Northwestern Agricultural Research Center Field Day

TUESDAY, JULY 10, 2018

agresearch.montana.edu/nwarc/

MONTANA STATE UNIVERSITY
College of AGRICULTURE & MONTANA AGRICULTURAL EXPERIMENT STATION

MONTANA STATE UNIVERSITY 125 YEARS IN THE PEOPLE'S INTEREST

2:00 pm Registration and Introductions

2:30 pm Field Tours

5:00 pm Dinner

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Northwestern Agricultural Research Center Staff

Back Row: Jordan Penney, Dove Carlin, Sage Rasmussen, Kyle Byers, Mark Byers, Don Edsall, Ze Tian Fang, Breno Bicego, Amanda Shine, Tana Simpson

Front Row: Mike Davis, Jessica Torrion

Advisory Committee

Flathead County

Markus Braaten, Matt Cottle, Tryg Koch, Andy Lybeck, Pat McGlynn

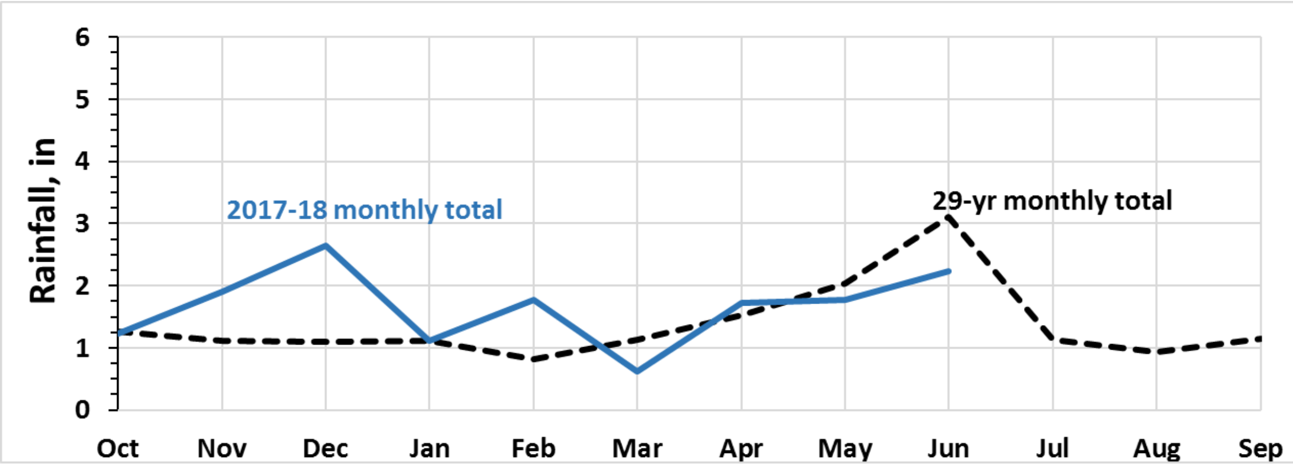
Lake County

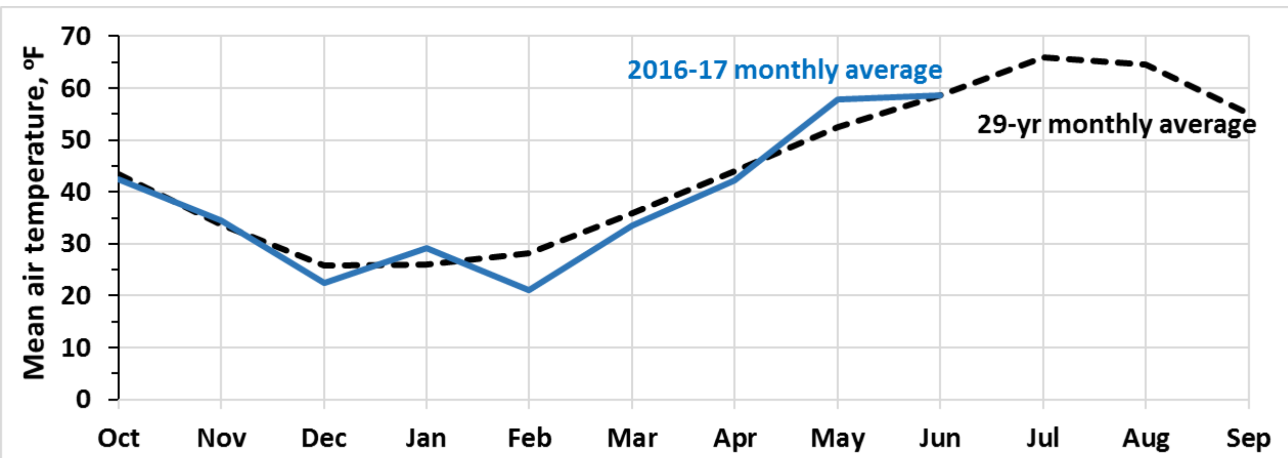
Dan Barz, Scott Buxbaum, Dan Lake, Jack Stivers, Ken McAlpin

