PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

MICHIGAN STATE UNIVERSITY | Extension

Soybean Irrigation Management

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http://msue.anr.msu.edu/resources/irrigation

https://engineering.purdue.edu/ABE/Engagement/Irrigation

Treat your irrigated field like star performer

Re-think your management practices and inputs

- Soil pH
- Variable rate lime applications
- P and K rate and placement
- N rate and timing
- Sulfur placement, rate and timing
- Zinc placement, rate and timing
- Weed control
- Crop herbicide risk / damage
- Weed resistance
- Herbicide carry-over issues

- Drainage
- Crop rotation
- Seed selection
- Seeding rate and placement
- Planting date
- Emergence
- Pest scouting
- Pest management thresholds
- Residue management
- Compaction issues

Irrigate to assure the best plant stand possible "It's an ART"

- Irrigate, if necessary, to make sure to get maximum germination and uniform emergence. (Either before or after planting)
- ½ inch in most irrigated soil within five days of planting. Monitor crusting issues
- Maintain a moist surface, 0.10" to 0.20" applications, (rotary hoe if necessary).

Are you ready to irrigate the day you plant?

Using irrigation to get the most from pesticides and nutrients

Timely application of irrigation water:

- Improves incorporation of herbicides.
- Improves activation of herbicides.
- Humid irrigated environment slows some insects.

- Reduces nitrogen volatilization.
- Maximizes yield to utilize the resources.

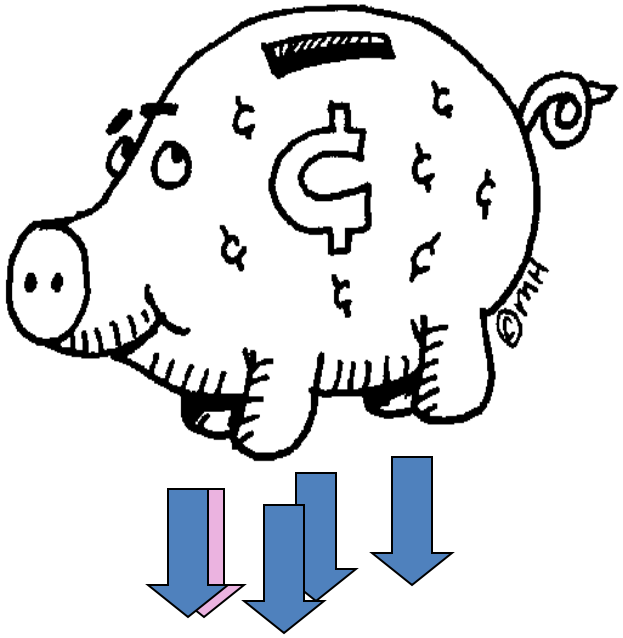
(Water stressed weed to get better glyphosate kill)

Irrigation - think of your soil as a bank

Water holding capacity:
The soil (bank) can hold only a given volume of water before it allow it to pass lower down.

Soil type :
Heavier soil can hold more water / foot of depth than light soils

Intake rate:
Water applied faster than the soil intake rate is lost.



Rooting depth:
The plant can only get water to the depth of it's roots.

Deletion:
Plants can pull out only 30 - 60% of the total water

Water lost from the bottom of the profile can wash out (leach) water soluble nutrients and pesticides.

SMaRT Soybean Management and Research Technology

SOYBEAN FACTS

February 2011

Summary of Irrigated Soybean Research in Michigan

Kurt Thelen, MSU Biofuels Specialist
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Nearly 100,000 acres of soybeans are grown under irrigation in Michigan. Yield increases due to irrigation water applications are common in Michigan. However, the yield increases have been highly variable and lower than expected. This fact sheet summarizes soybean irrigation research conducted in Southwest Michigan from 2001 to 2003. Utilizing this information will help producers improve irrigated soybean yields.

different irrigation schedules, 3) learn how irrigation affects weed control with glyphosate and 4) learn how irrigation affects soybean aphid populations.

Materials and Methods

Five irrigation treatments were identified and implemented in each year of the project. The irrigation treatments were based on soybean

http://michigansoybean.org/MSPCSite/GrowerResources/FactSheets/2001To2003SWMRECIrrigatedSoybeanTrial.pdf

Summary of Irrigated Soybean Research in Michigan

SMaRT Soybean Facts – 2/2011

Summary

Based on the three years of data, it appears that maximizing soybean yields in Michigan is dependent on maintaining adequate soil moisture beginning at full bloom (R2) or beginning pod (R3), provided that the soil water deficit does not exceed 75% prior to that growth stage.

Waiting to irrigate until pod elongation (R3-R4)

maximized water use efficiency in two of the three years as long as the soil water deficit never reached 75%.

R3: Beginning Pod

Any pod that is ***~3/16 inch long*** and is on one of the four uppermost nodes of the main stem.

Developing pods, withering flowers, open flowers, & flower buds can all be found during this stage.

