MONTANA STATE UNIVERSITY | MONTANA AGRICULTURAL EXPERIMENT STATION

Northwestern Agricultural Research Center

FIELD DAY
Thursday, July 17, 2025

8:30 a.m. **Arrival & Registration**

9:00 a.m. **Field Tours** **Pages**

- **Barley & Forages** **5-6**
  Dr. Joseph Jensen – MSU Northwestern Agricultural Research Center
  Toby Hook – Producer
- **Barley & Fertility/Amendments** **7-8**
  Dr. Jamie Sherman – MSU Plant Sciences & Plant Pathology
  Bridgett Cheff – Lake Seeds
- **Applying Silicon & Nitrogen in Spring Wheat** **9-11**
  Dr. Marilyn Dalen – MSU Northwestern Agricultural Research Center
  McKenzie Dey – Extension Agent
- **Alternative Crops & Cropping Systems** **12-13**
  Dr. Perry Miller – MSU Dept. of Land Resources & Environmental Sciences
  Ken McAlpin – Producer
- **Precision Agriculture** **14**
  Dr. Anish Sapkota – MSU Dept. of Land Resources & Environmental Sciences
  Patrick Mangan – Extension Agent
- **Winter Wheat Breeding Program** **15-16**
  Dr. Sue Mondal – MSU Plant Sciences & Plant Pathology
  Carissa McNamara – Producer

11:50 a.m. **Lunch**

12:15 p.m. **Welcome Remarks, Bridgett Cheff – NWARC Advisory Committee Chair**

12:20 p.m. **Updates, Dr. Jessica A. Torrion – Department Head of the Research Centers**

12:30 p.m. **College of Ag/MAES Updates, Dr. Sreekala Bajwa – Vice President, Dean & Director**

12:40 p.m. **Montana Ag Experiment Station Updates, Dr. Darrin Boss, Associate Director**

12:50 p.m. **CHS Crop & Grain Updates, Andy Lybeck**

1:00 p.m. **Networking/Socials**

NORTHWESTERN AG RESEARCH CENTER FACULTY & STAFF

Pictured from left to right: Emily McGarvey, Rook Arakaki, Dr. Joseph Jensen, Saurabha Koirala, Moose Larson, Dr. Marilyn Dalen, Zach Sippel, Dr. Jessica Torrion, Jordan Penney, Ellana Schreifels, Sarah Peterson. Not pictured: Ashley Goodman, Joe Cain

ADVISORY COMMITTEE MEMBERS

Wendy Carr, Mackenzie Dey, Toby Hook, Bridgett Cheff, Patrick Mangan, Ken McAlpin, Carissa McNamarra, Mike Nicholson, Kenny Smith, Chuck Stephens, Terry Stephens

THANK YOU TO OUR SPONSORS

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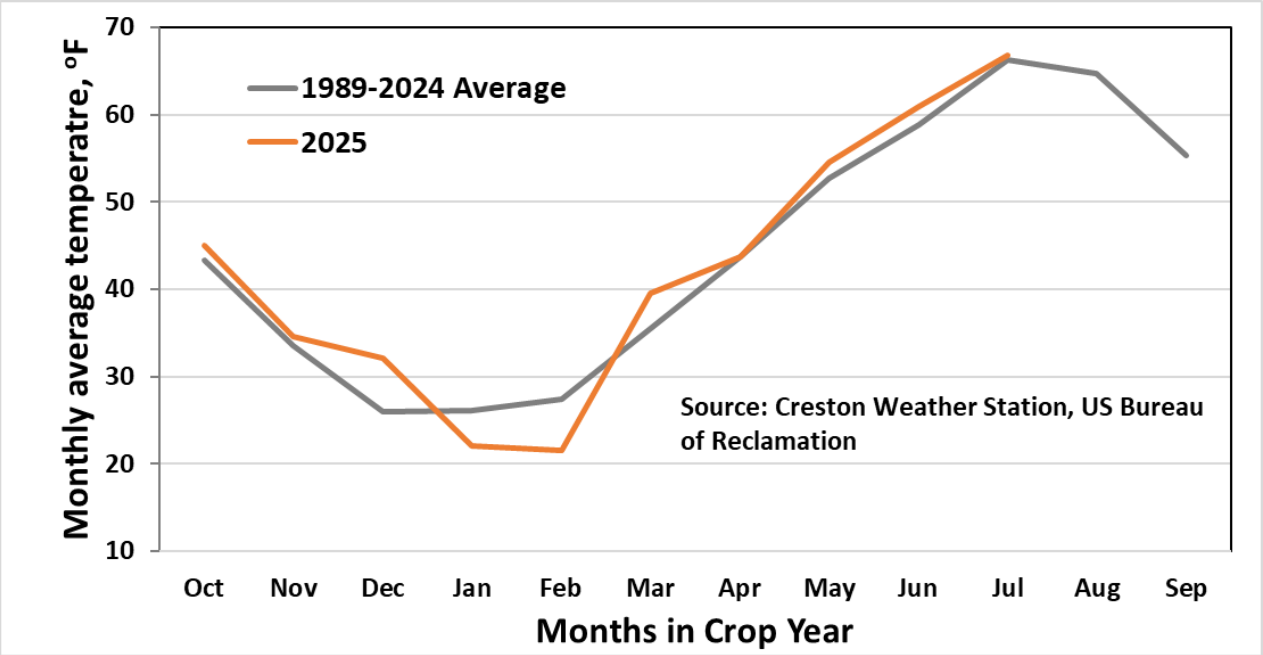
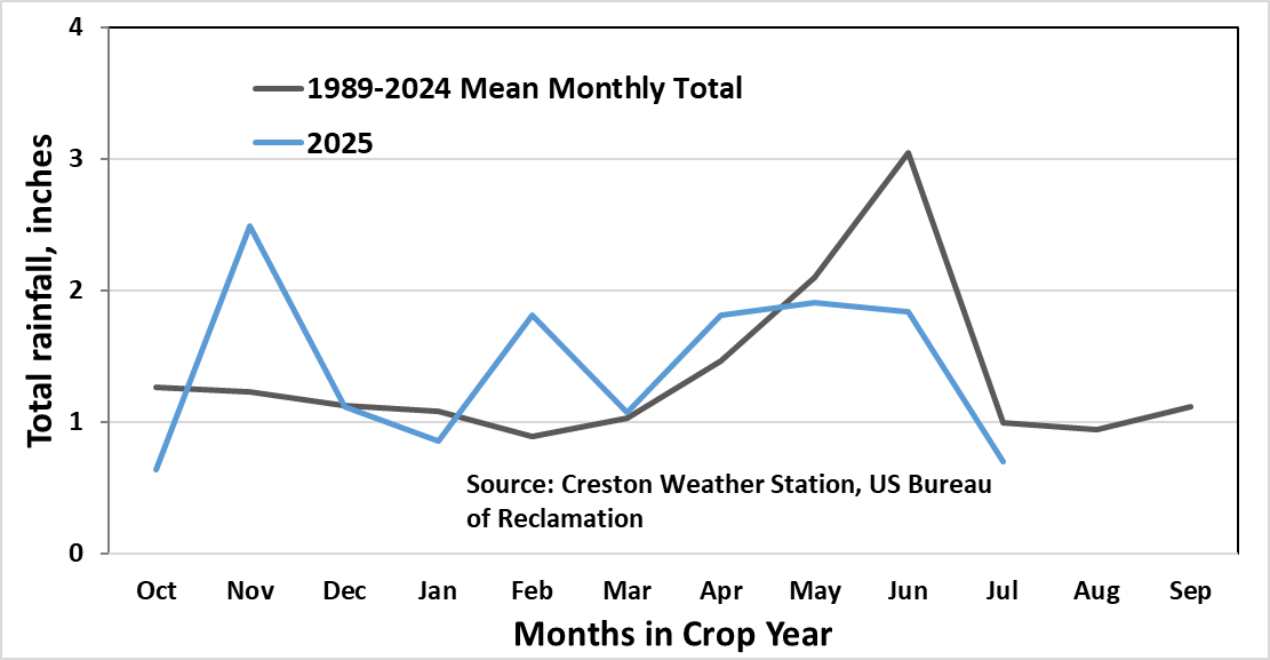
RDO Equipment Co. | Montana Farmers Union | Creston Seed

