

IRRIGATION WATER MANAGEMENT WORKSHOP SERIES: Adapting to Drought Conditions

SESSION 2

Developing and Improving Your Management Skills

Irrigation Water Management (IWM) Basic Tools

Todd M. Peplin

Deschutes Soil and Water
Conservation District

7/18/2022



RECAP:

Workshop 1

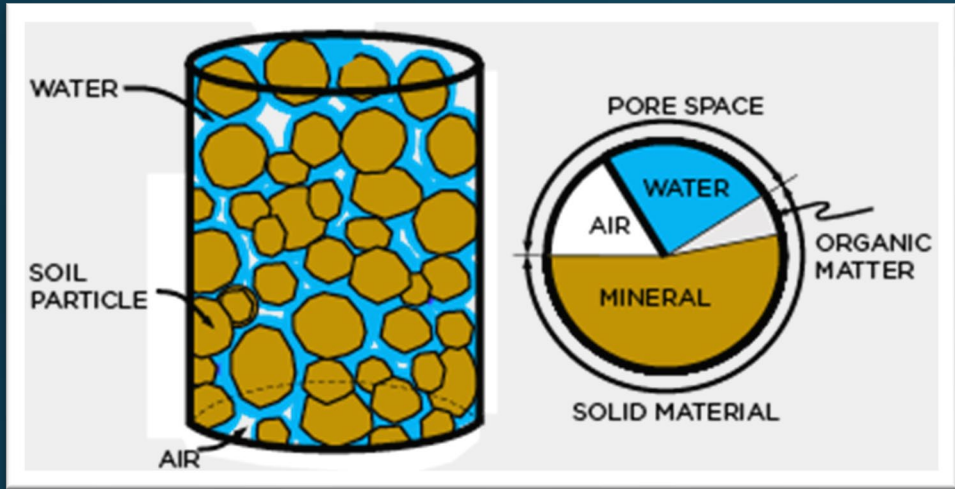
Soil and Water
relationship

Presented by Maria Zamora Re

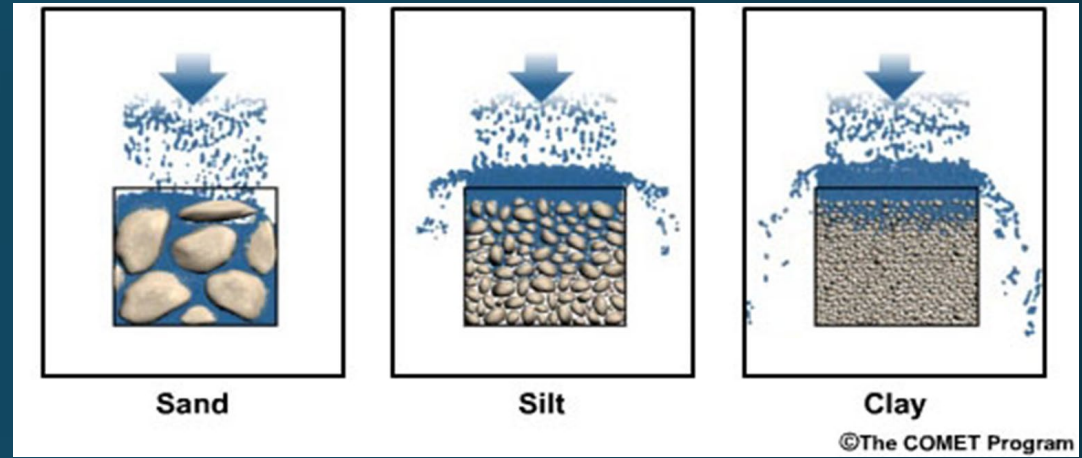
*Elements for irrigation
water scheduling:*