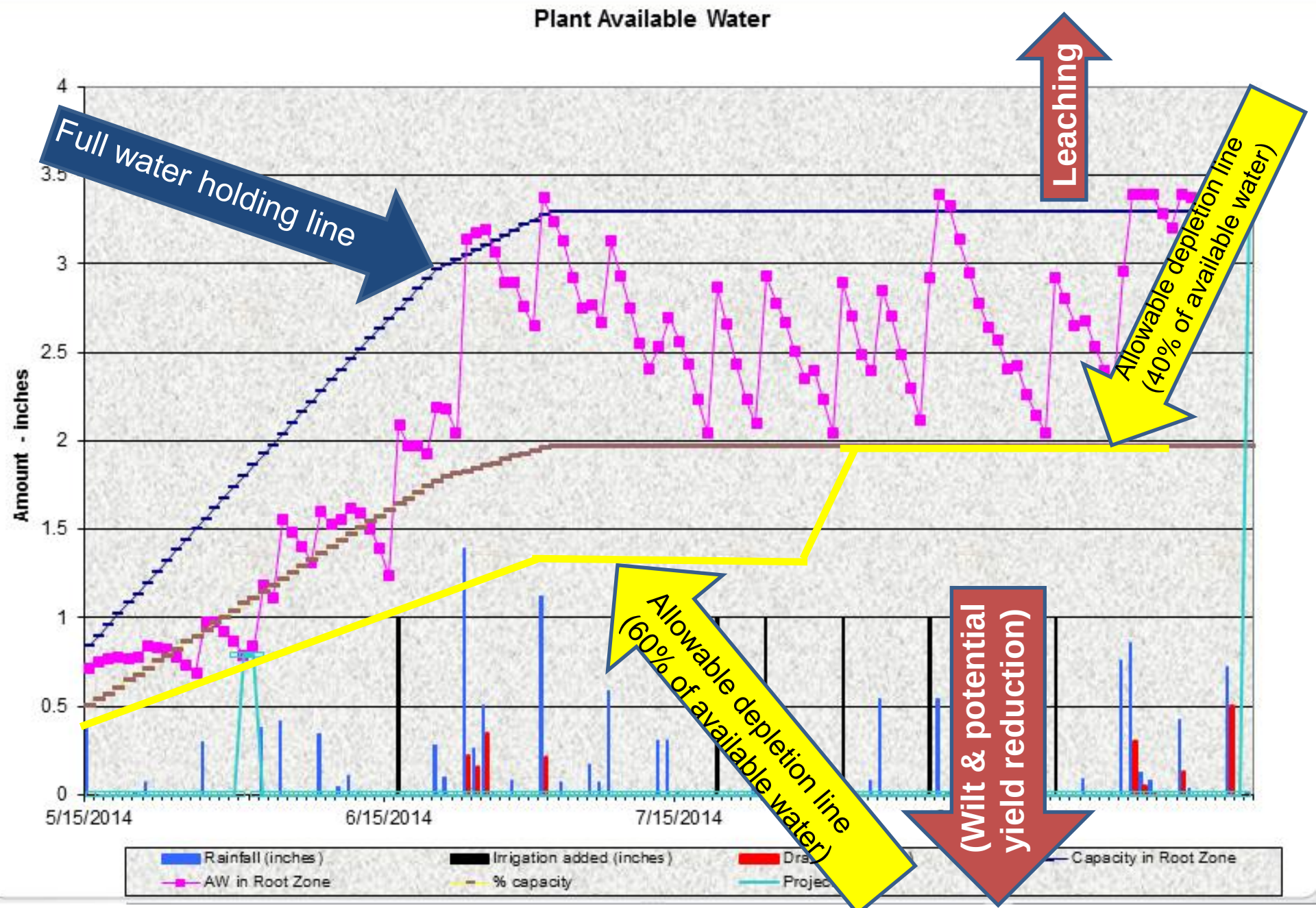
Summary – con't

Waiting to irrigate until pod elongation (R3-R4) maximized water use efficiency in two of the three years as long as the soil water deficit never reached 75%.

In two of the three years, an **emergency irrigation** water application was required to prevent the soil water deficit from reaching 75% so waiting until pod elongation may not be recommended in some years.

Use data from irrigated soybean **variety performance** trials to select high-yielding, disease resistant/tolerant varieties that resist lodging to maximize irrigated soybean yields.