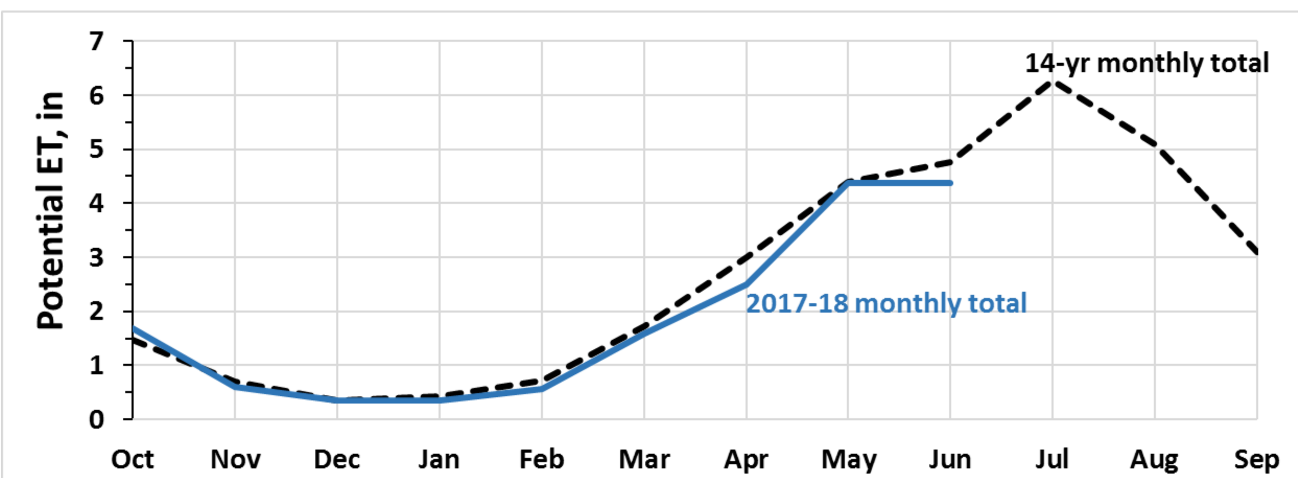
Sanders County

Jason Badger

2017-2018 Weather Trend in Relation with the 29-year (1989-2017) Climate Data







Spring Wheat Irrigation Strategies: what we learn

Jessica A. Torrion

Water is becoming a limited resource here and elsewhere. The increasing cost of irrigation including energy, water, and labor may lower farm economic returns. Applying irrigation can be done with the use of soil moisture sensors or by the 'Checkbook Method' which is a detailed record keeping of plant growth, rainfall events, irrigation amounts, daily crop water usage, and other losses such as drainage and run-off. Determining when to schedule irrigation can be difficult and imprecise. Our research goal is to provide practical approaches to improve irrigation management in wheat.

Various cultivars tend to have similar yield response to moisture availability but some can have a much better degree of the rate of yield response than others. We also investigate wheat genetics to determine influence of the levels of moisture on wheat quality.

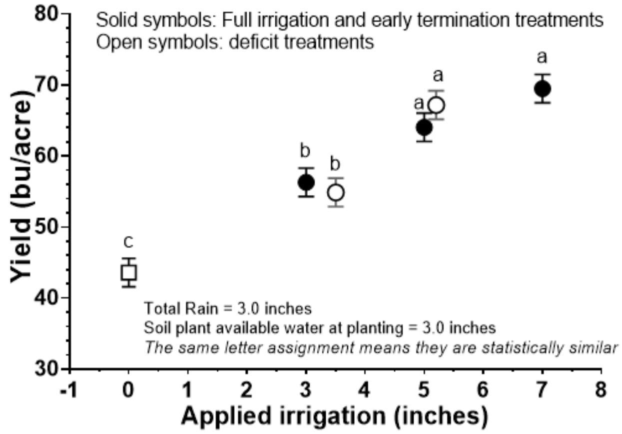
2018 treatment and management information

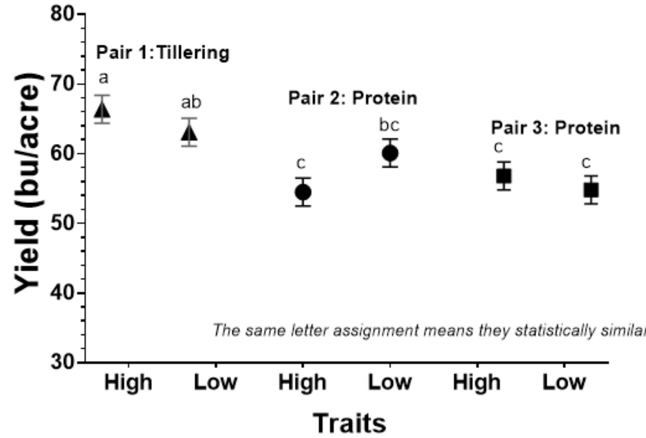
Wheat traits	High and low protein High and low tiller
Six moisture levels	(1) Rainfed, deficit irrigation such as 75% and 50% of crop evapotranspiration (ET) denoted as: (2) '75ET', and (3) '50ET', respectively, applying the final irrigation at near (4) flower and (5) milk stages; and a 'no-stress' control treatment (6) '100ET'.
Planted/Emerged:	May 2 / May 10
Soil test/ Fertilizer:	48-14-234 / 102-38-97
Herbicide:	Huskie, Axial XL
Fungicide:	Headline
Insecticide:	