- Soil
- Crop
- Evapotranspiration
- Irrigation scheduling

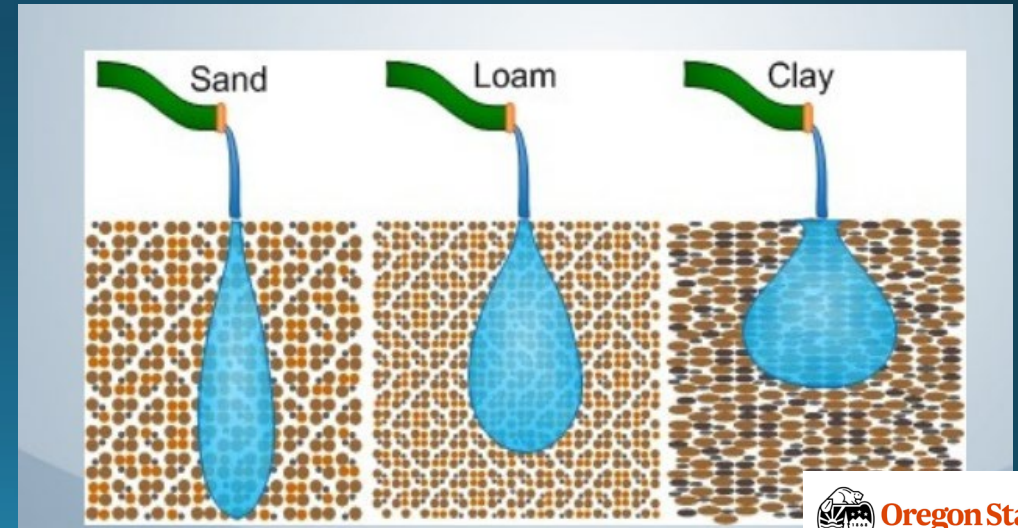
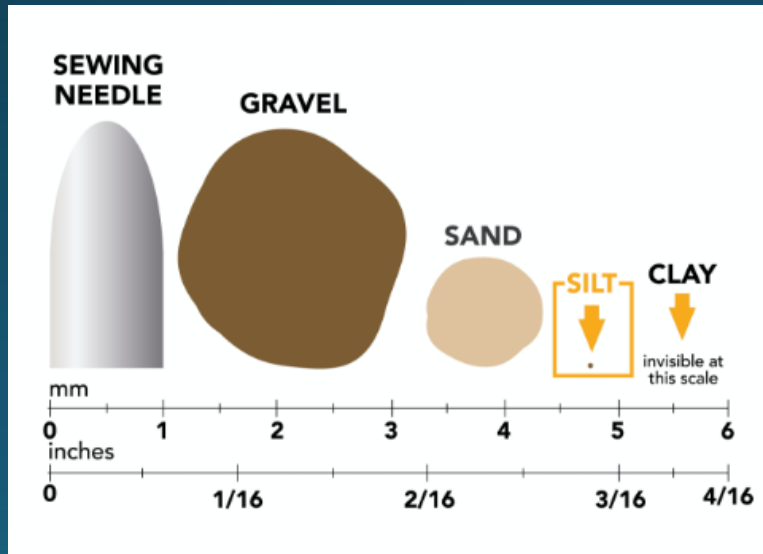
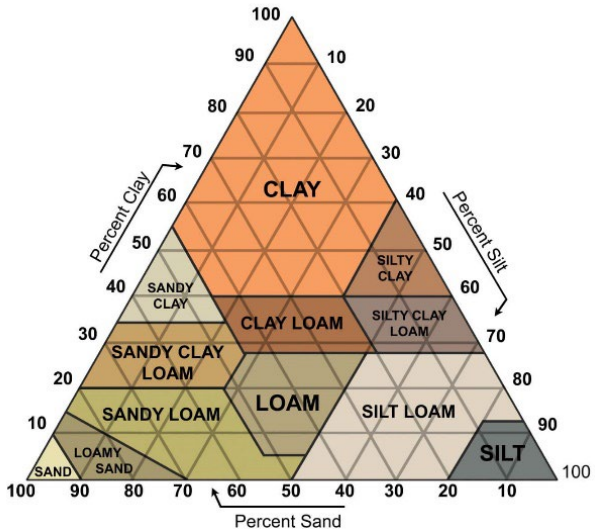
Soils



Infiltration



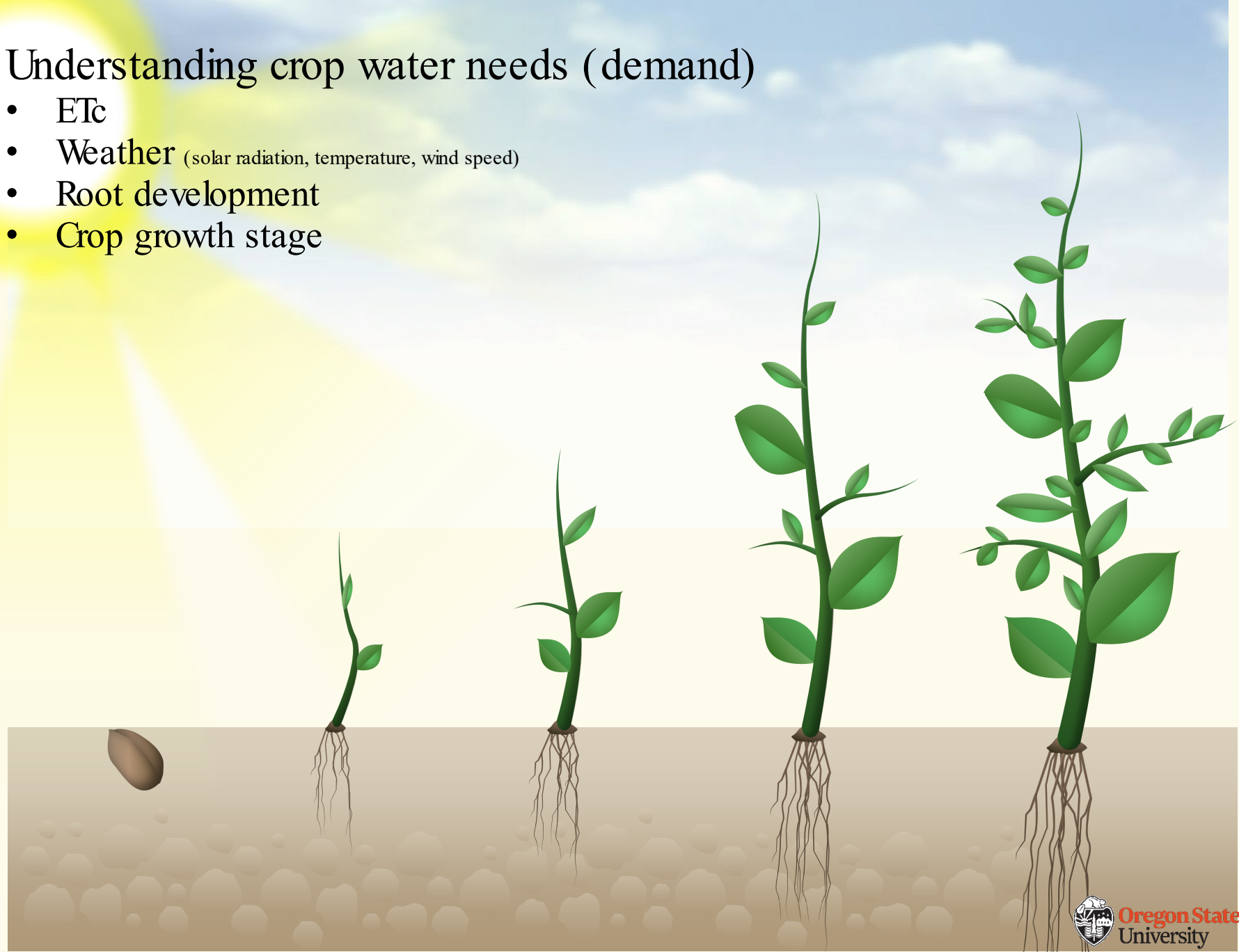
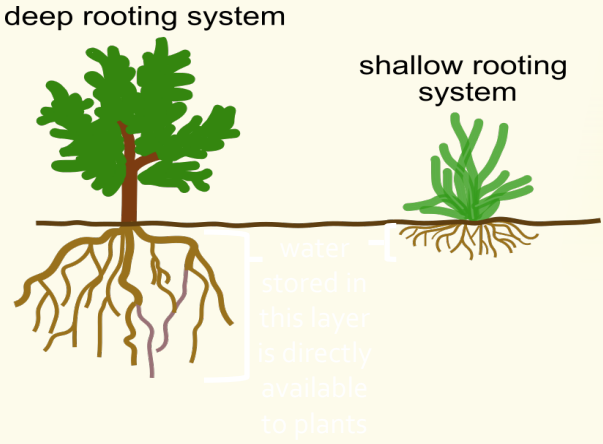
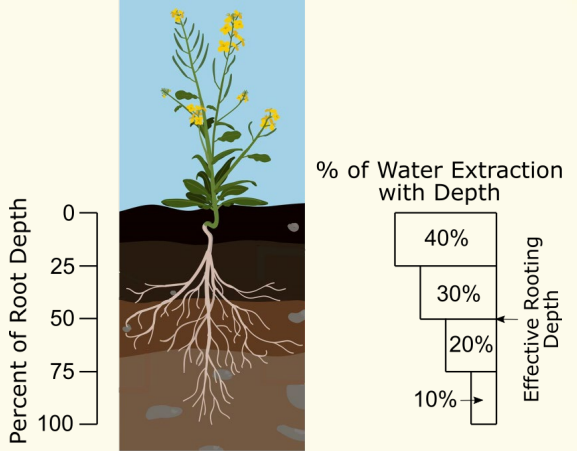
Soil Water Holding Capacity



