



BLACKFOOT CHALLENGE IRRIGATION SCHEDULING PROGRAM ANNUAL REPORT 2020

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PROGRAM SUMMARY

This is our 11th year providing information to irrigators in the Blackfoot Drainage and together we've learned a lot. Our goal is to help apply the right amount of water at the right time to meet crop goals and watershed objectives. Weekly reports are circulated basin-wide to over 100 irrigators and water managers that include crop water use, irrigation tips, drought strategies, soil and crop management options, soil health concerns and other information. Reports are also posted on the Blackfoot Challenge website. The past two years we also helped install, calibrate and use soil moisture sensors. Our work together has identified irrigation practices that can provide both good crop production and adequate late-season stream flows during dry years. This year (2020) was the third in a row with good snowpack, soil moisture storage and rainfall plus excellent growing conditions during much of the season.

2020 HIGHLIGHTS

- 8-10 inches of rain fell on Blackfoot croplands during the 2020 growing season depending on location (the historic average is about 7 inches). Most of it fell before July 4.
- Early season soil moisture was as good as last year with most soils above 75% of their water holding capacity on May 1.
- Cool, moist weather dominated the early growing season – perfect for crop production, then hot weather with no rain until mid-September
- 2020 potential crop water use in inches was slightly above average:
hay = 27, pasture = 22, grains = 16-17
- High soil moisture levels, average snowpack, well-timed rainfall and available irrigation water combined to make another good year for crop production in the Blackfoot Drainage.
- Good water availability and warm weather in September supported second cuttings, new seedings and abundant fall pasture for many.
- Blackfoot irrigators installed soil moisture monitoring equipment and expanded soil health practices.

2020 WEATHER

2020 was the third year in a row for great crop weather, especially up to mid-July. The winter snowpack on May 1 was 125% of average (last year was average). There was significant rainfall almost every week from May 1 to July 3 with most local croplands getting at least 6 ½ inches. This is slightly more than average for the entire growing season May 1 to October 1 (**Figure 1**). The past three years have had the most growing season rainfall in the 11 years of this program. **Figure 3** lists weekly rainfall throughout the 2020 season. Temperatures from April to mid-July were generally cool then switched abruptly to warmer than average. The early cool, moist weather made it easy for irrigators to keep up with crop water use up to first cutting in mid-July. Hot, rain-less weather then dominated from mid-July to mid-September. This hot weather is great for growing conditions but causes higher crop water use. For those with water it provided extra production and abundant second cuttings and fall pasture.



BLACKFOOT CHALLENGE WEEKLY IRRIGATION REPORT Friday July 3, 2015

Independence Day could have been declared a holiday for irrigators – most of them are extremely independent. This one will be warm and dry following another week of high potential crop water use (>1 ½ inches). A few drops were reported but virtually no rain fell on Blackfoot croplands again. Crops again responded well to warm temperatures and clear skies with impressive growth spurts in some fields. A condensed overview of the entire irrigation season is presented on the last page of this report as a reminder to plan ahead. More information about irrigation is available on the Challenge website.



WEATHER – WARM LAST WEEK AND WARM NEXT

Very warm, dry weather prevailed last week and will continue next week. Only scattered showers are predicted. Temperatures will again be in the 80 and 90s. The 30 and 90 day forecasts continue to suggest above normal temperatures and normal rainfall. Low streamflows are becoming very low streamflows.



HIGH CROP WATER USE CONTINUES

Crop water use continued to be above 1 ½ inches for most crops last week – still above normal. It will continue to be high next week with hot temperatures and low humidity. The table and chart on Page 3 illustrate crop water use throughout the whole season.

WATER USE IN INCHES	LAST 7 DAYS	NEXT 7 DAYS	SEASON TOTAL
HAY CROPS	1.7	1.7 (1.5 - 1.8)	13.20
PASTURE	1.4	1.4 (1.3 - 1.6)	11.50
SPRING GRAINS (planted May)	1.8	1.8 (1.7 - 2.1)	7.8
WINTER WHEAT	1.8	1.8 (1.7 - 2.1)	14.6
LAWNS	1.6	1.6 (1.5 - 1.8)	12.9