We have learned over the four years of wheat irrigation research that:

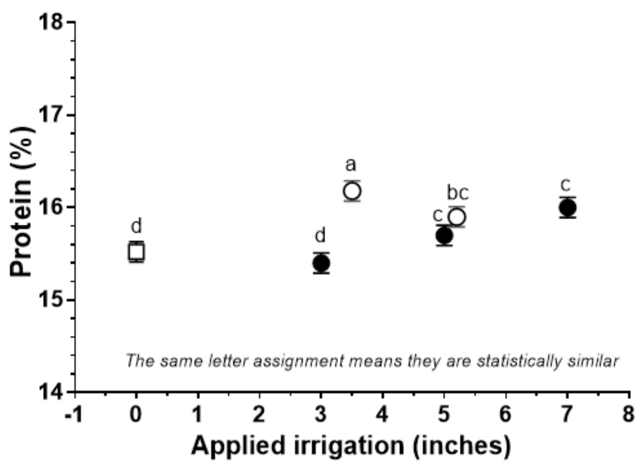
1. Wheat can handle stress as long as it is done right. Applying irrigation in reduced amounts improve rainfall storage for use by the plants and possibly promotes root growth.
2. High probability of yield reduction if final irrigation is applied near the flowering stage.
3. Low probability of yield reduction when applying final irrigation at milk stage.
4. No guaranteed protein increases with late irrigation applications (i.e., past milk stage)
5. High probability of reduced falling number (i.e., an increase of amylase activity – breaking down starch to sugar) if irrigation is applied near the soft dough stage.
6. Overall, irrigating past medium-milk does not improve yield or quality.

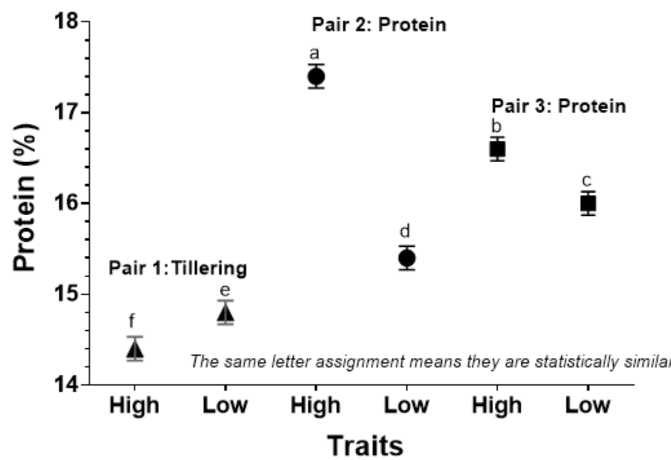
Yield response in 2017





Protein response in 2017





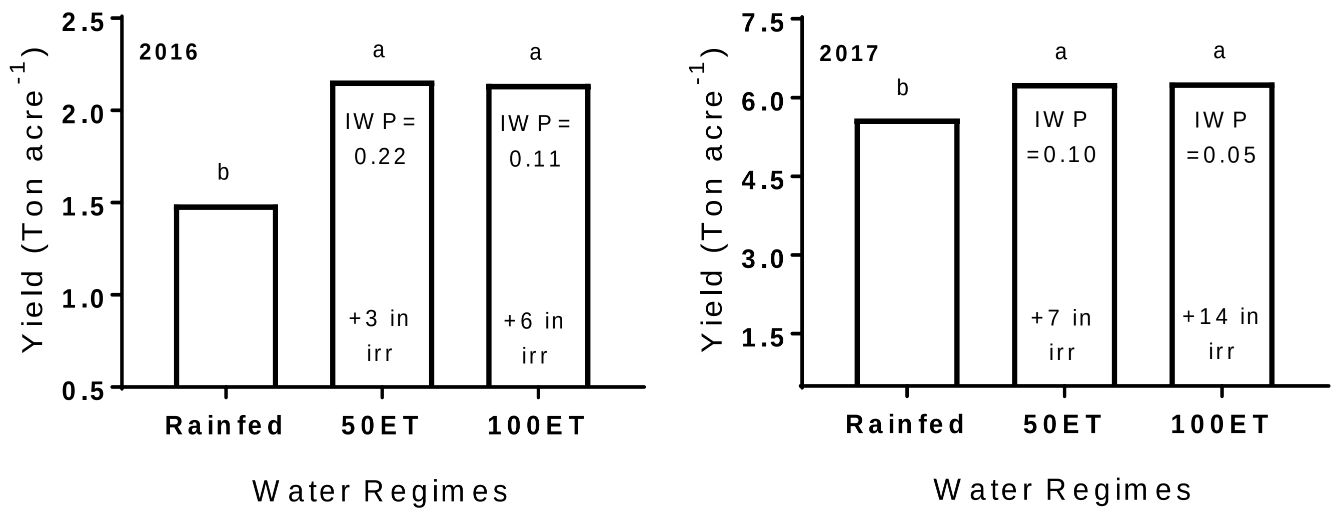
Growing alfalfa on various water regimes

Jessica A. Torrion

Alfalfa is a preferred forage for feeding livestock as it contains low fiber and high protein. Alfalfa has a greater demand for water than other crops. Considering that water is becoming a limited resource, research efforts on prioritizing irrigation water use are needed. The overall goal of this project is to develop a semi-automated irrigation tool to optimize irrigation water application for alfalfa. This project is in collaboration with the University of Florida, University of California – Davis, and Arizona State University.

