Cooperative Extension, University of California

Water & Land Resource Manager

TEHAMA, GLENN, COLUSA, AND SHASTA COUNTIES
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Irrigation System Performance

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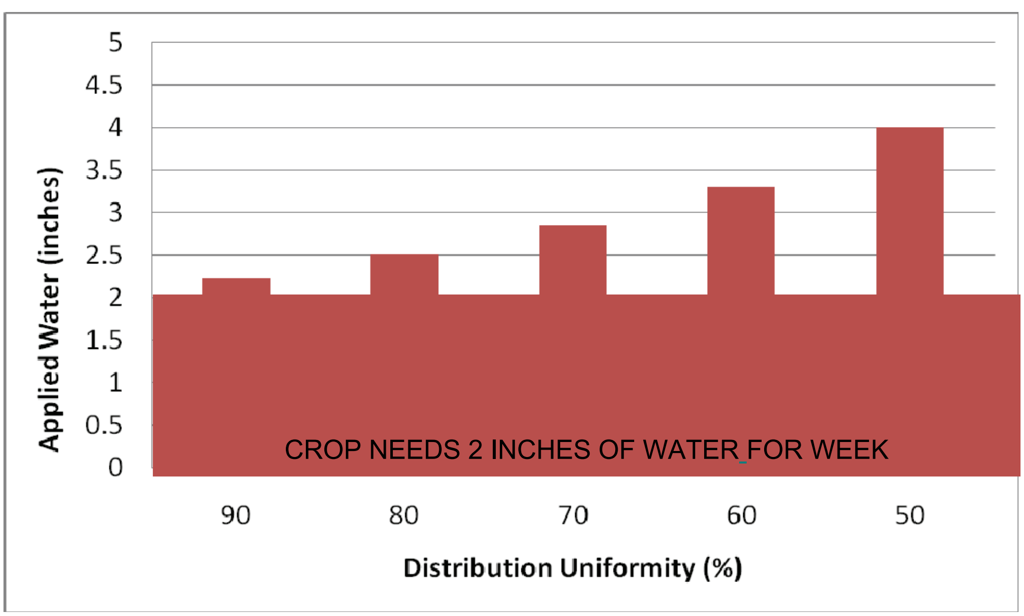
The Tehama County Resource Conservation District (TCRCD) provides on-site evaluations of agricultural irrigation systems through the Mobile Irrigation Lab (MIL) service. The goal of the MIL is to provide growers with an overall snapshot of their irrigation system. The MIL provides valuable information to growers such as application rates, distribution uniformity (the measurement of how uniform water is being applied), irrigation scheduling, soil reports, and improvement suggestions. After the evaluation, all of this information is provided in a full report, completely free to the grower. Since 2002, the MIL has performed evaluations on over 250 irrigation systems in Butte, Shasta, Glenn and Tehama Counties.

For growers, there are a number of different options when choosing an irrigation system. While some systems lend themselves to more control than others, the grower must tackle a number of issues such as, expense, crop type, soil type, land characteristics, climate, and maintenance.

