Project Title: Off-Station spring barley variety performance trials in Central Montana – CARC

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Objectives:
Identify top performing spring barley cultivars in central Montana.

Methods:
Standard spring barley variety performance trials were conducted on chemical fallow or minimal tillage during 2020 at Moccasin (CARC) and on farms near Denton, Geraldine, and Fort Benton. Trials consisted of both named varieties of barley and additional experimental lines. Each variety was seeded in three 5-row, 16-foot plots in a randomized experimental design. Seeding dates were April 29 at Moccasin, May 5, at Geraldine, and May 6, 2020 at Denton and Fort Benton. All plots were trimmed to a harvest length of approximately 12 feet and harvested with a small plot combine. Plots were harvested on August 21 at Fort Benton, August 25 at Moccasin, August 28 at Geraldine, and September 1 at Denton

Results:
The 2020 growing season at CARC started out with good recharge soil moisture and above average precipitation in September, which prevented access to the fields. Total annual precipitation was below the 110-year average (Table 1). This created favorable conditions for spring wheat growth during the mid-spring period. Average annual temperature was 0.1°F higher than the 110-year mean, with individual monthly averages 9.9°F below average in October but 5.4°F warmer in December. August was the hottest month with an average monthly temperature of 68.9°F (3.9°F above normal). Rainfall was 0.71 in above average in June while July and August were 0.68 and 1.23 in below average, respectively.

Average yield was 48.3 bu/ac at Moccasin (Table 2), 23.9 bu/ac at Denton (Table 3), and 43.8 bu/ac at Geraldine (Table 4). At Moccasin, the top yielding varieties were Ellinor (59.6 bu/ac), Opera (54.3 bu/ac), Metcalfe (53.5 bu/ac), and Hays (52.2 bu/ac). Differences in yield were not significant among the tested varieties at Denton or Geraldine. Average protein was 8.2% at Moccasin, 9.6% at Denton, and 9.1% at Geraldine.

Summary:
While rainfall in June was above the historic average, below average rainfall in July and August may have negatively impacted yields at Moccasin, where yields were about 12 bu/ac below the 3-year average. At Geraldine and Denton, grasshopper infestations were observed which may have negatively impacted yields at these locations. This work has been strongly supported by producers at the off-station locations and by the Central Agricultural Research Center Advisory Council. With budget and other resources allowing, plans are in place to continue off-station cereal variety investigation throughout the central Montana region.

Funding Summary:
An expenditure summary will be provided by OSP. No additional grant support was provided for this project.

MWBC FY 2020 Grant Submission Plans:
A request for continuing this project was submitted for funding consideration for the next fiscal year.

Table 1: Monthly precipitation and temperature data during the 2019-20 growing season and the long-term average at the Central Ag. Research Center in Moccasin, MT.

Month	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Year
Year	2019	2019	2019	2019	2020	2020	2020	2020	2020	2020	2020	2020	
Precipitation (inches)													Total
Average (1910-2020)	1.45	0.92	0.57	0.53	0.53	0.46	0.7	1.22	2.64	3.08	1.64	1.58	15.32
Current Year	2.87	0.85	0.78	0.30	0.26	0.56	0.43	0.77	2.68	3.79	0.96	0.35	14.60
Difference	1.42	-0.07	0.21	-0.23	-0.27	0.10	-0.27	-0.45	0.04	0.71	-0.68	-1.23	-0.72
Temperature (°F)													Average
Average (1910-2020)	55.9	34.9	31.0	30.4	26.1	26.6	30.5	36.7	50.8	59.0	64.8	68.9	43.0
Current Year	54.9	44.8	32.9	25.0	21.9	24.5	30.6	40.8	50.1	57.9	65.9	65.0	42.9
Difference	1.0	-9.9	-1.9	5.4	4.2	2.1	-0.1	-4.1	0.7	1.1	-1.1	3.9	0.1

Table 2: Barley variety trial at Moccasin, MT.

