University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Historical Materials from University of Nebraska-Lincoln Extension

Extension

1979

EC79-723 Irrigation Scheduling Using Soil Moisture Blocks in Deep Soil

Dean E. Eisenhauer
University of Nebraska-Lincoln, deisenhauer1@unl.edu

Paul E. Fischbach

Walter L. Trimmer

Follow this and additional works at: http://digitalcommons.unl.edu/extensionhist

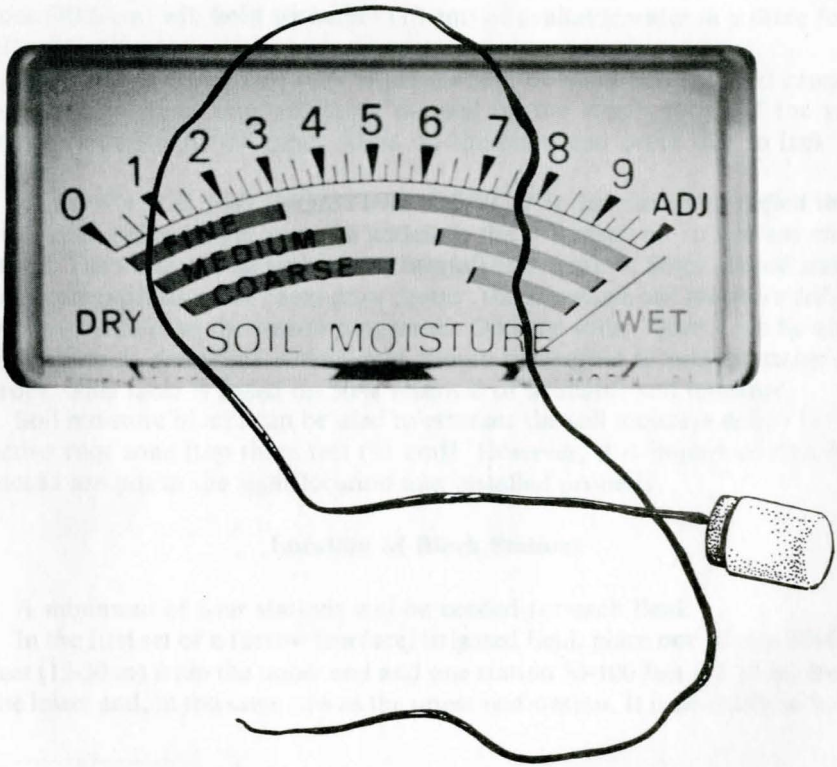
Eisenhauer, Dean E.; Fischbach, Paul E.; and Trimmer, Walter L., "EC79-723 Irrigation Scheduling Using Soil Moisture Blocks in Deep Soil" (1979). *Historical Materials from University of Nebraska-Lincoln Extension*. 4512.
http://digitalcommons.unl.edu/extensionhist/4512

This Article is brought to you for free and open access by the Extension at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Historical Materials from University of Nebraska-Lincoln Extension by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

AGRI
S
85
E7
#79-723

EC 79-723

Irrigation Scheduling Using Soil Moisture Blocks in Deep Soil



Extension work in "Agriculture, Home Economics and subjects relating thereto," The Cooperative Extension Service, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, Cooperating with the Counties and the U.S. Department of Agriculture
Leo E. Lucas, Director

Irrigation Scheduling Using Soil Moisture Blocks in Deep Soil

Dean E. Eisenhauer, Paul E. Fischbach, Walter L. Trimmer, and Richard A. Krohn/[1]

A. Soil Moisture Deficit

The soil profile is similar to a reservoir or tank. It will hold a certain amount of moisture, and is the source of water for the plant. The capacity of this reservoir depends upon the soil's available water-holding capacity and the depth of root development of the crop. The root depth by stage of growth and available water-holding capacity of several soils are listed in *Tables 1* and *2*, respectively. A silt loam that holds two inches (5 cm) of available water per foot (30.5 cm) will hold six inches (15 cm) of available water in a three foot (91 cm) root zone.

SOIL MOISTURE DEFICIT is the amount of water below "field capacity" that has been removed from the soil by the crop's roots. If the soil moisture deficit is too great, stress on the plant can occur due to lack of water.