John Deere | Whitefish Credit Union

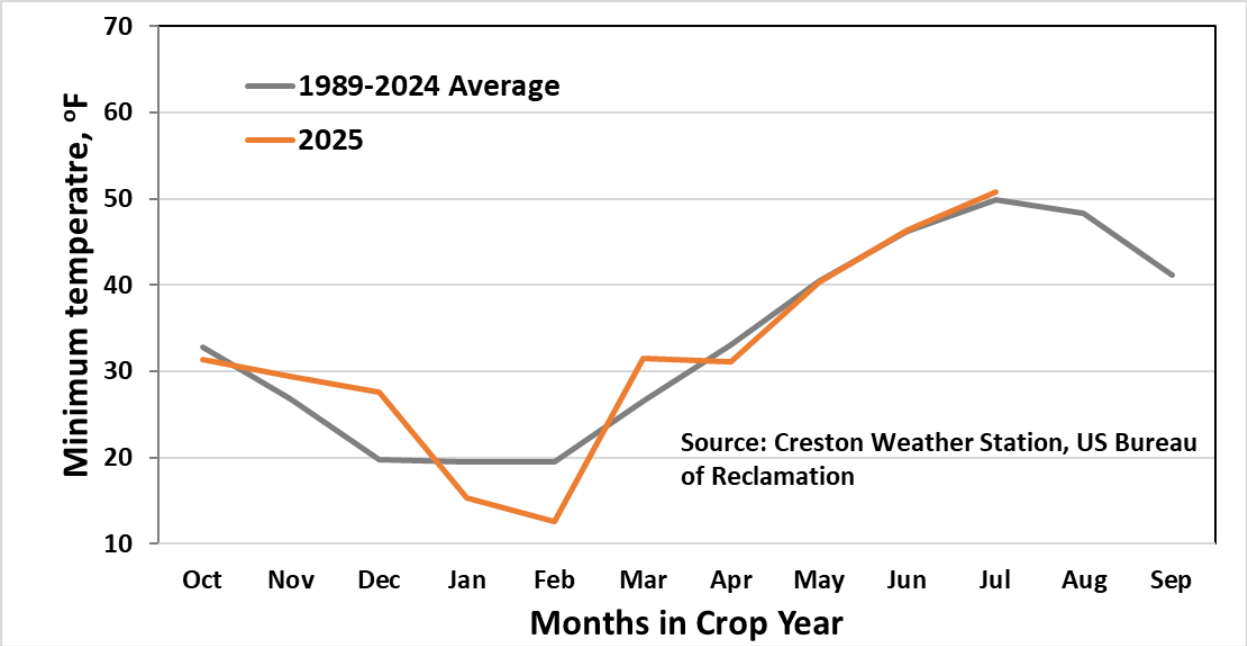
Monthly Average Air Temperature



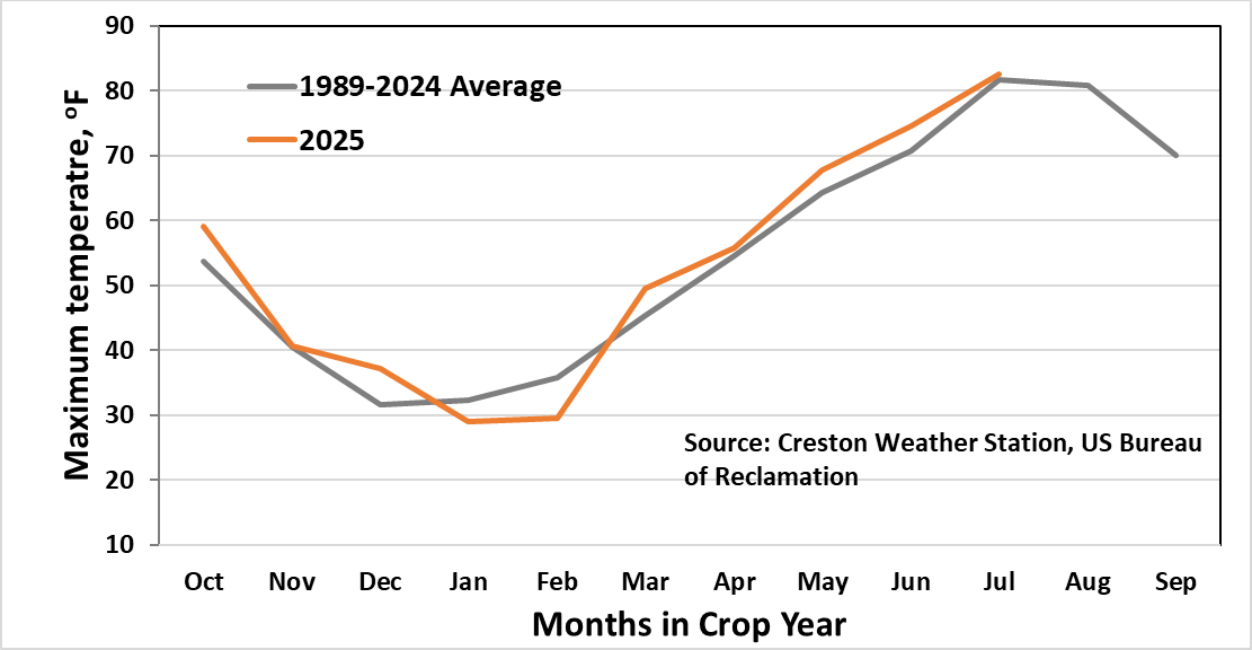
Monthly Total Rainfall



Monthly (Average) Minimum Air Temperature



Monthly (Average) Maximum Air Temperature



Barley & Forages

Dr. Joseph Jensen – MSU Northwestern Agricultural Research Center

MTWF7_19-7 is on track to be our first winter forage barley release. While the name is still a work in progress, it has consistently ranked in the top three for biomass production across seven years of data (Fig. 1). MTWF7_19-7 has also shown increased grain yield (Fig. 2) and winter survival (Fig. 3) compared to other high biomass lines. Our target release date is winter 2027, with foundation seed available for sale in fall 2027.