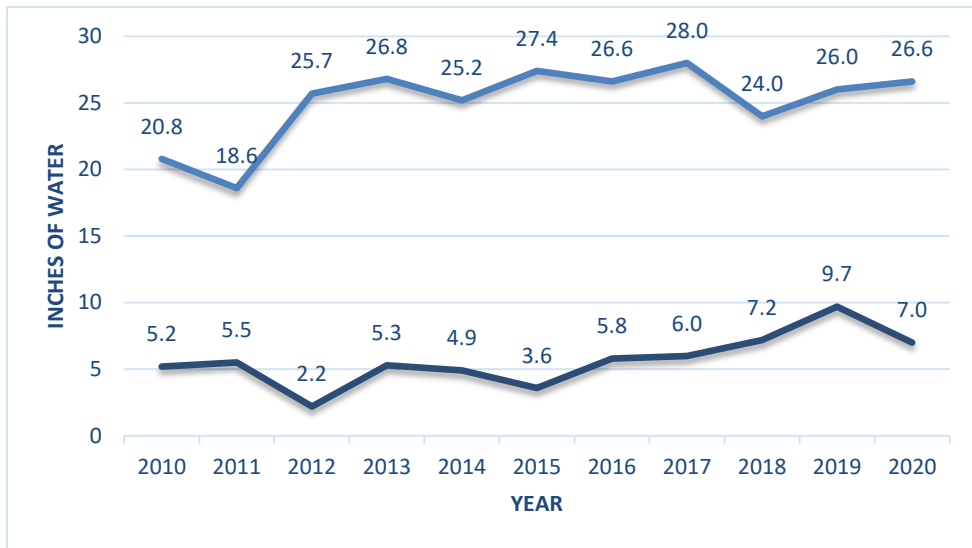
*Expected water use (range) if weather becomes cooler or hotter than expected.
†Expected April 1 – now to 2015-16 are annual not seasonal total. Now 1st row include April



SOIL MOISTURE – ADD WHAT YOU CAN

Ideally you have a full soil profile and are ready for your first cutting. However, most of those in the Blackfoot Drainage on Planet Earth are struggling to boost moisture at all. Do the best you can, leave time for the surface to dry out before cutting and get back on if you can as soon as possible.

FIGURE 1. AVERAGE GROWING SEASON RAINFALL AND POTENTIAL CROP WATER USE FOR HAY IN THE BLACKFOOT DRAINAGE 2010-2020



AVERAGE POTENTIAL CROP WATER USE MAY1 TO OCTOBER 1 = 25 INCHES

This is an average across the entire drainage and does not vary as much as rainfall at individual sites. It shows a steady increase over these 11 years.

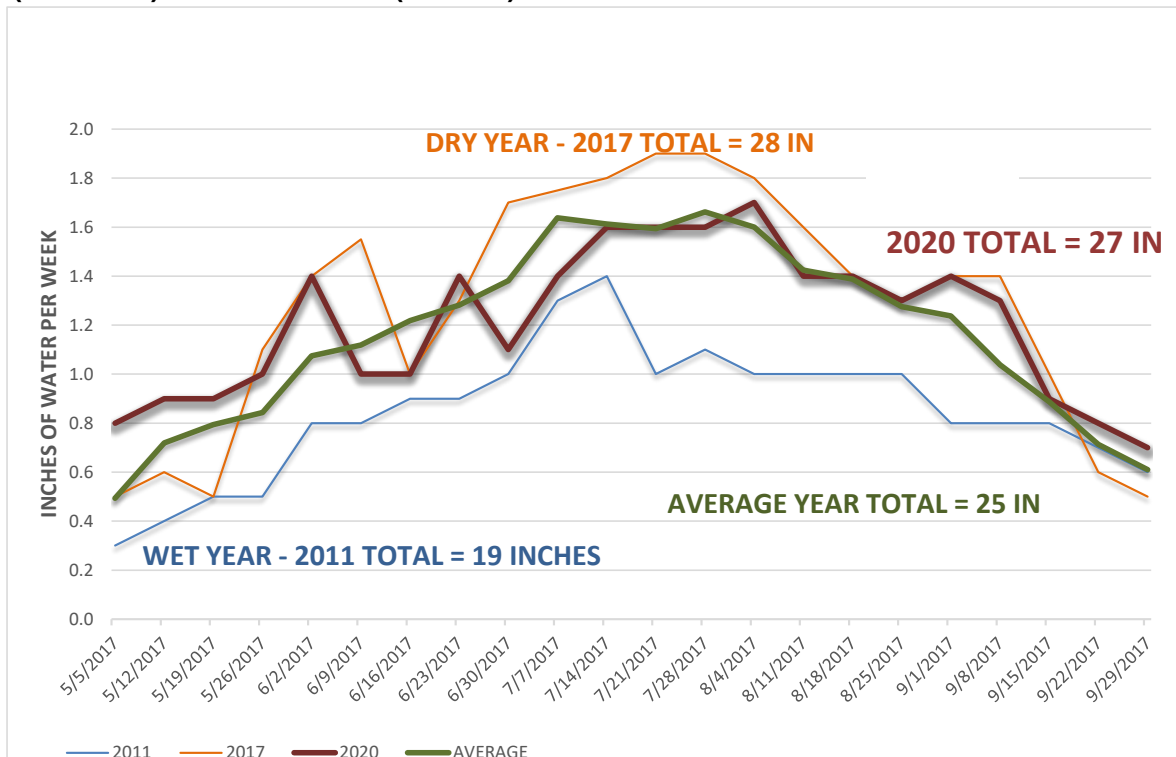
AVERAGE CROPLAND RAINFALL MAY1 TO OCTOBER 1 = 6 INCHES