MSU Excel Irrigation Schedule Checkbook Method - Mendon 2014



Calculating Water Holding Capacity

Soil Name	Depth Inches	Available water holding capacity	Average Available water holding capacity	Ave. Available water holding capacity (24 in.)	Ave. Available water holding capacity (36 in.)
Oshtemo	0 - 14 14 – 35 35 - 60	0.10 – 0.15 0.12 – 0.19 0.06 – 0.10	0.125 0.155 0.08	14” x 0.125=1.75 10” x 0.155=1.55 ---------- = 3.3	14” x 0.125= 1.75 21” x 0.155= 3.26 1” x 0.08 = 0.08 ---------- = 5.09
Spinks	0 – 10 10 – 26 26 - 60	0.08 – 0.10 0.08 – 0.10 0.04 – 0.08	0.09 0.09 0.06	10” x 0.09= 0.9 14” x 0.09= 1.26 ---------- = 2.16	10” x 0.09= 0.9 16” x 0.09= 1.26 8” x 0.06= 0.48 ---------- = 2.64

Water Holding Capacity at 40% and 60% Threshold to Full (in Inches)

Soil Type/Soil depth	Bronson		Capac		Oshtemo		Spinks	
	40%	60%	40%	60%	40%	60%	40%	60%
0 to 6	0.50	0.34	0.72	0.48	0.45	0.30	0.32	0.22
0 to 12	1.02	0.68	1.44	0.96	0.90	0.60	0.65	0.43
0 to 18	1.56	1.04	2.03	1.36	1.42	0.95	0.97	0.65
0 to 24	2.10	1.40	2.63	1.75	1.98	1.32	1.30	0.86
0 to 30	2.88	1.92	3.22	2.15	2.54	1.69	1.55	1.03

Soybeans rooting depth for scheduling purposes - 24”

Average water use for Soybeans in inches/day –adapted From " Irrigation Scheduling Checkbook Method, Jerry Wright, University of Minnesota, 2002

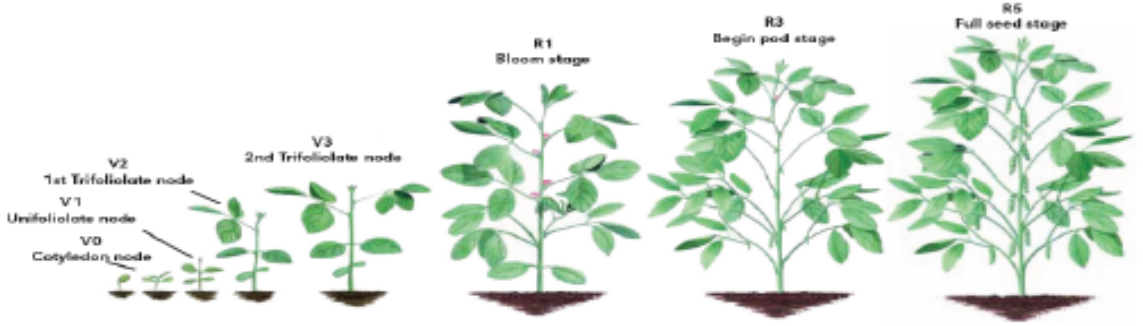
	Week after emergence																
Temperature	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
50-59	02	02	.04	.04	.06	.07	.08	.09	09	09	09	08	.07	.05	.05	.03	.02
60-69	.02	.03	.05	.07	.09	.10	.11	.13	.13	.13	.13	.11	.10	.08	.07	.04	.02
70-79	.03	.05	.07	.09	.12	.13	.15	.17	.18	.18	.17	.15	.13	.10	.09	.05	.03
80-89	.04	.06	.10	.13	.16	.19	.20	.21	.22	.22	.21	.18	.16	.13	.11	.06	.03
90-99	.05	.07	.11	.14	.17	.20	.22	.25	.26	.26	.25	.22	.19	.16	.13	.08	.05
Soybean growth stages				2nd trifoli-ate		1st flower			seed filling			leaves yel-lowing					

Crop Water Use by Growth Stage — Soybeans

University of Nebraska Lincoln EXTENSION
Know how. Know now.

Soybean Growth Stages

V0	Cotyledon node 0 — cotyledons extended
V1	Unifoliolate node 1 — unifoliolate leaves expanded
V2	1st Trifol node 2 — trifoliolate leaves expanded
V3	2nd Trifol node 3 — trifoliolate leaves expanded
R1	Begin bloom — one flower any node
R2	Full bloom — flowers at top 2 nodes
R3	Begin Pod — A pod 3/16 inch long in any of the top 4 nodes
R4	Full Pod — A pod 3/4 inch long in any of the top 4 nodes
R5	Full Seed — A seed 1/8 inch long in any of the top 4 nodes
R6	Full Seed — A seed filling a pod cavity in 4 top nodes
R7	Begin Pod Mature (leaf fall) — one brown pod anywhere on plant
R8	95% pods mature
Mature	Harvest-ready