Crop

Understanding crop water needs (demand)

- Etc
- **Weather** (solar radiation, temperature, wind speed)
- Root development
- Crop growth stage



Evapotranspiration

Evapotranspiration (ET)
consists of:

(E) Soil Evaporation

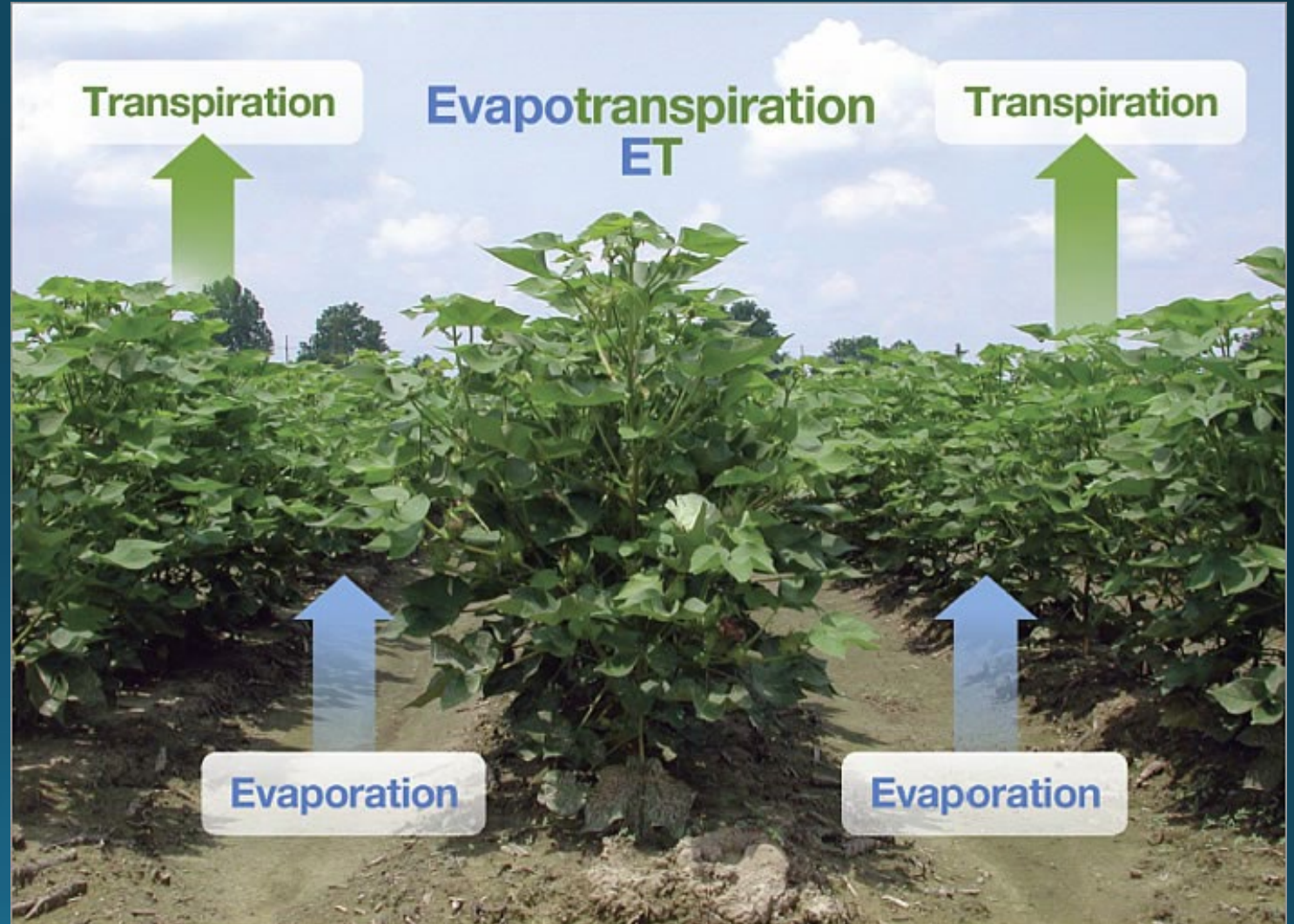
Water in the soil that evaporates before being used by plants

