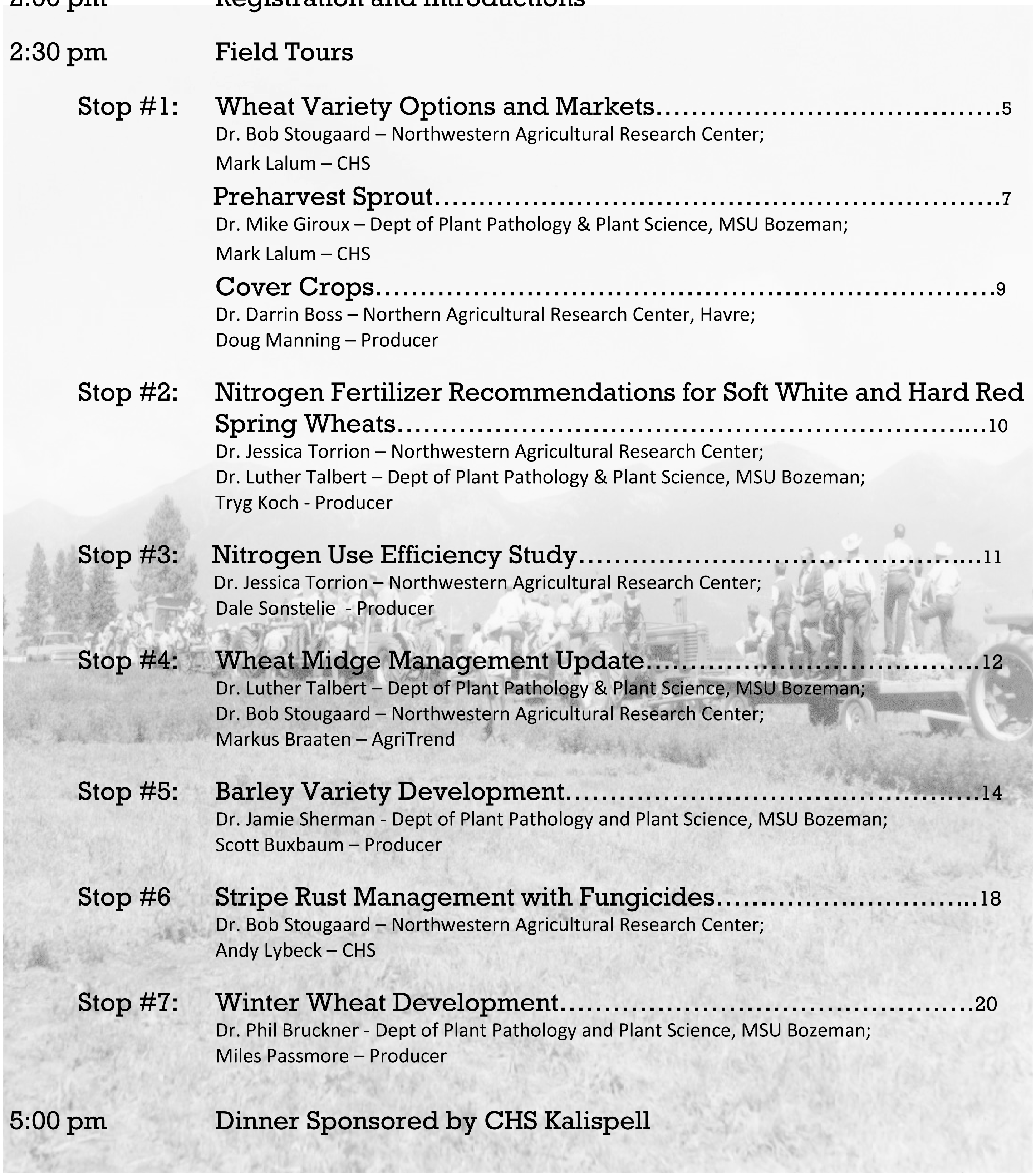
Northwestern Agricultural Research Center Field Day

July 12, 2016



2:00 pm Registration and Introductions

2:30 pm Field Tours

5:00 pm Dinner Sponsored by CHS Kalispell

Northwestern Agricultural Research Center

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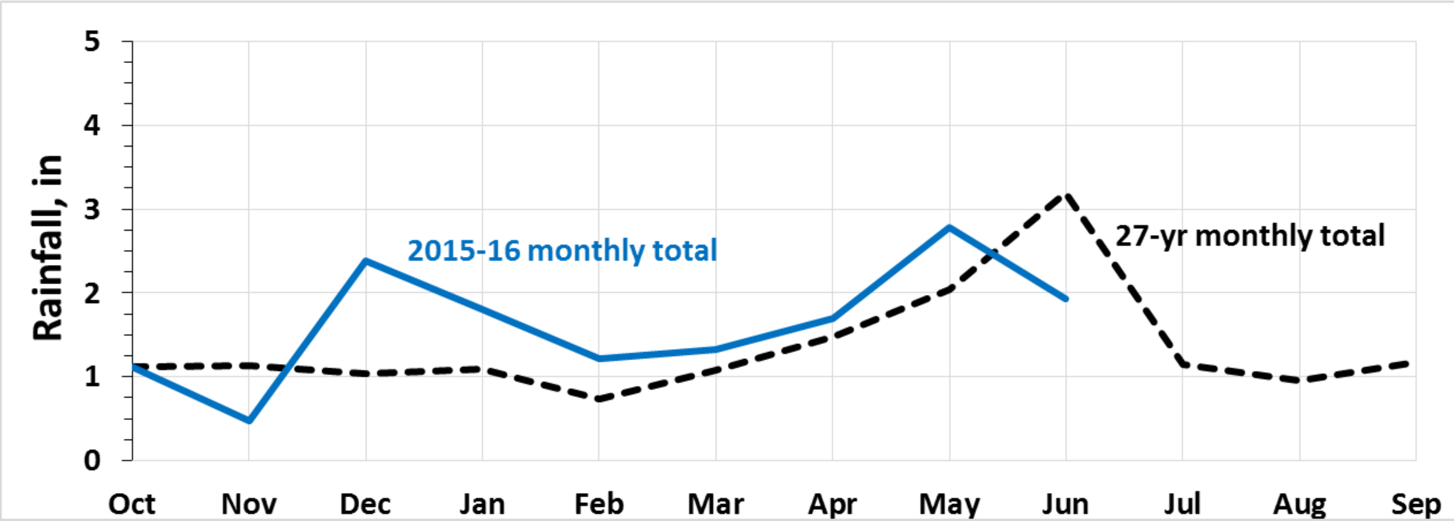
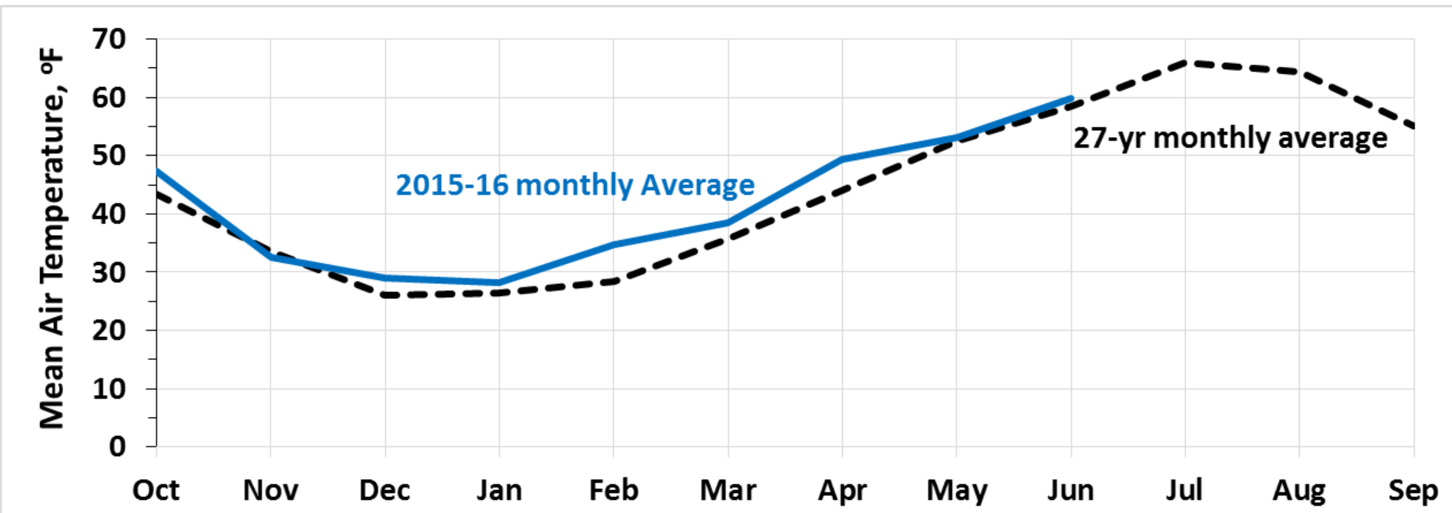
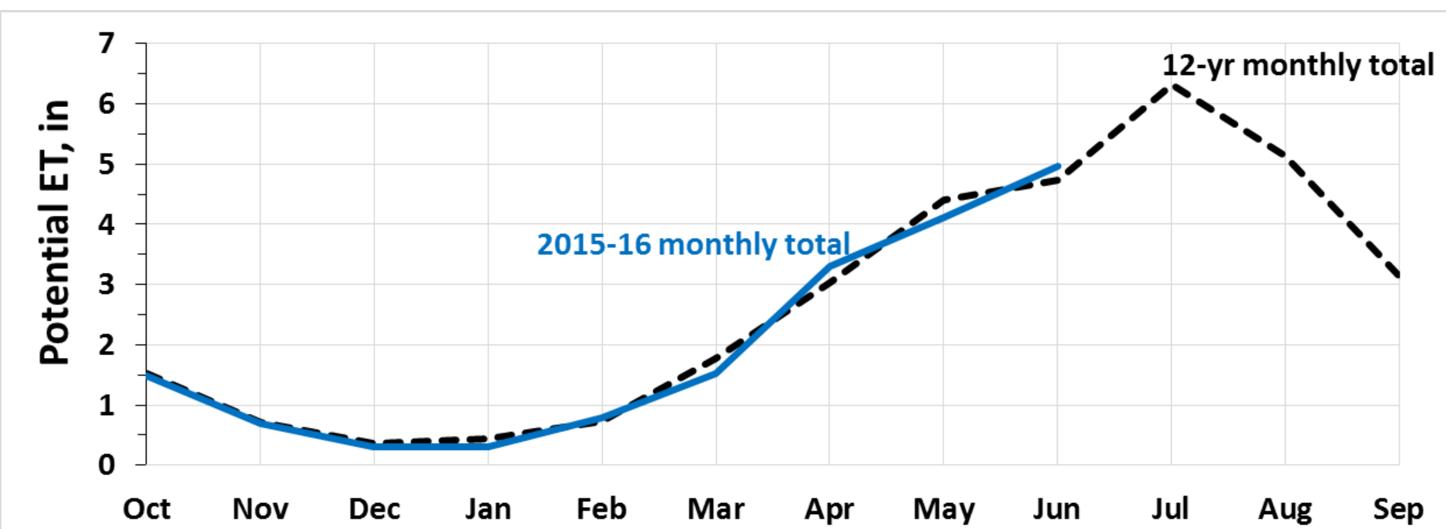
2015-2016 Weather Trend in Relation with the 27-year (1989-2015) Climate Data