2022 to 2024	Biomass (tons/ac)				
Variety	Bozeman	Kalispell	Havre	Sheridon	All Locations
Loc Years	3	2	1	1	7
MTWF7_19-7	7.22	6.96	4.67	3.17	6.2
MTWF6(F2)_50-2	6.9	6.17	5.38	3.25	5.95
MTWF6(F2)_50-11	6.26	6.92	5.8	3.24	5.95
Saturn	6.47	5.41	3.49	2.05	5.01
Winter Wheat	8.72	7.16	8.01	4.12	7.31

Figure 1. Biomass data for our top 3 winter forage barley lines, along with Saturn as a grain yield check, and forage winter wheat for comparison.

Figure 2. Grain yields for all five lines. While MTWF7_19-7 doesn't yield as much as Saturn, a winter feed barley, it is still the highest yielder of our top biomass producers.

2023 to 2024	Yield (bu/a)			
Variety	Bozeman	Kalispell	Havre	All Locations
Loc Years	2	2	1	5
MTWF7_19-7	82.1	82.4	79.8	81.4
MTWF6(F2)_50-2	61.9	70.8	89.5	74.1
MTWF6(F2)_50-11	59.3	44.0	68.7	57.3
Saturn	150.7	137.0	103.1	130.3
Winter Wheat	91.7	156.3	99.3	115.8

2023 to 2024	Winter survival (%)				
Variety	Bozeman	Kalispell	Havre	Sheridon	All Locations
Loc Years	1	2	1	1	5
MTWF7_19-7	83	74	70	73	75
MTWF6(F2)_50-2	80	64	73	71	72
MTWF6(F2)_50-11	90	68	65	64	72
Saturn	90	76	71	74	78
Winter Wheat	100	70	72	64	76

Figure 3. Variation in winter survival has been limited to either total survival or total loss of a line. Two of the Bozeman locations saw 100% survival across all tested lines, so the data isn't included in this table.

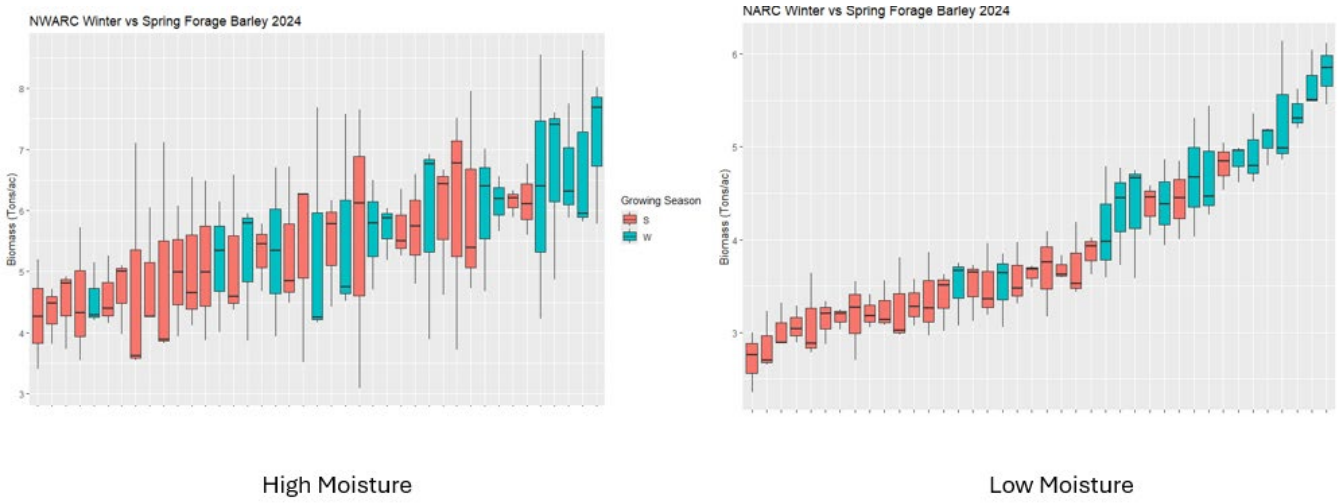


Figure 4. Comparing forage biomass in Winter (blue) vs Spring (red) barley. In lower moisture environments, the winter types see a greater increase in biomass vs the spring types.

Bozeman Malt Feed PYT 2024

ID	Yield	Plumps	Protein	S. Protein	S/T	FAN
MTWF6(F4)_87-185	84.7	93.74	10.4	4.8	45.98%	213
MTWF4(F1)20_62	109.1	94.64	8.6	3.8	44.34%	181
MTWF6(F4)_30-3	130.1	94.14	9.4	4.4	46.91%	191
MTWF4(F1)20_74	133.7	96.63	9.1	3.3	36.34%	151
MTWF4(F1)20_13	136.6	97.08	9.0	3.8	42.36%	177
MTWF4(F1)20_59	162.6	97.80	13.4	4.4	32.88%	182
Charles	113.6	94.06	12.1	4.3	35.50%	208
AMBA guidelines		>90	≤12.8	4.8-5.6	38-47%	140-210+

Bozeman Malt Feed PYT 2024

ID	Extract (CG db)	B-Glucan	AA	DP
MTWF6(F4)_87-185	80.1	120	83	150
MTWF4(F1)20_62	80.4	86	91	162
MTWF6(F4)_30-3	80.6	63	84	135
MTWF4(F1)20_74	80.7	76	76	129
MTWF4(F1)20_13	80.6	103	76	149
MTWF4(F1)20_59	77.5	96	61	216
Charles	82.9	50	103	152
AMBA guidelines	>80 (on FG)	<100	40-70+	110-150+

Figure 5. I've pulled out six lines that have the potential to be malt lines from last year's PYT. MTWF4(F1)20_59 is in the interstate while the rest are in the EYT. More testing in more environments is needed, but this is an exciting first step for a malt barley line adapted for Montana.

Joe Jensen – Cell: 406-366-9010 Email: joseph.jensen4@montana.edu

Varieties

Barley 2025

MONTANA STATE UNIVERSITY

Jamie Sherman
jsherman@montana.edu
www.montana.edu/barleybreeding

Feed/Forages

MT Double Barrel

Spring, two-row, hooded dual purpose (feed/forage) barley variety with:

- High grain and forage yield
- Improved quality
- Replacement for Hays due to similar plant stature and development
- Large seed size due to stay green maybe related to lower Test weight.

Certified seed available through MSU Foundation Seed for 2026 season.