(T) Plant Transpiration

Water used by plants to grow

(I) Leaf Interception

Water that lands on leaves and evaporates before reaching ground



(Photo credit Firas et al., 2020)

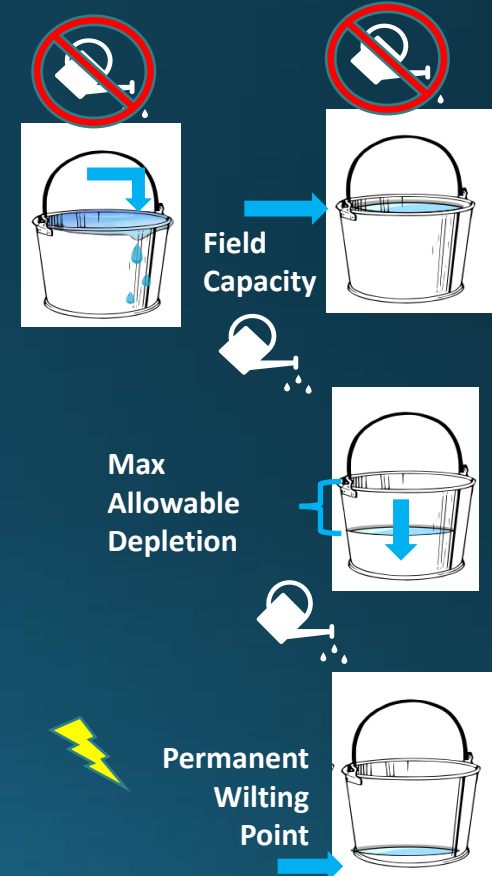
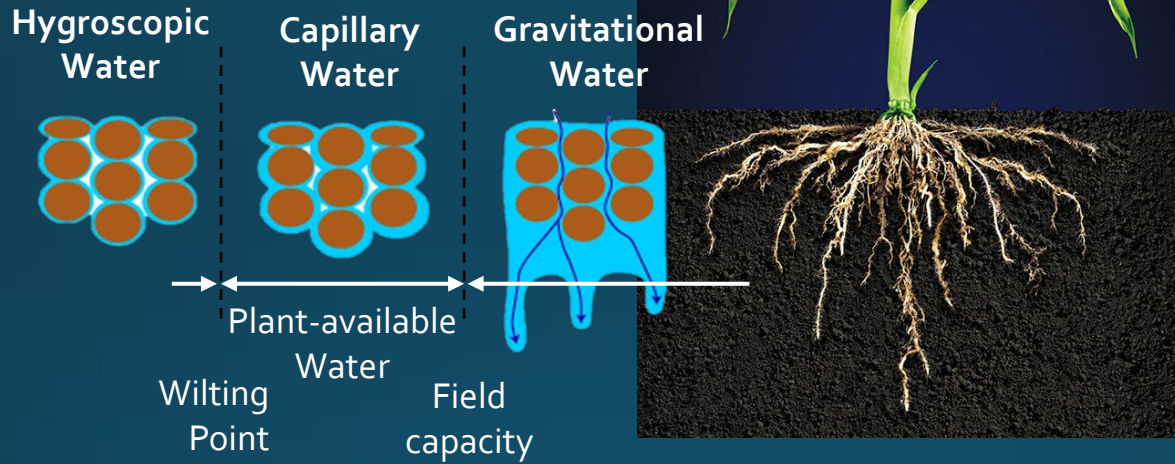
Irrigation scheduling

- How much water are we delivering?
→ Application rate

- How is that water applied throughout the field?

→ Uniformity

Avoid water losses



Why should we do irrigation scheduling?



- Irrigation scheduling saves you time, money, and labor
 - Avoids over- or under- irrigation
 - Minimize water stress on crops for maximum yield
 - Helps reduce water losses through deep percolation and evaporation
 - Helps reduce nutrient losses from the rootzone (e.g., fertilizer)
 - Improves soil quality, which improves crop quality and increases seasonal return
 - Maximizes irrigation efficiency

Basic Tools:





Information for IWM:

- Know your soils
- Know the soils available water holding capacity (AWC)
- Know the soils available water storage (AWS)
- Know the percent of water at field capacity
- Know the percent of water at wilting point
- Know the percent of available water