Wheat Variety Options and Markets

Cultivar selection is hugely important from an economic perspective. The table below demonstrates how yields can vary in our region, so consideration to growing an adapted variety is critical. This table also illustrates that Western Montana is one of the most productive regions in the state.

2015 Winter Wheat Intrastate Nursery

Variety	Yield (bu/A)
Colter	146.3
Yellowstone	139.4
SY Clearstone 2CL	138.6
Warhorse	136.6
Judee	120.1
Rampart	104.6
CDC Falcon	83.0
Decade	76.3
Bearpaw	74.4
Genou	63.0
Jerry	60.5

LSD: 17

However, the environmental conditions that result in high yields also contribute to several production problems that are unique to western Montana. As such, varieties that do well east of the mountains don't necessarily perform well in this region. Accordingly, we try to cast our net wider and evaluate wheat varieties developed from the Pacific Northwest region.

This year we established the Western Regional Hard Wheat Nursery, which consist primarily of hard reds, but also contains hard whites. We also initiated a nursery to evaluate materials being developed by private industry. Finally, we are also evaluating the Western Regional Soft Wheat Nursery.

Soft white wheats yield well is this area and market prices sometimes favor soft whites over hard reds. Softs white wheats also benefits from low protein requirements. The potential negatives include the fact that soft whites are typically less winter-hardy than hard reds, plus soft whites tend to be more susceptible to preharvest sprout and low falling numbers. Fortunately there is a great deal of genetic diversity associated with these traits, suggesting that we could identify acceptable varieties in our screening process.

Western Regional Hard Red Nursery

Entry #	Origin	Cultivar	Entry #	Origin	Cultivar
1	UC Davis	Patwin 515 HW	9	MSU	MT 1572
2	WSU	Glee	10	MSU	MT 1574
3	Westbred	WB9518	11	Syngenta	06PN3015-08
4	UI	Jefferson	12	UI	IDO1602S HW
5	UI	UI Platinum HW	13	WSU	WA 8258
6	UI	UI Winchester	14	MSU	Egan
7	Syngenta	04PN3051-9	15	Westbred	Solano
8	UC Davis	Yurok	16	Westbred	Volt

Private Hard Red Nursery

Entry#	Origin	Cultivar	Entry#	Origin	Cultivar
1	Winfield	HRS 3504	9	Syngenta	SY3015-8
2	Winfield	HRS 3361	10	Syngenta	SY3051-9
3	Winfield	HRS 3100	11	Syngenta	Cabernet
4	Winfield	HRS 3530	12	MSU	Egan
5	Winfield	HRS 3616	13	WestBred	Solano 16
6	Syngenta	SY SELWAY	14	WestBred	Solano 24
7	Syngenta	SY COHO	15	WestBred	Solano 32
8	Syngenta	SY Teton	16	WestBred	Solano 40

Western Regional Soft White Nursery

Entry #	Origin	Cultivar	Entry #	Origin	Cultivar
1	WSU/OSU/UI/ARS	ALPOWA	9	ARS	DH09X503-188-0
2	WSU/OSU/UI/ARS	LOUISE	10	ARS	DH09X101-41-0
3	Westbred	WB6121	11	UI	IDO1405S
4	UI	UI Stone	12	WSU	WA 8253
5	UI	IDO1401S	13	WSU	WA 8254
6	UI	IDO1403S	14	UI	Treasure 16
7	Syngenta	06PN3024-2	15	UI	Treasure 24
8	LCS-PB1	12-SWW-052	16	UI	Treasure 32

Assessment and Management of Pre-Harvest Sprout and Falling Number in Montana Wheat

Bob Stougaard: Weed Scientist, NWARC, Kalispell
Mike Giroux: Geneticist, PSPP, MSU-Bozeman
Justin Vetch: MS Graduate Student, MSU, Bozeman and Kalispell
Brooke Bohannon: Research Associate, NWARC, Kalispell
Andy Hogg: Research Associate, MSU-Bozeman

GOALS:

1. Assess Montana wheat varieties for preharvest sprout (PHS) and falling number.
2. Incorporate the *TaPHS1* allele conferring partial PHS resistance into current varieties.
3. Evaluate foliar applications of abscisic acid (ABA) for PHS prevention.

BACKGROUND AND JUSTIFICATION

The Problem Defined: Today's grain buyers are demanding that specific quality standards be met. As a result, marketing at the elevator now involves a host of tests to prove that the wheat meets these quality attributes. Preharvest sprout (PHS) and falling number (FN) are two such tests that affect both the grade and marketing price of wheat, and in turn, net profitability.

PHS and falling number both measure germination, but by different means. PHS is a visual assessment of the grain to determine if germination has begun. Visible indications of PHS include kernel swelling, germ discoloration, seed-coat splitting, and root and shoot emergence. Falling number also measures the degree of germination, but is more precise because it can assess whether or not germination has commenced *before* there is any visible sign of sprouting.

Cause and effect: PHS and low falling numbers generally occur when it rains after the grain has reached physiological maturity and alpha amylase is produced. Alpha-amylase leads to starch being broken down and poor end product quality.

- There are three alpha-amylase (AA) gene families, AA 1 is the major gene, AA 2 is associated with high altitude and cold weather shocks during grain filling and AA 3 which gets expressed during insect feeding.
- Wheat varieties vary in AA levels and red wheats generally are less susceptible to PHS although some wheat varieties commonly grown in MT are susceptible to PHS.

PROCEDURES

- Assess Montana spring and winter wheat varieties for PHS and falling number.
- PHS will be assessed by harvesting heads at physiological maturity and measuring PHS after incubation in a mist bench.