Our 2016-217 irrigation study revealed that irrigation increased yield by 45% during the year of establishment (2016, left figure below), but increased yield only 12% the following year (2017, the right figure below). Deficit irrigation (50% of what was applied in full irrigation denoted as '50ET') had the same yield as the fully irrigated alfalfa (denoted as '100ET') which resulted to greater irrigation water use productivity (IWP) at deficit irrigation than in fully irrigated plots.

Yield response of various water regimes in 2016 and 2017



2018 Alfalfa study agronomic management and information

Water regimes:	Rainfed, full irrigation ('100ET'), and deficit ('50ET').
Fall dormancies:	Pairs of 2.0, 3.0, and 6.0
Planted / Emerged:	May 21 / May 28
Soil test / Fertilizer:	360-34-118 / 0-0-100
Herbicide:	Pursuit

Planting soybean in Montana

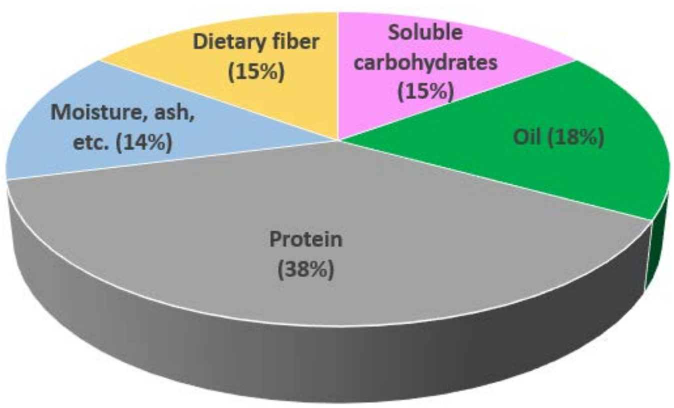
Jessica Torrion

Soybean is a common crop planted in the Midwestern USA, often planted in rotation with corn. It is a relatively new crop in Montana; although, producers in the Yellowstone River Valley began planting soybean in the early 2000's. Recent report claims that around 10,000 acres are currently planted with soybean in Montana.

Soybean can be an important alternative plant for crop rotation. Rotating crops promotes soil health improvement, breaks the life cycle of pests and diseases, and possibly even farm profits. In addition, soybean fixes atmospheric nitrogen, provided that favorable populations of biological nitrogen fixers are present in the soil. The amount of fixed nitrogen from the atmosphere is reportedly enough to support the growth of soybean.

Soybean plants are sensitive to both temperature and the length of the night. Our short local growing season presents a challenge to growing soybean. Thus, research efforts are directed towards determining optimal planting date as well as an appropriate variety that will allow plants to reach maturity.

Lastly, soybean duration from establishment to maturity or 'adaptation' is referred to as Maturity Groups (MGs). Based on what is grown in the Northern latitudes, we anticipate that MGs of 0.1 or lower may be adaptable to local conditions. Thus, MGs included in this research are: 0.02, 0.03, 0.05, and 0.08.



Soybean seed composition

Treatment and management information

Planting Dates:	May 15, May 29, and June 12
Maturity Groups:	0.02, 0.03, 0.05, and 0.08
Planted on:	Creston silt loam soil
Soil analysis:	93-14-168
Fertilizer:	06-50-0
Herbicide:	None (hand-weeded)

Variety Options for Peas, Lentils, and Faba Beans

Montana is the leading grower of pulse crops in the United States. Pulses are excellent rotational crops in wheat-based cropping system as they serve as ‘break’ crops which improve soil and plant health. They fix atmospheric nitrogen (N) for growth and yield (**Table 1**). Most pulse crops provide a nitrogen credit of 10 to 20 lb/A. They are also reported to be good scavengers of P and other nutrients. Improved rooting environment (physical and microbial) is another rotational benefit.

Table 1. Nitrogen (N) fixed estimates. Source: Dr. Schoenau, U of Saskatchewan

Crop	**Fixed N, lbs/acre**
Pea	50-150
Lentil	30-120
Faba bean	80-160

Seed inoculation is an important consideration in growing pulse crops. Seed treatment for disease and insect control is another management factor that impacts pulse production. Weed control is important for all crops, but particularly so for lentils. Unfortunately, there are few herbicide options available (Table 2). This year, pea leaf weevil was found in the area, thus, an insecticide was applied first week of June.