ALLOWABLE SOIL MOISTURE DEFICIT is the maximum deficit that can occur before water must be added to the soil reservoir to prevent crop stress. The water can be replaced by rainfall or irrigation. Since the soil water reservoir expands as the roots grow deeper, the allowable soil moisture deficit *becomes greater* as the *season progresses.* On *deep* soils, *Table 3* can be used as a guide to determine when water should be applied to prevent stress on crops. This table is based on 50% removal of available soil moisture.

Soil moisture blocks can be used to estimate the soil moisture deficit in the active root zone [top three feet (91 cm)]. However, it is important that the blocks are put in the right location and installed properly.

Location of Block Stations

A minimum of four stations will be needed for each field.

In the first set of a furrow (surface) irrigated field, place one station 50-100 feet (15-30 m) from the upper end and one station 50-100 feet (15-30 m) from the lower end, in the same row as the upper end station. It is desirable to have

[1]Dean E. Eisenhauer and Walter L. Trimmer are District Extension Specialists (Irrigation); Paul E. Fischbach is Extension Irrigationist; and Richard A. Krohn is Extension Associate (resigned).

four stations in the first set for averaging purposes if every other furrow was compacted during planting and cultivating operations. Also, two stations in the last irrigation set are desirable to help when rainfall occurs. *Figures 1* and *2* can be used as a guide in locating stations. Refer to a soil map if available.

Some general guidelines for locating each station:

1. Place electrical resistance blocks in the crop row. For furrow irrigation, angle the blocks toward the furrow.
2. Locate the stations in representative areas of the field. Don't place the blocks in low spots in the field, or on excessively steep or flat slopes of the irrigation run.
3. Select a station where the plant population is representative of the field. (*Caution:* Don't destroy crop near electrical resistance block station.)
4. Keep the soil around the electrical resistance block station from becoming compacted when taking readings. Don't walk in furrows in which soil moisture readings are being measured. Walk in the adjacent furrow. Mark each "walk" furrow when installing the resistance blocks by placing flags in each row beside the walk furrow.
5. When using sprinkler systems, make sure the blocks are set so they will not be damaged when the sprinkler is moved. For center pivots, place stations 1 and 3 eighty-five percent, and stations 2 and 4 fifteen percent of the length of center pivot system from the pivot point. Place stations 1 and 2 far enough away from stop position to insure that water does not reach the stations when the center pivot is in park position.

Depth of Installation

To estimate soil moisture deficit, use *three* depths at each station. These three blocks should be placed at 0.5, 1.5, and 2.5 feet (15, 45.7, and 76 cm). These depths would be *relative to level ground surface at planting time* (after cultivation for listing). The 0.5 foot (15 cm) block would represent the first foot (30.5 cm) of soil, and the 1.5 and 2.5 foot (45.7 and 76 cm) blocks represent the second and third foot (61 and 91 cm), respectively. For established alfalfa, an additional block at 3.5 feet (1.07 m) is desirable.

Installation of Blocks

Equipment needed:

Soil probe
1/2 inch (1.3 cm) conduit, 4 feet (1.2 m) long with slot one inch (2.54 cm) from the end

Flags
Lath
Water and bucket
Block meter
Blocks
3/8 or 1/2 inch (.95 or 1.3 cm) dowel pin 4 feet (1.2 m) long

