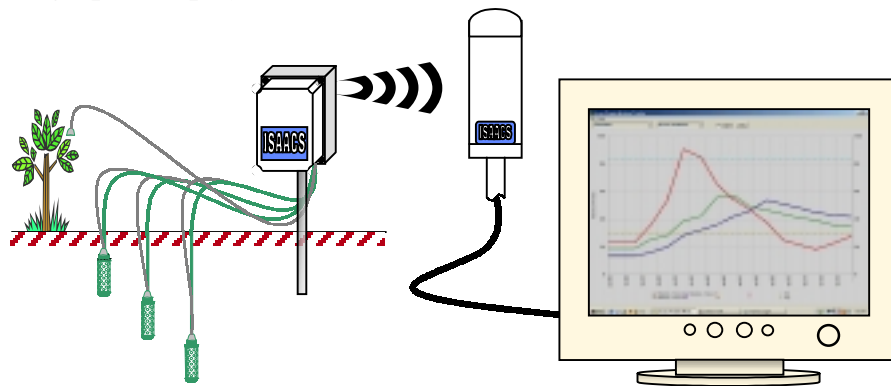




SOIL MOISTURE MONITORING SYSTEM Reference

THE ISAACS SOIL MOISTURE MONITORING ADVANTAGE

The Isaacs Remote Soil Moisture Monitoring System is designed to make tracking soil moisture levels easier and faster by reporting via radio to a central computer for data logging and graphic display.



In-field measurements of soil moisture help determine how fast the soil is being depleted of moisture, and WHEN to initiate an irrigation cycle to replenish moisture for maximum plant growth. By obtaining soil moisture readings in different areas of the field, and at different depths in the root zone, an irrigator can establish HOW MUCH water to apply and WHERE to apply it. With experience this "Irrigation to Need" can help:

- ***Reduce Water Usage***
- ***Lower Energy Bills***
- ***Increase Crop Yields and Quality***
- ***Prevent Excessive Leaching of Fertilizers and Chemicals***
- ***Reduce Crop Disease***

USING THE ISAACS SOIL MOISTURE MONITORING SYSTEM

Moisture Points, graphed from WET Saturated Soil to DRY near Wilting Point Soil, provide data to evaluate the range of moisture available to the plant. The graph has two adjustable dashed limit lines. The high level line (blue dashes) allows a quick visual reference to chosen Full Capacity levels. The low level line (amber dashes) can be set as a soil drying limit.

The point at which the rate of soil moisture extraction begins to decrease (indicating that the plant is running out of available water) may differ from one site to another due to soil and other variations. Therefore, although, the “Moisture Points” used in the graph roughly parallel centibar readings from a Watermark meter, it is suggested to **concentrate on the trends** in the graphs instead of the specific numbers.

By going out and observing field wet/dry conditions and comparing that information to the graph of your Isaacs software, you will soon be able to schedule irrigation without going to the field. **However, you do have to learn how to evaluate and apply the readings to each of your monitoring sites and sensors.**

WHAT THE READINGS MEAN

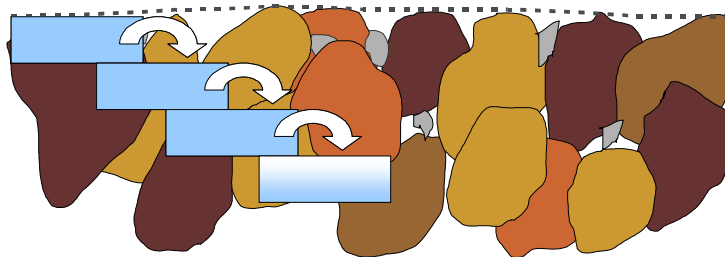
The Isaacs Soil Moisture Monitoring readings reflect soil water tension or suction. The system internally converts the electrical reading of the sensors to this tension or suction value. This value is a direct indicator of how hard the plant root system has to work to extract water from the soil. (On the graph, wetter soils have a lower number and drier soils have a higher number.)

WHERE TO MEASURE THE SOIL MOISTURE PROFILE

Water will travel to subsequent soil layers only as the *Field Capacity* is reached in the adjoining layer. Therefore, measuring soil moisture in each layer of soil within the plant root zone seems prudent. Research indicates that 70% of the water used by a plant comes from the top 50% of the root zone. So if we have a single soil layer throughout the root zone will one sensor suffice? That depends on the plants potential root zone. You might want the root to grow to its optimum depth for various reasons including insurance against drought in the upper layers of soil. Additional probes at various depths can provide valuable information.

WATER MOVEMENT

*Water moves to the next deeper layer of the soil reservoir
Only after each part of the soil reservoir exceeds field capacity*



HOW OFTEN READINGS SHOULD BE TAKEN

Isaacs Moisture Management System is set to take readings every four (4) hours, but the time intervals can be changed to read the Watermark sensors every one (1), six (6), or twelve (12) hours. Consistent, regular readings provide a window of observation in real time without going to the field.

SOIL – WATER – PLANT RELATIONSHIPS

Plants rely upon the soil for two things, “*Support*” and “*Sustenance*”. *Support* means that the plant roots to be sufficiently established to physically support the plant *Sustenance* means that the soil readily supplies the nutrients and water required by the plant.

Evaluating the soil’s ability to support a crop is done based on historical evidence. Evaluating soil’s ability to *sustain* a crop is also based in part on historical evidence. This variable is however, more difficult to observe as the nutrient and water are both constantly changing, hidden from view below the soil surface.

The soil acts as a reservoir for the water and nutrients. Different soils have different abilities to hold water depending on the adhesive properties of the soil. Adhesion is tension (how strongly the soil holds onto the water in its pores.) “*Tension*” exists in a gradient within the soil. The higher the bond between the water and soil the harder the plant must work to extract the necessary water for continued plant growth.

