Corn Irrigation Water Management Using ET and Soil Moisture Sensors

Texas AgriLife Extension Service
Colorado County
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Summary

Colorado County, located in the Coastal Bend Region of Texas, is comprised of about 32% cropland with Rice and Corn being the primary produced grains. Much of the cropland has the ability to be irrigated, with the most common irrigation practice being surface-furrow. Crop yields were widely reduced in 2008 and 2009 due to droughts and late or inadequate irrigation. Growers are beginning to adopt center pivot irrigation which required different water management practices than surface irrigation.

Three On-Farm Irrigation Demonstrations were conducted in Colorado County in 2010:

Two Demonstrations were with growers who had recently installed center pivot irrigation systems.

The third demonstration involved a producer employing surface-furrow irrigation.

On each field, one station of soil moisture sensors (Irrometer, WaterMark Sensor) was installed at depths of 1 foot, 2 foot and 3 foot. The growers regularly read the sensor, and transmitted the information along with irrigation and rainfall data to College Station. Extension Ag Engineering then produced graphs and displayed the data on the TexasET Network Website (http://TexasET.tamu.edu). The information was used along with real-time ET (evapotranspiration) data in order to determine the timing and amount of irrigations.

The information was found to be very useful to the cooperators in irrigation scheduling, with two growers eliminating an irrigation event at the end of the season which they would have applied without the sensors and data.

Objective

The goal of the demonstrations was to demonstrate how to use soil moisture and ET data for determining timing, amounts, and need for irrigation.

Materials and Methods

With assistance from Extension Ag Engineering, each grower installed 1 station of soil moisture sensors (Irrometer, WaterMark Sensor) at depths of 1 foot, 2 foot and 3 foot. The growers regularly read the sensors using a hand-held meter, and sent the readings along with rainfall and irrigation amounts to College Station using email and cell phones. Extension Ag Engineering then graphed the data and

posted the graphs on the TexasET Network Website (http://TexasET.tamu.edu). These graphs were constantly updated during the growing season and used to make irrigation decisions. Charts shows crop water requirements (ETc) and applied water (both irrigation and total water) were also created.

Grower	Kevin Hoffman	Mahalitc Brothers Farms	Fitz Leopold
Field Size	80 Acres	91 Acres	20 Acres
Planting Date	March 19, 2010	March 15, 2010	March 11, 2010
Sensor Install Date	April 16, 2010	May 7, 2010	May 7, 2010
Fertilizer	150 lb-N 18 lb-P 0 lb-K	150 lb-N 24 lb-P 0 lb-K	130.5 lb-N 15.84 lb-P 8.72 lb-K
Total Rainfall	14.7 inches	14.6 inches	14.6 inches
Total Irrigation	2.5 inches	2.25 inches	0.0 inches
Total Water*	17.2 Inches	16.85 Inches	14.6 Inches
Soil Type	Brazoria Clay	Norwood Loam & Mohat Loam	Laewest Clay
Irrigation System	Center Pivot	Center Pivot	Surface/Furrow with Gated Pipe

*Table does not reflect any pre-planting nor pre-sensor installation rainfall events.

Results and Discussion

Cooperator 1: Kevin Hoffman

Yield: 128 bu/ac

Total Crop Evapotranspiration: 23.22 inches

Fertilizer Use Efficiency- Nitrogen: 0.85 bu/acre/lb of Nitrogen
Fertilizer Use Efficiency- Phosphorus: 7.11 bu/acre/lb of Phosphorus

The 8.3 inches of rainfall which fell from May to early June delivered adequate and timely rainfall for the corn during its early growth and reproductive stages. Thus, only two irrigation events were necessary from the time the soil moisture sensors were installed until harvest time. The heavy soil type was key to the overall water use efficiency due to the significant water holding capacity to store soil moisture from rainfall during the corn's growth period.

Cooperator 2: Mahalitc Brothers Farms

Yield: 160 bu/ac

Total Crop Evapotranspiration: 22.73 inches

Fertilizer Use Efficiency-Nitrogen: 1.07 bu/acre/lb of Nitrogen
Fertilizer Use Efficiency- Phosphorus: 6.67 bu/acre/lb of Phosphorus

The lighter loam soil posed a greater management challenge for the growers to manage their crops' available water. Deep soils and frequent, timely rainfall events resulted in good soil moisture throughout the growing season. Despite receiving almost 4 inches of rainfall at the beginning of June, due to the low water holding capacity of the soil and the rainfall occurring during the peak water use of the corn (reproduction stages), the rainfall was barely sufficient to meet the crop water needs until harvest time. The growers noted that the use of the soil moisture sensors aided in the decision to cancel a planned irrigation event at the end of June.