1. The electrical resistance blocks should be thoroughly soaked for one hour in a pail of water and allowed to dry for about a day. (An oven can be used to speed up the cycling of the blocks.) *Repeat* this cycle *two more times* before installing. Soaking removes air from the blocks and helps to insure accurate readings of soil moisture. (See manufacturer's recommendations for soaking time.)
2. A soil probe is used to make a hole in the row slightly larger than the electrical resistance block. Make each hole the desired depth. Each block should be placed in a separate hole.
3. Check each soil moisture block with the block meter. Each block should have a reading of 10 when operating properly (200 on the old Delmhorst scale).
4. Pour a small amount of water through the conduit to excessively wet the soil in the bottom of the hole so that the block will push into the soil easily.
5. Thread the soil moisture block through the slot in the 1/2 inch (1.3 cm) conduit. Using the conduit, set the block solidly into the moist soil at the bottom of the hole with a firm push. *Firm soil contact between the block and surrounding soil must be made.*
6. Fill the hole with soil, three or four inches (7.6 or 10 cm) at a time, tamping the soil firmly as the hole is filled. Make sure the hole is filled completely with compacted soil.
7. Stake the wire leads. Bring the wire leads from the blocks to a single stake midway between the holes and tie them to the stake. Make sure you can tell the wires apart. Tie one knot in the wires of the 0.5 foot (15 cm) block, two for the 1.5 foot (45.7 cm) block, and three for the 2.5 foot (76 cm) block. (Other identification procedures such as water proof tags can be used, or tie the leads to the stake in the same order as the depths they represent.)
8. Check each block with the block meter to make certain that no damage was done to it during installation. The block meter should read 10 on the new scale or 200 on the old Delmhorst meter scale.

9. Properly mark the row in which the blocks are placed. Use flags or lath so the block stations can be found easily.

10. Install the blocks early, before lay-by time if possible (but no later than a few days after lay-by), to allow time for the plant roots to grow around the moisture block. If the blocks are installed late in the growing season, it may create problems in securing representative readings.

B. Calculating Soil Moisture Deficit

The following is an example of how the soil moisture deficit in the active root zone can be calculated from block readings.

Assume that the following block readings were taken on July 30 on a furrow-irrigated field. Also, assume that the field is a Holdrege silt loam which has a silt loam topsoil and a silty clay loam subsoil. Two block stations are located in the first set and two stations are in the last irrigation set.

First Irrigation Set	*Depth*	*Block Readings*
Upper End—Station #1	0.5' (15.2 cm)	1.5
	1.5' (45.7 cm)	3.5
	2.5' (76.2 cm)	10.0
Lower End—Station #2	0.5' (15.2 cm)	5.0
	1.5' (45.7 cm)	2.5
	2.5' (76.2 cm)	10.0
Last Irrigation Set		
Upper End—Station #3	0.5' (15.2 cm)	6.0
	1.5' (45.7 cm)	3.5
	2.5' (76.2 cm)	10.0
Lower End—Station #4	0.5' (15.2 cm)	6.5
	1.5' (45.7 cm)	4.0
	2.5' (76.2 cm)	10.0

First, record the readings on the data sheet. (See example data sheet.)

The deficit for each foot (30.5 cm) of soil is obtained by referring to *Table 4* and using Soil Type 3. The deficit for Station #1 was 1.55 inches (3.94 cm) for the first foot (30.5 cm), 0.85 inch (2.16 cm) in the second foot (61 cm), and 0.0 inches (0.0 cm) for the third foot (91 cm). The total deficit in the top three feet (91 cm) is the sum of each one-foot (30.5 cm) layer or 2.40 inches (6.10 cm) [1.55 + .85 + 0 (3.94 + 2.16 + 0)]. Therefore, with the block readings, the soil moisture deficit is 2.40 inches (6.10 cm) for Station #1. After finding the soil moisture deficit for each station, Stations #1 and #2 are averaged in the first irrigation set [2.4 + 1.72 divided by 2 = 2.06 inches (6.10 + 4.37 divided by 2 = 5.24 cm)]. Therefore, the average soil moisture

deficit is 2.06 inches (5.24 cm) and 1.23 inches (3.12 cm) in the first and last set respectively.

C. Predicting Irrigation Timing and Amount Based on Soil Moisture Deficit and Crop Water Use

THE REMAINING USABLE MOISTURE is equal to the allowable soil moisture deficit minus the present soil moisture deficit. The maximum number of days before the next irrigation is equal to the remaining usable moisture divided by the predicted daily water use rate; i.e. how long will the remaining usable moisture last?