Table 1. Kalispell, 2014

Variety	Falling Number
Egan	378
McNeal	370
Reeder	306
Mott	296
Choteau	288
Brennan	259
Duclair	231
SY Tyra	210
Vida	177
mean	279

Photo 1. Differences in PHS tolerance among different HRSW varieties (Source: James Anderson, University of Minnesota).

- Falling numbers will be determined for each variety utilizing a Perten Falling Number FN 1700 instrument. Alpha amylase activity will be measured on flour samples using a Megazyme alpha amylase kit.
- Montana spring and winter wheat varieties will be screened for molecular markers associated with PHS resistance.
- A germination rate index will be determined for each entry/variety.
- The information will be used to help select PHS resistant wheat varieties.
- Abscisic acid applications will be evaluated for PHS prevention.

Statewide Cover Crop Trials

Montana Research and Economic Develop Grant Funded Effort

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First year study – No data contact your local research center cooperator for local information. Objective:

1. To evaluate alternative monocultures, or polycultures (cocktails) at the 7 RCs. Various species are being recommended within cocktails but we do not know if they even germinate or produce a significant amount of biomass alone or in competition in cocktails (polycultures).
2. Determine Above Ground Biomass (AGB)
    a. Determine Nutrient profiles of AGB and the nitrate content

Associated with the Large Grazing trial at NARC and the statewide effort there is also a study being funded at Bozeman with Emily Glunk, emily.glunk@montana.edu, Animal and Range Science Department, utilizing sheep as a termination step. Once data has been collected this year it will be able to have a life time economic analysis done by Anton Bekkerman, anton.bekkerman@montana.edu, Ag Economics, Bozeman.

Seed cost associated with the polycultures and single species in following table.

ATTRIBUTES & ECONOMICS OF "MONTANA BIN BLEND" COOL SEASON COVER CROP MIX*

Species	Lbs Seeding Rate[1]	Lbs Full Seeding Rate	Blend Weight	Number of Seeds	Seeds	Cost	Cost	C:N Ratio[2]	N Fix	Grazing	Drought	Frost	Diversity	Salinity
	per acre	*per acre*	*%*	*per foot*	*per lb*	*per lb*	*per acre*		*on a scale of 1 to 10, 10 being the best*					
Purple Top turnip	0.94	4	4	7.67	181,600	$1.65	$1.55	33	0.7	9.2	6.5	8.5	5.5	6.9
Spring forage pea	6.37	44	26	1.04	4,774	$0.40	$2.55		Increase soil organic matter - 7.2					
Spring oat	12.65	73	53	4.69	15,562	$0.23	$2.91							
Rapeseed/canola	1	4	4	3.1	108,095	$1.00	$1.00							
Safflower	3.1	9	13	1.22	14,502	$0.65	$2.02							
			Total	17.72										
Total Lbs/Acre[3]	24.06			Mixing		$0.50	$12.03							
Total Seeds/Acre	591,434			Inoculant		$0.025	$0.60							
				Total			$22.66							

* Results were obtained using Green Cover Seed's SMARTmix4.0 calculator.

1 Calculated on a Pure Live Seed basis.

2 24 is the optimum Carbon:Nitrogen ratio.

3 Seed is packaged in tote bags, *shipping is not included* .

Fertilizer Tax

Nitrogen Fertilizer Recommendations for Soft White and Hard Red Spring Wheats

The **goal of this research** is to assess Nitrogen (N) requirement for yield and protein of two spring wheat market classes- Hard Red and Soft White Spring Wheat. Market price of hard red spring wheat is discounted when protein falls below 14%. High protein is desired in hard red spring wheat. On the other hand, the price of soft white spring wheat is discounted when protein is high. Low protein is desired for soft white spring wheats.

Our research investigates whether total N input can be reduced when planting soft white spring wheat considering protein requirement is low as compared to hard red spring wheat. Essentially, increasing yield is the main focus in soft white rather than managing both yield and protein in the case of hard red spring wheats.

The study is duplicated in both dryland and irrigated conditions. **Four hard red spring wheat** varieties (Egan, McNeal, Solano and Vida) and **four soft whites** varieties (Alturas, Alpowa, Penewawa, UI-Stone) were randomly arranged within five N levels applied (0, 40, 80, 120, and 160 lbs N). Residual soil N, plus, previous alfalfa crop credit amounts to 98.0 lbs N.

For irrigated plots, irrigation events are applied as long as 35% of the plant available water is depleted in the root zone. Studies in 2014-2015 at NWARC (Unpublished) revealed that water productivity is at least 6 bushels per inch of water with maximum water yield response attained on irrigation applied at medium milk. Irrigation applied at seed fill delays the occurrence of physiological maturity extending the seed-fill period. We expect that managing optimal irrigation water from plant establishment through late milk stage will increase yield and eventual decrease in protein of soft white wheat spring wheats.

Increasing yield on the other hand on hard red spring wheat makes protein management (high protein) a challenge. Moreover, we anticipate that Egan- the newly commercialized high protein spring wheat will provide us new information on aspects of Water and N management.

Table 1. Agronomic management information for 2016.

Planted :	April 21	Applied herbicide @4-leaf :	Husky + Axial
Emerged :	April 30	Fungicide :	Prosaro
Target plants :	25/ft^2	Insecticide :	Warrior II
Seed treatment:	Cruiser Maxx Vibrance	Fertilizer applied :	____ -33-92

For the long-term, an understanding of the genes controlling grain protein content and its interaction with water and nitrogen will help guide breeding efforts for future varieties. Popular varieties change over the years; however, good genes can be passed from old to new varieties by breeding. This research will provide a foundation for future work to identify the best genes for wheat varieties adapted to Northwest Montana.

Nitrogen Management for Egan Spring Wheat under Dryland and Irrigated Environments

Montana State University released '**Egan**' hard red spring wheat, a variety bred for the control of Orange Wheat Blossom Midge and stripe rust, and also contains *Gpc-B1* gene for high protein (Blake et al., 2014). This variety has been evaluated at the seven research centers in MT and consistently produced high grain protein content. The adoption of 'Egan' and continuity in breeding for high grain protein content may promote sustainability and profitability for the farm because fertilizing for yield, and maybe less for protein, can be a shift of focus.

The **goal of this research** is to assess Nitrogen (N) x Water management of this new MT variety and establish a minimum N level for optimal yield and protein at various water inputs. The <u>**N treatments**</u> are 0, 50, 100, and 150 lbs N, pre-plant applied and incorporated. Residual soil N, plus previous alfalfa crop credit amounts to 98.0 lbs N.

The <u>**water treatments**</u> include dryland, 50% evapotranspiration (ET), 75%ET, and 100%ET. Irrigation is delivered using a surface drip tape. Replenishing water in 100%ET is done when 35% of plant available water is used up. The 50%ET and 75%ET are applied at the same time as 100%ET, but only 0.50 and 0.75 respectively, of the irrigation amount applied in 100%ET plots.

The gene (*Gpc-B1)* responsible for high protein in Egan is assumed to enhance senescence or shortening the duration of seed fill period (heading to maturity). This process reallocates massive amounts of N to the seed. We will also investigate the effect of water levels (water stress) on its effect on enhancing plant senescence (death) or abundance of water and N levels in delaying senescence.

How Egan adjusts its growth habit with N x Water treatment combinations will be documented. Management of this variety for yield and quality is yet to be determined.

Table 1. Agronomic management information.

Planted :	April 22	Applied herbicide @4-leaf :	Husky + Axial
Emerged :	April 30	Insecticide :	Warrior II
Target plants :	25/ft^2	Fertilizer applied :	____ -33-92
Seed treatment:	Cruiser Maxx Vibrance		

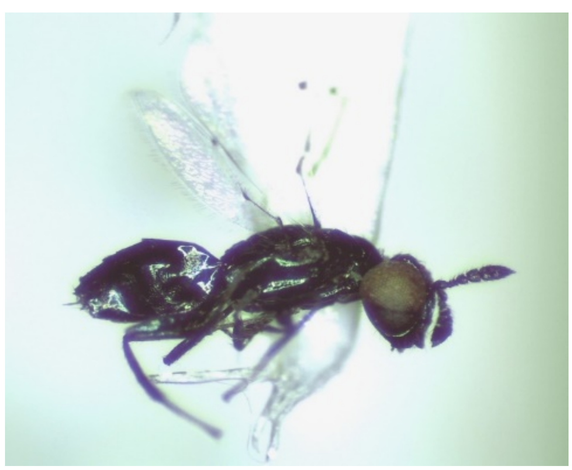
Wheat Midge Management Update

Genetic resistance offers an ideal method for control of the orange wheat blossom midge (OWBM). Resistance is due to a single gene called 'Sm1'. This gene was crossed into a genetic background adapted to northwest Montana, resulting in an OWBM-resistant variety called 'Egan'. In addition to OWBM resistance, Egan has shown resistance to stripe rust and it has higher grain protein than other widely grown varieties. This summer marks the first commercial plantings of Egan.