MT Double Barrel
Released 2025

Forage

MT Cowgirl

Spring, two-row, hooded forage barley variety with:

- High forage yield
- Improved quality
- Taller plant stature
- Earlier heading supporting larger seed
- Certified seed available through MSU Foundation

MT Cowgirl
Released 2021

Malt

Buzz

Spring, two-row, awned malt barley with:

- Plump grain and low grain protein across environments and management practices
- Reduced lodging from Hockett
- Good malt quality with decreased malting time
- Certified seed available through MSU Foundation Seed

Buzz
Released 2019

Feed/Malt

MT Boy Howdy

Spring, two-row, awned dual purpose (feed/malt) barley variety with:

- High stable grain yield
- Pre-harvest sprout resistance
- Smooth awns, fewer hairs increase grower comfort
- Good malt quality after dormancy broken
- Good for all malt distilling (**NO GN**)

Certified seed available through MSU Foundation Seed

MT Boy Howdy
Released 2024

Malt

MT Endurance

Spring, two-row, awned malt barley variety for dryland production with:

- High stable grain yield and malt quality
- Stable low protein and plump seed dryland
- 3% higher malt extract
- Extended grain fill

Certified seed available through MSU Foundation Seed

MT Endurance
Released 2024

Barley News 2025

Extended Grain fill-

- Can increase grain yield
- Maintains low protein and high plumps in drought

	Year	Bozeman			Havre		
		short grainfill	long grainfill		short grainfill	long grainfill	
Yield(bu/ac)	2021	90.61 ± 8.04	86.14 ± 9.14	*	42.44 ± 6.57	39.72 ± 6.70	**
	2022	81.99 ± 11.11	82.59 ± 8.76,	ns	65.99 ± 5.80	65.46 ± 4.99	ns
	2023	127.44 ± 15.22	139.80 ± 14.57	***	52.70 ± 6.13	55.88 ± 5.86	**
Grain Protein (%)	2021	12.66 ± 0.73	12.22 ± 0.74	***	16.06 ± 1.03	14.82 ± 0.98	***
	2022	11.99 ± 0.78	11.40 ± 0.64	***	13.65 ± 0.81	12.80 ± 0.51	***
	2023	12.45 ± 1.45	11.35 ± 0.71	***	16.25 ± 1.24	14.86 ± 1.12	***
Plump 6/64 (%)	2021	93.10 ± 4.62	94.92 ± 3.85	***	58.59 ± 12.87	72.58 ± 12.87	***
	2022	85.54 ± 7.16	92.03 ± 5.05	***	72.03 ± 9.35	79.64 ± 8.13	***
	2023	95.00 ± 5.50	96.63 ± 5.85	*	40.43 ± 15.95	57.23 ± 17.20	***
Days from Heading to Maturity	2021	25.65 ±2.30	32.44 ±1.73	***	15.93 ±1.52	24.11 ±2.13	***
	2022	23.62 ±1.0	28.81 ±1.53	***	24.86 ±1.59	32.97 ±2.39	***
	2023	31.09 ±3.51	39.98 ±3.63	***	17.8 ±2.06	27.41 ±2.07	***

* p<0.05, **p≤0.01, ***p≤0.001

- Is controlled by at least 4 gene regions
- 1 stay green region decreases grain protein while another may increase

2024 Greenhouse Experiment
Low N (50 ppm), High N (300 ppm)

NIL	Nitrogen Level	Yield (g)	Protein (%)	Plump (%)	Average Seed Weight (mg)	Average Seeds Per Head	Grainfill
2H-ND	Low N	4.24	13.21	**93.12***	**50.96***	**12.07***	27.13
2H-MT	Low N	4.62	12.35	82.01	44.05	15.93	25.73
2H-ND	High N	9.38	12.67	94.41	49.68	**13.17***	34.87
2H-MT	High N	8.93	11.69	93.50	47.50	19.37	31.90
6H-ND	Low N	4.49	**12.30***	**91.47***	**50.41***	16.07	28.29
6H-MT	Low N	4.30	14.35	80.91	44.76	15.03	25.77
6H-ND	High N	10.40	**12.68***	**97.78***	52.65	**19.68***	35.79
6H-MT	High N	7.82	14.34	92.10	49.10	16.40	31.38

- May increase heat tolerance

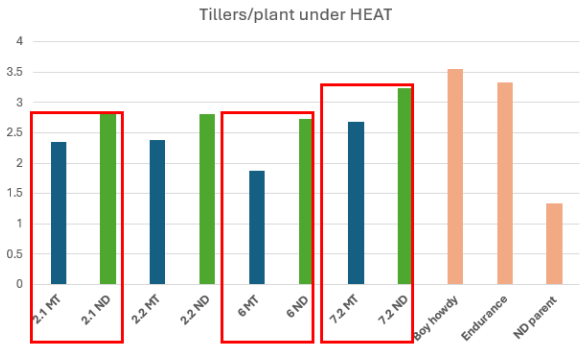
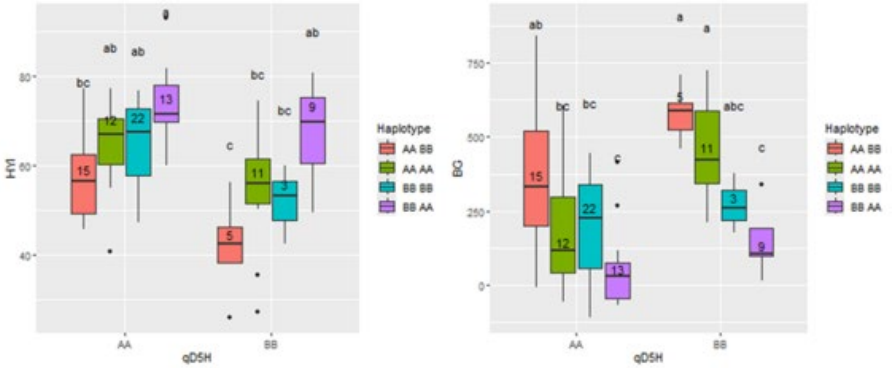


Fig 1: Stay green lines(GREEN) tend to tiller more under heat stress than non-stay green lines (BLUE)

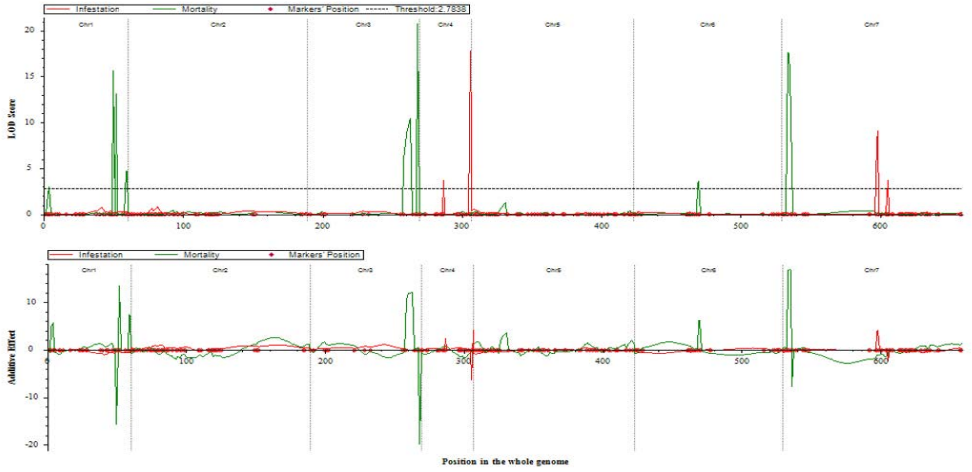
We can have PHS resistance and good malt - Boy Howdy



Jensen et al., 2024 Plant Breeding
onlinelibrary.wiley.com/doi/10.1111/pbr.13217

Barley kills WSS without solid stems!