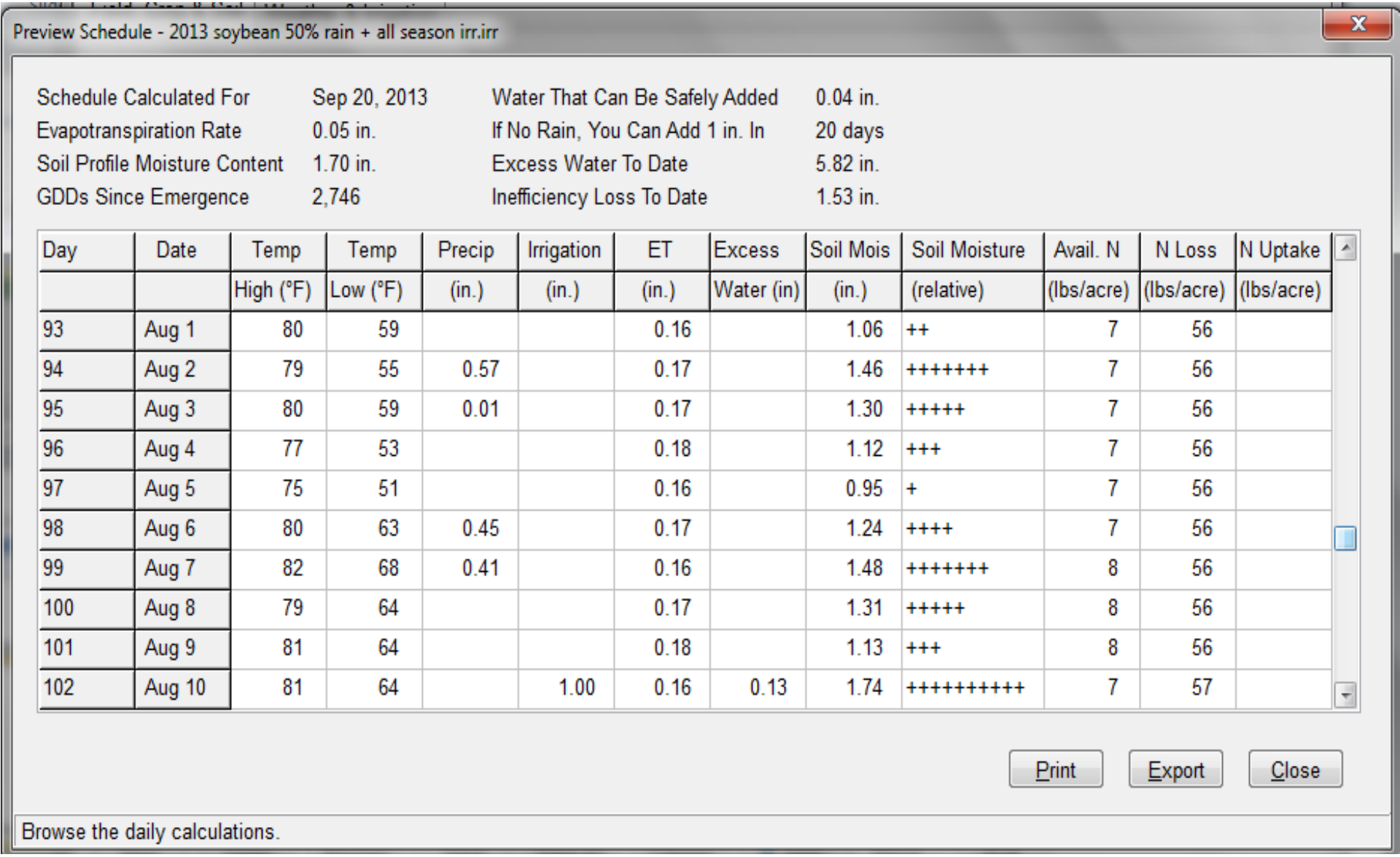
Crop Stage	Crop coeffient Kc	Root Depth (in)	% of Growing Season
V0 Cotyledon	0.2	6	0
V1 1st Node	0.3	9	4
V2 2nd Node	0.5	12	8
V3 3rd Node	0.6	16	11
R1 Begin Bloom	1.0	24	26
R2 Full Bloom	1.1	24	32

Crop Stage	Crop coeffient Kc	Root Depth (in)	% of Growing Season
R3 Begin Pod	1.2	24	41
R4 Full Pod	1.2	24	50
R5 Begin Seed	1.2	24	63
R6 Full Seed	1.2	24	80
R7 Begin Pod Mature	1.0	24	89
R8 95% Pods Mature	0.2	24	100

