Monitoring Water Use in Field Crops

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Irrigation on Texas High Plains

- 3,464,720 acres of cotton planted
- 2,706,690 acres cotton harvested
- 55% is irrigated
- 45% is dryland
- 1,250,000 acres grain crops
Equipment Options

- There are many different options for measuring soil moisture.
- Some equipment measures moisture in the soil while other equipment measures plant stress.
- The cost of soil moisture monitoring equipment varies considerably.
- An effective system is capable of measuring moisture or stress in the full range of wetness or dryness experienced by the crop.
Moisture by “Feel” Method

- Probes are inexpensive.
- Moisture by feel is based on soil moisture holding capacity.
- It is possible to probe in one foot increments to a depth of three feet.
- Probe data is easy to understand and convey to a grower.
- Moisture by feel is an excellent tool, but it is not precise.
Other Advantages of the Soil Probe
Tensiometers

- Relatively inexpensive and reusable from one year to the next
- Somewhat labor intensive to install
- Often break suction under dry soil conditions
- Work well in corn that is grown in clay loam soils
Gypsum Blocks

- Inexpensive compared to other moisture monitoring equipment
- Labor intensive to install and monitor
- Time consuming to read blocks and post charts
- Unreliable when soils become dry
Gypsum Blocks - Seasonal Moisture Data

Graph showing seasonal moisture data with lines representing moisture levels at different depths:
- 1 Foot
- 2 Foot
- 3 Foot

Moisture levels vary throughout the season with peaks and troughs indicated for each depth.
Aqua Spy Capacitance Probes

- Measures moisture in 4 inch increments to 40 inches
- Updates charts every 15 minutes
- Extremely accurate and sensitive over the entire moisture ranges from very dry to very wet
- Charts can be manipulated to better view data
Limitations of Capacitance Probes

- The equipment is expensive.
- Learning to interpret data and manipulate charts requires time and patience.
- The system is currently dependent on cellular phone systems for communication to website.
C Probe Installation
July 15th – September 4th
4 Inch Sensor Only
4 and 8 Inch Sensors
4, 8, and 12 Inch Sensors
4, 8, 12, and 16 Inch Sensors
4, 8, 12, 16, and 24 Inch Sensors
4, 8, 12, 16, 24, and 28 Inch Sensors
4 to 40 Inches Summed Graph
Infrared thermometer takes canopy temp. does not measure soil moisture.

Technology developed by USDA

Easy to install.

Relatively expensive startup cost.
Known forever; less water = higher temperatures.

Asked forever; how high is too high?

**BIOTIC** uses a novel approach to determine how high:

**Time-Temperature Threshold**

(USDA Patent No. 5,539,637)
BIOTIC logic:

Is the Canopy Temperature above the Stress Temperature?

AND

Is the actual Relative Humidity below the Limited Relative Humidity (can irrigation cool the plant)?

IF both “YES” THEN

Add 15 minutes to the Stress Time

IF

Stress Time for the day is above the Time Threshold

THEN

Send “Irrigate” signal.
**Irrigation Signal**
Stress Time reaches Time Threshold

- **Time Threshold**
  - Based on local climate history

- **Stress Time**
  - Accumulates daily and resets at midnight

- **Limiting RH**
  - Too humid to cool plant with water
Those who are successful in managing irrigation with the aid of soil moisture or plant stress monitoring devices always track ET for the crop they are monitoring.
Conclusions

- Tools used to aid in irrigation decision making should be capable of measuring the full range of wetness or dryness expected for the crop being monitored.
- A good irrigation monitoring system in no substitute for a poor irrigator.
- ET data should be tracked season long and used to validate the accuracy of other methods employed to monitor water use or plant stress.
- An irrigator must understand the relationship between water use and yield potential.
Hypothetical Water Use Curve
Irrigated Cotton

Yield

% ET

40% 60% 80% 100%
Hypothetical Water Use Curve
Irrigated Corn

Bushels/ac

40% 60% 80% 100% 120%
% ET
“The frog does not drink up the pond in which he lives.”

American Indian Saying