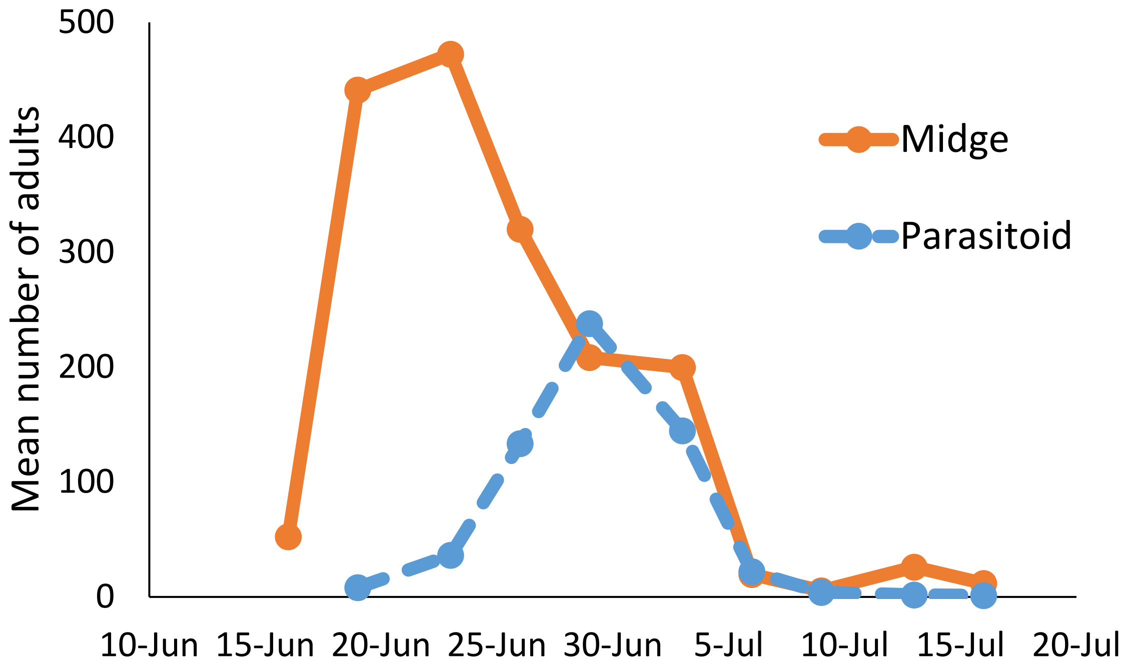
Unique guidelines for planting Egan have been developed. The Sm1 gene causes complete mortality of the OWBM, except for those rare OWBM that may have obtained a mutation to allow them to overcome the gene. Mating of these resistant OWBM would quickly lead to development of population dominated by resistant OWBM, in that the susceptible OWBM are killed by the resistance gene Sm1. A strategy of 'refuge-in-a-bag' has been developed to allow long-term use of Sm1. This strategy requires growers to blend Egan with a 10% ratio of a susceptible variety, allowing the susceptible OWBM to maintain relative high numbers. Thus, the gene that allowed the mutant OWBM to survive should remain in the population at a very low frequency. Thus, Sm1 will provide good control of the OWBM for the long-term.

The OWBM has moved from the Flathead Valley to wheat-growers areas east of the mountains. These areas are also impacted by the wheat stem sawfly. Egan is susceptible to damage caused by the wheat stem sawfly. Thus, a current effort on the spring wheat breeding program is to introduce the Sm1 gene for resistance to OWBM into solid stem lines. New varieties with solid stems and Sm1 should protection against both insects.

Biological control is another management tactic. A small parasitic wasp, *Macroglenes penetrans*, attacks the wheat midge, helping to regulate populations. This parasitoid is credited with controlling about 25 to 40 percent of the midge population in parts of Canada and North Dakota. In some instances, parasitism rates of greater than 75 percent have been documented.



In an effort to provide growers with additional pest management tools, this wasp was introduced from North Dakota into Flathead County in 2008. After the initial release, the parasitoid population slowly increased, and by 2014, high numbers of the wasp could be found throughout Flathead County. In 2015 a monitoring program was initiated to document the distribution of the wasp throughout Flathead County as well to help predict wasp emergence patterns.

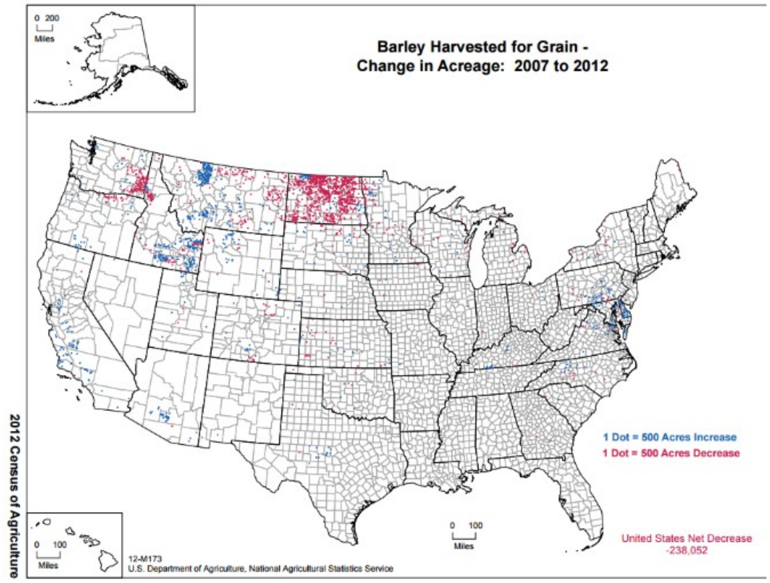


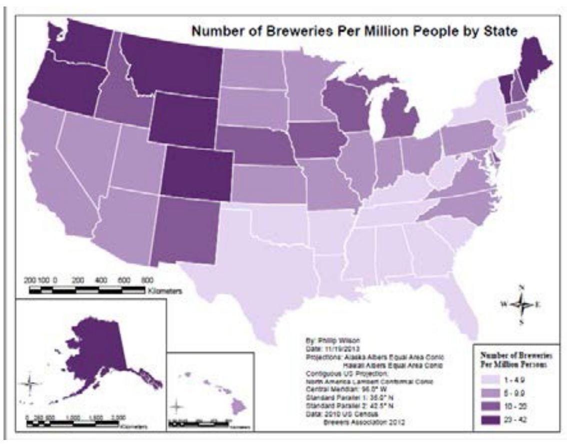
Eight fields were monitored throughout Flathead County. Wasps were found at each location, indicating that the wasp is widely distributed in the area. The wasp emerged about five days after the midge and over a narrower period compared to the midge.

This effort produced an unexpected outcome; we discovered that another species of parasitoid was present in the area. *Euxestonotus error* was identified at eight different sights in Flathead County. This indicates that these other parasitoid species should survive and multiply in Montana and provide additional help in managing the wheat midge.

Why Barley?