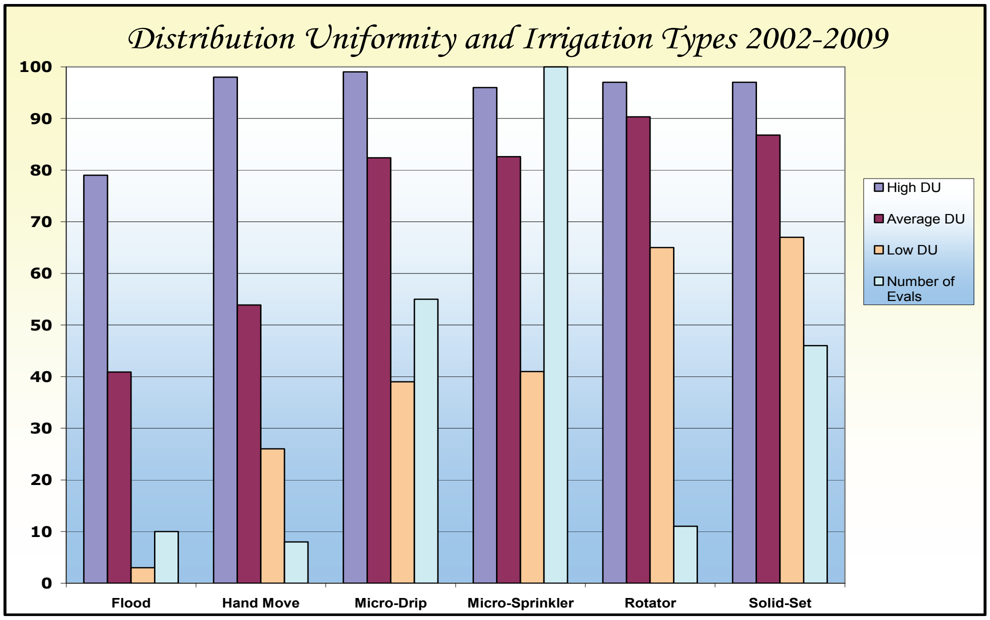
An important part of an evaluation is determining the irrigation distribution uniformity (DU). An irrigation system that applies water uniformly is more likely to promote healthier and more productive crops while saving irrigation and energy costs. Figure 1 illustrates the concept that irrigation systems with higher DU's are more efficient. Less than ¼ of an inch of extra water and only 10 percent additional irrigation (pumping) time is needed to ensure all areas of a crop receive 2 inches of water when the DU is 90 percent. In contrast, when the DU ranges from 50 to 80 percent an additional 0.5 to 2.0 inches of applied water is needed to ensure all areas of the crop receive at least 2 inches of applied water. This equates to 20 to 50 percent more irrigation (pumping) time.

Figure 1. Applied water versus irrigation system distribution uniformity.



Of all irrigation options, microsystems such as drip and microsprinkler have the ability to achieve the highest distribution uniformity (DU) ratings. When microsystems are installed, run, and maintained properly, DU's above 90 percent can be attained, although field tests throughout California average just over 80%. In the Northern Sacramento Valley, the TCRCD MIL has performed over 150 evaluations on microsystems since 2002 with average uniformities just above 81% (Figure 2). Distribution uniformities of Microsystems ranged from a low of 39 percent to a high of 99 percent.

Figure 2. Summary of TCRCD MIL evaluations performed from 2002 through 2009.



So why are some microsystems not performing up to their capability? This could be attributed to a number of factors, two of the most prominent being, the high level of maintenance associated with microirrigation and problems with system design.

Common maintenance issues with drip and microsprinkler are clogging, cracks, leaks, wear and tear. Plugging of small diameter flowpaths, emitters and microsprinkler orifices may occur when sediment is introduced into these low pressure systems. There are a number of ways this sediment may be introduced into the system, mainly through inadequate filtration systems, breaks in pipelines, cracks, and weak connections. Leaks can occur from the environmental stresses of winter freezes and summer heat, which cause connections in the plastic to loosen over time. Also farm equipment damage and thirsty rodents chewing on lines can create openings where sediment is able to enter the system. Another cause of plugging is the build up of bacteria or chemical deposits. Microsprinklers may still allow water through but at slower rates, until eventually the small openings become plugged.

Maintenance is the key to keeping these systems operating at their designed capacity. It is highly recommended that high quality filters are used that will help keep as much sediment as possible out of the micro lines, especially when the pump is known to extract sediments from the well. Flushing lines on a regular basis by opening end caps will remove sediment. Use a chemical injection method to control bacteria growth or calcium buildup in the filters and irrigation lines. Frequent inspections for cracks, leaks and sediment buildup will extend the life of the system as well as keep the DU at a high percentage.

Another key element to having high uniformity is a good design. In our field tests, we have found high variability in the drip line pressures. Emitters are designed to output a specific amount of water, but this only occurs if the manufacturer recommended pressures are attained. Systems really need to be designed with a good idea of how much pressure and water the pump will provide to the microsystem. We often see irrigation systems that are much too large for the amount of water and pressure available. This may also indicate wear and tear on the pump. Possibly, the pump no longer provides the pressure and water that it once did when it was newer and in better operating condition. So, pumping plant maintenance is also important.