This is a rough average of cropland rainfall across the entire drainage and requires adjustment for individual locations. It does however, represent the general pattern for rainfall over these years

2020 CROP WATER USE

Figure 1 shows that rainfall and weekly crop water use in 2020 were both slightly above average. Figure 2 shows weekly hay water use starting out above average in May and early June then mostly dropping below average until August. It then jumped above average throughout hot dry conditions in August and September. Excellent crops were again harvested due to good growing conditions throughout most of the season including mild temperatures and above-average rainfall.

FIGURE 2. WEEKLY POTENTIAL HAY WATER USE IN 2020 (RED) COMPARED TO WET (BLUE), DRY (ORANGE) AND AVERAGE (GREEN) YEARS



It is important to remember that these **potential crop water use** figures are for a dense, robust stand that is well-irrigated, well-fertilized and mostly disease/insect free. Crops not in such good condition use less water. Actual crop water use across the drainage varies due to water availability, fertilizer, stand quality, micro-climate, management style, and many other factors.

One of the most significant results of this program is that it continues to reveal that over-irrigation is not common among sprinkler irrigators. Most sprinkler irrigators in the drainage apply only 50-75% of the **potential** crop water use when you consider the entire irrigation season. However, if you just consider the period before cutting, many irrigators participating in this program apply 75-100% of the **potential** crop water demand. This suggests irrigators are smartly concentrating on their first cutting which is where the most production is and the biggest bang for the buck. They then may irrigate in a more relaxed manner to produce pasture, start a new crop or keep alfalfa happy. Many cease irrigating due to water availability, water rights, stream flows or other reasons (boating and fishing?).

FIGURE 3. POTENTIAL WEEKLY CROP WATER USE THROUGHOUT THE 2020 IRRIGATION SEASON FOR ALL CROPS INCLUDING COMPARISONS TO AVERAGE, HOT AND COOL WEEKS