Cooperator 3: Fitz Leopold

Yield:	120.2 bu/ac
Total Crop Evapotranspiration:	22.91 inches
Fertilizer Use Efficiency- Nitrogen:	0.9 bu/acre/lb of Nitrogen
Fertilizer Use Efficiency- Phosphorus:	7.59 bu/acre/lb of Phosphorus
Fertilizer Use Efficiency- Potassium:	13.78 bu/acre/lb of Potassium

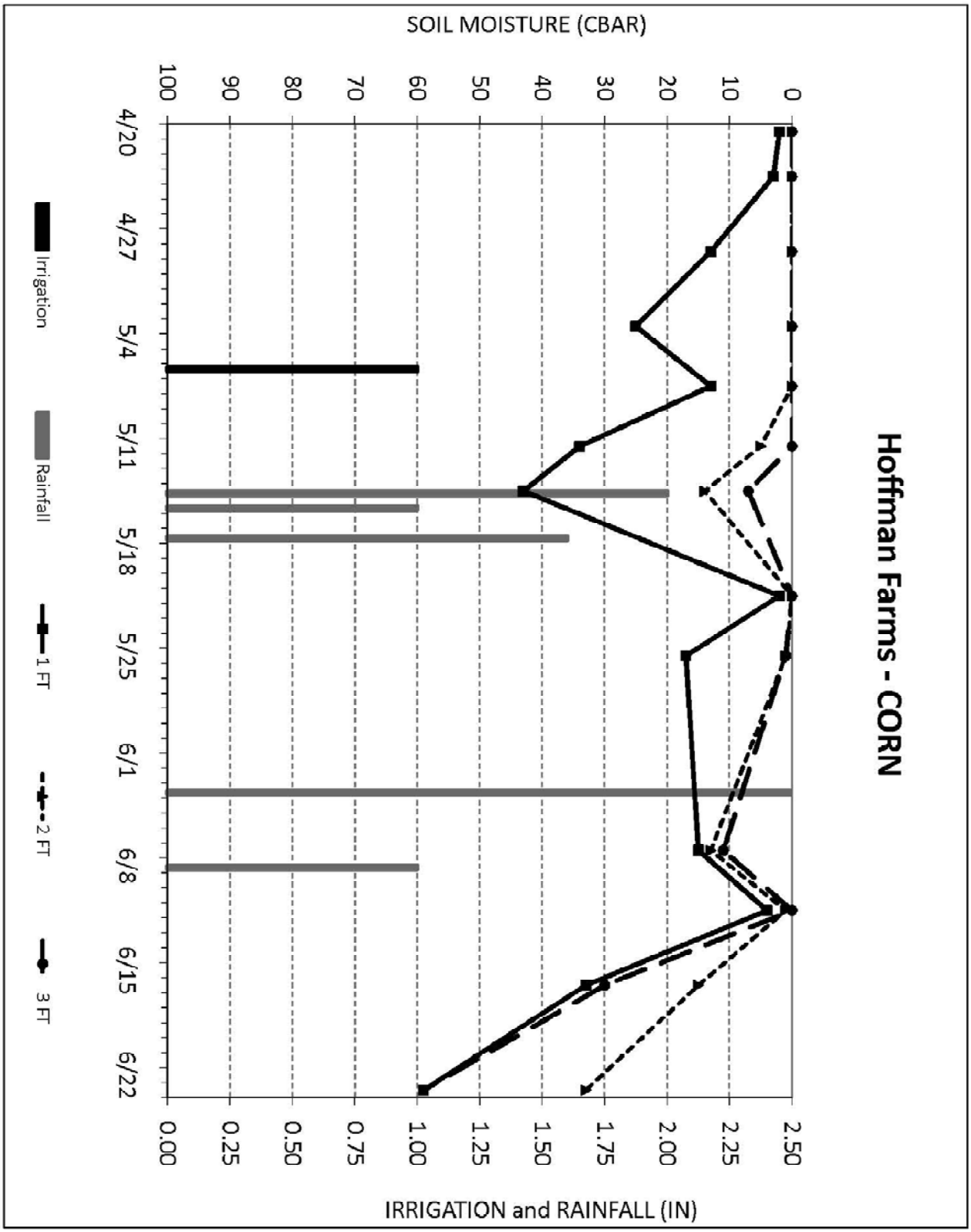
Heavy soils and significant rainfall events eliminated the need for any irrigation throughout the growing season for this grower. Soil moisture readings indicate consistent water use throughout all the soil depth profiles during the growing season. The use of soil moisture sensors proved key for this grower by providing the needed management data and eliminating the need to install the labor intensive gated pipe that would have been used to irrigate the field. Sensor readings showed direct responses to all rainfall events assuming that all rainfall was allowed to be effectively stored within the three soil moisture profiles.