Trait	Checks	mean	SD	Group
Mortality	Craft	93.89	4.63	b
Mortality	MT124148	75.00	3.40	b
Mortality	Hockett	68.37	7.25	ab
Mortality	MT124128	43.59	5.63	a



Montana Fertilizer Advisory Committee

Silicon nitrogen application (M.S Dalen, J.A Torrion and D. Porter)

Objective: To evaluate the effects of silicon and nitrogen fertilization on wheat production in Montana.

Silicon (Si) is a naturally occurring element in the soil and the second most abundant element in the earth's crust. While it is prevalent in the soil, Si primarily exists as silica (SiO2) which is not available for plant uptake. It is not an essential nutrient for all plants, but it is considered a beneficial nutrient for many species. The greatest benefit of Si is its role in enhancing growth and yield of crops by promoting stronger and thicker stems, prevents lodging, provides resistance to bacterial and fungal diseases and decrease some abiotic stress such as drought, salinity, heavy metal and aluminum toxicity.

Treatments:
Silicon application rate: 0, 0.5, 1.0, 2.0, and 4.0 t/Ac
Silicon Source: Silicate slag, wollastonite, volcanic ash
Nitrogen application rate: Control (residual, 42.5 N/Ac) and 150 lbs N/Ac (residual + added N)
Variety: Dagmar and Vida

Results:

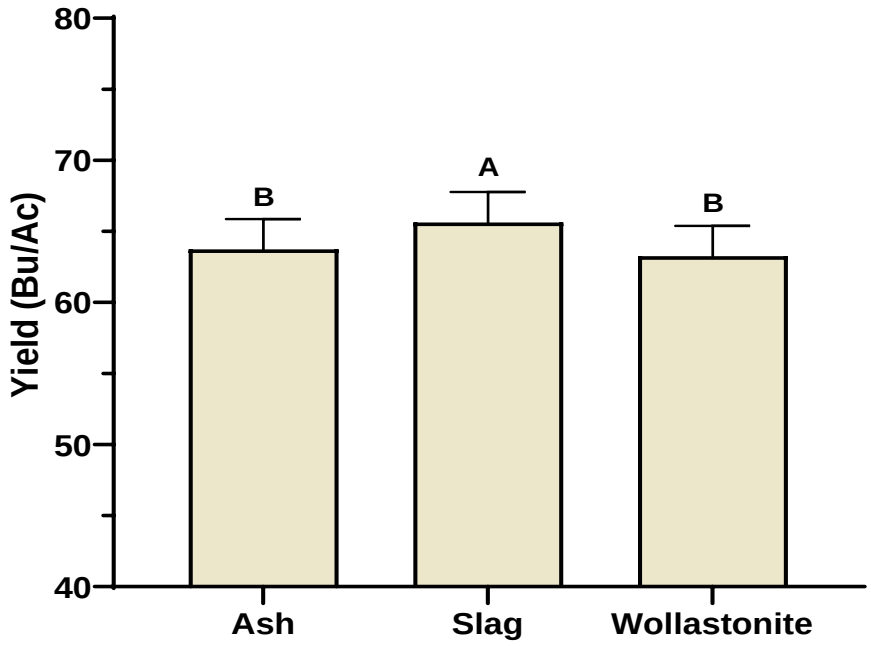


Figure 1. Yield response with silicon source. The same letter assignment denotes an insignificant difference at α =0.05.

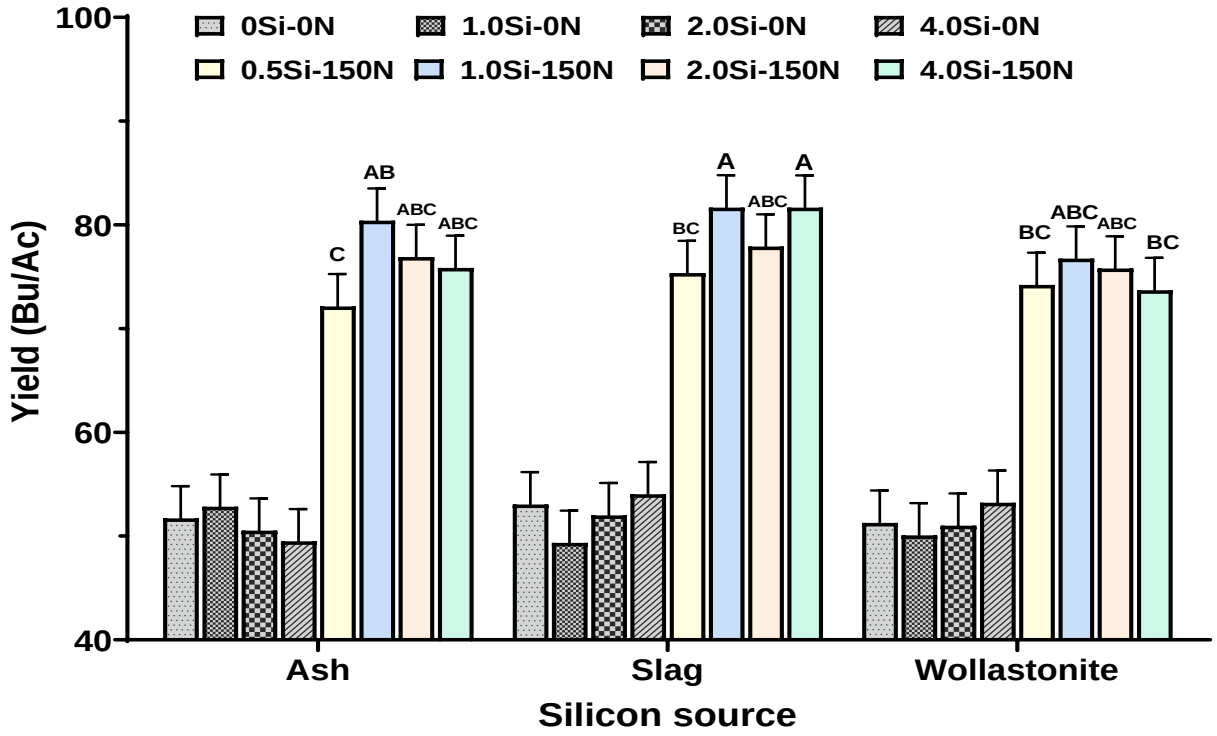


Figure 2. Significant interaction between silicon rate and source. The same letter assignment denotes an insignificant difference within a variety at α =0.05. Error bars are the standard error of the interaction means.