Table 2. Management information

Soil: Creston silt loam	Soil analysis: 93-14-168 Fertilizer: 06-50-00
Planted: May 8, 2018 Emerged: May 18 (Pea, lentil); May 20 (Faba)	Herbicide: Triflurex (preplant incorporated) Post application (except lentil): Varisto
Seed Treatment Insecticide: Cruiser 5FS Fungicide: Apron Maxx RTA	Insecticide (except lentil): Warrior II
Inoculant: N-charge	

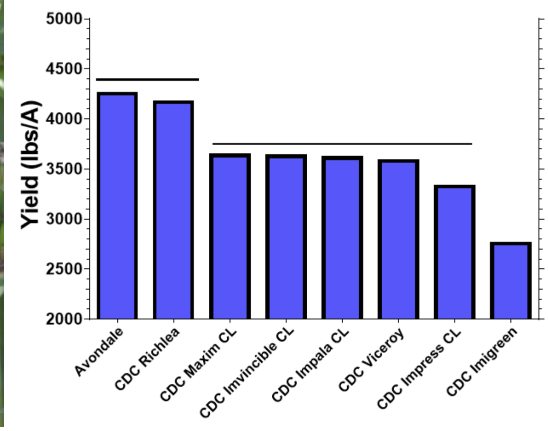
Faba bean is a new option being considered for this area. Among pulses, it has the highest N-fixing ability (Table 1). There are quite a number of unknowns in terms of managing Faba bean agronomically. In our experience, planting Faba bean can impose a challenge at planting. It is a relatively large-seeded crop with an irregular shape which can potentially plug the seeder openers. Planting at the slowest speed can reduce faba bean hose plugging, thus, occasional checking is recommended. In Canada, Lygus, blister beetles, grass hoppers, and aphids can be problematic. It is also prone to diseases and one of them is Chocolate Spot. The crop may require a desiccant to help with harvest. In 2017, dessicant was not applied and it was possible to harvest with green stems.

Faba in 2017: 1) Ascochyta leaf spot, 2) Angular leaf spot, and 3) Thrips

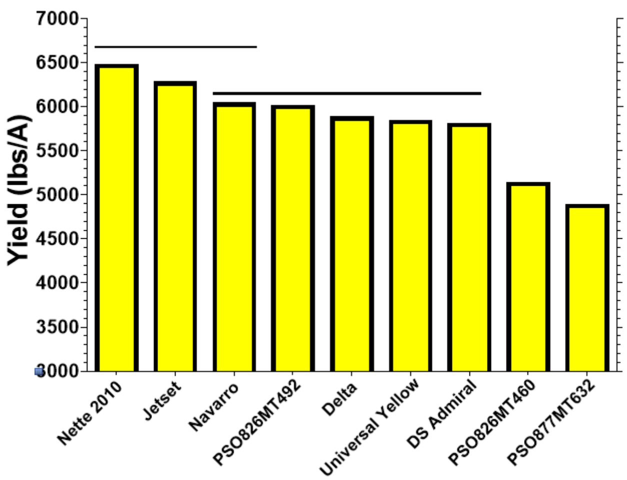
Faba Yield in 2017 : 3,100 – 4,570 lbs/A
Plant height: 35 – 50 inches
Seed protein: 27-31 %
Seed size: (194-492 g /1000 seeds)

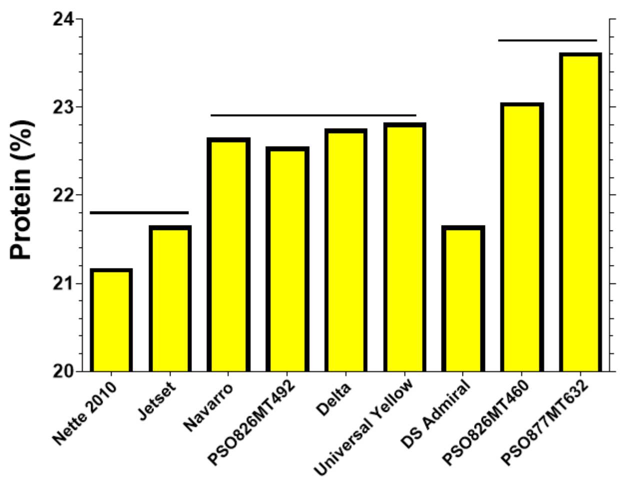
brown – tannin containing
Pale – zero to low tannin (more susceptible to Fusarium)