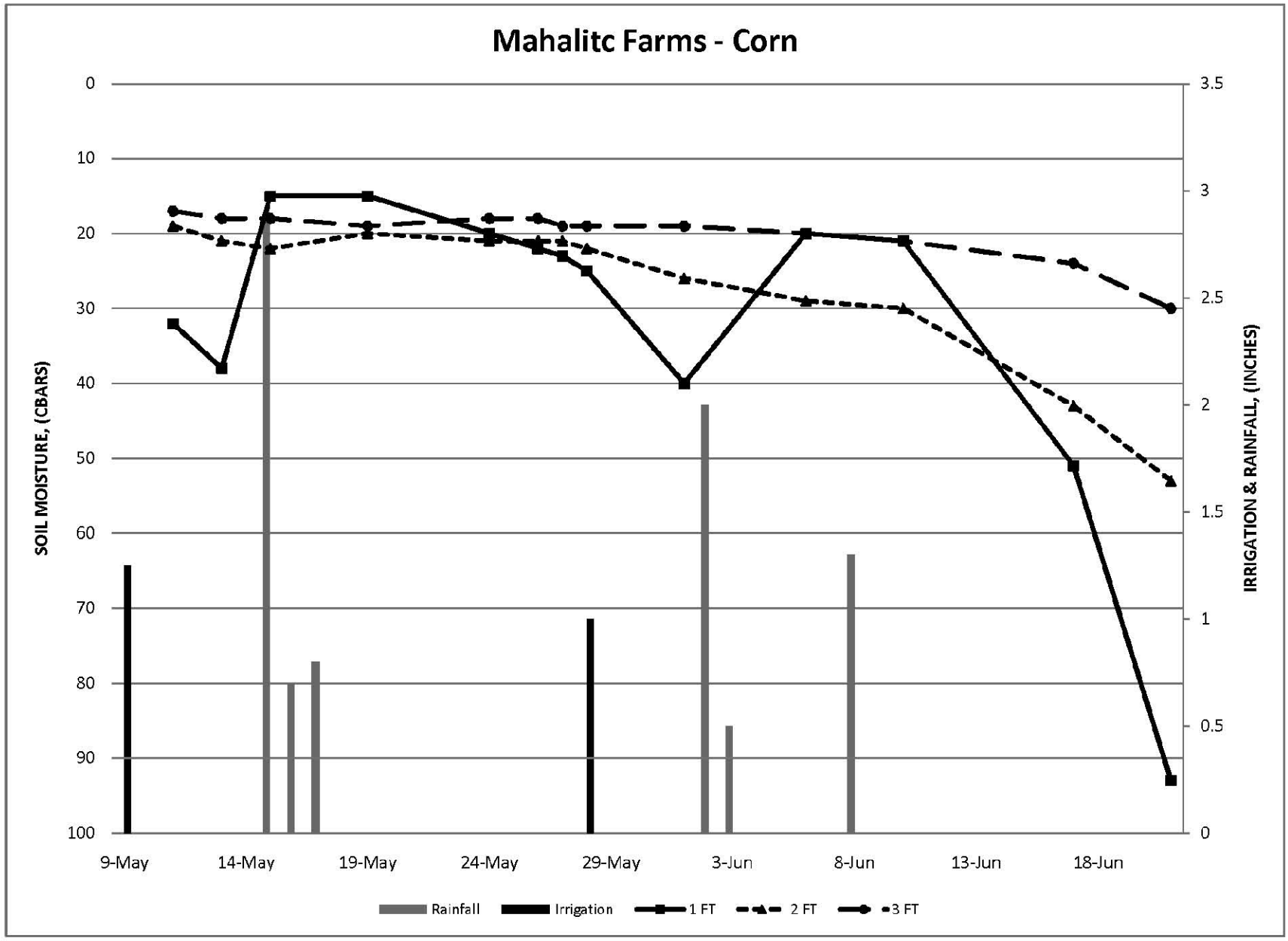
Conclusions

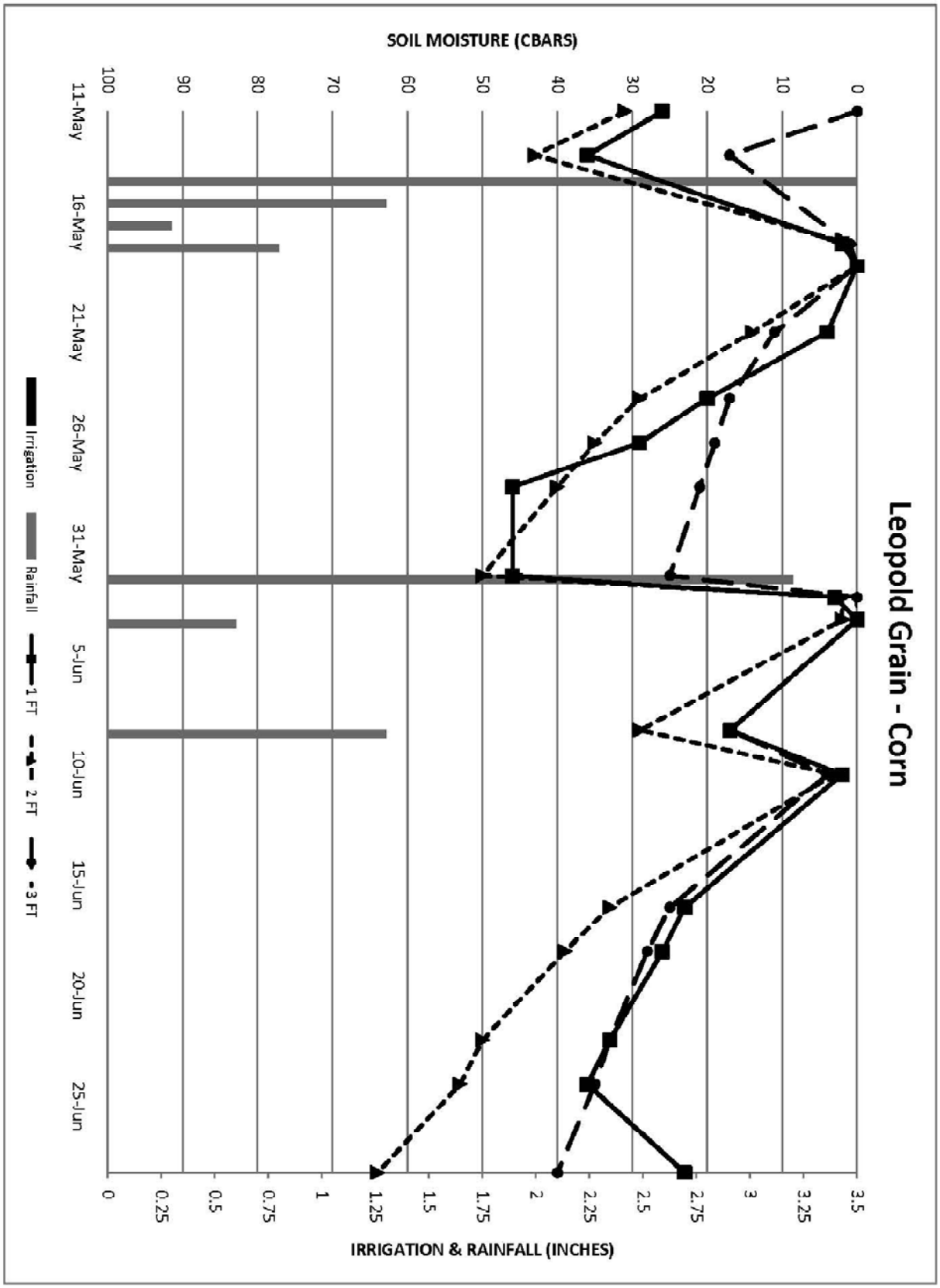
The use of soil moisture sensors proved to be a valuable decision making tool for the producer for the corn production year of 2010. As a result, the growers noted that the decision for irrigation was terminated based on their soil moisture sensors leading to cost savings in both energy and labor. The growers have expressed interest in continuing and expanding their use of soil moisture sensors for next year.

Acknowledgements

We would like to acknowledge Colorado County Extension Agent, Kara Matheney for her assistance in working with the growers to collect data during the course of the demonstration.