Some bench mark levels of soil tension on water are:

Saturation: All the pores of one layer of soil are filled with water and gravity pulls water deeper into the soil profile. *Saturation* of an upper soil layer is required before water will move through to a different soil layer. . (The amount of water required per foot of soil varies with soil type.) *Note: Saturated soil has no air space resulting in poor crop performance.*

Field Capacity: This is the amount of water that each differing soil type can hold after gravity has pulled (against the soil tension) all the water it can down through the soil profile. *Field Capacity* offers the plant the optimum balance of air, nutrient and water. The amount of water in the soil profile at this bench mark level varies with soil type.

Wilting Point: This is the level of soil water content at which one sees plants begin to wilt. At this level the plant’s ability to withdraw water from the soil reservoir (suction) is less than the soil ability to hold onto the water (tension). This bench mark level varies with soil type and also crops. Different crops have different abilities to extract (suction) water from the soil without adverse effects (*wilting*). If re-wet, a plant will recover from this level of *suction*, but crop performance will likely suffer.

Permanent Wilting Point: Here the tension is also greater than the plant suction however, plants will not recover after being re-wet.

It is easy to understand that for optimum crop performance soil water tension needs to be managed to near field capacity. (Where water will move through the profile and plant suction will be at some point above the Wilting Point.) The Isaacs Soil Moisture System gives the manager the ability to collect data at regular intervals for evaluating crop needs. The sensor technology utilized measures tension exerted on the water by the soil. Because the Wilting Point of a crop is determined by the suction required of the plant to get needed water, the resulting values indicate how hard the plant is having to work to continue to thrive. Sounds complicated, but is easy to follow with the IMMS.

SAMPLE WATERMARK READINGS

The following information was developed by, and provide with permission of, Howard Nebling from the University of Idaho Extension Office: These are examples of different holding capacities and tension values of different soils and crops.

WATERMARK READINGS	
Heavier-Textured Silt Loam (2.25"/ft) Stress Point = 50% available (alfalfa, beets, grain, corn, pasture)	
0 Saturated Soil	
0-30 Leaching Possible	
30-75 Best Crop Growth	
>75 Crop Water Stress	
Percent Available Soil Water	Watermark Reading cbars
100	30
85	38
80	42
75	45
70	50
65	55
60	62
55	68
50	75

WATERMARK READINGS	
Heavier-Textured Silt Loam (2.25"/ft) Stress Point = 50% available (potatoes, mint, onions, dry beans)	
0 Saturated Soil	
0-30 Leaching Possible	
30-62 Best Crop Growth	
>62 Crop Water Stress	
Percent Available Soil Water	Watermark Reading cbars
100	30
85	38
80	42
75	45
70	50
65	55
60	62
55	68
50	75

WATERMARK READINGS	
Light-Textured Silt Loam (1.97"/ft) Stress Point = 50% available (alfalfa, beets, grain, corn, pasture)	
0 Saturated Soil	
0-10 Leaching Possible	
10-40 Best Crop Growth	
>40 Crop Water Stress	
Percent Available Soil Water	Watermark Reading cbars
100	10
85	15
80	17
75	20
70	22
65	25
60	30
55	35
50	40

WATERMARK READINGS	
Light-Textured Silt Loam (1.97"/ft) Stress Point = 50% available (potatoes, mint, onions, dry beans)	
0 Saturated Soil	
0-10 Leaching Possible	
10-25 Best Crop Growth	
>25 Crop Water Stress	
Percent Available Soil Water	Watermark Reading cbars
100	10
85	15
80	17
75	20
70	22
65	25
60	30
55	35
50	40

WATERMARK READINGS	
Light-Textured Silt Loam (1.67"/ft) Stress Point = 50% available (alfalfa, beets, grain, corn, pasture)	
0 Saturated Soil	
0-10 Leaching Possible	
10-30 Best Crop Growth	
>30 Crop Water Stress	
Percent Available Soil Water	Watermark Reading cbars
100	10
85	12
80	14
75	16
70	18
65	20
60	24
55	27
50	30

WATERMARK READINGS	
Light-Textured Silt Loam (1.67"/ft) Stress Point = 50% available (potatoes, mint, onions, dry beans)	
0 Saturated Soil	
0-10 Leaching Possible	
10-24 Best Crop Growth	
>24 Crop Water Stress	
Percent Available Soil Water	Watermark Reading cbars
100	10
85	12
80	14
75	16
70	18
65	20
60	24
55	27
50	30

WATERMARK READINGS	
Light-Textured Silt Loam (1.41"/ft) Stress Point = 50% available (alfalfa, beets, grain, corn, pasture)	
0 Saturated Soil	
0-20 Leaching Possible	
20-58 Best Crop Growth	
>58 Crop Water Stress	
Percent Available Soil Water	Watermark Reading cbars
100	20
85	25
80	29
75	34
70	38
65	41
60	45
55	50
50	58

WATERMARK READINGS	
Light-Textured Silt Loam (1.41"/ft) Stress Point = 50% available (potatoes, mint, onions, dry beans)	
0 Saturated Soil	
0-20 Leaching Possible	
20-45 Best Crop Growth	
>45 Crop Water Stress	
Percent Available Soil Water	Watermark Reading cbars
100	20
85	25
80	29
75	34
70	38
65	41
60	45
55	50
50	58

NOTE:

Specifications and Technical Assistance: While we provide application assistance personally and through our literature, it is the customer's responsibility to determine suitability of the product to the application and correctness of the assistance. Specifications may change at any time and without notice. The information supplied is believed to be accurate and reliable. We assume no responsibility for its use.



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