Example: (see scheduling data sheet, first set)

Allowable soil moisture deficit	= 3.0" (7.62 cm)
Present deficit based on block readings	= 2.06" (5.23 cm)
Remaining usable moisture	= 3.0" - 2.06" = 0.94" (7.62 cm - 5.23 cm = 2.39 cm)
Days until next irrigation	= 0.94" ÷ 0.30" per day = 3 days (2.39 cm ÷ 0.76 cm per day = 3 days)

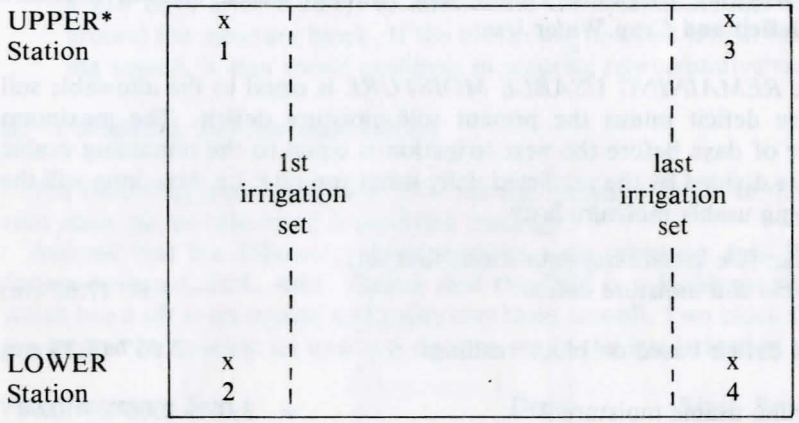
Predicted daily water use for various crops can be based on what occurred during the previous week. This information may be available from various sources. If not, the normal water use by stage of growth as presented in *Table 5* can be used.

Water should be added to the soil profile on or before the allowable soil moisture deficit occurs. The irrigation schedule will depend upon the calculated soil moisture deficits and the amount of time it takes to irrigate the field. For example, if it takes five days to irrigate the field in the example problem, irrigation should be started in one day. This is because there are six days of moisture remaining in the last set, but it will take five days to get there; therefore, the system should be started in one day.

The soil moisture deficit on the day of irrigation is the maximum amount of water should be applied; i.e., if you allow three inches (7.62 cm) to be depleted during pollination, three inches (7.62 cm) is the *maximum* gross amount that should be applied. When the gross application does not exceed the soil moisture deficit, there will be room left in the root zone for capturing and storing rainfall. This is because water applications are not 100 percent efficient.

For more information on measuring and calculating irrigation water applications, refer to NebGuides G78-392 (Selecting and Using Irrigation Propeller Meters) and G78-393 (Water Measurement Calculations).

Figure 1. Location of block stations for furrow irrigation systems and set-type sprinkler systems, such as tow lines, traveling guns and booms.



*When using four row equipment, you will have tractor wheel tracks in every other furrow. You may wish to place four stations instead of two stations in the first set—two representing compacted furrows and two representing non-compacted furrows.

Figure 2: Location of block stations for center pivot systems.

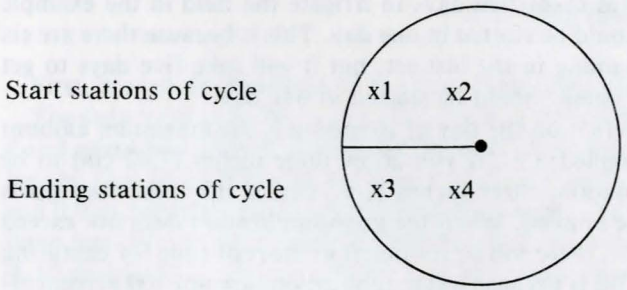


Table 1. Root depth versus stage of growth.

Assumed Root Depth	*Stage of Crop Development*		
	Corn	*Grain Sorghum*	*Soybeans*
ft (m)			
2.0 (0.6)	12 leaf		Early Bloom
2.5 (0.75)	Early Tassel—16 leaf	Flag Leaf	Full Bloom
3.0 (0.9)	Silking	Boot	Pod Development
3.5 (1.05)	Blister	Bloom	
4.0 (1.20)	Beginning Dent	Dough	Full Seed Fill (Green bean)

Root development may be restricted to a depth less than assumed due to compaction or limiting layers. Established alfalfa has a root zone greater than 4 feet (1.20 m) unless root development is restricted.