For Solid-Set and Rotator systems, the MIL has seen DU averages between 85 and 90% which, on average, is 5 to 10 percent higher than for drip or microsprinkler systems. This finding may be surprising and there are a few reasons for it. With solid set and rotator systems, there is less maintenance involved. Leaks in the lines and opportunities for plugging from sediments are far less frequent because buried PVC pipeline is used in place of polyethylene tubing that is either placed on the soil surface or buried shallow. The polyethylene tubing is prone to more animal damage, cracks, disconnects, and exposure of foreign materials entering the system. Sprinkler heads and nozzles are also more durable and therefore require less attention.

There is still plenty of room for improvement in these systems as we do commonly see DU numbers down in the 75% range. With solid set sprinkler heads, it is very important to pay attention to nozzle size. Frequently nozzles are replaced with spare parts which may be a fraction larger or smaller than the original. Nozzles can also change sizes as high pressure and sand will eventually increase the opening, causing a higher application rate of water. One way to help decrease nozzle deterioration is installing and maintaining a high quality filtration system. The less silt and sand running through the pump and into the system the longer it will last with less required maintenance.

Being able to tell by eye if a nozzle is applying its specified amount of water is near impossible, but there is a way to check. A simple water volume test comparing the quantity of applied water through the heads can help growers gage nozzle uniformity. By holding one end of a hose against the nozzle and the other into a bucket, you can run a timer for 30 seconds to a minute and check the volume collected in a graduated bucket or cylinder.

Hand move and flood irrigation are typically the least efficient way to use water. Hand move sprinklers tend to have more problems with leaking connections as seals have high amounts of wear and tear. Plugged and mismatched nozzles can also be an issue. When pipes are moved, dirt, grass and other foreign material can be introduced into the system. Flood irrigation can be an efficient way to irrigate if management is closely scrutinized, however mismanagement can severely downgrade system performance. Widths and lengths of rows in conjunction with soil type and available water must be carefully planned. An issue the MIL often encounters with flood irrigation is the fact that fields are laid out for specific water quantities. If water is not delivered to the system at exact specifications, DU can dramatically decrease.

With so many irrigation options and crop details to consider, picking one irrigation method over another is no easy task. Whatever the choice may be, the TCRCD MIL is willing to assist all growers in the region by providing free evaluations of all system types.

2010 Spring Groundwater Levels Following Three Years of Drought

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Tehama, Glenn, Colusa, and Shasta Counties

In late March 2010, groundwater levels in the northern Sacramento Valley were measured by the California Department of Water Resources, Northern Region. They are of interest following three consecutive years of drought from 2007-09 and the abundance of precipitation that followed this past winter and spring (2009/10). Spring groundwater measurements were taken in 509 wells throughout the Shasta, Tehama, Glenn, Butte, and Colusa Counties from an assortment of active and inactive wells drilled by various methods, with varying designs, and for various uses. Highlights include:

- On average groundwater levels were up about 0.2 foot in the northern Sacramento Valley and Redding Basins in the Spring of 2010 compared to the Spring of 2009.
- The greatest increase in groundwater elevation was in a Tehama County observation well with groundwater elevation 9.8 feet higher in March 2010 than in March 2009.
- The greatest decrease in groundwater elevation was on the west side of Glenn County in an irrigation well that had a decline of 25.6 feet from March 2009 to March 2010.
- On average, groundwater levels were up slightly, 0.25 foot in all types of wells including domestic, irrigation, observation, and other types of wells.
- Groundwater levels were also up (0.4 foot), on average, for all wells less than 600 feet in depth. Wells deeper than 600 feet or with unknown depths, on average, showed a decline in groundwater levels (down 0.85 foot).

A detailed report of the Spring 2010 groundwater levels in the north valley is available at: http://www.nd.water.ca.gov/PPAs/GroundwaterLevel/index.cfm.