	A	B	C	D	E	F	G	H	I	J	K	L	N	O
18	Date	Root Depth (inches)	Rainfall (inches)	Irrigation added (inches)	Potential ET (inches)	% Canopy Cover (Kc)	ET modified for crop (inches)	Capacity of root zone (inches)	Available Water in root zone (inches)	% capacity filled	Drainage (inches)	Additional capacity of root zone (inches)	Proj ETO	Proj ET
111	1-Aug	24.0	0		0.17	0.96	0.16	3.15	2.62	83	0.00	**0.53**		0.00
112	2-Aug	24.0	0.4		0.08	0.97	0.08	3.15	2.94	93	0.00	**0.21**		0.00
113	3-Aug	24.0	0		0.18	0.98	0.18	3.15	2.76	88	0.00	**0.39**		0.00
114	4-Aug	24.0	0		0.17	0.99	0.17	3.15	2.59	82	0.00	**0.56**		0.00
115	5-Aug	24.0	0		0.08	1.00	0.08	3.15	2.51	80	0.00	**0.64**		0.00
116	6-Aug	24.0	0.3		0.1	1.01	0.10	3.15	2.71	86	0.00	**0.44**		0.00
117	7-Aug	24.0	0		0.09	1.02	0.09	3.15	2.62	83	0.00	**0.53**		0.00
118	8-Aug	24.0	0		0.14	1.01	0.14	3.15	2.48	79	0.00	**0.67**		0.00
119	9-Aug	24.0	0		0.16	1.00	0.16	3.15	2.32	74	0.00	**0.83**		0.00
120	10-Aug	24.0	0		0.16	1.00	0.16	3.15	2.16	68	0.00	**0.99**		0.00
121	11-Aug	24.0	0		0.15	0.99	0.15	3.15	2.01	64	0.00	**1.14**		0.00
122	12-Aug	24.0	0.8		0.09	0.98	0.09	3.15	2.72	86	0.00	**0.43**		0.00
123	13-Aug	24.0	0		0.13	0.97	0.13	3.15	2.59	82	0.00	**0.56**		0.00
124	14-Aug	24.0	0		0.14	0.97	0.14	3.15	2.46	78	0.00	**0.69**		0.00
125	15-Aug	24.0	0		0.12	0.96	0.12	3.15	2.34	74	0.00	**0.81**		0.00
126	16-Aug	24.0	0		0.16	0.95	0.15	3.15	2.19	70	0.00	**0.96**		0.00
127	17-Aug	24.0	0		0.16	0.94	0.15	3.15	2.04	65	0.00	**1.11**		0.00
128	18-Aug	24.0	0		0.14	0.94	0.13	3.15	1.91	61	0.00	**1.24**		0.00
129	19-Aug	24.0	0		0.16	0.93	0.15	3.15	1.76	56	0.00	**1.39**		0.00
130	20-Aug	24.0	0	1	0.16	0.92	0.15	3.15	2.61	83	0.00	**0.54**		0.20
131	21-Aug	24.0	0		0.16	0.91	0.15	3.15	2.47	78	0.00	**0.68**		0.30
132	22-Aug	24.0	0.2		0.07	0.90	0.06	3.15	2.61	83	0.00	**0.54**		0.15
133	23-Aug	24.0	0		0.17	0.89	0.15	3.15	2.46	78	0.00	**0.69**		0.05
134	24-Aug	24.0	0		0.17	0.87	0.15	3.15	2.31	73	0.00	**0.84**		0.00
135	25-Aug	24.0	3.5		0.16	0.86	0.14	3.15	3.24	103	2.52	**0.00**		0.00
136	26-Aug	24.0	0.5		0.13	0.85	0.11	3.15	3.63	115	-2.03	**0.00**		0.00