BLACKFOOT 2020 GROWING SEASON WEEKLY RAINFALL & CROP WATER USE (INCHES OF WATER)										
WEEK ENDING	RAIN ¹	2020 WEEKLY POTENTIAL CROP WATER USE ²						AVERAGE WEEKLY CROP WATER USE ³		
	RAIN	HAY CROPS ⁴	PASTURE	SPRING GRAINS 5-1 START	SPRING GRAINS 5-15 START	WINTER WHEAT	LAWNS	LONGTERM AVERAGE HAY WATER USE	HOT WEEK HAY WATER USE	COOL WEEK HAY WATER USE
5/8/2020	0.01	0.80	0.70	0.10	0.10	0.90	0.90	0.70	1.00	0.50
5/15/2020	0.30	0.90	0.80	0.10	0.10	0.90	0.90	0.80	1.10	0.60
5/22/2020	1.25	0.80	0.70	0.30	0.20	0.80	0.80	1.00	1.20	0.60
5/29/2020	0.10	1.00	0.80	0.70	0.40	1.20	0.90	1.20	1.30	0.80
6/5/2020	1.00	1.40	1.20	1.00	0.70	1.50	1.30	1.40	1.50	1.00
6/12/2020	1.00	1.00	0.90	1.00	0.90	1.10	1.00	1.45	1.70	1.00
6/19/2020	0.25	0.90	0.70	0.90	0.90	1.00	0.80	1.50	1.90	1.10
6/26/2020	0.25	1.40	1.20	1.70	1.70	1.70	1.30	1.55	2.00	1.10
7/3/2020	1.00	1.00	0.80	1.20	1.20	1.20	0.90	1.60	2.00	1.20
7/10/2020	0.01	1.40	1.10	1.50	1.50	1.40	1.20	1.60	2.10	1.20
7/17/2020	0.01	1.60	1.30	1.80	1.80	1.20	1.50	1.55	2.20	1.20
7/24/2020	0.01	1.60	1.30	1.80	1.80	0.80	1.50	1.50	2.20	1.20
7/31/2020	0.01	1.60	1.30	1.80	1.80	0.80	1.50	1.40	2.00	1.10
8/7/2020	0.01	1.70	1.40	1.20	2.00	0.25	1.60	1.20	1.80	0.90
8/14/2020	0.01	1.40	1.20	0.50	1.00	0.00	1.30	1.10	1.60	1.10
8/21/2020	0.01	1.40	1.10	0.00	0.50	0.00	1.20	1.00	1.50	1.00
8/28/2020	0.01	1.30	1.00	0.00	0.00	0.00	1.20	1.00	1.40	0.90
9/4/2020	0.01	1.40	1.10	0.00	0.00	0.00	1.30	0.80	1.40	0.80
9/11/2020	0.25	1.30	1.00	0.00	0.00	0.00	1.20	0.70	1.30	0.70
9/18/2020	0.30	0.90	0.60	0.00	0.00	0.00	0.80	0.60	1.20	0.60
9/30/2020	0.01	0.80	0.50	0.00	0.00	0.00	1.00	0.50	1.00	0.50
TOTAL	7.06	26.60	21.70	15.70	16.70	15.85	25.10	24.15	33.40	19.10

¹ Rainfall should be reduced to account for immediate evaporation from crop and soil surfaces (0.1-April,May and Sept, 0.15-June and August, 0.2-July)
(This rainfall figure is an average across all Blackfoot croplands - use your own rain gauge for better accuracy)

² **This years** maximum water use by healthy crops that are well-fertilized and irrigated, disease and insect-free. Will vary slightly across the drainage.

³ **Longterm average** water use for each crop each week based on long-term historic data.

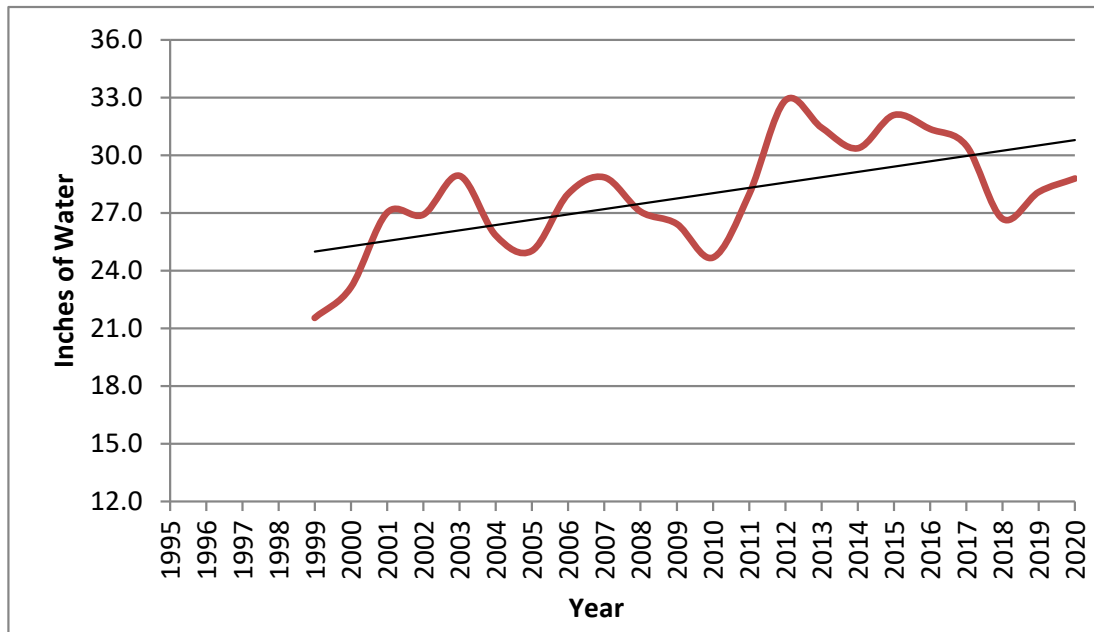
⁴ Hay Crop water use drops approximately 2/3 the first week after cutting, 1/2 the second and 1/3 the third.