Because groundwater levels vary depending upon local settings and seasons, Table 1 provides a closer look at Spring and Late Season groundwater levels within Tehama County in 2009 and 2010. The County consists of 12 different sub-basins and groundwater levels from key wells within each sub-basin are shown. Spring Trigger Levels 1 and 2 and a Late Season Trigger Level are shown for comparison. These Trigger Levels were established last year in accordance with the Tehama County Flood Control and Water Conservation District's Coordinated AB 3030 Groundwater Management Plan. The key wells are representative of other wells in their respective sub-basins and have a historic record (usually 20 to 30 years) of the groundwater levels within each sub-basin. The Spring Trigger Level 1 is defined as the historical low of spring measurements plus 20 % of the range of spring measurements. The Spring Trigger Level 2 is the historical low of spring measurements in the past 20 to 30 years. The Late Season Trigger Level represents the historical low of late season groundwater measurements (August – October). For more information on the Trigger Level methods refer to: http://www.tehamacountywater.ca.gov/trigger_level_tech_memo.htm.

Table 1 shows that groundwater levels have recovered to varying degrees throughout Tehama County. Drought conditions from 2007-09 followed by substantial rains in the winter and spring of 2009/10 have generally resulted in improved spring groundwater levels in March 2010. Even with the abundance of recent winter/spring precipitation, March 2010 Spring groundwater levels in select key wells within the Corning East, Red Bluff East, and Vina sub-basins indicate that groundwater levels in portions of these sub-areas remain below the Spring Trigger Level 2 and are deeper than groundwater levels recorded in the past 20 to 30 years.

TABLE 1

Comparison of Groundwater Levels in Key Wells of Tehama County

And Spring and Late Season Trigger Levels

Well ID No.	General Location	Spring Trigger Level 1	Spring Trigger Level 2	Late Season Trigger Level	March 2009 Level	March 2010 Level	August 2009 Level
		Depth to Water Below Ground Surface (feet)					
ANTELOPE SUB-BASIN							
27N03W10B01M	St. Mary & Trinity Ave	58.8	62.7	65.1	60.9	56.8	60.5
27N03W16N02M	Belle Mill Rd	28.4	32.6	35.1	25.0	23.2	26.1
27N03W23D01M	Hogsback Rd & Hwy 99E	26.0	29.5	39.0	***30.0***	26.6	41.2
27N02W31C01M	Bray & Craig Ave	28.1	31.2	38.1	28.4	29.6	33.1
26N02W17E01M	LeClaire & Decker Ave	16.2	18.5	20.2	17.9	16.4	20.0
BOWMAN SUB-BASIN							
29N04W28D01	Hooker Creek & Jeffries Rd	101.5	103.3	104.3	100.5	100.5	104.7
29N04W35B01	I-5 & Snively Rd	90.2	92.5	90.2	87.0	87.4	86.7
29N04W15E02	Draper Rd & Oak Lane	35.3	36.7	39.8	33.9[8]	33.4[8]	37.5[8]
28N04W04P01	Hooker Creek Rd & Hooker Rd	126.5	133.0	128.2	124.2	NA[9]	132.2
CORNING EAST SUB-BASIN							
24N04W14N02	Corning Rd & Freeman School House Rc	72.6	78.7	100.0	***84.6***	***82.2***	102.9
24N03W02R01	Harvest Rd & Olive Rd	28.6	35.0	52.0	***37.8***	***42.1***	58.0
23N03W05G01	Liberal Ave & Cushman Lane	53.7	60.3	61.3	NA[9]	50.4	56.4
24N02W29E01	Hall Rd & South Ave	43.0	47.8	75.6	ND[6]	ND[6]	ND[6]
23N02W16B01	Near Cattle Drive	38.2	44.2	64.3	35.1	32.3	ND[1]
23N03W24A02	Capay Rd & Sour Grass Creek	38.5	42.9	65.7	***43.8***	38.2	62.7
DYE CREEK SUB-BASIN							
26N02W14G01M	Foothill Rd	78.2	80.6	88.1	77.3	77.8	78.1
27N02W30C02M	Cone Grove Rd	33.7	41.7	45.8	38.4	30.6	40.6
26N02W16C01M	68th & Schafer Ave	17.2	19.3	33.3	16.4	14.6	20.3
26N02W21Q01M	9th Ave & Hwy 99E	19.0	20.6	26.2	17.6	18.2	24.9
26N02W29R02M	5th Ave	3.5	5.3	12.0	2.2	1.5	10.4
LOS MOLINOS SUB-BASIN							
25N02W09G01	Buena Vista Ave	40.6	43.3	43.5	38.0	36.9	44.0
25N02W21B01	Lee & Sherman St	12.4	14.6	18.3	13.1	12.0	17.5
25N02W34K01	Hwy 99 E & Dye Crk	15.4	16.7	22.2	14.1	13.3	20.1
24N02W02E01	Tehama Vina St	4.9	8.0	11.7	4.9	4.6	8.8
25N01W32P01	Leninger Rd & Deer Crk	75.6	78.0	77.9	76.6	77.6	80.0