Barley is particularly suited to Montana's environment and can be a useful part of a crop rotation. **Barley production is moving west.** In the map to the right, blue indicates increase in barley production; while red indicates decrease. New markets for barley (micromalt, microbreweries, aquaculture and human food) can provide additional revenue to Montana growers. The map below indicates that **Montana has one of the highest densities of microbrews in the nation per capita.**





Historical Importance of Barley to Montana

1893 Montana Experiment Station

1893-1938 Varietal Testing and Management

1941 – First line released – Compana

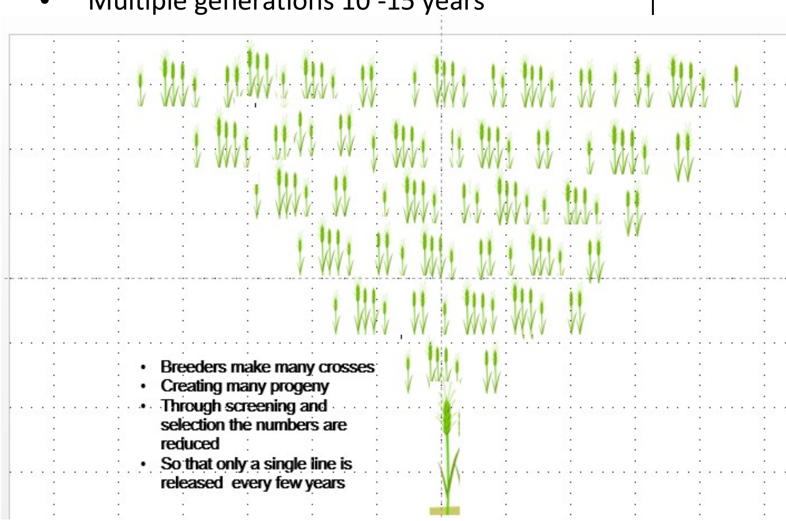
Lines have been released for a variety of purposes: **Malt**, food, feed and *forage* - Glacier 1943, **Unitan 1959**, **Hypana 1965, Erbet & Shabet 1971,** Purcell 1974, *Ridawn* **& Clark 1980, Lewis 1985,** Gallatin 1986, *Haybet* **& BearPaw 1989, Chinook 1995,** Prowashanupana 1996**, Valier 1999,** Haxby 2003, *Hays 2006*, **Hockett 2008,** *Lavina 2010*

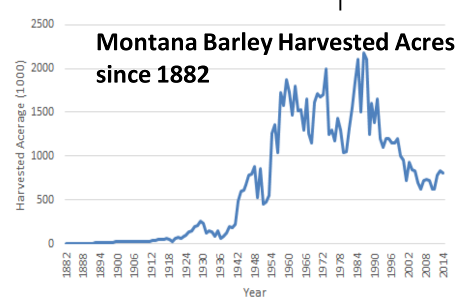
Why institute breeding?

Allows creation of new lines specifically adapted to Montana.

What is breeding?

- Making controlled crosses
- Making selections
- Multiple generations 10 -15 years





Breeding Barley for Multiple Uses

Summary of the Offstation nursery performance, including 8 Dryland sites and 4 irrigated/high moisture sites. Lines are organized from high to low yield. Note the highest performing lines in irrigation are not highest performing in dryland. Of interest are the low protein experimental lines that we are hopeful will make malt under low moisture conditions. We are working to determine best management practices for low protein lines.

Also included are feed lines – Champion and Haxby and forage lines Lavina and Haybet.

Offstation Performance Trials - Irrigated/High Rainfall **Statewide Summary 2015**

Name	Grain Yield bu/ac	Plant Height cm	Plump Kernels %	Grain Protein %	Test Weight (lb/bu)
Moravian153	107.13	83.05	75.77	10.47	47.87
Moravian150	102.83	70.41	80.53	11.03	47.83
Moravian69	101.47	72.66	74.00	10.83	47.80
Moravian165	93.33	97.72	83.47	11.77	49.63
Champion	86.44	72.12	81.70	10.58	51.64
Merit	78.69	69.75	78.23	11.87	48.90
MT100120	78.42	74.27	84.06	9.99	51.49
Haxby	78.40	71.00	81.02	10.68	52.09
MT124027	78.09	71.24	85.02	10.55	50.16
MT124728	77.90	68.29	84.64	11.32	50.72
MT100126	76.84	74.64	86.09	10.16	51.58
Conrad	76.03	69.19	84.91	11.87	50.68
Harrington	75.77	69.28	78.63	11.30	49.55
Hockett	75.01	71.11	89.24	11.13	51.78
Craft	74.28	76.33	87.88	11.21	52.05
ACMetcalfe	73.84	72.79	83.28	11.45	50.09
Moravian115	72.71	57.83	79.59	11.43	48.27
Lavina	69.79	68.81	55.90	11.46	46.06
Stockford	65.40	71.65	87.04	10.81	47.72
Haybet	56.90	72.75	44.19	12.33	46.03
GRAND MEAN	**75.98**	**61.86**	**79.73**	**11.07**	**49.89**

Offstation Performance Trials - Dryland **Statewide Summary 2015**

Name	Grain Yield bu/ac	Plant Height cm	Plump Kernels %	Grain Protein %	Test Weight (lb/bu)
Champion	59.08	61.06	75.63	11.00	51.56
Haxby	57.26	60.16	74.88	11.24	51.92
Lavina	54.50	60.38	48.51	11.98	46.28
Merit	53.32	58.38	69.96	12.90	48.45
MT100126	53.15	62.76	81.13	10.94	50.91
MT124728	52.73	58.05	79.15	12.13	50.30
Hockett	52.27	61.30	87.19	11.93	51.94
MT124027	52.17	60.24	80.28	11.46	49.71
MT010158	51.48	67.77	69.43	14.03	51.28
Harrington	51.01	58.60	72.22	12.18	49.49
Muskwa	50.93	66.00	50.70	12.70	50.38
ACMetcalfe	50.81	61.25	78.36	12.41	49.68
Craft	50.76	65.19	84.88	11.80	52.15
MT100120	50.62	61.68	78.11	10.70	51.07
Conrad	49.99	58.74	80.49	12.80	50.53
Moravian115	49.41	49.64	73.06	12.48	48.52
Stockford	48.40	62.63	85.32	11.19	47.76
Moravian153	46.70	56.40	61.90	12.10	48.70
Haybet	46.40	63.53	37.57	12.59	46.49
Moravian165	45.40	73.70	67.50	13.80	49.10
Moravian69	45.40	55.90	55.80	13.00	46.50
Moravian150	42.30	53.30	60.40	12.70	47.90
GRAND MEAN	**52.21**	**60.16**	**74.05**	**11.83**	**49.73**

Below is a summary of the mean forage performance in dryland. Lavina and Haybet are the most commonly grown barley forage lines in Montana. Note they have about same dry matter production. However, Lavina has much higher grain yield. Notice we have several experimental lines with as much or more tons/acre but none that have the grain yield of Lavina.

Forage Barley - Dryland **Bozeman and Moccasin, MT Summary 2015**

Name	Grain Yield bu/ac	Dry Matter tons/ac	Test Weight lb/bu	Grain Protein %	Dry Matter %	Plant Height cm	Maturity Date julian
Haybet	37.9	1.8	46.0	15.10	38.7	61.7	192.0
Hays	44.3	1.5	48.5	14.10	37.7	54.2	199.0
Lavina	46.3	1.8	46.5	13.60	39.2	58.5	195.5
MT103038-4	27.3	1.5	46.2	18.60	38.8	50.4	198.5
MT103038-5	22.6	1.1	45.6	18.50	37.1	50.3	196.5
MT103038-6	24.4	1.5	46.4	19.00	37.1	50.4	199.0
MT103045-6	34.7	1.4	47.1	16.00	37.9	53.9	200.0
MT103081-4	26.6	1.4	53.0	17.80	34.8	65.5	202.0
MT103084-1	18.0	1.4	46.9	18.20	33.1	71.3	201.0
MT103089-3	30.4	1.8	42.4	17.00	37.4	57.3	197.5
MT103097-1	35.4	1.7	46.6	14.40	39.6	64.4	194.0
MT103099-3	28.6	1.8	47.3	17.20	39.9	61.2	201.0
MT103101-5	32.8	1.9	45.9	14.80	39.2	63.7	192.0
MT103105-4	36.2	1.6	45.1	17.00	38.4	57.8	200.0
MT981427	39.8	1.7	48.5	15.80	37.5	61.6	194.0
STEPFORD	41.3	1.8	43.8	14.30	39.1	62.9	194.0
GRAND MEAN	32.9	1.6	46.7	16.31	37.8	59.1	197.2
CV	16.6	16.0	2.0	3.81	3.2	5.4	1.2
LSD	7.1	0.4	1.2	1.32	2.0	4.1	5.1

Quality tests indicate room for improvement of varieties for digestability and leaf protein.

Forage Line	%NDF	%ADF	% leaf protein
MT103038-5	47.5517	29.9971	7.3329
MT103038-6	48.06493	30.86274	7.1796
MT103038-4	48.76126	30.94779	
MT103099-3	49.71779	32.5565	6.653367
HAYBET	50.73448	32.49325	
MT103101-5	51.00289	34.35671	
LAVINA	51.63023	34.96658	
MT103081-4	51.80088	35.33416	
MT103089-3	52.03157	34.72925	6.411967
MT103105-4	52.75324	33.75302	7.460833
HAYS	52.92017	33.60742	7.7681
STEPFORD	53.20781	36.76957	
MT103084-1	53.39724	37.0563	7.594833
MT103045-6	54.03062	35.24608	8.0026

Energy available for feed is inversely related to the amount of acid detergent fiber (ADF) in the forage. Neutral detergent fiber (NDF) is inversely related to dry matter intake. As NDF increases cows consume less dry matter because of rumen fill. Therefore forage with lower NDF and ADF are more efficient feed and can provide an economic advantage by increase weight gain or milk production. It has been estimated that a 1% increase in digestability results in a 3% increase in daily weight gain.

