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SUSTAINABLE AGRICULTURE TECHNIQUES

Dealing with Drought: Conserving Irrigation Water

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Figure 1: Native wildflower and native grass seed crops need only 4-10 acre-inches of irrigation water.

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Irrigation water is a precious commodity. During drought, planning crop choices and irrigation priorities become critical.

Crops vary greatly in their water use

Water use of selected Malheur County crops was based on estimated evapotranspiration at the OSU Malheur Experiment Station, Ontario, Oregon (Table 1). Depending on the irrigation efficiency of one's farming operation, actual water use may be more or less than these values. They are a good, relative guide. Know the water use requirements of the crops you intend to grow to make sure you have enough water to get an economic yield.

Table 1. Crop water use at Ontario, Oregon.

Crops	23-yr average water use, inches/year	2014 water use, inches/year
Alfalfa	43	49
Winter wheat	25	30
Spring wheat	27	33
Sugar beets	35	38
Onions	30	35
Potatoes	28	32
Dry beans	22	27
Field corn	28	34

Timing of crop water use

Irrigation districts may only be able to deliver water at the beginning of the irrigation season. Crops such as winter wheat and canola only require irrigation at the beginning of the irrigation season.

Consider growing crops with very low irrigation water demands.

Native wildflower seed production has proven to require less than 10 acre-inches of irrigation water for reasonable yields (Figure 1). Camelina was grown successfully without irrigation at Ontario, Oregon in 2014 and 2015 with 5.75 and 4.17 inches, respectively, of

precipitation from planting to harvest (Figures 2 and 3). Although camelina is of only modest value, costs of production are low and soil cover can be maintained.

Figure 2. Camelina growing at the OSU Malheur Experiment Station in 2015 without irrigation.

Figure 2. Camelina seed, an oil seed crop.

Eliminate runoff water from your farm

It is possible to eliminate runoff water from your farm by adopting sprinkler irrigation, drip irrigation, or redesigning a furrow or flood irrigation system to recover tailwater using sedimentation ponds and pumpback systems. The pumping will be cost effective if water is scarce.

Examples saving water with furrow irrigation

Many of the irrigation systems that are in use were built before modern considerations of water use efficiency. When water is plentiful growers usually arrange work hours for irrigation practices around other farming practices. As an example, most growers change their furrow irrigation sets at 12 or 24-hour intervals because it is convenient and efficiently manages labor. When water is in short supply, we need to rethink some of our practices and make water stretch to obtain the maximum benefit. Strategies for efficient irrigation water use become essential. After all, water is our second most important resource behind the land itself. Growers should realize that to some extent they can exchange management and labor for water. Not all growers are facing serious water shortages, but they may in the future. Also there is pressure to conserve water and use it for power generation and for endangered species such as salmon and bull trout. The issues affecting the Klamath Basin or similar ones such as Total Maximum Daily Load (TMDL) may only be a few years away from affecting all areas of Oregon.

Additional suggestions:

Hopefully one or more of them will work on your farm. They are not listed in a prioritized order but some of them will have more impact on water savings than others.

- Leave some ground unirrigated and apply the water to the high value crops. Since irrigation districts have to keep their system charged with water, this idea would have a greater impact if everyone in the district cut back on irrigated acres.
- Do not over irrigate - sounds simple but is not easily accomplished. Most growers tend to err on the side of excess when it

comes to irrigation. Too much water does not have the visual impact that too little does but too much water erodes soil and wastes fertilizer, as well as water. Avoiding over-irrigation reduces nitrate leaching to groundwater.