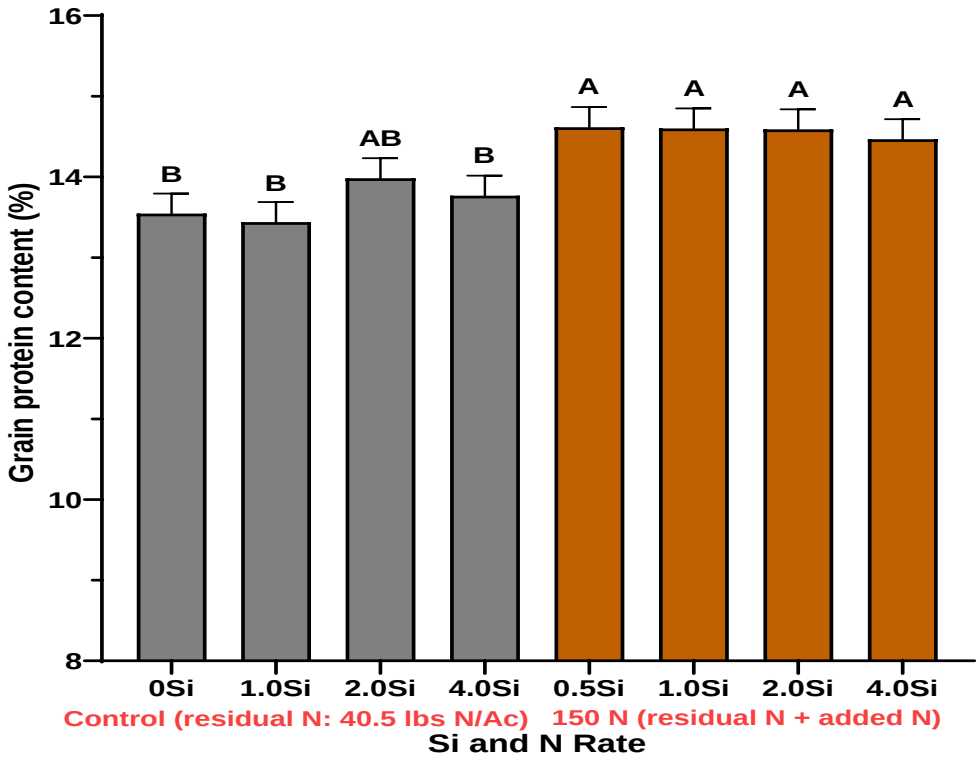


Figure 3. Grain protein content of spring wheat with silicon and nitrogen application rates. The same letter assignment denotes an insignificant difference within a variety at α =0.05.

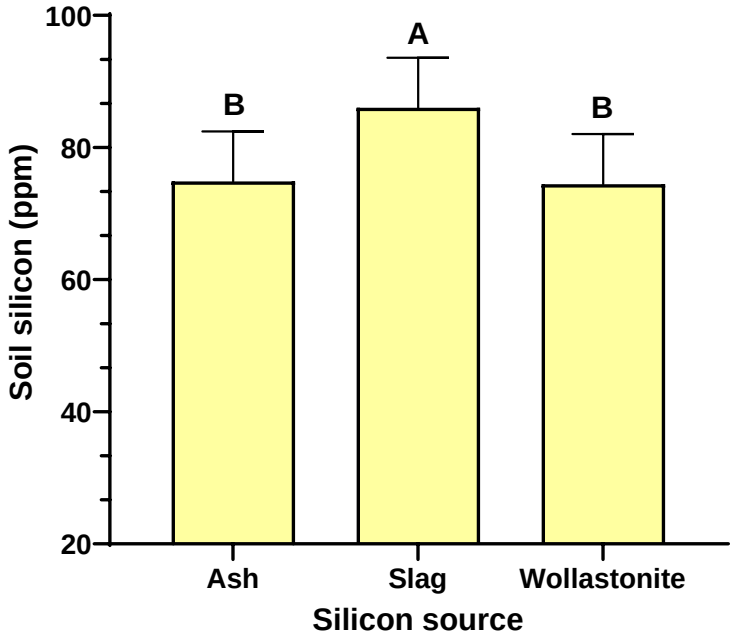


Figure 4. Soil silicon content of spring wheat with silicon source and nitrogen application rates. The same letter assignment denotes an insignificant difference within a variety at α

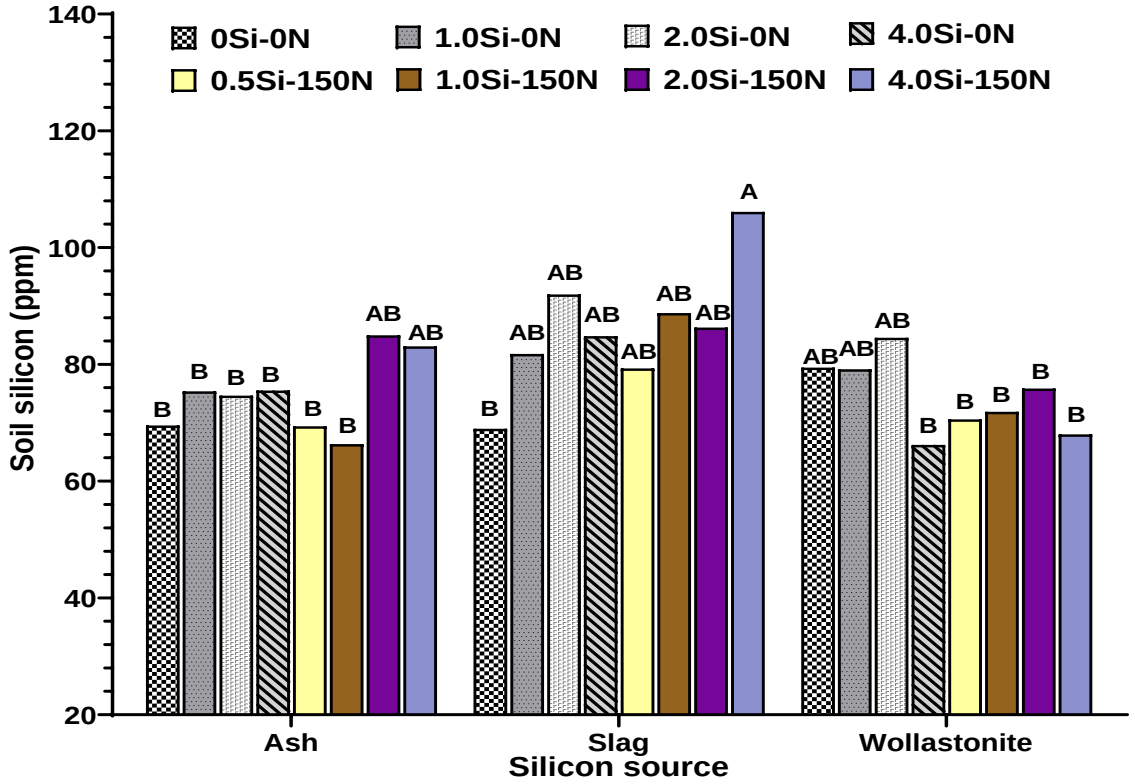


Figure 5. Significant interaction between silicon rate and source. The same letter assignment denotes an insignificant difference within a variety at α =0.05. Error bars are the standard error of the interaction means.