Websoil Survey

- <https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>

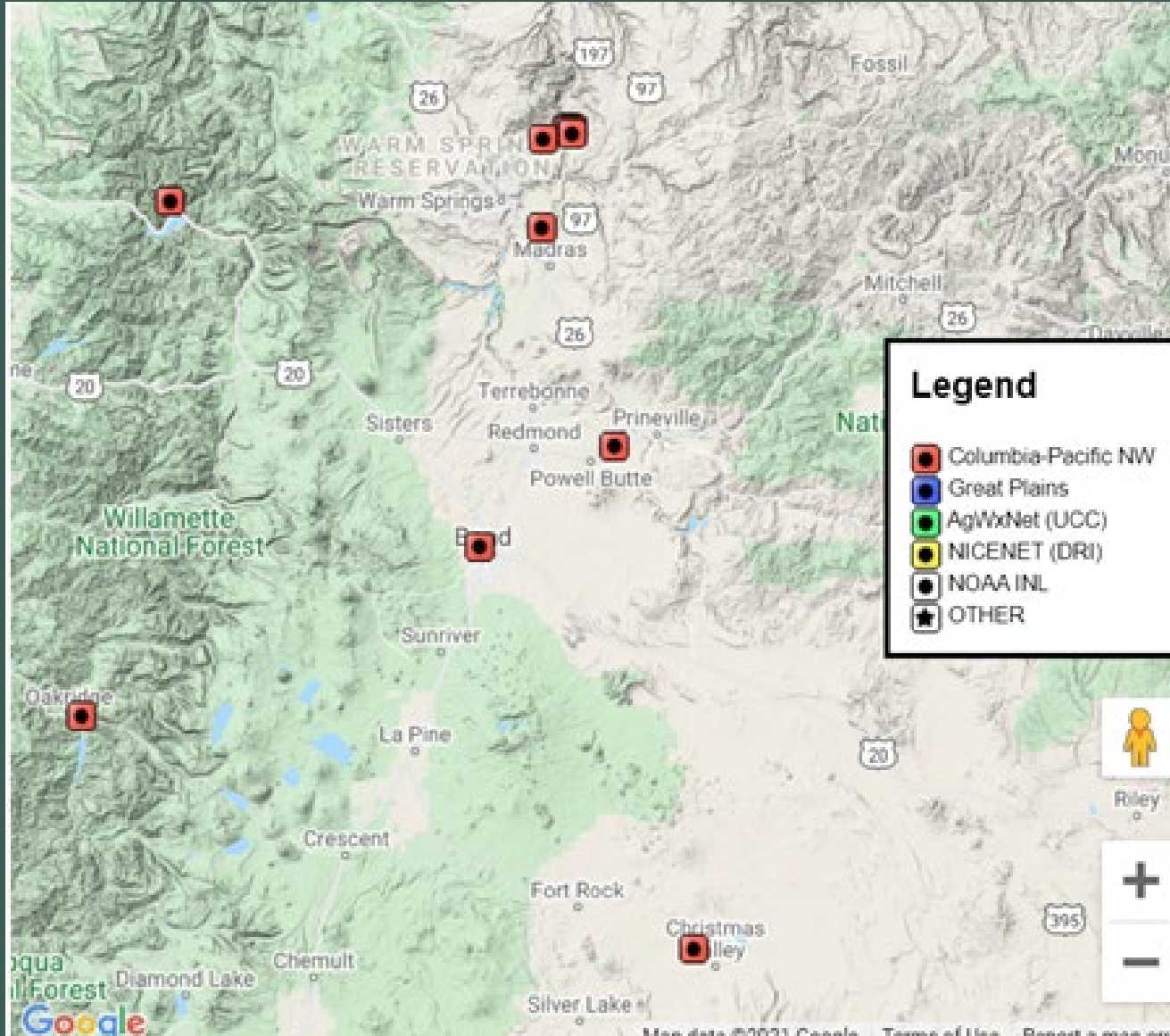
Walk through the steps of obtaining the information

Provide step-by-step handout



Information for IWM:

- Daily water use
- Daily forecast
- Sum of crop water use for the last 7 or 14 days
- ET Summary Table showing daily crop water use for each crop for the entire growing season.
- Month Average Reference Evapotranspiration



Local Weather Stations

Primary Weather Stations in Central Oregon:

Bend, Oregon AgriMet Weather Station (bewo) est. 2003

Madras, Oregon AgriMet Weather Station (mrso) est. 1984

Powell Butte, Oregon AgriMet Weather Station (pobo) est. 1993

Weather Stations in Central Oregon

MRSO MADRAS OREGON WEATHER STATION

OB	15 Minute Average Temperature (Deg F)						
OBX	15 Minute Maximum Temperature (Deg F)						
OBN	15 Minute Minimum Temperature (Deg F)						
PC	PRECIP - 25" LOAD CELL STORAGE GAGE (CUMULATIVE INCHES OF WATER)						
SI	INCREMENTAL GLOBAL SOLAR RADIATION (LANGLEYS PER HOUR)						
SI2	INCREMENTAL DIFFUSE SOLAR RADIATION (LANGLEYS PER HOUR)						
SQ	GLOBAL SOLAR RADIATION (LANGLEYS CUMULATIVE)						
SQ2	DIFFUSE SOLAR RADIATION (LANGLEYS CUMULATIVE)						
SV	SOIL TEMPERATURE - 8 INCH DEPTH (DEG F)						
SW	SOIL TEMPERATURE - 4 INCH DEPTH (DEG F)						
TP	Average Dew Point Temperature (Deg F)						
TU	15 Minute Average Relative Humidity (%)						
TUX	15 Minute Maximum Relative Humidity (%)						
TUN	15 Minute Minimum Relative Humidity (%)						
EA	Average Actual Vapor Pressure (kPa)						
UI	CUMULATIVE WIND RUN (MILES)						
WD	WIND DIRECTION (DEGREES)						
WG	PEAK WIND GUST (MPH)						
WS	AVERAGE WIND SPEED (MPH)						
ZA	-						