- Use the evapotranspiration (ET) charts published by the Bureau of Reclamation AgriMet system. They are available on the Malheur Experiment Station website <www.cropinfo.net>. The charts make fairly accurate daily and weekly estimates of crop water use. This can help you estimate when you need to irrigate.
- Soil moisture monitoring equipment will tell you how much moisture is in the soil. There are many types of sensors available. The most common ones used in this area are Watermark Soil Moisture Sensors that measure soil water tension. These instruments, along with ET charts will provide a fairly accurate estimate of irrigation needs. The charts can be automated with various commercially available monitors.
- Graph soil moisture readings. We believe that the most important aspect of soil moisture monitoring is to create a graph of the readings. Even if you use a shovel and your fingers for measuring soil moisture, you can record the readings. This will improve your irrigation accuracy.
- Some plants handle drought stress better than others. Barley uses less water than wheat. Sugar beets are able to extract moisture from a greater depth than most crops. Crops such as potatoes suffer greatly in quality when drought stressed. Potatoes loose tuber grade and fry color with water stress. Water stress on onions lowers yield, grade, and the percent of bulbs with single centers. Wheat and corn lose test weight and yield. For most crops, water stress at the flowering stage is most damaging.
- Know the water holding capacity of the different soils on your farm. A sandy loam soil will not hold as much water as a silt loam soil, thus it will need to be irrigated more frequently. Lighter, sandy loam should not have as much water applied during each irrigation as the heavier soil because it cannot hold as much water. The extra water is lost to leaching.
- Consider surge irrigation or at least a modified surge program on the first irrigation. The wetting-drying cycle of surge irrigation reduces water loss to deep percolation. Water losses to deep percolation are particularly important on the first irrigation when the soil is friable and takes a lot of water. Modified surge irrigation is when you alternate siphon tubes or hoses between rows every couple of hours. This method can save water and reduce nitrogen loss through leaching.
- Alternate row irrigation is when you irrigate one side of the bed on one irrigation, the other row or side of the bed on the next one. This practice works well with crops which are less sensitive to moisture stress such as wheat and sugar beets.
- Compact the soft non-traffic rows in furrow irrigated fields so that the infiltration rate is similar to the wheel-traffic rows.
- Irrigate only the wheel rows. Since the infiltration rate in the soft row is usually much higher than the wheel row, irrigating the wheel row will reduce deep movement of the water. This will help keep the water in the root zone.
- Switch to sprinkler irrigation. This allows you to manage water more efficiently and apply it to the depth needed. Remember that some crops such as onions may have increased diseases under sprinklers because the foliage is kept wet. Capturing energy from gravity can help reduce pumping costs.
- Many crops can be produced with reduced tillage including the use of no-till drills or strip tillage systems. Reduced tillage saves water.

- Drip irrigation can save you a lot of water, in many cases almost half of what you use under furrow irrigation. It will often increase yields as well. Drip irrigation systems are costly to set up, but drip irrigation is practical for onions and promising for other crops. The Malheur Experiment Station is investigating ways to obtain long term benefits from the tape by leaving it in the ground through several cropping cycles.
- Change irrigation sets when water reaches the end of the furrows rather than at a specified time of day.
- Use PAM (polyacrylamide) or straw mulch to improve water infiltration in tight soils.
- Eliminate deep watering of shallow rooted crops. Crops such as onions and beans have shallow root systems. Frequent, light irrigations can help keep the water in the root zone where the plant can use it.
- For furrow irrigation systems slightly drought stress the bottom of the field by cutting off furrow irrigation as soon as it reaches the end of the field in order to keep the top end from receiving too much water. Usually we over water the top of the field and cause stress from over watering and nitrogen deficiency from leached nitrogen. Production losses should be similar. Straw the bottom end of the field so that the water that gets there soaks in.

Reading on related topics:

Eliminating runoff water from your farm.
http://www.cropinfo.net/publications/extension/ExtCrs142-EliminatingRunoff.php

Tailwater recovery using sedimentation ponds and pumpback systems.
http://www.cropinfo.net/publications/extension/ExtCrs134-TailwaterRecovery.php

Strategies for efficient irrigation water use.
http://www.cropinfo.net/publications/extension/em8783-StrategiesEfficientIrrigation.php

Nitrate pollution in groundwater: a grower's guide.
http://www.cropinfo.net/publications/extension/ExtCrs137-NitratePolutionGroundwater.php

Irrigation monitoring using soil water tension.
http://www.cropinfo.net/publications/extension/em8900-IrrigationMonitoringSWT.php

Successful onion irrigation scheduling.
http://www.cropinfo.net/publications/extension/sr1097-OnionIrrigationScheduling.php

Surge Irrigation.
http://www.cropinfo.net/publications/extension/ExtCrs135-SurgeIrrigation.php

Make strip tillage work for you: a grower's guide.
http://www.cropinfo.net/publications/extension/ExtCrs140-MakeStripTillageWork.php

Drip irrigation, an introduction.
http://www.cropinfo.net/publications/extension/em8782-DripIrrigationIntroduction.php

Drip irrigation guide for onion growers.
http://www.cropinfo.net/publications/extension/em8901-DripIrrigationOnions.php

Make polyacrylamide work for you.
http://www.cropinfo.net/publications/extension/em8958-MakePolyacrylamideWork.php

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Disclaimer: The intent of this document is to share the findings of the OSU Malheur Experiment Station in regards to dealing with drought. Its intent is not to endorse any product or criticize competing products.