To the left are reported the state-wide averages of hull-less lines in irrigated and dry-land environments. Note experimental lines show promise due to high yield and high protein. Hull-less lines might provide new markets for Montana growers for human food and aquaculture.

Intrastate Hull-less Spring Barley - Dryland **Statewide Summary 2015**

Name	Index Rating	Grain Yield lb/ac	*Grain Yield bu/ac	Test Weight lb/bu	Grain Protein %	Plant Height cm	Heading Date julian
09WA-265.12	62	3864.9	80.5	58.8	13.3	74.3	171.5
Goose1	36	2297.9	47.9	61.0	15.6	75.6	166.8
Goose2	37	2462.4	51.3	61.0	15.2	75.8	167.1
Goose4	41	2392.9	49.9	60.9	15.0	73.5	166.9
Goose5	37	2289.5	47.7	60.9	15.0	73.0	167.1
Goose6	36	2375.8	49.5	61.0	14.7	74.1	167.3
MT110008	59	3341.1	69.6	58.5	14.1	74.8	170.5
MT110009	53	3067.4	63.9	57.6	15.2	76.7	172.4
MT110016	54	3234.7	67.4	58.3	14.5	73.2	170.4
MT110061	54	3409.4	71.0	58.1	14.4	70.2	170.9
MT110065	55	3523.5	73.4	58.1	14.3	74.2	173.1
MT110066	51	3277.6	68.3	57.5	14.6	71.7	170.5
PI596299	45	2925.1	60.9	47.4	15.6	67.9	167.4
X05013-T1	65	3861.8	80.5	57.8	14.0	68.4	171.6
X0626-T229	60	3371.8	70.2	57.0	14.8	65.3	167.6
X07G30-T131	54	3421.1	71.3	57.9	14.8	69.1	172.2
GRAND MEAN	50	3069.8	63.9	58.3	14.7	72.3	169.5
CV		10.7	10.7	1.9	3.8	5.1	0.7
LSD		217.4	4.5	0.7	0.4	2.4	0.7

Intrastate Hull-less Spring Barley - Irrigated **Statewide Summary 2015**

Name	Index Rating	Grain Yield lb/ac	*Grain Yield bu/ac	Test Weight lb/bu	Grain Protein %	Plant Height cm	Heading Date julian
09WA-265.12	65	4878.9	101.6	60.4	11.5	84.0	172.0
Goose1	39	2387.5	49.7	58.8	15.6	75.1	167.6
Goose2	41	2558.5	53.3	58.3	15.1	81.4	167.9
Goose4	41	2601.8	54.2	58.3	14.5	74.4	167.6
Goose5	40	2529.5	52.7	59.0	14.8	74.9	167.8
Goose6	41	2585.0	53.9	58.7	15.0	74.8	167.9
MT110008	60	4409.4	91.9	57.1	12.7	82.1	171.9
MT110009	57	4101.6	85.5	55.6	13.3	87.3	173.3
MT110016	62	4581.5	95.5	56.7	12.7	82.3	171.3
MT110061	56	3982.5	83.0	56.6	13.3	79.0	171.5
MT110065	57	4110.0	85.6	55.9	12.4	83.0	173.3
MT110066	56	4013.1	83.6	56.9	13.6	78.3	170.6
PI596299	51	3637.3	75.8	46.6	14.8	75.0	167.5
X05013-T1	67	5002.5	104.2	59.2	12.7	81.3	171.9
X0626-T229	61	4421.9	92.1	57.5	13.1	75.8	168.8
X07G30-T131	61	4498.0	93.7	58.4	12.2	81.8	173.2
GRAND MEAN	54	3768.6	78.5	57.1	13.5	79.4	170.2
CV		10.0	10.0	2.1	7.3	6.5	0.6
LSD		305.8	6.3	1.0	0.9	4.1	0.8

Jamie Sherman, Barley Breeder, Montana State University (Jsherman@montana.edu)

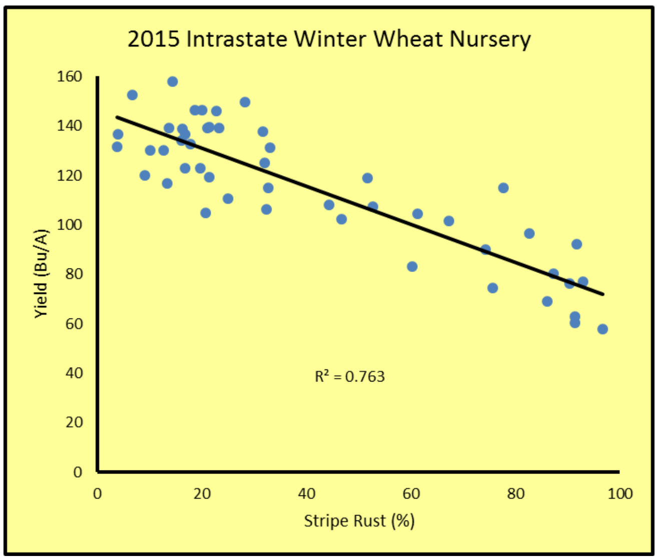
Liz Elmore, Research Associate, Montana State University (lizelmore@montana.edu)

For complete report go to http://plantsciences.montana.edu/crops/2015BarleyReport.pdf

Stripe Rust Management with Fungicides

Stripe rust is a recurring pest problem in northwestern Montana, and yield losses can be severe. The disease is named for the yellow-red stripes found on infected plants. Stripe rust reduces photosynthetic area, and increases transpiration. Consequently, stripe rust reduces root growth, yield, and test weight. Both winter wheat and spring wheat are susceptible, but yield losses are more severe for winter wheat.

Stripe rust is not new to this area and can typically be found in the Flathead Valley every year. However, the level of infection and the degree of damage varies from season to season, largely as a result of varying weather patterns. Severe outbreaks require free water on the leaf surface from intermittent rains or heavy dews, and cool temperatures. The optimum temperature for the development of this disease is 50-59°F, with disease progression ceasing at temperatures above 70°F. Nevertheless, yield losses during the 2015 growing season approached 40 percent inspite of extreme drought conditions.



Research efforts at NWARC focus on evaluating fungicides chemistry as well as screening winter and spring wheat varieties for resistance to the disease.

Effect of fungicide rate on stripe rust control in winter wheat, 2016.

	Rate	Stripe Rust (%)		
Treatment	fl oz/A	28-May	3-Jun	10-Jun
Check		53	76	86
Absolute 500SC	4	13	32	22
Absolute 500SC	4	15	22	23
Prosaro 421 SC Fungicide	4	23	32	24
Prosaro 421 SC Fungicide	6.5	28	32	37
Tebuconazol	4	22	28	28
LSD		12.32	21.6	18.4

Applications were made on May 13 when the crop was 24 inches tall.

Effect of fungicide and application timing in Decade winter wheat, 2016.

	Rate		Stripe Rust (%)				
Treatment	fl oz/A	Timing	2-May	18-May	28-May	3-Jun	9-Jun
Check			2	22	50	78	85
Alto	4	Tiller	0	8	11	34	55
Quilt Xcel	7	Tiller	0	4	11	48	60
Trivapro	9.4	Tiller	0	5	11	56	93
Priaxor	2	Tiller	0	6	28	62	92
Tebuconazole	2	Tiller	0	5	16	56	87
Alto	4	Flag leaf	1	14	9	7	7
Quilt Xcel	10.5	Flag leaf	1	29	13	10	9
Trivapro	13.7	Flag leaf	2	26	20	9	5
Priaxor	4	Flag leaf	1	38	27	19	13
Tebuconazole	4	Flag leaf	1	37	33	17	10
LSD			1.83	21.07	17.64	23.42	24.65

Tiller applications made on April 15 and flag leaf applications were made on May 13 when crop height was 7 and 22 inches, respectively.