2017 Lentils

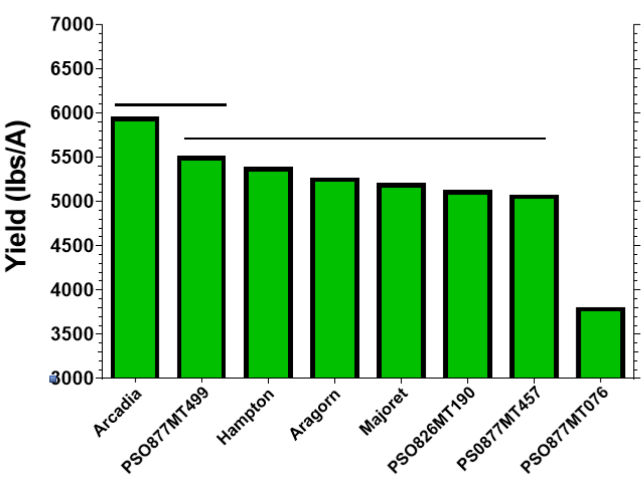


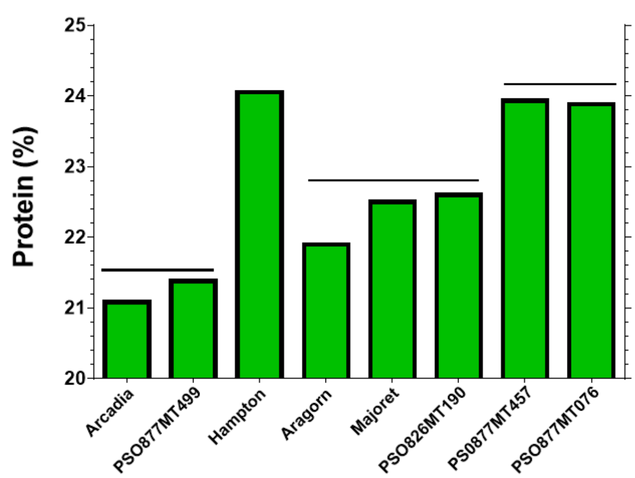
2017 Yellow Pea





2017 Green Pea





Straight lines above the bars indicate statistical similarity

Spring Wheat Yield and Yield Components

Brittney Brewer, Luther Talbert, and Jessica Torrion

Brittney.brewer@montana.edu

Environment and genetics determine the yield potential of field crops. Grain yield is the economic harvestable grains influenced by the number of tillers or productive spikes per area, seeds per spike and seed size. These are called yield components. This study is a collection of spring wheat lines derived originally from crosses between spring wheat and durum wheat with the purpose of targeting specific traits such as:

1) Yield
2) Seed size
3) Number of seeds
4) Tiller number

The original spring wheat and durum crosses was done to identify beneficial yield component genes associated with durum wheat in a spring wheat background. These crosses were also done with the aim of increasing genetic diversity in spring wheat by introgression of beneficial yield related genes from durum wheat. Several durum alleles were identified from the original crosses to have a beneficial impact on yield and yield components. These genes were then moved into additional spring wheat backgrounds to further validate and confirm these impacts.

Lines in this population consist of pairs (near-isogenic lines) which are fixed in their genetic background except for presence of a durum or spring wheat gene for the specified yield component traits. This allows us to evaluate the impact of a durum yield component genes in a spring wheat background by comparing it to its pair containing the spring wheat allele.

Subjecting the above traits to various environment and management will allow identification of wheat characteristics that can withstand weather variability such as: heat and low moisture. A relatively high yield, despite a harsh weather is the goal in this selection and hope to identify lines that are compensatory in nature to lessen negative yield impact.

Agronomic Information

Planted / emerged:	May 2 / May 10
Target seeding:	25 plants/ft^2
Soil test / fertilizer:	120-13-81 / 40-40-100
Herbicide:	Huskie complete
Fungicide:	Headline
Insecticide:	Warrior II

MAES Winter Wheat

Northwestern Agricultural Research Center (NWARC) at Kalispell is an important winter wheat evaluation site for the MAES Winter Wheat Cultivar Development program. Historically, the Montana Intrastate winter wheat trial, which contains currently grown proprietary and public cultivars as well as candidate experimental lines, has been grown at NWARC. The trial contains 49 entries in three replications. Since 1990, the winter wheat Intrastate trial has been grown here in Kalispell 27 times, averaging 94 bushels/acre [range 47-144 bu/acre]. Kalispell is generally the highest yielding site in our trial and generally has higher levels of stripe rust, which makes it a useful site in developing stripe rust-resistant winter wheat cultivars. Data for winter wheat cultivars currently being tested in the Montana Intrastate Winter Wheat Trial is attached.

Foundation seed of two new MAES-developed winter wheat cultivars is currently being increased for release to Montana Seed Growers. New winter wheat cultivars include:

Ray is a winter wheat forage variety. Bred as an awnless livestock forage, Ray is named after the late MSU Professor Ray Ditterline, who taught plant sciences in the College of Agriculture courses and bred alfalfa forage varieties for the Montana Agricultural Experiment Station for 34 years. Ray is suitable as a one-cut, annual hay crop in Montana, producing similar hay yields and forage quality as Willow Creek. Unlike its forage predecessor, Willow Creek, Ray has a much higher seed yield and is bred for dual-use as a forage and a cereal grain.

Table 1. Grain and Forage production characteristics of Ray and check cultivars in Winter Annual Forage Trials, 2014-2017.

Variety	Field Analysis						Forage Analysis			
	Grain yield lb/a	Test weight lb/bu	Heading date Julian	Heading date Calendar	Plant height in	Dry matter yield ton/a	Protein %	ADF %	NDF %	TDN %
location-years	9	9	15		16	20	6	6	6	6
Trical 102	2976	49.4	161.8	11-Jun	52.2	**4.04**	11.4	32.8	63.8	65.7
Ray	**3896**	**58.7**	164.5	14-Jun	35.6	3.45	11.2	31.5	60.7	67.3
MTF1435	3220	**59.0**	162.7	12-Jun	39.4	3.54	11.6	32.3	62.4	65.9
Willow Creek	2383	**59.7**	168.3	17-Jun	43.8	3.37	11.4	33.0	62.6	65.5
LSD (0.05)	**388**	**1.1**	**0.9**		**2.4**	**0.31**	**ns**	**ns**	**ns**	**ns**