Cropping Systems Professor – Land Resources and Env. Sci. Dept, Bozeman
Perry Miller – Professor of Cropping Systems (pmiller@montana.edu) 406-994-5431

Alternative crops ... I've grown over 60 annual and perennial crops in my career. I've had a long experience with pulse and oilseed crops. Currently my program is actively researching the following alternative crops:

- Winter canola
- Chickpea, lentil, pea
- Cowpea (you might be surprised at the heat and drought tolerance)
- Early maturing grain sorghum (aimed at habitat market)
- Fiber Hemp
- Early flowering Nyger, aka Ramtil (Amazingly attractive to pollinators and has other potential oilseed properties beyond birdseed)
- Kernza (perennial 'wheat')

Winter canola – Why should I grow it?

If you're going to grow canola in dryland Montana the yield potential of winter types is roughly 2X that of spring types, but could vary from 0 to 4X! Last year at Bozeman we averaged 100.4 bu/ac (10% grain moisture) across 12 plots in one set of treatments (Aug 29 seed date on chem fallow). Seed size tends to be about 2X larger than spring types and oil % can easily be 10% higher than springs. But first job is to get it through the winter. In a 3-year, 3-location project we're running 5 ¼ out of 9 attempts ... a **0.583 batting average** would be very impressive in baseball but maybe not so much for crop establishment!

General recommendations

1. Grow only in areas where winter temperatures and snow cover make winter wheat survival 100% reliable.
2. Ideal planting time is last half of August ... but how often do you have wet enough soil to get canola emerged and secured into moist soil that time of year? Got to go when have wet soil which might be before or after. If plant very early the large robust cabbage can use up a lot of water and fertility.
3. If seeding in summer, might need microenvironment that slows evaporation of incident rain showers that would get the crop growing ... tall, dense cereal stubble can be helpful.
4. If seeding in September, beware of microenvironments that will slow pace of emergence and leaf development. Avoid cereal stubble. Need the plants to be at least 5-leaf stage to have best chance of winter survival.
5. So far we're not seeing any important differences in studies on chem fallow for urea N applied all at seeding, vs. all in the spring, or 50-50. Sulfur should be critically important.

Challenges

1. Research funding for canola is sparse and haphazard making it very difficult to conduct robust multi-year studies. Our current 4-year study (3 seeding dates x 6 fertility treatments) has excellent support from the Montana Fertilizer Advisory Committee, otherwise it would not have been possible.
2. Relying on August rain to get ANY crop started in Montana is a haphazard strategy. I've looked at various locations around Montana and the rainfall records show that we might have sufficient rain events in August anywhere from 1 in 2 years to 1 in 4 years depending on your location.
3. Crop insurance requires stand density equivalent to spring canola. Very high yield potential from winter canola occurs at stand densities < 1 plant/ft2 … after next year we should have a robust set of data to convince RMA of a different set of guidelines for winter canola.
4. Harvesting is currently a major challenge given that winter survival is often uneven across a field, resulting in variable ripening. Plants might be shattering in one part of a field while still flowering in others. The anti-shatter genetics in spring canola could be enormously important in winter canola … I've been told this is "5 years away" for the last 3 years. Sooner or later …

Precision irrigation in spring wheat to enhance crop productivity

Safal Adhikari, Marilyn Dalen, Jessica Torrion, and Anish Sapkota*
Montana State University
*anish.sapkota@montana.edu | 406-994-5712

MONTANA STATE UNIVERSITY
Mountains & Minds

Objective:

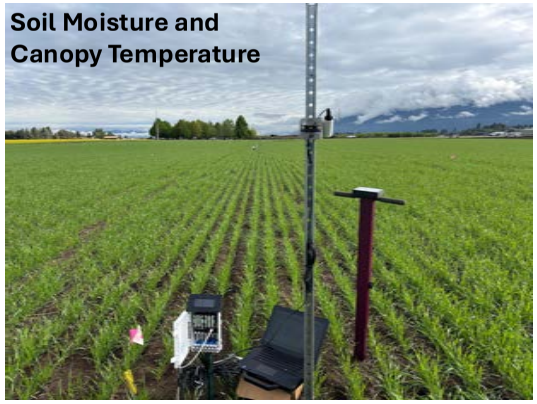
- To estimate actual evapotranspiration (ETa) using high resolution imageries obtained from Unmanned Aerial System for precision irrigation.
- To evaluate the effects of varying rates of irrigation on spring wheat physiology, soil respiration, and yield to providing insights into the crop's response to water availability and the development of more efficient, data-driven irrigation strategies.

Materials and Methods

- Location: NWARC, Creston, MT
- Irrigation treatments:
  - Rainfed, 100-, 50- and 25-% evapotranspiration (ET) based irrigation; nozzle control central pivot irrigation systems; three replications
- Fertilizer application: 130-45-100-10 (N-P_2O_5-K_2O-S lb/acre) on 04/16/2025
- Planted on 04/18/2025 (Dutton spring wheat at 76 lb/acre, 7.5" row spacing)
- Herbicide application: Cleansweep at 16 oz/A and Axial Bold at 15 oz/A
- Data collection:
  - Plant height; stomatal conductance, transpiration; chlorophyll content; leaf area index
  - Continuous measurement of soil moistures at 5 different depths (15-, 30-, 50-, 75-, and 100-cm) and canopy temperature
  - Multispectral and thermal data collection using drone

Expected Outcomes

- Optimize irrigation rates
- Enhance crop productivity
- Estimate crop ET using drone sensing



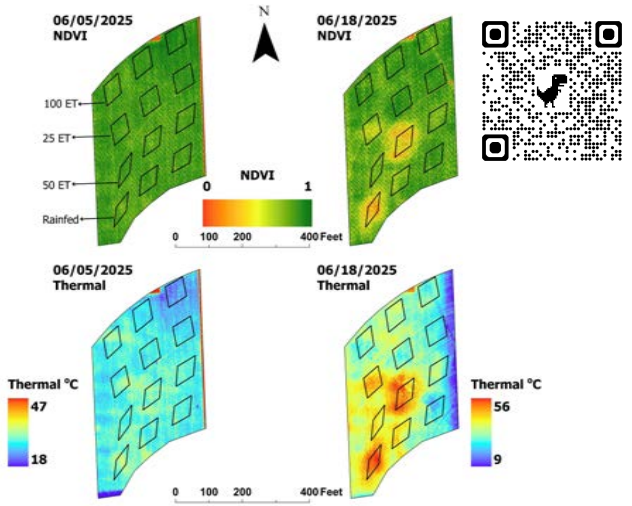


Fig 1: NDVI and canopy temperature's spatiotemporal variability in a field with variable rate irrigation