Trade Name	**Active**	**Company**
Absolute	tebuconozole + trifloxystrobin	Bayer
Alto 100 SL	cyproconazole	Syngenta
Aproach	picoxystrobin	DuPont
Aproach Prima	cyproconazole + picoxystrobin	DuPont
Caramba 0.75 SL	metconozole	BASF
Evito 480 SC	fluoxastrobin	Arysta
Folicur 3.6 F	tebuconozole	Bayer
Headline SC	pyaclostrobin	BASF
Priaxor	fluxapyoxad + pyraclostrobin	BASF
Proline 480 SC	prothioconazole	Bayer
Prosaro 421 SC	prothioconazole + tebuconazole	Bayer
Quadris	azoxystrobin	Syngenta
Quilt Xcel	propiconazole + azoxystrobin	Syngenta
Stratego YLD	propiconazole + trifloxystrobin	Bayer
Tilt 3.6 EC	propiconazole	Syngenta
Trivapro	propiconazole + azoxystrobin + benzovindiflupyr	Syngenta
Twinline 1.75 EC	metconazole + pyraclostrobin	BASF

Recommended Winter Wheat Varieties

Phil Bruckner and Jim Berg, Winter Wheat Breeding Program, Montana State University
Updated 12/2015

2015 Recommended Varieties: Hard Winter Wheat for Montana by District

Variety	Origin (Release year)	Districts 1 Northwest	2 Southwest	3 Southeast	4 Central	5 North Central	6 Northeast
Bearpaw[1/]	Montana (2011)			**D**	**D**	**D**	
Broadview	Alberta/Meridian Seeds (2009)					**D**	**D**
Carter	WestBred (2006)		**D**	**D**	**D**	**D**	**D**
CDC Falcon	Saskatchewan/WestBred (1999)		**DI**	**DI**	**DI**	**DI**	**DI**
Colter	Montana (2013)		**D**	**D**	**D**	**D**	
Decade	Montana/North Dakota (2010)			**D**	**D**	**D**	**D**
Jerry	North Dakota (2001)						**D**
Judee[1/]	Montana (2011)			**D**	**D**	**D**	
Ledger	WestBred (2004)		**D**		**D**	**D**	
Northern	Montana (2015)		**D**	**D**	**D**	**D**	
SY Wolf	Syngenta (2010)		**D**	**D**	**D**	**D**	
Warhorse[1/]	Montana (2015)			**D**	**D**	**D**	
WB-Quake	WestBred (2011)	**D**	**D**	**D**	**D**	**D**	**D**
Yellowstone	Montana (2005)	**D**	**D**	**D**	**D**	**D**	

D = Dryland
I = Irrigated
1/ = sawfly areas only

Table 1. Yield of Recommended Winter Wheat varieties, 2012-2015[1/]

Variety	Districts 1 Kalispell	2 Bozeman	3 Huntley[2/]	4 Moccasin[3/]	5 Conrad[4/]	5 Havre[5/]	**6**- Sidney & Williston	**All Locations**
location-years	4	4	3	4	4	4	4	27
Colter	**132.3****	**87.9***	**77.8***	**54.2***	**94.2***	65.2	**57.2***	**81.4****
Yellowstone	**122.4***	**91.7***	**78.1****	**55.8****	**98.1***	61.6	**60.6****	**81.3***
Northern	**116.7***	**87.6***	**76.4***	**54.7***	**98.5****	63.2	**54.2***	**78.8***
SY Wolf	104.6	**92.0****	**77.5***	50.4	**95.5***	64.7	42.7	**75.3***
Warhorse	112.9	80.6	**74.2***	48.9	78.6	57.5	48.2	71.4
CDC Falcon	82.4	75.4	**72.3***	51.1	90.7	59.5	**55.5***	69.5
WB-Quake	108.1	77.5	67.8	46.0	79.2	55.9	**50.9***	69.4
Judee	107.3	79.2	67.9	42.7	83.7	60.8	34.7	68.0
Broadview	67.4	70.6	67.4	49.8	**91.2***	63.4	**57.9***	66.8
Ledger	93.6	74.3	62.9	44.3	83.2	59.0	42.6	65.8
Decade	58.5	77.2	**73.8***	**51.5***	88.4	59.7	**50.9***	65.4
Jerry	59.7	73.9	64.1	49.6	82.9	54.4	**59.3***	63.4
Bearpaw	61.6	73.0	67.5	49.4	81.5	59.4	49.6	63.0
LSD (0.05)	**19.2**	**11.2**	**8.9**	**4.5**	**7.7**	**ns**	**10.1**	**6.2**

** = indicates highest value within a column
 * = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)
1/ = 2012-2015 Intrastate tests; 'Carter' is also on the recommended list, but testing discontinued for 2015

Table 2. Agronomic characteristics of Recommended Hollow-Stemmed Varieties, 2012-2015[1/]

Variety	Test weight lb/bu	Winter survival %	Heading date Julian	Heading date Calendar	Pla height in	Lodging %	Protein %	Sawfly cutting %	Stripe rust %	Coleoptile length in
location-years	27	4	28		28	2	27	3	5	2
Bearpaw	58.2	34	162.0	11-Jun	31.6	12	**13.4****	**4***	68	3.0
Broadview	58.2	**51***	162.8	12-Jun	32.3	10	12.9	7	64	2.8
CDC Falcon	58.8	**53***	161.9	11-Jun	30.6	2	12.7	**6***	55	2.9
Colter	**59.7***	**47***	164.2	13-Jun	34.0	2	12.9	11	**25***	2.9
Decade	58.5	**50***	161.1	10-Jun	32.1	2	**13.3***	11	72	3.2
Jerry	57.9	**59****	163.5	13-Jun	37.1	8	12.9	9	80	3.2
Judee	**59.4***	17	162.5	12-Jun	32.5	15	**13.4****	**3***	**19***	3.8
Ledger	**60.1***	29	162.2	11-Jun	31.9	7	12.4	7	56	3.3
Northern	**59.4***	39	164.4	13-Jun	32.9	12	**13.1***	**6***	**22***	2.5
SY Wolf	**60.3****	25	160.5	10-Jun	31.2	0	12.9	7	**23***	3.0
Warhorse	**59.3***	37	163.7	13-Jun	31.8	15	**13.2***	**2[illegible]***	**18****	3.3
WB-Quake	**59.6***	35	164.6	14-Jun	32.8	12	**13.2***	**3***	**34***	2.8
Yellowstone	**59.4***	43	163.7	13-Jun	34.2	0	12.6	7	**33***	2.7
LSD (0.05)	**1.0**	**13**	**0.6**		**0.6**	**ns**	**0.4**	**4**	**18**	**0.2**

1/ = 2012-2015 Intrastate tests
** = indicates highest value within a column
* = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

Winter wheat varietal resistance to stripe rust, 2016.

Cultivar	Stripe Rust (%) 24-May	Stripe Rust (%) 10-Jun	Cultivar	Stripe Rust (%) 24-May	Stripe Rust (%) 10-Jun
MT1471	2	7	Keldin	5	59
SY Sunrise	3	8	Brawl CLP	41	86
WB4623CLP	1	9	Rampart	24	88
SY Monument	2	10	Decade	41	95
Warhorse	6	15	CO11D174 (Avery)	63	95
Colter	7	20	Cowboy	67	96
Judee	6	22	Broadview	35	96
WB-Quake	15	26	Byrd	42	96
Freeman	5	26	CDC Chase	63	96
Northern	11	27	Jerry	61	97
SY Wolf	14	33	Bearpaw	46	97
SY Clearstone 2CL	10	47	WB4059CLP	65	98
Yellowstone	7	50	BZ9W09-2075	70	98

LSD May: 13.59

LSD June: 13.56

FY17 MONTANA WHEAT & BARLEY GRANTS

GRANT TITLE	PRINCIPAL INVESTIGATOR	MSU	CARC	EARC	NARC	NWARC	SARC	WARC	WTARC
Genetically improved winter wheat cultivars for MT	Phil Bruckner	X	X	X	X	X	X	X	X
Building genomics foundations to accelerate wheat & barley improvement for Montana	Hikmet Budak	X							
Expansion of on-farm research network in Montana	Mary Burrows	X							
Using warm-season crops to enhance wheat-based cropping system resillence	Pat Carr		X						
Molecular breeding pipeline for wheat	Jason Cook	X							
Wheat double haploid project	Jason Cook	X							
Advanced disease resistance in Montana wheat	Alan Dyer	X							
A novel approach to barley & wheat drought resistance	Andres Fischer	X							
Creation & yield testing of new semi-drawfing alleles	Mike Giroux	X							
Field evaluation & mapping of novel stem solidness genes in wheat	Jack Martin	X							
Developing a dynamic crop coefficient to improve irrigation efficiency	Kent McVay					X	X		
Assessing agronomic practices to advance cereal production in Montana	Kent McVay	X	X	X	X	X	X	X	X
Legacy effects of long-term diversified cropping systems	Perry Miller	X							
On-farm assessment of field bindweed impacts crop yields & response to organic management	Zach Miller							X	
Improved quality of Montana hard red & hard white wheat	Deanna Nash	X							
Effect of soil water storage and evapotranspiration on total grain & protein yields	Roger Ondoua								X
Eval of effectiveness on entomopathogens & trap crops for the mgmt of wireworm on spr wheat	Gadi V.P. Reddy								X
Identifying and developing improved barley varieties for Montana	Jamie Sherman	X	X	X	X	X	X	X	X
MSU barley quality lab	Jamie Sherman	X							
Orange wheat blossom midge management	Bob Stougaard					X			X
Assessment & management of preharvest sprout and falling number in Montana wheat	Bob Stougaard					X			
Remote technologies for precision ag in wheat agroecosystems	Paul Stoy	X				X	X		
Spring wheat breeding & genetics	Luther Talbert	X	X	X	X	X	X	X	X
IPM of wheat stem sawfly	David Weaver	X			X	X			