Weather Stations in Central Oregon

POBO POWELL BUTTE OREGON WEATHER STATION

OB	15 Minute Average Temperature (Deg F)				
OBX	15 Minute Maximum Temperature (Deg F)				
OBN	15 Minute Minimum Temperature (Deg F)				
PC	PRECIP - 12" BELFORT (CUMULATIVE INCHES OF WATER)				
SI	INCREMENTAL GLOBAL SOLAR RADIATION (LANGLEYS PER HOUR)				
SI2	-				
SQ	GLOBAL SOLAR RADIATION (LANGLEYS CUMULATIVE)				
SQ2	-				
SV	SOIL TEMPERATURE - 8 INCH DEPTH (DEG F)				
SW	SOIL TEMPERATURE - 4 INCH DEPTH (DEG F)				
TP	Average Dew Point Temperature (Deg F)				
TU	15 Minute Average Relative Humidity (%)				
TUX	15 Minute Maximum Relative Humidity (%)				
TUN	15 Minute Minimum Relative Humidity (%)				
EA	Average Actual Vapor Pressure (kPa)				
UI	CUMULATIVE WIND RUN (MILES)				
WD	WIND DIRECTION (DEGREES)				
WG	PEAK WIND GUST (MPH)				
WS	AVERAGE WIND SPEED (MPH)				
ZA	SOIL TEMPERATURE - 2 INCH DEPTH (DEG F)				



Weather Stations in Central Oregon

BEWO BEND OREGON WEATHER STATION	
OB	15 Minute Average Temperature (Deg F)
OBX	15 Minute Maximum Temperature (Deg F)
OBN	15 Minute Minimum Temperature (Deg F)
PC	PRECIP - HEATED TIPPING BUCKET (CUMULATIVE INCHES OF WATER)
SI	INCREMENTAL GLOBAL SOLAR RADIATION (LANGLEYS PER HOUR)
SI2	-
SQ	GLOBAL SOLAR RADIATION (LANGLEYS CUMULATIVE)
SQ2	-
SV	-
SW	-
TP	Average Dew Point Temperature (Deg F)
TU	15 Minute Average Relative Humidity (%)
TUX	15 Minute Maximum Relative Humidity (%)
TUN	15 Minute Minimum Relative Humidity (%)
EA	Average Actual Vapor Pressure (kPa)
UI	CUMULATIVE WIND RUN (MILES)
WD	WIND DIRECTION (DEGREES)
WG	PEAK WIND GUST (MPH)
WS	AVERAGE WIND SPEED (MPH)
ZA	-



AgriMet

<https://www.usbr.gov/pn/agrimet/>

Walk through the steps of obtaining the information

Provide brochure

Using AgriMet

- Snake River Area Office
- Contracting Opportunities
- Programs & Activities
- Environmental Documents
- Water Operations

- AgriMet**
- Program Information
- Weather Data
- Crop Water Use
- Graphs
- Maps
- News
- Contact AgriMet
- Links
- Other Information

- Hydromet
- Recreation
- Site Index



Using AgriMet

Contracting
Opportunities

Programs & Activities

Environmental
Documents

Water Operations

AgriMet

Program Information

Weather Data

Crop Water Use

Graphs

Maps

News

Contact Us

Links

Other Information

Hydromet

Recreation

Site Index

Contact Us

AgriMet is excited to announce a partnership with Washington State University to incorporate AgriMet data into WSU's Irrigation Scheduler. To customize crop consumptive water use specific to your field or fields, [click here](#).

Crop Water Use Charts (available April through October, updated daily by 6:30 am MDT)

Information about AgriMet Crop Water Use Charts

The 1982 Kimberly-Penman Reference Evapotranspiration Model

The ASCE-EWRI Standardized ET Equation

Key to Crop Codes in Water Use Charts

Historical ET (evapotranspiration) Summary Data (Current and previous years)

Annual Evapotranspiration Totals and Averages (All crops, all stations, period of record)

Monthly Average Reference Evapotranspiration

Graphs of daily evapotranspiration for each AgriMet station. (Updated each morning at 6:00 am)

AgriMet Crop Coefficients (Graphical and Tabular Format)

AgriMet Crop Coefficients (Text File)