CROP WATER USE TRENDS

Crop water use for hay in 2020 was about 27 inches, slightly above the 25 inch average over the past 11 years of this program. Eight of the last 11 years have been above average (**Figure 1**). There is a general increase in crop water use across all years with 2018 the most recent dip. This trend of increasing crop water use is also reflected in the Deer Lodge Agrimet weather station data (**Figure 4**). These two sources suggest the local average crop water use for hay is now 25-28 inches. It's interesting to note that the local NRCS irrigation guides from the 1980s listed crop water use for hay as only 15 inches. With all water rights already allocated in the Blackfoot drainage it will be increasingly important for irrigators to recognize seasonal conditions early and take advantage of above average water years.

FIGURE 4. ANNUAL POTENTIAL CROP WATER USE FOR ALFALFA HAY SHOWING AN UPWARD TREND OVER THE PAST 20 YEARS. Data from Deer Lodge Agrimet Weather Station

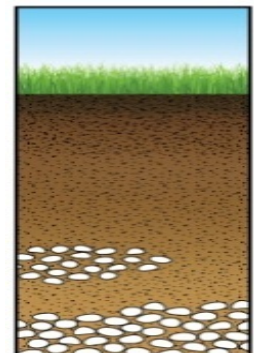
<https://www.usbr.gov/pn/agrimet/agrimetmap/drlmda.html>



2020	28.8
2019	28.1
2018	26.7
2017	30.5
2016	31.4
2015	32.1
2014	30.4
2013	31.4
2012	32.9
2011	28.0
2010	24.7
2009	26.4
2008	27.1
2007	28.9
2006	28.0
2005	25.0
2004	25.8
2003	28.9
2002	26.9
2001	27.0
2000	23.1
1999	21.6
AVERAGE	27.9

2020 SOIL MOISTURE

Early season soil moisture in 2020 was good for the third year in a row due to an above-average snowpack (125% on May 1) and some well-timed spring rains. At the beginning of May most local hay root zones held about 75% of their water holding capacity. Soils dried out significantly in early May unless irrigated. Then rains, cool temperatures and below-average crop water use kept soil moisture higher than average and made irrigation relatively easy until late July. These high soil moisture contents translated into good crop yields. After late July, rainfall ceased until late September and soil moisture was completely dependent on irrigation. Luckily, water was more available than in recent years for irrigation and the hot, dry weather combined with irrigation yielded some excellent additional crop production.



2020 IRRIGATION TIPS AND SPECIAL EFFORTS

Irrigation tips were provided each week according to crop stage, weather conditions and other factors. This year's tips concentrated on irrigation application rates, uniformity, and below-average crop water use during the early season due to cooler, wetter weather. Tips this year included soil health concerns, soil moisture monitoring equipment and more responses to irrigator questions. These discussions highlighted new crop choices, weeds, diversifying plantings and monitoring soil health improvements.

