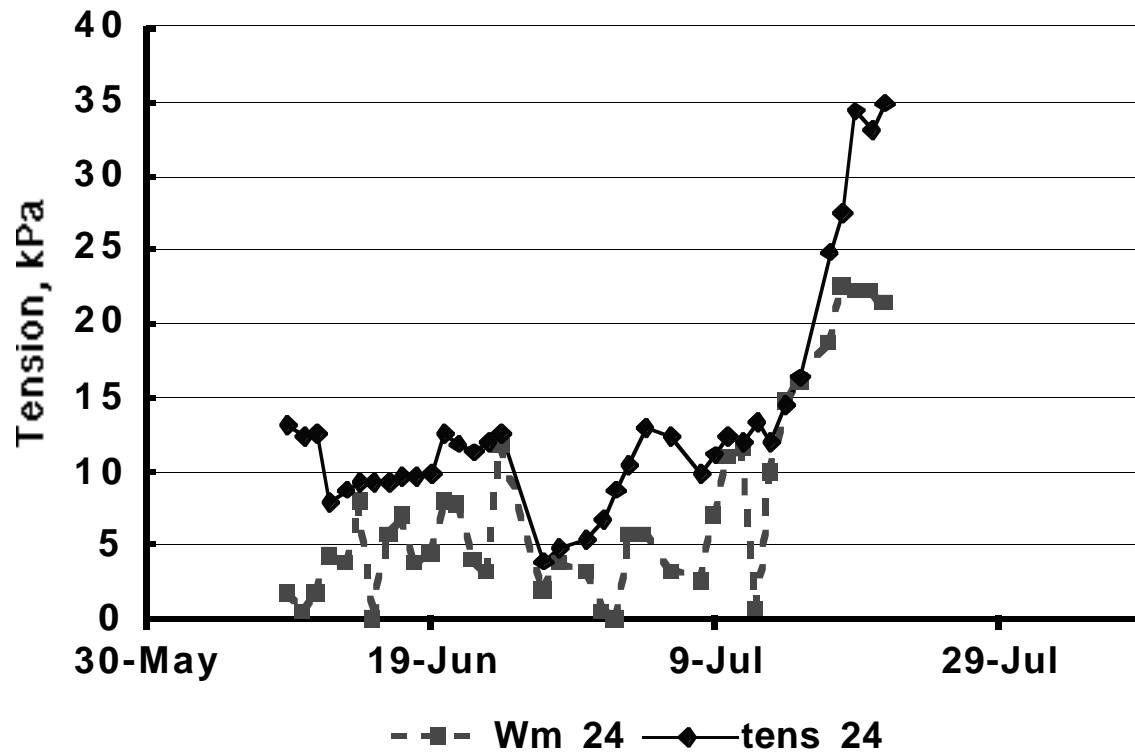


Figure 3. Tensiometer (Tens 24) and watermark (Wm 24) soil moisture tension readings from a sweet corn crop grown on a silt loam soil at Castana, Ia., 2000. The devices were placed at the 24-inch soil depth and the correlation over the time period measured was $r = .72$.