FourOsix is a new grain cultivar named by Jim Berg, MSU winter wheat research associate, after our state's area code, and denoting the cultivars area of adaptation. FourOsix is intended as a replacement to Yellowstone, well-known for its high yield and milling and baking qualities. Yellowstone accounted for 18.8 percent of the state's planted wheat acreage in 2016. FourOsix is 3 to 4 inches shorter, similar in yield, higher in test weight and grain protein, and appears to have better stripe rust resistance than Yellowstone. FourOsix produces "very good" milling and baking qualities. The National Wheat Quality Council, a coordinated effort by breeders, producers and processors to improve wheat quality, endorsed FourOsix for its high loaf value, absorption and mixing characteristics. According to Doug Holen, Montana Foundation Seed Program manager, foundation seed of Ray and FourOsix will be distributed to certified seed producers this fall and will potentially be available for the 2019 growing season.

Table 2. Yield of FourOsix vs. a set of varieties, 2016-2017[1/]

Variety	Districts							All Locations
	1 Kalispell	2 Bozeman	3 Huntley[2/]	4 Moccasin[3/]	5 Conrad[4/]	5 Havre[5/]	6- Sidney & Williston	
location-years	1	2	7	7	6	6	3	32
Keldin	101.1	91.6	**83.0**	**64.6**	**83.4**	59.0	54.6	**73.0**
SY Monument	127.0	96.1	**81.8**	**62.2**	**83.2**	56.4	57.0	**73.0**
FourOsix	**135.0**	96.4	**83.5**	**61.2**	77.4	55.7	50.1	**71.5**
SY Wolf	98.6	79.2	**82.6**	**63.4**	**79.0**	54.6	56.1	**70.3**
Northern	**133.7**	87.3	**77.5**	58.0	77.0	55.7	48.6	68.7
Decade	18.5	46.9	69.6	58.2	70.7	52.7	52.6	59.5
LSD (0.05)	**10.2**	**14.7**	**7.4**	**4.2**	**4.7**	**ns**	**ns**	**4.8**

1/ = 2016-17 Intrastate and 2017 Off Station tests

MSU/MAES Winter Wheat Varieties

Phil Bruckner and Jim Berg, Winter Wheat Breeding Program, Montana State University
Updated 12/2017

Montana Tested Hard Winter Wheat Varieties:

Shaded entries are MSU/MAES developed varieties

Variety	Origin	Release year	Solid-stem	Clearfield
Bearpaw	Montana	2011	X	
Brawl CL Plus	Colorado	2011		X
CDC Falcon	Saskatchewan/WestBred (1999)	1999		
Decade	Montana/North Dakota (2010)	2010		
Judee	Montana	2011	X	
Keldin	WestBred/Monsanto	2011		
Loma	Montana	2016	X	
Northern	Montana	2015		
SY Clearstone 2CL	Montana/Syngenta	2012		X
SY Monument	Syngenta	2014		
SY Wolf	Syngenta	2010	X	
Warhorse	Montana	2015	X	
WB-Quake	WestBred	2011	X	
Yellowstone	Montana	2010		

Table 1. Yield of Winter Wheat varieties, 2015-2017[1/]

Variety	Districts							All Locations
	1	2	3	4	5	5	6- Sidney &	
	Kalispell	Bozeman	Huntley[2/]	Moccasin[3/]	Conrad[4/]	Havre[5/]	Williston	
location-years	2	2	6	7	6	5	3	31
SY Monument	**124.3**	**89.4**	**73.7**	**53.1**	**84.0**	**61.3**	55.6	**73.3**
Keldin	**111.7**	**85.3**	**74.3**	**55.6**	**85.0**	**60.3**	54.0	**72.8**
Yellowstone	**117.7**	**89.8**	**75.9**	**51.8**	78.7	**60.8**	62.2	**72.5**
Northern	**132.3**	83.6	**71.6**	**51.2**	**79.3**	**60.1**	53.2	**71.2**
SY Clearstone 2CL	**124.6**	**86.4**	**72.2**	**54.1**	78.3	**57.2**	53.6	**71.1**
SY Wolf	102.2	82.0	**76.0**	**54.6**	**80.9**	**57.4**	57.0	**71.1**
Loma	**136.4**	**91.0**	69.5	46.9	77.1	**55.4**	48.9	**68.8**
Brawl CL Plus	72.5	76.3	70.3	48.5	78.7	**56.3**	50.0	64.9
Warhorse	**129.6**	73.7	66.5	47.3	68.9	**54.0**	42.7	64.4
Judee	**122.1**	66.5	65.0	44.7	69.4	53.5	42.8	62.5
CDC Falcon	66.4	55.0	65.8	46.9	73.6	**54.9**	55.1	61.1
WB-Quake	**122.5**	71.1	61.8	42.6	64.1	53.1	46.4	60.9
Decade	43.9	48.9	64.4	50.5	71.6	**54.9**	51.6	59.2
Bearpaw	48.9	44.5	64.6	46.5	70.9	47.1	43.9	56.1
LSD (0.05)	**33.6**	**6.9**	**5.2**	**5.4**	**5.9**	**7.5**	**ns**	**5.1**

bold = indicates highest value w ithin a column
bold = indicates varieties w ith values equal to highest variety w ithin a column based on Fisher's Protected LSD (p =0.05)
1/ = 2015-2016 Intrastate and 2017 Off-Station tests
2/ includes data from Fort Smith, Hardin area, Hysham, Molt, Rapelje
3/ includes data from Belt, Denton, Geraldine, Highw ood, Winifred
4/ includes data from Choteau, Cut Bank, The Knees, Shelby
5/ includes data from Carter, Loma, Turner