Table 2. Available water capacity of various soil profiles

Soil Type	*Soil Profile*		*Inches/foot (mm/m)*
0	Sandy Clay Loam		2.0 (166.6)
1	Silty Clay Loam		1.8 (149.9)
2	Clay Loam		1.8 (149.9)
3	Loam, Very Fine Sandy Loam, or Silt Loam Topsoil	Silty clay loam, or silty clay subsoil	2.0 (166.6)
4	Loam, Very Fine Sandy Loam, or Silt Loam Topsoil	Medium textured subsoil	2.5 (208.3)
5	Fine Sandy Loam		1.8 (149.9)
6	Sandy Loam		1.4 (116.6)
7*	Loamy Sand		1.1 (91.6)
8*	Fine Sands		1.0 (83.3)
9	Silty Clay Clay		1.6 (133.3)

*Note: Tensiometers should be used on Soil Types 7 and 8.

Table 3. Allowable soil moisture deficit, inches.

Soil Type (See Table 2)	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Root Dept, ft.										
1.5	1.5	1.4	1.4	1.5	1.9	1.4	1.0	0.8	0.8	1.2
2.0	2.0	1.8	1.8	2.0	2.5	1.8	1.4	1.1	1.0	1.6
2.5	2.5	2.2	2.2	2.5	3.1	2.2	1.8	1.4	1.2	2.0
3.0	3.0	2.7	2.7	3.0	3.8	2.7	2.1	1.6	1.5	2.4

Allowable soil moisture deficit, millimeters (mm)

	0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Root Depth, m										
.45	38.1	35.6	35.6	38.1	48.3	35.6	25.4	20.3	20.3	30.5
.60	50.8	45.7	45.7	50.8	63.5	45.7	35.6	27.9	25.4	40.6
.75	63.5	55.9	55.9	63.5	78.7	55.9	45.7	35.6	30.5	50.8
.90	76.2	68.9	68.9	76.2	96.5	68.9	53.3	40.6	38.1	61.0

For corn and grain sorghum, 75% of available soil moisture may be removed after dough stage of growth when monitoring a 3-foot (.90 m) depth.

Table 4. Soil moisture deficit vs. block readings (Delmhorst blocks).

Soil Type[1/]		*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Block Readings		Inches Depletion per Foot of Soil									
New Scale	Old Scale										
10.0	200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.5	190	0.00	0.00	0.05	0.00	0.00	0.25	0.20	0.13	0.13	0.10
9.0	180	0.00	0.00	0.10	0.00	0.00	0.50	0.40	0.25	0.27	0.20
8.5	170	0.13	0.10	0.22	0.08	0.15	0.60	0.48	0.30	0.33	0.30
8.0	160	0.26	0.21	0.34	0.16	0.30	0.70	0.56	0.35	0.39	0.40
7.5	150	0.38	0.30	0.39	0.23	0.38	0.75	0.61	0.38	0.42	0.49
7.0	140	0.50	0.40	0.45	0.30	0.45	0.80	0.65	0.40	0.45	0.58
6.5	130	0.60	0.50	0.50	0.38	0.55	0.90	0.70	0.44	0.48	0.63
6.0	120	0.70	0.60	0.56	0.45	0.65	1.00	0.74	0.47	0.52	0.68
5.5	110	0.77	0.65	0.61	0.53	0.73	1.01	0.77	0.49	0.55	0.73
5.0	100	0.85	0.71	0.67	0.60	0.80	1.03	0.80	0.51	0.58	0.78
4.5	90	0.95	0.83	0.74	0.69	0.90	1.07	0.83	0.53	0.60	0.83
4.0	80	1.05	0.95	0.82	0.78	1.00	1.10	0.85	0.55	0.63	0.88
3.5	70	1.27	1.03	0.87	0.85	1.13	1.15	0.90	0.60	0.66	0.94
3.0	60	1.30	1.12	0.93	0.94	1.25	1.20	0.95	0.65	0.69	1.00
2.5	50	1.40	1.31	1.09	1.12	1.48	1.30	1.08	0.73	0.74	1.10
2.0	40	1.50	1.50	1.25	1.30	1.70	1.40	1.20	0.80	0.80	1.20
1.5	30	1.73	1.62	1.42	1.55	1.95	1.55	1.30	0.90	0.86	1.35
1.0	20	1.96	1.75	1.70	1.80	2.20	1.70	1.40	1.00	0.93	1.50
0.5	10	1.98	1.77	1.75	1.90	2.35	1.72	1.40	1.05	0.96	1.55
0.0	0	2.00	1.80	1.80	2.00	2.50	1.80	1.40	1.10	1.00	1.60

1/ See Table 2 for soil types.