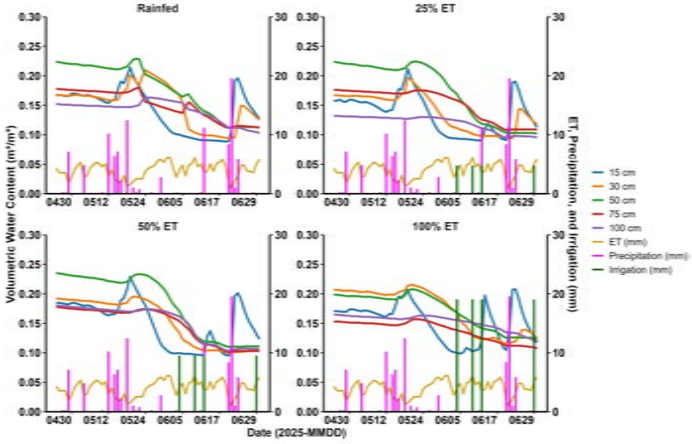


Fig 2: Soil moisture dynamics across varying depths

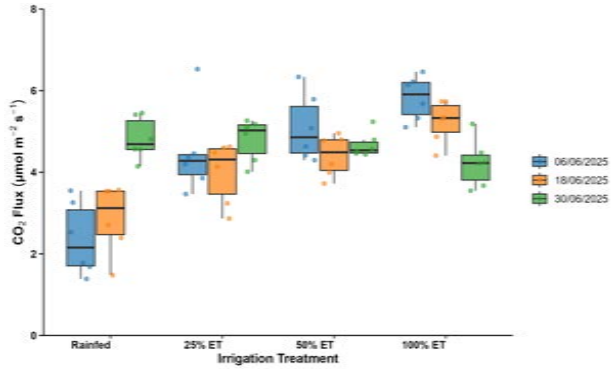


Fig 3: Effect of irrigation on the rates of soil respiration

Acknowledgements:
This research was supported by the College of Agriculture mini-grants, Montana State University. We would like to thank the support we have received from Chris Snider for his help in collecting data and from everyone at the NWARC. We also acknowledge the help received from the Nugent Lab at MSU with the drone flights.

Winter Wheat Breeding

Intrastate Yield trial results

Intrastate yield trial (IYT) is conducted by the Montana Agriculture Experiment Stations (MAES) across the agro-climatic zones to evaluate the performance of hard red winter varieties and newly developed breeding lines across Montana. Thus, IYT plays critical role identifying new varieties.

Table 1. Grain yield and agronomic data of MSU, private and other public varieties evaluated in the Intrastate trial of 2024

Cultivars	Grain Yield bu/ac	Days to Heading (Julian)	Plant Height (inches)	Sawfly Cutting[1] (1-10)	Test Weight (lb/bu)	Protein (%)	Stripe Rust[2] (%)
AP Solid	70.3	162	30.6	2.0	60.2	12.2	67
Bobcat	76.0	164	29.5	2.0	62.2	12.5	7
Brawl CL Plus	71.6	158	31.5	4.0	59.7	12.6	70
CS Bridger CLP	78.7	162	30.1	6.0	58.9	12.6	12
Flathead	76.5	160	32.3	4.0	61.7	12.3	0
FourOsix	79.9	164	31.5	5.0	62.0	12.5	10
Judee	70.9	164	31.6	2.0	59.1	**13.1**	0
Keldin	76.5	163	31.1	4.0	61.8	11.7	17
LCS Steel AX	74.8	163	32.5	7.0	61.1	11.3	50
Loma	76.8	166	31.2	3.0	55.5	12.8	8
Milestone	72.5	162	30.2	6.0	59.8	12.0	22
MT WarCat	74.3	167	29.6	2.0	58.9	12.8	17
MT Barrett	**80.7**	**163**	**34.8**	**7.0**	**61.3**	**12.0**	**0**
Northern	72.5	165	33.0	4.0	58.5	12.8	0
Ramsay	**82.0**	164	31.9	4.0	61.5	12.1	23
StandClear CLP	77.4	164	32.2	2.0	62.8	12.8	0
SY Clearstone 2CL	77.6	165	34.9	6.0	60.8	12.4	15
Warhorse	68.6	165	31.2	1.0	61.6	12.8	5
Yellowstone	77.7	164	34.1	7.0	61.4	12.6	8
Grand Mean	74.5	163	31.6	3.6	60.0	12.3	29
LSD	8.3	1	2.2	2.2	6.42	0.51	45
CV	15.6	0.6	11.5	18.3	14.54	3.97	50.5
Genotype significance	***	***	***	***	NS	***	***
GenxEnv significance	***	***	NS	***	***	***	***
Env significance	***	***	***	*	***	***	NS

[1]Cutting scores from Ft Benton, trial conducted by Nutrien Ag Solutions. Rated 1-10, with 10 being severe cutting

[2]Data from Sidney, MT

MSU Winter Wheat Varieties

MT BARRETT

MT Barrett is a high yielding, tall, hollow stem line that carries the WSM2 gene and shows moderate resistance to wheat streak mosaic virus. It has shown stable yield performance across the testing locations. Being a hollow stem line, it is susceptible to wheat stem sawfly cutting. It has resistance to stripe rust, but susceptible to stem and leaf rust. Released by Montana Agricultural Experiment Station in 2025

MT MEADOWLARK

A high yielding solid stem winter wheat variety with good stripe rust resistance and does well in low pH soils. The variety does not show PLS in contrast to other varieties. Similar in heading and maturity to Bobcat and Warhorse with average height. Low in PPO and good end-use quality. Released by Montana Agricultural Experiment Station in 2024

CS BRIDGER CLP

A high yielding 2 gene-Clearfield hollow winter wheat variety with good strip rust resistance and winter hardiness. Low in PPO and rated as excellent in alkaline noodle quality by Wheat Quality Council, Kansas. Overall, the end-use quality is good. Released by Montana Agricultural Experiment Station in 2023

MT CASH

New tall early forage winter wheat variety with forage yield like Ray and good straw strength. ADF and NDF values are like Ray and Willowcreek, though seed yield is higher than Willowcreek it is lower than Ray. Excellent stripe rust resistance and end-use quality. Released by Montana Agricultural Experiment Station in 2023.

For more information on new released varieties write to: Doug Holen (douglas.holen@montana.edu) OR BranDee Johnston (brandee.johnston@montana.edu) OR Dr. Sue Mondal (suchismita.mondal@montana.edu)