FY17 FERTILIZER TAX AWARDS

GRANT TITLE	PRINCIPAL INVESTIGATOR	MSU	CARC	EARC	NARC	NWARC	SARC	WARC	WTARC
Optimization of nitrogen fertilizer in sugarbeet under no-till management	Chengci Chen			X					
Nitrogen sources for short season dryland grain corn production in a low rainfall environment	Peggy Lamb				X				
Foliar applications to correct micro-nutrient deficiencies in winter wheat	Kent McVay						X		
Enhancing Yield and Nutritional Quality of Dry Pea through Micro-nutrient Fertilization	Yesuf Mohammed			X					
Optimizing Boron maintenance fertilization for alfalfa	Jessica Torrion					X			
Nitrogen Fertilizer Recommendations for Contrasting Protein Requirements	Jessica Torrion					X			
Second and third year evaluation of alfalfa response to spring broadcast fertilizer in central Montana’s Cascade, Fergus and Judith Basin Counties	Dave Wichman		X						

FY17 PEA AND LENTIL AWARDS

GRANT TITLE	PRINCIPAL INVESTIGATOR	MSU	CARC	EARC	NARC	NWARC	SARC	WARC	WTARC
Montana Statewide Pea, Lentil and Chickpea Variety Evaluation	Chengci Chen	X	X	X	X	X	X	X	X
Harvesting the Pea Genome, GAB II	Norm Weeden	X							
Western Retional Cool Season Food Legume Evolution Trials	Chengci Chen	X	X	X	X	X	X	X	X
Management of Pulse Crop Seedbourne Fungi	Bright Agindotan	X							
Enhancing Yield and Nutritional Quality of Dry Pea through Micronutrient Fertilization	Yesuf Mohammed			X					
Determining Pea Weevil Population, Distribution, Abundance and Pea Damage Assessments	Gadi V.P. Reddy								X
The Effect of Fungal Pathogens on Germination of Stored Chickpea	Jessica Rupp	X							

BUSHELS FOR BOBCATS

DONATE A PORTION OF YOUR HARVEST THROUGH THE BUSHELS FOR BOBCATS PROGRAM.

WHY DONATE YOUR HARVEST?

By contributing commodities to the Montana State University Alumni Foundation, a Montana not-for-profit corporation, you are providing Montana State University with a donation that retains the full value of your crop.

Example: You donate $3,000 worth of your crop to the MSU Alumni Foundation, which then sells it for $3,000. Then the university receives the entire $3,000. However, if you sell the crop first and donate that revenue after taxes, you donate approximately $1,940 to the university. The amount may vary depending on the current market.

HOW TO DONATE

If you deliver your grain donation to an elevator, request the storage receipt be made out to the Montana State University Alumni Foundation. Or, if you store your grain on the farm, prepare a notarized letter of transfer to the MSU Alumni Foundation.

Mail, fax or email the storage receipt or a notarized letter of transfer along with the form to the MSU Alumni Foundation to:

Samantha Beebout
Associate Director of Estate, Trust and Gift Planning
Montana State University Alumni Foundation
P.O. Box 172750 Bozeman, MT 59717-2750
Fax: 406-994-6081
Email: samantha.beebout@msuaf.org

A Montana State University development officer will work with you to make sure your gift goes to your preferred use.

Endowments: to establish an endowment of $25,000 or more, contact Kevin Brown at kevin.brown@msuaf.org.

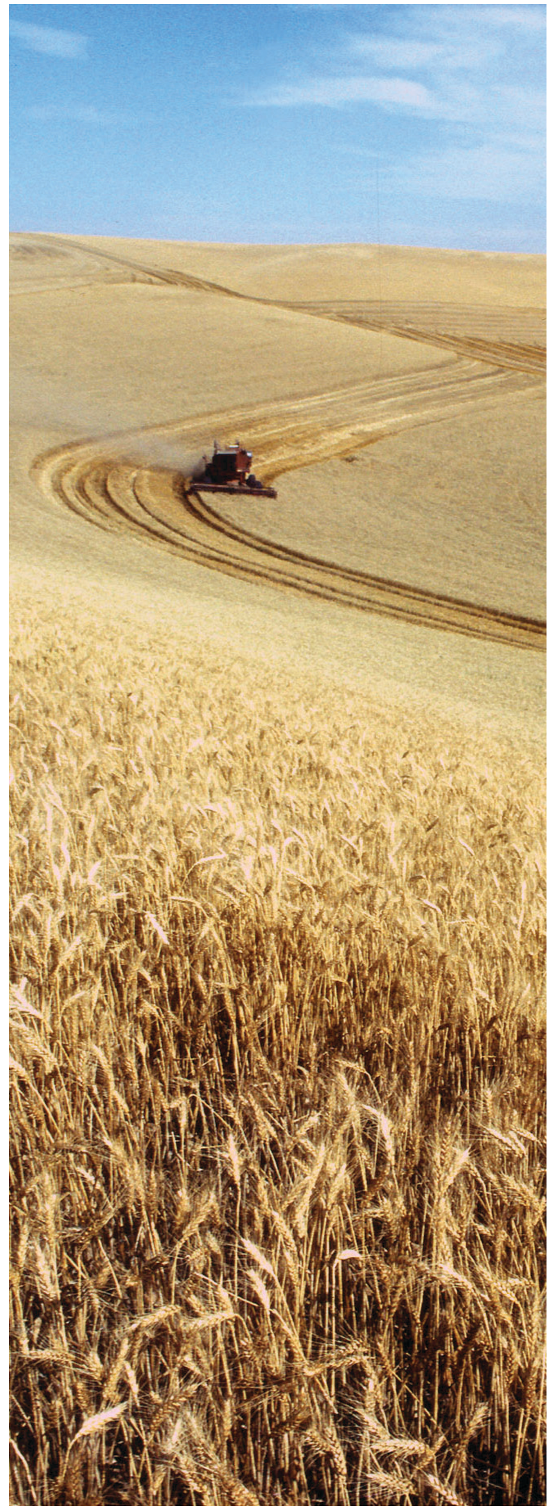
THE IMPACT OF GIVING

"Having people give their time and money to support students like me at Montana State makes me want to do well in school. Having a scholarship means that I can be more active and get involved on campus."

Taylor Brown '17
Agricultural Education

FOR MORE INFORMATION, VISIT MSUAF.ORG/BUSHELS

HOW TO GIFT YOUR BUSHELS.



TIMING

It is best to donate grain grown in a previous tax year. Make the donation early enough in the year so that there is no question that it came from the prior year's crop.

UNSOLD COMMODITY

The gift should be from unsold inventory with no sale commitment made prior to the gift.

PHYSICAL DELIVERY

The gift must be in the form of farm commodities, not warehouse receipts, which may be considered a cash equivalent. The charity (MSU Alumni Foundation) must be able to demonstrate "control and dominion" over the gifted property.

RETENTION OF CONTROL

The grower shall provide no guidance in the transfer agreement as to the retention or sale of the gifted commodity.

DOCUMENTATION

Provide either a properly executed warehouse receipt in the name of the "Montana State University Alumni Foundation; or a notarized letter of transfer for crops stored on the farm. The original sales invoice should list the charity (MSU Alumni Foundation) as the seller.

STORAGE AND TRANSPORTATION COSTS

After the transfer, the Montana State University Alumni Foundation will assume costs of storage, marketing or transportation.

CROP SHARE LEASES

Gifting will not work for a crop share landlord. A share of a crop received as a rental payment is considered the equivalent of rental income.

DONOR GIFT VALUE

The MSU Alumni Foundation will provide you with a donor receipt for the net settlement amount for your records. You do not need to declare a deduction or sale to the IRS.

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