Table 4. (Continued)

Soil Type[1]		*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Block Readings New Scale	Old Scale	Millimeters Depletion per Meter of Soil									
10.0	200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.5	190	0.00	0.00	4.17	0.00	0.00	20.83	16.66	10.83	10.83	8.33
9.0	180	0.00	0.00	8.33	0.00	0.00	41.65	33.32	20.83	22.49	16.66
8.5	170	10.83	8.33	18.33	6.66	12.50	49.98	39.98	24.99	27.49	24.99
8.0	160	21.66	17.49	28.32	13.33	24.99	58.31	46.65	29.16	32.49	33.22
7.5	150	31.65	24.99	32.49	19.16	31.65	62.48	50.81	31.65	34.99	40.82
7.0	140	41.65	33.32	37.49	24.99	37.49	66.64	54.15	33.32	37.49	48.31
6.5	130	49.98	41.65	41.65	31.65	45.82	74.97	58.31	36.65	39.98	52.48
6.0	120	58.31	49.98	46.65	37.49	54.15	83.30	61.64	39.15	43.34	56.64
5.5	110	64.14	54.15	50.81	44.15	60.81	84.13	64.14	40.82	45.82	60.81
5.0	100	70.81	59.14	55.81	49.98	66.64	85.80	66.64	42.48	48.31	64.97
4.5	90	79.14	69.14	61.64	57.48	74.97	89.13	69.14	44.15	49.98	69.14
4.0	80	87.47	79.14	68.31	64.97	83.30	91.63	70.81	45.82	52.48	73.30
3.5	70	105.79	85.80	72.47	70.81	94.13	95.80	74.97	49.98	54.98	78.30
3.0	60	108.29	93.30	77.47	78.30	104.13	99.96	79.14	54.15	57.48	83.30
2.5	50	116.62	109.12	90.80	93.30	123.28	108.29	89.96	60.81	61.64	91.63
2.0	40	124.95	124.95	104.13	108.29	141.61	116.62	99.96	66.64	66.64	99.96
1.5	30	144.11	134.95	118.29	129.12	162.44	129.12	108.29	74.97	71.84	112.46
1.0	20	163.27	145.78	141.61	149.94	183.26	141.61	116.62	83.30	77.47	124.95
0.5	10	164.93	147.44	145.78	158.27	195.76	143.28	116.62	87.47	79.97	129.12
0.0	0	166.60	149.94	149.94	166.60	208.25	149.94	116.62	91.63	83.30	133.28

[1]/See Table 2 for soil types.

Table 5. Approximate water use rates by stage of growth for various crops

Water Use Rate in/day (mm/day)	*Corn*	*Grain Sorghum*	*Soybeans*	*Alfalfa*[1]/
0.18 (4.57)				
0.20 (5.08)			Full Bloom	
0.24 (6.10)	12 Leaf			
0.26 (6.60)		Flag Leaf	Beginning Pod	
0.28 (7.11)	Early Tassel	Boot		June 15
0.30 (7.62)	Silking	Half Bloom	Full Pod Development	July 1
0.28 (7.11)				August 1
0.26 (6.60)	Blister Kernel	Soft Dough		
0.24 (6.10)	Milk		Full Seed Fill	August 15
0.22 (5.59)				September 1
0.20 (5.08)	Beginning Dent			
0.18 (4.57)	Full Dent	Hard Dough		

[1]/Alfalfa water use rates should be multiplied by 0.50 during the first ten days following cutting and by 0.75 from the tenth to twentieth following cutting.