Soil Moisture Sensor Program for Irrigators

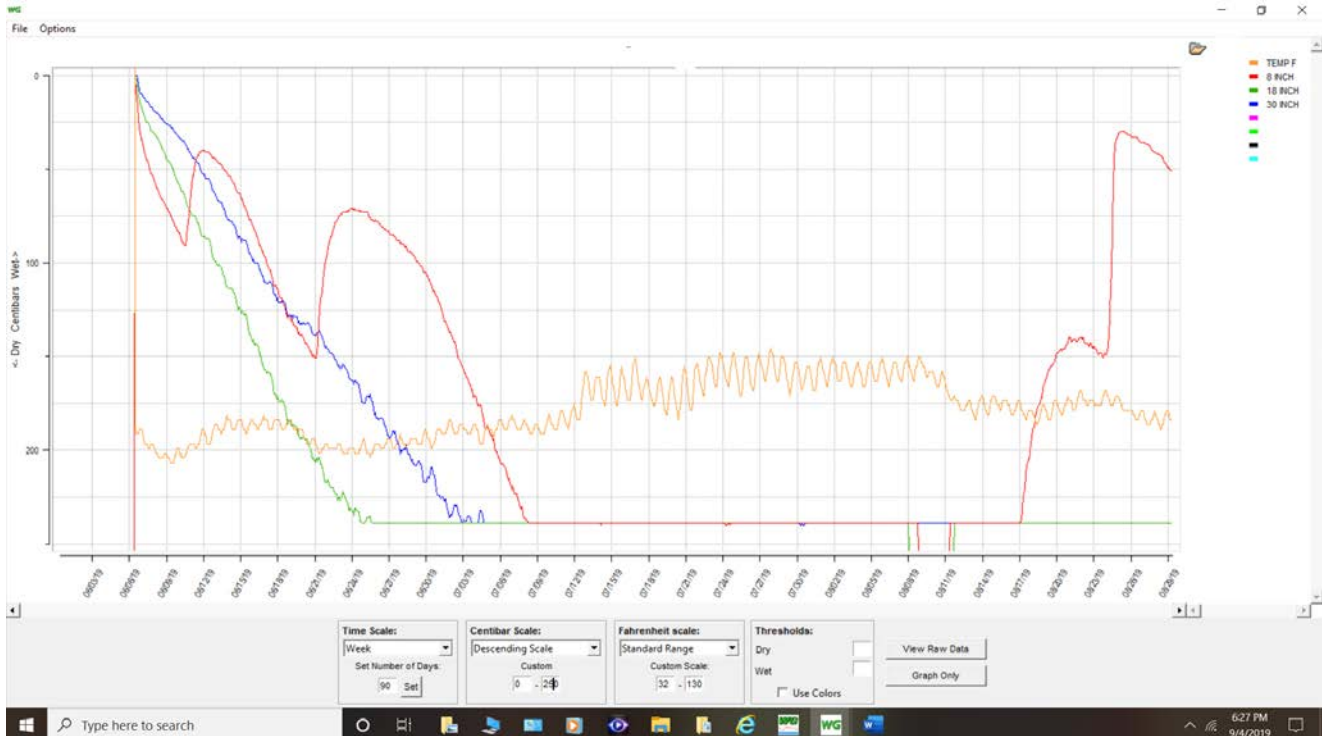
In 2020 the Challenge helped install and calibrate soil moisture sensors at 5 more pivots providing instant soil moisture and temperature readouts at each field. In addition to instant readings, data recorders collect moisture data from several depths and provide a permanent record. These charts show the effects of individual irrigations including the depth of water penetration and how long before its depleted by crop use.



Soil moisture sensors are installed at 8, 18 and 30 inches to represent the 1st, 2nd and 3rd foot of soil. This year we added soil moisture sensors at 54 inches (the middle of the 5th foot of soil) to evaluate how deeply irrigation is penetrating local soils. One goal of soil health is encouraging deep root penetration to grow your crop in a larger volume of soil. This provides more water and nutrient storage and a larger population of worms, nematodes, fungi and microbes to work for you making nutrients available.

The Blackfoot Challenge assists with equipment costs, installation and calibration of sensors as well as training in how to interpret and use the results. Contact Jennifer Schoonen if you are interested.

Example Soil Moisture and Temperature Graph from June to September



Soil Health

Soil Health continues to be a popular local topic, not just the worms and nematodes but the practices that encourage them. Blackfoot farmers and ranchers continue to try different grazing, harvesting, tilling, irrigating and other techniques. Jim Stone continues bale grazing experiments for happier cows. Scott Gordon grew another cover crop this year including turnips for hayfield renovation. The Vannoy and Paws Up ranches added soil moisture sensors this year and now have push-button answers and permanent records.



On a down-sized Soil Health tour this year, the Mannix ranches explained their new grazing intensities and durations along with the effects on forage health and weeds. Kyle Graveley showed how he is competing fiercely in the race to move more cows more often and is liking the results. He also displayed a new implement that looks effective for breaking up sod and incorporating organic matter in preparation for re-establishing hayfields. From a strict soil health viewpoint, regular tillage that breaks down soil structure (dirt clods) this effectively is discouraged. However, if the goal is to use tillage occasionally to rehabilitate a sodded field it seems a worthwhile option. Kyles new implement looks promising for accelerating conversion to a new stand of improved species. Thanks to Brad Weitzen from the Challenge who organized this event and continues to coordinate local soil health activities. You can get more information on what folks are doing about soil health from Brad and from our participating partners with the NRCS and Conservation Districts in Powell, Missoula and Lake Counties. We invite everyone interested in Soil Health to join the Soil Health listserv and receive announcements about this important topic. Anyone who wants to sign up can email (jennifer@blackfootchallenge.org) or Brad (brad@blackfootchallenge.org).