Information about AgriMet Crop Coefficients

Definitions of Crop Start, Cover, and Terminate Dates

Irrigation Guide

Last Updated: 8/31/16

Using AgriMet

Crop Water Use Information

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*****
*
* ESTIMATED CROP WATER USE - Apr 06, 2021 POBO
*
*****
*
* DAILY
* CROP WATER USE-(IN) * DAILY* * * * *
* CROP START* PENMAN ET - Apr * FORE *COVER* TERM* SUM * 7 * 14 *
* DATE*-----* CAST * DATE* DATE* ET * USE* DAY *
* * 2 3 4 5 * * * * *
*-----*
* ETr 03/20* 0.24 0.16 0.17 0.17 * 0.17 *03/20*10/25* 2.6 * 1.4* 2.4 *
*-----*
* ALFP 04/01* 0.04 0.03 0.03 0.03 * 0.03 *06/01*10/05* 0.2 * 0.2* 0.2 *
*-----*
* ALFM 04/01* 0.04 0.03 0.03 0.03 * 0.03 *06/01*10/05* 0.2 * 0.2* 0.2 *
*-----*
* HAYP 03/25* 0.17 0.12 0.12 0.13 * 0.12 *06/01*10/25* 1.5 * 1.0* 1.5 *
*-----*
* HAYM 03/25* 0.17 0.12 0.12 0.13 * 0.12 *06/01*10/25* 1.5 * 1.0* 1.5 *
*-----*
* PAST 03/25* 0.08 0.05 0.06 0.06 * 0.06 *05/20*10/05* 0.7 * 0.4* 0.7 *
*-----*
* LAWN 03/25* 0.10 0.07 0.08 0.09 * 0.08 *05/10*10/05* 0.7 * 0.5* 0.7 *
*-----*
* BLGR 03/25* 0.10 0.07 0.08 0.08 * 0.07 *05/20*07/20* 0.8 * 0.6* 0.8 *
*-----*
* WGRN 03/20* 0.12 0.08 0.09 0.10 * 0.09 *06/05*07/25* 1.1 * 0.7* 1.1 *
*-----*
* SGRN 04/15* 0.00 0.00 0.00 0.00 * 0.00 *07/01*08/05* 0.0 * 0.0* 0.0 *
*-----*
* SGRN 05/01* 0.00 0.00 0.00 0.00 * 0.00 *07/10*08/15* 0.0 * 0.0* 0.0 *
*-----*
* SGRN 05/15* 0.00 0.00 0.00 0.00 * 0.00 *07/20*08/25* 0.0 * 0.0* 0.0 *
*-----*
* SGRN 05/20* 0.00 0.00 0.00 0.00 * 0.00 *07/20*08/25* 0.0 * 0.0* 0.0 *
*-----*
* FCRN 05/20* 0.00 0.00 0.00 0.00 * 0.00 *07/25*09/25* 0.0 * 0.0* 0.0 *
*****

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POBO - ET SUMMARY - 2020

DATE	ETr	ALFP	ALFM	HAYP	HAYM	PAST	LAWN	BLGR	WGRN	SGRN	SGRN	SGRN	SGRN	FCRN	FCRN	SOYB	GAR
03/11	0.14	--	--	--	--	--	--	--	0.03	--	--	--	--	--	--	--	
03/12	0.12	--	--	--	--	--	--	--	0.03	--	--	--	--	--	--	--	
03/13	0.12	--	--	--	--	--	--	--	0.03	--	--	--	--	--	--	--	
03/14	0.03	--	--	--	--	--	--	--	0.01	--	--	--	--	--	--	--	
03/15	0.02	--	--	0.01	0.01	0.01	0.00	0.01	0.01	--	--	--	--	--	--	--	
03/16	0.04	--	--	0.02	0.02	0.01	0.01	0.01	0.01	--	--	--	--	--	--	--	
03/17	0.08	--	--	0.05	0.05	0.02	0.01	0.03	0.03	--	--	--	--	--	--	--	
03/18	0.09	--	--	0.06	0.06	0.02	0.02	0.03	0.04	--	--	--	--	--	--	--	
03/19	0.11	--	--	0.07	0.07	0.03	0.02	0.04	0.05	--	--	--	--	--	--	--	
03/20	0.13	0.02	0.02	0.09	0.09	0.04	0.03	0.05	0.06	--	--	--	--	--	--	--	
03/21	0.14	0.02	0.02	0.09	0.09	0.04	0.04	0.05	0.06	--	--	--	--	--	--	--	
03/22	0.16	0.03	0.03	0.11	0.11	0.05	0.05	0.06	0.08	--	--	--	--	--	--	--	
03/23	0.15	0.03	0.03	0.11	0.11	0.05	0.06	0.06	0.07	--	--	--	--	--	--	--	
03/24	0.09	0.02	0.02	0.06	0.06	0.03	0.04	0.04	0.05	--	--	--	--	--	--	--	
03/25	0.08	0.02	0.02	0.06	0.06	0.03	0.04	0.04	0.04	--	--	--	--	--	--	--	
03/26	0.11	0.02	0.02	0.08	0.08	0.04	0.06	0.05	0.06	--	--	--	--	--	--	--	
03/27	0.08	0.02	0.02	0.06	0.06	0.03	0.04	0.04	0.05	--	--	--	--	--	--	--	
03/28	0.09	0.02	0.02	0.07	0.07	0.03	0.05	0.05	0.05	--	--	--	--	--	--	--	
03/29	0.16	0.05	0.05	0.12	0.12	0.06	0.09	0.09	0.10	--	--	--	--	--	--	--	
03/30	0.13	0.04	0.04	0.10	0.10	0.05	0.08	0.08	0.08	--	--	--	--	--	--	--	
03/31	0.09	0.03	0.03	0.07	0.07	0.04	0.06	0.05	0.06	--	--	--	--	--	--	--	
04/01	0.09	0.04	0.04	0.07	0.07	0.04	0.06	0.06	0.06	--	--	--	--	--	--	--	
04/02	0.08	0.03	0.03	0.07	0.07	0.04	0.05	0.05	0.05	--	--	--	--	--	--	--	
04/03	0.11	0.05	0.05	0.09	0.09	0.05	0.08	0.08	0.08	--	--	--	--	--	--	--	
04/04	0.07	0.03	0.03	0.06	0.06	0.03	0.05	0.05	0.05	--	--	--	--	--	--	--	
04/05	0.07	0.04	0.04	0.06	0.06	0.03	0.05	0.05	0.05	--	--	--	--	--	--	--	
04/06	0.10	0.05	0.05	0.09	0.09	0.05	0.07	0.08	0.07	--	--	--	--	--	--	--	
04/07	0.16	0.09	0.09	0.14	0.14	0.08	0.12	0.13	0.12	--	--	--	--	--	--	--	
04/08	0.20	0.12	0.12	0.17	0.17	0.11	0.15	0.16	0.15	--	--	--	--	--	--	--	
04/09	0.20	0.12	0.12	0.17	0.17	0.11	0.15	0.17	0.16	--	--	--	--	--	--	--	
04/10	0.25	0.16	0.16	0.22	0.22	0.14	0.19	0.21	0.20	0.05	--	--	--	--	--	--	
04/11	0.27	0.17	0.17	0.24	0.24	0.16	0.21	0.23	0.22	0.05	--	--	--	--	--	--	
04/12	0.16	0.11	0.11	0.14	0.14	0.10	0.13	0.14	0.13	0.03	--	--	--	--	--	--	
04/13	0.17	0.12	0.12	0.15	0.15	0.10	0.14	0.15	0.14	0.03	--	--	--	--	--	--	
04/14	0.25	0.17	0.17	0.22	0.22	0.15	0.20	0.22	0.21	0.05	--	--	--	--	--	--	