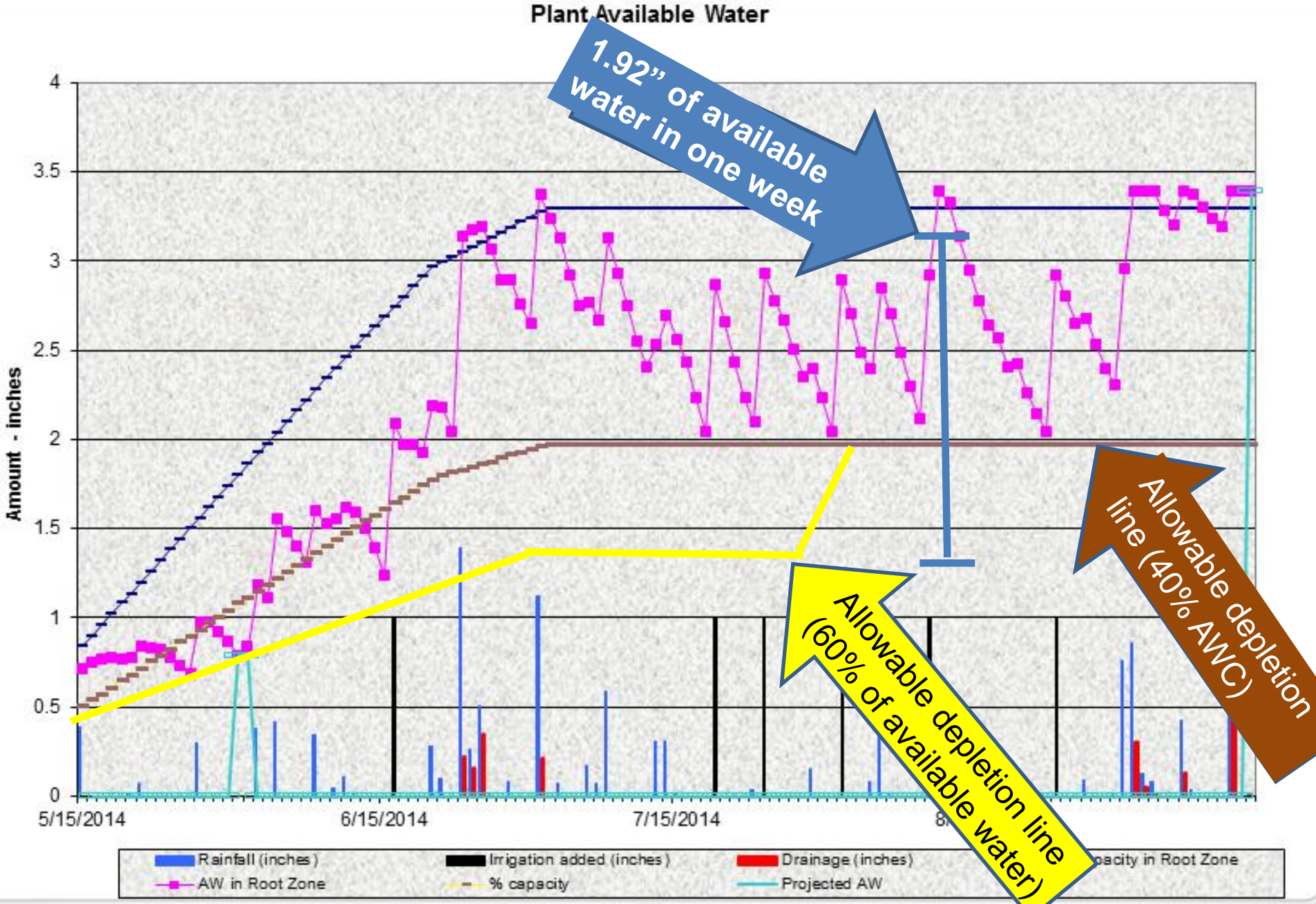
Help | **Calculations** | Soil Moisture | Cumulative data | Table1 | Caluations | Crop & Soil Tables

http://www.agweather.geo.msu.edu/mawn/irrigation/



http://www.purdue.edu/agsoftware/irrigation/

MSU Excel Irrigation Schedule Checkbook Method - Mendon 2009



20% increase in Water Holding Capacity

Soybeans rooting depth - 24”

Soil Type / depth	Bronson	Capac	Oshtemo	Spinks
24”	1.0”	1.1”	0.8”	0.5”

20% increase in Water Holding Capacity plus one weeks soybean water use at R3 stage

0.15” x 7 days = 1.05”

Soil Type / depth	Bronson	Capac	Oshtemo	Spinks
24”	2.5”	2.6”	2.4”	2.1”

Limited Water Supply Irrigation Management

- ❖ Diversify the crops sharing the water supply between high and low water use. (? Potato and soybeans ?)
- ❖ Diversify the crops sharing the water supply and peak water use times (? corn and soybeans ?)
- Start irrigating early to bank water ahead.

(Soybeans lack rooting depth to make bank ahead work well)

Nebraska limited water plan:

- R3
- R6
- Sizing (soybean seed production concern)

Ideal Irrigation Application Volume

- wet at least top half of root mass
- allow room for a predictable rain fall – 1”
- never wet below the root zone
- large enough to minimize the number of times soil surface and crop are wetted.

(save water / reduce disease)

Typical applications:

- May to mid July 0.3” to 0.5”
- July 0.5” to 0.7”
- August 0.7” to 1.0”
- September 0.3” to 0.7”

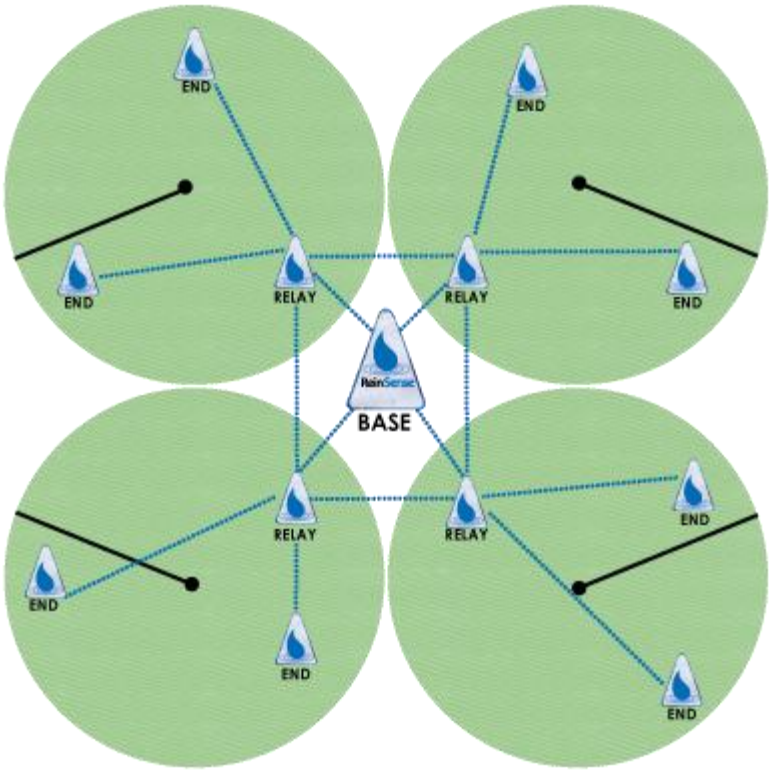
Large Irrigation Applications Volume Deliver More Effective Water To Crop