Table 2. Agronomic characteristics of Winter Wheat Varieties, 2015-2017[1/]

Variety	Test weight lb/bu	Winter survival %	Heading date Julian	Heading date Calendar	Plant height in	Lodging %	Protein %	Saw fly cutting %	Stripe rust %	Coleoptile length in
location-years	31	1	15		30	5	30	4	4	1
Bearpaw	59.3	73	155.9	5-Jun	29.8	27	**12.4**	**8**	73	3.0
Brawl CL Plus	**61.8**	53	151.1	31-May	30.7	19	**12.3**	37	70	3.5
CDC Falcon	59.7	94	156.0	5-Jun	28.9	25	11.9	39	52	2.9
Decade	59.7	78	155.9	5-Jun	30.5	34	**12.2**	30	70	2.9
Judee	**61.1**	40	156.3	5-Jun	30.9	33	**12.3**	**14**	**14**	3.7
Keldin	60.8	28	156.5	6-Jun	31.0	42	11.7	39	35	2.8
Loma	60.0	95	158.2	7-Jun	29.8	32	12.0	**16**	**14**	2.8
Northern	60.1	85	158.4	7-Jun	31.3	40	**12.2**	**19**	**19**	2.6
SY Clearstone 2CL	59.6	73	156.9	6-Jun	33.7	42	11.7	28	**30**	2.9
SY Monument	59.4	75	155.2	4-Jun	30.9	34	11.2	32	**14**	3.1
SY Wolf	**61.7**	55	154.9	4-Jun	30.3	39	11.8	31	**23**	3.1
Warhorse	60.2	78	157.5	7-Jun	30.4	21	**12.5**	**5**	**13**	3.2
WB-Quake	60.5	75	157.9	7-Jun	30.8	29	**12.2**	**10**	**27**	2.6
Yellowstone	60.0	93	156.9	6-Jun	32.6	30	11.7	22	33	2.7
LSD (0.05)	**0.7**	**22**	**0.7**		**0.6**	**ns**	**0.3**	**17**	**18**	**0.2**

1/ = 2015-2016 Intrastate and 2017 Off-Station tests
bold = indicates highest value w ithin a column
bold = indicates varieties w ith values equal to highest variety w ithin a column based on Fisher's Protected LSD (p =0.05)

Table 3. Mill and bake characteristics of Winter Wheat Varieties, 2015-2016

Variety	PPO[1/]	Kernel hardness	Flour yield %	Flour protein %	Flour Ash %	Mixograph tolerance (1-6)	Mixograph mix time min	Mixograph absorption %	Baking mix time min	Baking absorption %	Baking volume cc
location-years	8	8	8	8	8	8	8	8	8	8	8
Bearpaw	0.286	77.2	**70.7**	**11.0**	0.42	3.0	4.3	61.3	8.4	71.4	945
Brawl CL Plus	0.282	65.6	68.8	**11.4**	**0.40**	3.0	4.6	**63.2**	9.6	**73.6**	1009
Decade	0.252	70.1	68.8	10.7	0.41	**4.3**	8.0	**63.6**	21.9	**74.4**	970
Judee	0.258	77.0	68.8	**11.2**	0.41	**3.8**	5.2	62.1	11.3	72.2	**1082**
Keldin	0.329	64.0	69.0	10.3	0.44	**3.6**	4.9	61.4	10.3	71.9	916
Loma	0.163	77.4	**71.5**	10.6	0.42	**3.8**	6.7	**63.6**	17.7	**75.1**	**1033**
Northern	**0.096**	82.8	**70.9**	**11.3**	0.46	3.0	3.9	**62.5**	6.6	72.3	1014
SY Clearstone 2CL	0.276	73.7	68.5	10.4	0.43	**3.6**	5.4	**62.4**	10.2	73.2	980
SY Monument	0.174	71.8	69.9	10.1	**0.39**	**4.0**	9.1	**62.7**	19.2	**74.3**	928
SY Wolf	0.252	70.6	68.5	10.5	**0.40**	2.6	4.6	58.7	7.6	69.0	921
Warhorse	0.251	87.1	69.1	**11.5**	0.45	3.0	4.6	**63.3**	8.7	**73.7**	1009
Yellowstone	0.235	73.4	68.7	10.7	0.43	**3.9**	8.0	**64.0**	17.5	**75.3**	991
LSD (0.05)	**0.037**	**3.7**	**1.3**	**0.6**	**0.01**	**0.6**	**1.2**	**1.9**	**3.4**	**2.0**	**58**

bold = indicates highest value within a column
bold = indicates varieties with values equal to highest variety within a column based on Fisher's Protected LSD (p =0.05)
1/ polyphenol oxidase, low is best for noodles

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