Crop emergence date

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*****
*
* ESTIMATED CROP WATER USE - Jun 29, 2022      POBO
*
*****
*          DAILY
* CROP WATER USE-(IN) * DAILY*
* CROP START* PENMAN ET - Jun * FORE *COVER* TERM* SUM * DAY* DAY *
* DATE*-----* CAST * DATE* DATE* ET * USE* USE *
* 25  26  27  28 * * * *
*-----*
* ETr 01/01* 0.36 0.39 0.45 0.38 * 0.41 *01/01*10/31* 29.6 * 2.6* 4.2 *
*-----*
* ALFP 03/20* 0.36 0.39 0.45 0.38 * 0.41 *05/20*10/05* 16.1 * 2.6* 4.2 *
*-----*
* ALFM 03/20* 0.31 0.33 0.38 0.32 * 0.35 *05/20*10/05* 14.1 * 2.2* 3.5 *
*-----*
* HAYP 03/15* 0.33 0.36 0.41 0.35 * 0.37 *05/10*10/05* 17.4 * 2.4* 3.8 *
*-----*
* HAYM 03/15* 0.29 0.31 0.36 0.30 * 0.33 *05/25*10/25* 16.6 * 2.1* 3.4 *
*-----*
* PAST 03/15* 0.24 0.27 0.31 0.26 * 0.28 *05/25*10/25* 11.6 * 1.8* 2.8 *
*-----*
* LAWN 03/15* 0.29 0.31 0.36 0.30 * 0.33 *05/01*10/05* 14.3 * 2.1* 3.3 *
*-----*
* BLGR 03/15* 0.13 0.13 0.15 0.12 * 0.14 *05/10*07/15* 14.3 * 0.9* 1.8 *
*-----*
* WGRN 03/10* 0.36 0.39 0.45 0.38 * 0.41 *06/01*07/25* 17.6 * 2.6* 4.2 *
*-----*
* SGRN 04/10* 0.36 0.39 0.45 0.38 * 0.41 *06/25*08/01* 12.7 * 2.6* 4.2 *
*-----*

```

Previous 4 day readings

Average of the last 3 days

Date the crop is at full foliage

Date the crop is at dormancy

Total crop water use since the start date

Sum of the crop water use in the last 7 days

Sum of the crop water use in the last 14 days



General indicators:

- Variation in flow and pressure
- Energy demand differences

Irrigation Energy Assessment:

Utility Name:

Annual kWh/season:

Avg. Electrical Rate (\$/kWh):

Estimated run hours:

What is your water source? Canal ___ River ___ Well ___

What is your pump type: Turbine ___ Centrifugal ___ Propeller ___

Motor HP:

Pump Make:

Pump Model: Serial No#:

Motor RPM:

Impeller size (inch):

Meter/Pump number:

Pump outlet pressure:

Meter/Pump Number:

Do you have a flow meter installed?

Do you practice irrigation water management principles (such as inspect system for leaks, control water pressure, not over irrigating, apply irrigation scheduling etc.)?

IRRIGATION SCHEDULING RECORD KEEPING

- Checkbook method
- Irrigation scheduler mobile
- Other scheduling methods



Table 2: Crop Water Use and Checkbook Method for Irrigation Scheduling

Make an entry for each irrigation.
 Column B values from current or historic crop water use data as specified in an IWM Plan.
 Column C values from Table 3 Record of Irrigation Water Application.
 Column E values should not be greater than Total Available Water Capacity nor less than the Minimum Balance (from Table 1). Adjust Column E values as needed based on soil water observations (Table 4).
 Column F includes notes on soil water observations, irrigation applications, etc.
 Irrigation should be scheduled when the available soil water reaches the Minimum Balance found in Table 1: "Soil Water Remaining at Irrigation".

Field:	Withdrawals	Deposits		Balance	Notes
A	B	C	D	E	F
Date:	Crop Water Use (ET)	Net Irrigation	Effective Rainfall (subtract 0.15" from measured rainfall)	Available Soil Water	Minimum Balance 4.3 in.
(mo/day)	(inches)	(inches)	(inches)	Previous E - B + C + D	Observed/measured soil moisture level or depletion
				(inches)	Date & amount of next irrigation

Example Data Entry
 Need to schedule irrigation when the Balance (Available Soil Water: Column E) is 4.3 inches

-----Example entries for daily values-----

7/1	--	--	--	5.42	Measured Soil Water
7/2	0.18	0	0	5.24	
7/3	0.20	0	0.45	5.34	
7/4	0.17	0	0	5.17	
7/5	0.22	0	0	4.95	
7/6	0.24	0	0	4.71	
7/7	0.26	0	0	4.45	Irrigate 1.2" (net) on 7/8
7/8	0.22	1.2	0	5.43	
7/9	0.17	0	0	5.26	

9

*“Irrigation water management
is more of an art than a
science”*

Rex Barber, Producer



Thank You!

Todd M. Peplin

Programs Lead/Planner

Deschutes Soil and Water Conservation District

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