- In a typical July a soybean crop E.T. will be 5.4”
- Evaporation varies greatly by canopy, crop residue and soil type
- The first 0.05” to 0.12”of each overhead application of water will evaporate from soil surface and crop canopy.

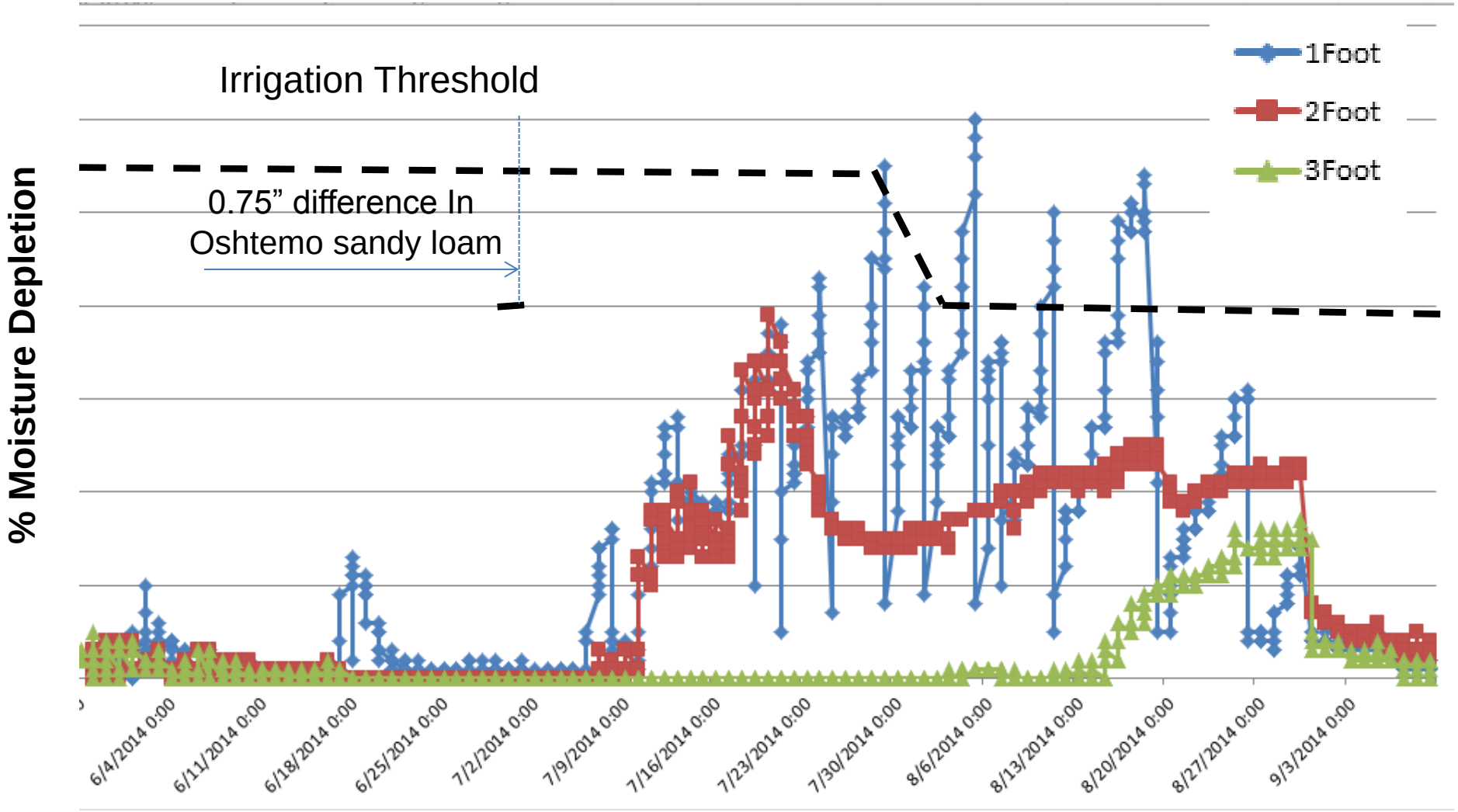
Effective water based on a 0.08” evaporation / application		
	Water evaporated from crop canopy & soil surface	**Effective water available for crop transpiration**
Six applications of 0.90”	**0.48”**	**4.92”**
Twelve applications of 0.45”	**0.96”**	**4.44”**
Eighteen applications of 0.30”	**1.44”**	**3.96”**