SCHEDULING DATA SHEET

NAME Joe Irrigator DATE 7/30

WELL NO. 1 CROP Corn

Block Readings
(See *Table 4* for Deficit)

	First Set				Last Set			
	Station #1 UPPER		Station #2 LOWER		Station #3 UPPER		Station #4 LOWER	
*Depths (ft)	Block Reading	*Deficit (inches)	Block Reading	Deficit (inches)	Block Reading	Deficit (inches)	Block Reading	Deficit (inches)
0.5	1.5	1.55	5.0	.60	6.0	.45	6.5	.38
1.5	3.5	.85	2.5	1.12	3.5	.85	4.0	.78
2.5	10.0	00	10.0	00	10.0	00	10.0	00
Total Deficit	Station #1	2.40	Station #2	1.72	Station #3	1.30	Station #4	1.16

Average Deficit First Set 2.06 (inches) Last Set 1.23 (inches)

Water Management Data

Step No.		1st Set inches	Last Set inches	
1.	Allowable deficit in top 3 feet before irrigation is recommended—See *Table 3* (at 50% depletion).	3.0	3.0	
2.	Present deficit in top 3 feet.	2.06	1.23	
3.	Remaining usable moisture in top 3 feet (1 minus 2).	.94	1.77	
4.	Estimated average daily water use rate (see *Table 5*).	.30	.30	
5.	Estimated number of days until irrigation is needed at block locations if no rain occurs (3 ÷ 4).	3	6	Days
6.	Water Meter Reading _____			
7.	Rainfall this period _____			

*To convert feet to meters, multiply by .30; to convert inches to millimeters, multiply by 25.4.

SCHEDULING DATA SHEET

NAME _____ DATE _____

WELL NO. _____ CROP _____

Block Readings
(See *Table 4* for Deficit)

	First Set				Last Set			
	Station #1 UPPER		Station #2 LOWER		Station #3 UPPER		Station #4 LOWER	
*Depths (ft)	Block Reading	*Deficit (inches)	Block Reading	Deficit (inches)	Block Reading	Deficit (inches)	Block Reading	Deficit (inches)
0.5								
1.5								
2.5								
Total Deficit	Station #1		Station #2		Station #3		Station #4	

Average Deficit First Set _____ (inches) Last Set _____ (inches)

Water Management Data

Step No.		1st Set inches	Last Set inches	
1.	Allowable deficit in top 3 feet before irrigation is recommended—See *Table 3* (at 50% depletion).			
2.	Present deficit in top 3 feet.			
3.	Remaining usable moisture in top 3 feet (1 minus 2).			
4.	Estimated average daily water use rate (see *Table 5*).			
5.	Estimated number of days until irrigation is needed at block locations if no rain occurs (3 ÷ 4).			Days
6.	Water Meter Reading _____			
7.	Rainfall this period _____			

*To convert feet to meters, multiply by .30; to convert inches to millimeters, multiply by 25.4.

SCHEDULING DATA SHEET

NAME _____ DATE _____

WELL NO. _____ CROP _____

Block Readings
(See *Table 4* for Deficit)

	First Set				Last Set			
	Station #1		Station #2		Station #3		Station #4	
	UPPER		LOWER		UPPER		LOWER	
*Depths (ft)	Block Reading	*Deficit (inches)	Block Reading	Deficit (inches)	Block Reading	Deficit (inches)	Block Reading	Deficit (inches)
0.5								
1.5								
2.5								
Total Deficit	Station #1		Station #2		Station #3		Station #4	

Average Deficit First Set _____(inches) Last Set _____(inches)

Water Management Data

Step No.		*1st Set inches*	*Last Set inches*	
1.	Allowable deficit in top 3 feet before irrigation is recommended—See *Table 3* (at 50% depletion).			
2.	Present deficit in top 3 feet.			
3.	Remaining usable moisture in top 3 feet (1 minus 2).			
4.	Estimated average daily water use rate (see *Table 5*).			
5.	Estimated number of days until irrigation is needed at block locations if no rain occurs (3 ÷ 4).			Days

6. Water Meter Reading _____

7. Rainfall this period _____

*To convert feet to meters, multiply by .30; to convert inches to millimeters, multiply by 25.4.

The Cooperative Extension Service provides information and educational programs to all people without regard to race, color or national origin.