Variety/Pedigree	Year of Release	Source	Heading Date	Height	Test Weight	Protein	Plumps	Grain Yield (bu/ac)			
			cal	(in)	(lb/bu)	(%)	(%)	2018	2019	2020	3 yr Avg
AAC Synergy			**6-Jul**	**19.0**	**45.4**	**8.5**	**90.5**			**46.7**	**46.7**
ABI Voyager			5-Jul	21.3	49.5	8.5	91.8			41.4	41.4
Balster			**6-Jul**	**19.3**	**48.8**	**8.0**	**86.3**	**93.6**	**65.6**	**43.9**	**67.7**
Buzz			4-Jul	19.3	51.1	7.9	95.6			47.0	47.0
CDC Copeland			**5-Jul**	**19.7**	**50.0**	**9.1**	**92.3**	**85.6**	**63.0**	**45.4**	**64.7**
Craft			4-Jul	21.3	52.4	8.9	94.4		60.9	49.5	55.2
Diablo			**10-Jul**	**18.7**	**49.6**	**8.6**	**89.4**			**48.6**	**48.6**
Ellinore			10-Jul	18.7	50.0	7.4	90.2			**59.6**	59.6
Expedition			**9-Jul**	**17.7**	**50.5**	**8.7**	**88.1**		**73.7**	**51.1**	**62.4**
Genie			10-Jul	16.7	50.7	8.0	90.6	**95.7**	71.5	45.1	70.8
Growler			**6-Jul**	**19.3**	**48.1**	**8.7**	**82.2**	**94.0**	**67.7**	**44.8**	**68.8**
Haxby	2003	MAES	4-Jul	18.3	50.1	8.9	86.3	**101.5**	66.3	48.7	72.2
Hays	**2003**	**MAES**	**9-Jul**	**19.0**	**50.1**	**8.4**	**74.6**	**89.4**	**60.8**	**52.2**	**67.5**
Hockett	2008	MAES	4-Jul	18.3	50.3	7.7	93.2	88.9	64.2	48.1	67.1
Lavina	**1989**	**MAES/USDA**	**7-Jul**	**20.0**	**48.8**	**7.9**	**74.3**			**47.3**	**47.3**
Leandra			10-Jul	15.0	46.4	8.4	88.1			47.0	47.0
Merit 57			**6-Jul**	**19.3**	**49.5**	**7.8**	**70.5**	**111.0**	**62.8**	**47.3**	**73.7**
Metcalfe		Canada	4-Jul	21.7	49.4	7.8	87.1	92.4	55.4	**53.5**	67.1
Odyssey			**10-Jul**	**17.0**	**48.7**	**8.1**	**87.3**	**86.7**	**61.8**	**46.6**	**65.0**
Opera			9-Jul	17.7	47.6	7.4	76.6		63.4	**54.3**	58.8
Mean			6-Jul	19.0	49.4	8.2	88.0	93.0	63.6	48.0	
CV%			0.0	5.3	5.4	6.1	2.6	17.1	14.1	12.1	
LSD			1.2	1.6	4.3	0.8	3.7	11.2	13.5	9.5	
P-Value			<0.001	<0.001	0.5860	0.0010	<0.001	0.0030	0.1000	0.1470	

Bolded and underlined values are the highest mean. Bolded values are not different from the highest value based on the Least Significant Difference (LSD) test

Note: Study averages include experimental lines not listed here.

N.S. = Not Significant

Table 3: Barley variety trial at Denton, MT.

Variety/Pedigree	Year of Release	Source	Height (in)	Test Weight (lb/bu)	Protein (%)	Plumps (%)	Grain Yield (bu/ac) 2018	2019	2020	3 yr Avg
AAC Synergy			**17.8**	**50.9**	**9.1**	**92.1**			**38.3**	**38.3**
ABI Voyager			18.0	50.8	9.5	94.3			29.1	29.1
Balster			**17.1**	**51.6**	**8.8**	**89.1**	**93.6**	**65.6**	**39.8**	**66.3**
Buzz			16.3	53.3	7.9	95.0			30.2	30.2
CDC Copeland			**18.4**	**53.1**	**10.0**	**91.7**	**85.6**	**63.0**	**37.0**	**61.9**
Craft			17.8	53.6	9.0	94.6		60.9	41.6	51.3
Diablo			**16.5**	**52.4**	**9.0**	**87.5**			**43.2**	**43.2**
Ellinore			16.1	52.1	8.8	88.8			44.2	44.2
Expedition			**16.6**	**51.5**	**9.4**	**91.6**		**73.7**	**46.2**	**60.0**
Genie			15.5	53.6	8.7	89.3	**95.7**	71.5	39.4	68.9
Growler			**17.5**	**50.5**	**10.3**	**86.2**	**94.0**	**67.7**	**38.7**	**66.8**
Haxby	2003	MAES	17.4	53.1	9.8	89.1	**101.5**	66.3	40.0	69.3
Hays	**2003**	**MAES**	**17.9**	**53.3**	**9.7**	**82.0**	**89.4**	**60.8**	**43.9**	**64.7**
Hockett	2008	MAES	17.1	53.4	8.7	93.6	88.9	64.2	31.9	61.7
Lavina	**1989**	**MAES/USDA**	**18.4**	**51.9**	**9.6**	**78.7**			**34.0**	**34.0**
Leandra			15.0	49.5	8.7	91.6			52.3	52.3
Merit 57			**17.2**	**51.3**	**8.8**	**78.2**	**111.0**	**62.8**	**34.9**	**69.6**
Metcalfe		Canada	17.9	52.7	8.5	90.8	92.4	55.4	42.1	63.3
Odyssey			**15.8**	**51.0**	**9.2**	**87.2**	**86.7**	**61.8**	**44.9**	**64.5**
Opera			16.1	51.8	7.8	83.0		63.4	52.6	58.0
Mean			9.5	56.4	9.6	91.3	93.0	63.6	23.9	
CV%			14.4	1.6	10.4	4.7	17.1	14.1	N.S.	
LSD			2.2	1.4	1.6	7.1	11.2	13.5	7.7	
P-Value			0.2260	0.0020	0.0040	0.0040	0.0030	0.1000	<0.001	