Mahalitc Farms - Corn
SOIL MOISTURE, (CBARS)
IRRIGATION & RAINFALL, (INCHES)
0
10
20
30
40
50
60
70
80
90
100
3.5
3
2.5
2
1.5
1
0.5
0
9-May
14-May
19-May
24-May
29-May
3-Jun
8-Jun
13-Jun
18-Jun
Rainfall
Irrigation
1 FT
2 FT
3 FT



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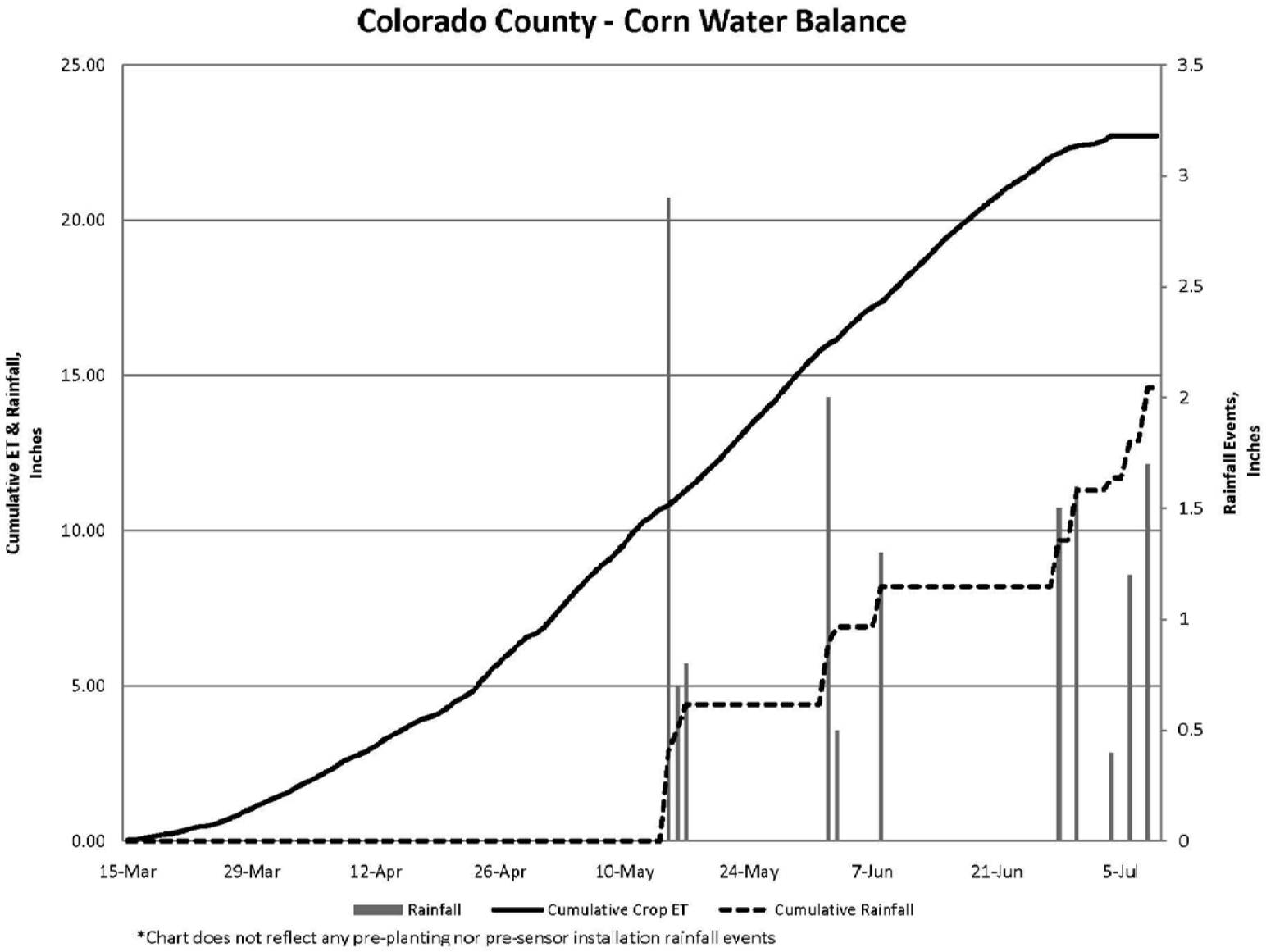
Colorado County - Corn Water Balance
25.00
20.00
15.00
10.00
5.00
0.00
3.5
3
2.5
2
1.5
1
0.5
0
Cumulative ET & Rainfall, Inches
Rainfall Events, Inches
15-Mar
29-Mar
12-Apr
26-Apr
10-May
24-May
7-Jun
21-Jun
5-Jul
Rainfall
Cumulative Crop ET
Cumulative Rainfall
*Chart does not reflect any pre-planting nor pre-sensor installation rainfall events