[1]Well Pumping
[6]Well destroyed
[8]Oil at water level
[9]Temporarily Inaccessible
[7]Measurement taken in early April 2009

Non-Italics: Groundwater level deeper than Spring Trigger Level 1 and/or Late Season Trigger Level
Bold, Italics: Groundwater level deeper than Spring Trigger Level 2

Well ID No.	General Location	Spring Trigger Level 1	Spring Trigger Level 2	Late Season Trigger Level	March 2009 Level	March 2010 Level	August 2009 Level
		---------- Depth to Water Below Ground Surface (feet) ----------					
RED BLUFF EAST SUB-BASIN							
25N03W10L01M	Rodeo & Central Ave	69.4	79.9	97.0	43.2	40.0	97.5
26N04W25J01M	Ottman Ave & Paskenta Rd	53.2	57.9	63.0	56.9	***58.7***	ND[1]
25N03W19N01M	Gyle Rd	56.3	60.5	95.9	***65.1***	***64.6***	108.7
26N03W11F01M	Tyler Rd	37.8	41.0	50.2	ND[6]	ND[6]	ND[6]
27N04W35E01M	Live Oak & Red Bank Rds	119.0	123.5	141.2	112.0	111.3	138.9
RED BLUFF WEST SUB-BASIN							
25N05W24C01	Rancho Tehama	72.1	74.8	79.6	73.2*	ND[6]	ND[6]
27N04W05G02	Hwy 36	45.0	47.2	64.8	43.5	NA[9]	61.2
ROSEWOOD SUB-BASIN							
29N05W16R01	Evergreen Rd	52.5	64.0	75.8	ND[9]	ND[9]	65.1
29N05W14L01	Old Gold Rd	34.8	37.0	43.8	35.9	34.3	40.2
29N05W33A04	Farquhar Rd	38.5	41.7	46.6	39.7	39.6	48.4
VINA SUB-BASIN							
24N01W05J03	Reed Orchard Rd	88.2	93.1	90.1	88.0	88.2	91.8
24N01W05Q02	Reed Orchard Rd	44.8	46.6	48.6	***46.9***	***48.8***	45.3
24N01W18N01	Hwy 99E	63.9	65.4	69.1	ND[9]	ND[9]	65.8
24N02W12P01	Vina Rd	30.0	34.5	31.7	30.6	27.9	34.1
24N02W23G01	Vadney Ave & Rowles Rd	25.0	27.5	29.1	26.7[8]	25.0[8]	30.5[8]
24N02W25G01	South Ave & Stephens Rd	23.0	29.7	26.6	22.8	22.5	26.0
BEND SUB-BASIN ***** No Groundwater Level Monitoring Available							
CORNING WEST SUB-BASIN ***** No Groundwater Level Monitoring Available							
SOUTH BATTLE CREEK SUB-BASIN ***** No Groundwater Level Monitoring Available							

[1]Well Pumping
[6]Well destroyed
[8]Oil at water level
[9]Temporarily Inaccessible
*Measurement taken in early April 2009

Non-Italics	Groundwater level deeper than Spring Trigger Level 1 and/or Late Season Trigger Level
Bold, Italics	Groundwater level deeper than Spring Trigger Level 2

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