Bolded and underlined values are the highest mean. Bolded values are not different from the highest value based on the Least Significant Difference (LSD) test

Note: Study averages include experimental lines not listed here.

N.S. = Not Significant

Table 4: Barley variety trial at Geraldine, MT.

Variety/Pedigree	Year of Release	Source	Height (in)	Test Weight (lb/bu)	Protein (%)	Plumps (%)	Grain Yield (bu/ac) 2018	2019	2020	3 yr Avg
AAC Synergy			**17.8**	**50.9**	**9.1**	**92.1**			**38.3**	**38.3**
ABI Voyager			18.0	50.8	9.5	**94.3**			29.1	29.1
Balster			**17.1**	**51.6**	**8.8**	**89.1**	**93.6**	**65.6**	**39.8**	**66.3**
Buzz			16.3	53.3	7.9	**95.0**			30.2	30.2
CDC Copeland			**18.4**	**53.1**	**10.0**	**91.7**	**85.6**	**63.0**	**37.0**	**61.9**
Craft			17.8	53.6	9.0	**94.6**		60.9	41.6	51.3
Diablo			**16.5**	**52.4**	**9.0**	**87.5**			**43.2**	**43.2**
Ellinore			16.1	52.1	8.8	**88.8**			44.2	44.2
Expedition			**16.6**	**51.5**	**9.4**	**91.6**		**73.7**	**46.2**	**60.0**
Genie			15.5	53.6	8.7	**89.3**	**95.7**	71.5	39.4	68.9
Growler			**17.5**	**50.5**	**10.3**	**86.2**	**94.0**	**67.7**	**38.7**	**66.8**
Haxby	2003	MAES	17.4	53.1	9.8	**89.1**	**101.5**	66.3	40.0	69.3
Hays	**2003**	**MAES**	**17.9**	**53.3**	**9.7**	**82.0**	**89.4**	**60.8**	**43.9**	**64.7**
Hockett	2008	MAES	17.1	53.4	8.7	**93.6**	88.9	64.2	31.9	61.7
Lavina	**1989**	**MAES/USDA**	**18.4**	**51.9**	**9.6**	**78.7**			**34.0**	**34.0**
Leandra			15.0	49.5	8.7	**91.6**			52.3	52.3
Merit 57			**17.2**	**51.3**	**8.8**	**78.2**	**111.0**	**62.8**	**34.9**	**69.6**
Metcalfe		Canada	17.9	52.7	8.5	**90.8**	92.4	55.4	42.1	63.3
Odyssey			**15.8**	**51.0**	**9.2**	**87.2**	**86.7**	**61.8**	**44.9**	**64.5**
Opera			16.1	51.8	7.8	83.0		63.4	52.6	58.0
Mean			22.7	50.6	9.1	89.6	93.0	63.6	43.8	
CV%			6.0	6.3	8.7	3.6	17.1	14.1	N.S.	
LSD			2.2	5.2	1.3	5.3	11.2	13.5	17.9	
P-Value			<0.001	0.2450	0.0010	<0.001	0.0030	0.1000	<0.001	

Bolded and underlined values are the highest mean. Bolded values are not different from the highest value based on the Least Significant Difference (LSD) test

Note: Study averages include experimental lines not listed here.

N.S. = Not Significant