Small irrigation applications volume will require more total water to get equal water to crop

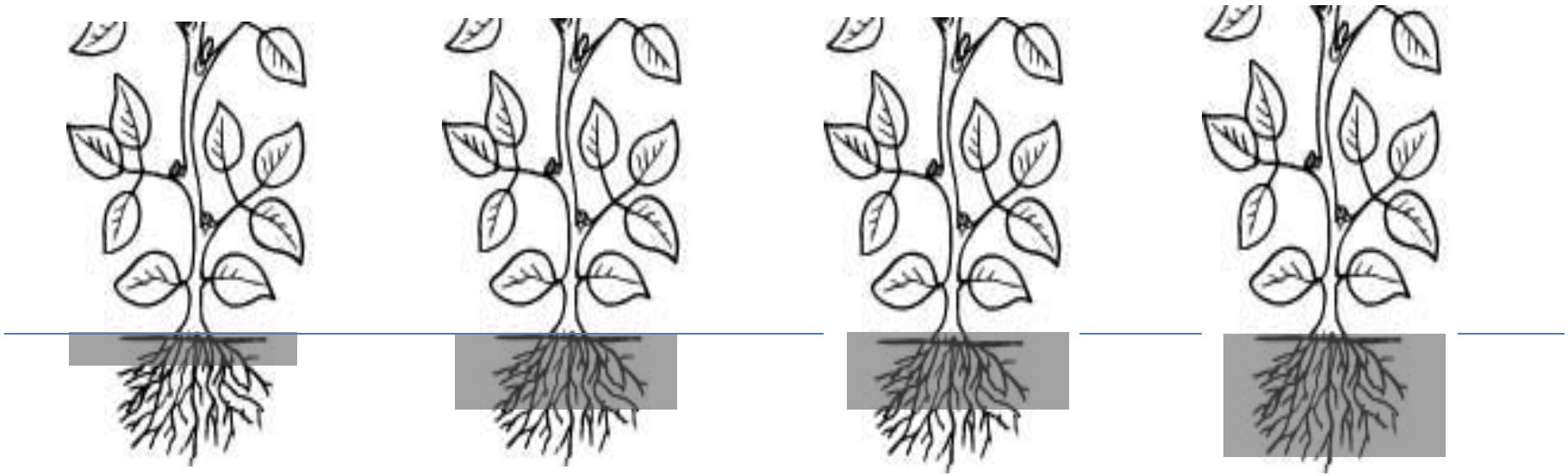
http://water.unl.edu/cropswater/nawmdn



Watermark Soil Moisture, 2014 Soybean, Constantine MI



Monitoring soil wetted front -12 hrs. after irrigation



½” into **dry** soil

½” into **moist** soil

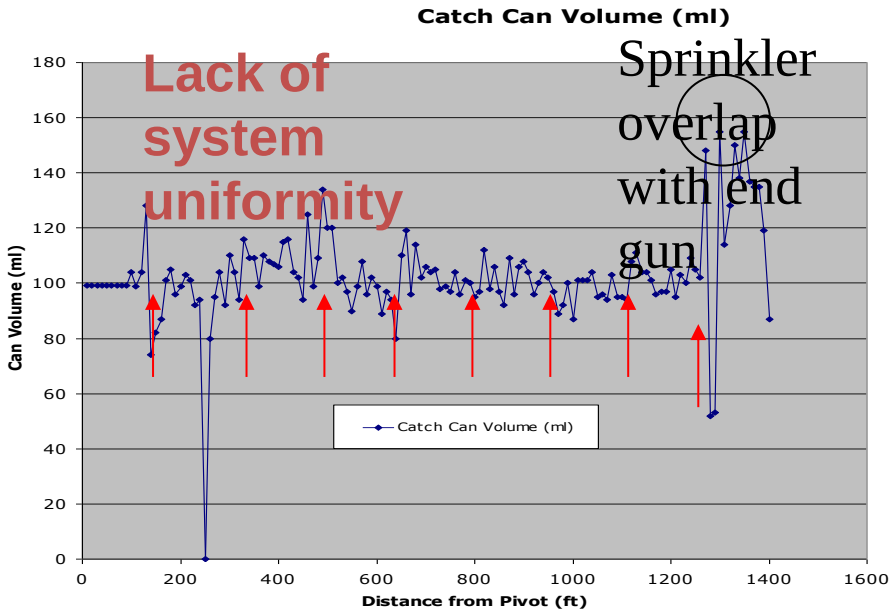
1” into **dry** soil

1” into **moist** soil

If your 1” application did not go down as far down as it did last week ???

- your not keeping up.

Factors that create over watered and lodged areas



Big Guns