Best Management Strategy for Blackfoot Irrigators

We continue to refine an over-all Best Management Strategy for both individual irrigators and water management across the entire drainage. We combine experience from the best local irrigators with irrigation science to fine-tune recommendations. Individual recommendations have come together in an overall strategy for irrigation that can **provide both good crop production and late-season stream flows** for fish and recreationists. This strategy is condensed into our irrigation calendar (page 6) and its main points are:

- early evaluation of the coming irrigation season in April – pay attention early,
- heavy irrigation early in the season to fill up the soil water holding capacity,
- heavy irrigation throughout June and up to cutting in early-mid July
- reduced irrigation or no irrigation during low water flows in late July To September
- taking advantage of wet years for 2nd cuttings, new plantings and cover crops

In dry years, irrigators who applied water early and kept pouring it on up until haying in mid-July had excellent crops. In moist years like 2020, irrigators who took advantage of the abundant moisture and longer growing season had great production, great second cuttings and abundant fall pasture. There is little doubt that the future will only get more challenging for Blackfoot irrigators. However, there will likely come opportunities to influence critical water decisions and participate in future water markets from here to the Pacific Ocean. All while living and irrigating in a great place so enjoy it!

THE BLACKFOOT DRAINAGE IRRIGATION SEASON IN BRIEF

This is a summary of general activities and recommendations with more detail provided throughout our irrigation guide.

APRIL – GET READY AND PLAN YOUR IRRIGATION STRATEGY!

- Get your irrigation system ready, evaluate spring soil moisture and weather to determine start date.
- Evaluate season weather predictions then plan for drought if needed, start irrigating if dry.



MAY – CHECK SOIL MOISTURE & BE READY FOR UNUSUAL HEAT OR COLD!

- Check the soil moisture content at the start of growing season (May 1) and fill up the soil to its water holding capacity during early irrigations (2-4 inches).
- Watch for dry soil conditions, especially with new plantings and apply water to ensure good germination and emergence.
- Irrigate deeply at least once early in the season to promote deep root growth.
- Apply 2-5 inches of irrigation to hay and pasture crops in May depending on weather. Apply 0-2 inches to spring grains and new plantings as needed based on weather and growth. Apply extra water to fill up the soil (2-4 in).

JUNE – THIS IS THE TIME TO MAKE YOUR BIGGEST EFFORT SO POUR IT ON!

- Apply 6-8 inches of irrigation in June to hay and pasture crops and winter wheat depending on weather.
- Apply 5-8 inches to spring grains and new plantings as needed based on weather and growth.
- Consider irrigating deeply to fill up soil root zone and promote deep root growth.
- Be sure small grains are irrigated well during their critical periods of boot, bloom and early heading.



JULY – POUR IT ON UNTIL HARVEST AND RETURN QUICKLY

- Apply 1 - 2 ½ inches of irrigation per week in July to all crops - depending on weather.
- Cutting is a critical stress period for hay crops, especially alfalfa so irrigate deeply to fill up the root zone before cutting then get back across the field quickly after cutting. Crop water use declines when hay is cut so this is a good opportunity to fill up the soil again. Irrigate at least once after cutting.
- Stop irrigating small grains at the milk to soft dough stage but be sure there are 1- 2 inches of soil moisture left at this stage to prevent kernels from shrinking.

AUGUST- BE DROUGHT AWARE!

- Stop irrigating if you can during drought periods or irrigate less often.
- Apply 1 - 2 inches of irrigation per week in August to hay and pasture crops for full production depending on weather. Irrigate new plantings as needed.
- Many folks irrigate for pasture following their one hay cutting. Irrigate according to how much pasture you seek and with consideration for other water needs in the drainage, especially in drought years.
- Reduce river withdrawals by rotating systems and reducing the amount of irrigation at one time. This is the least efficient time to irrigate (lots of water lost to evaporation) so don't irrigate unless you need to.



SEPTEMBER – APPLY AS NEEDED/AVAILABLE & GET READY FOR SPRING!

- Stop irrigating if you can during drought periods.
- Apply ½ - 1 ½ inches of irrigation per week in September to hay and pasture crops for full production depending on weather. Irrigate new plantings as needed. Prepare the system for winter and an early start next spring.