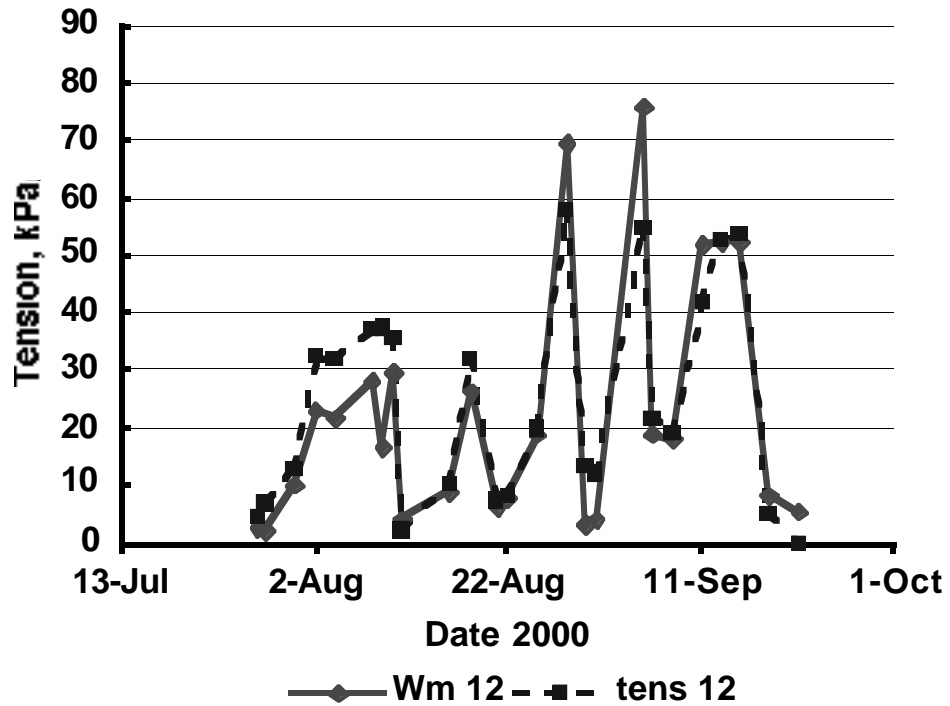
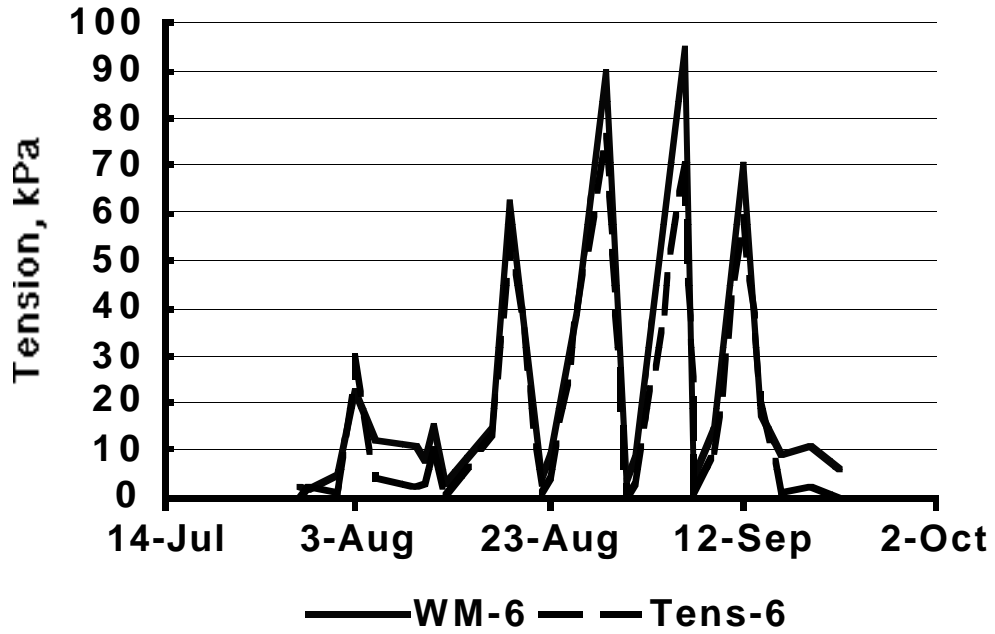


Figure 4. Tensiometer (Tens) and watermark (WM) soil moisture comparison with an asparagus crop, overhead irrigation. Soil type was a coarse sand at Fruitland (eastern Iowa). Each point is a mean of 4 replications. Correlation of watermark to tensiometer was $r = 0.98$ for 6-inch depth and $r = 0.92$ for the 12-inch depth.