2021 Montana Cool-Season Spring Pulse Variety Evaluation Annual Report

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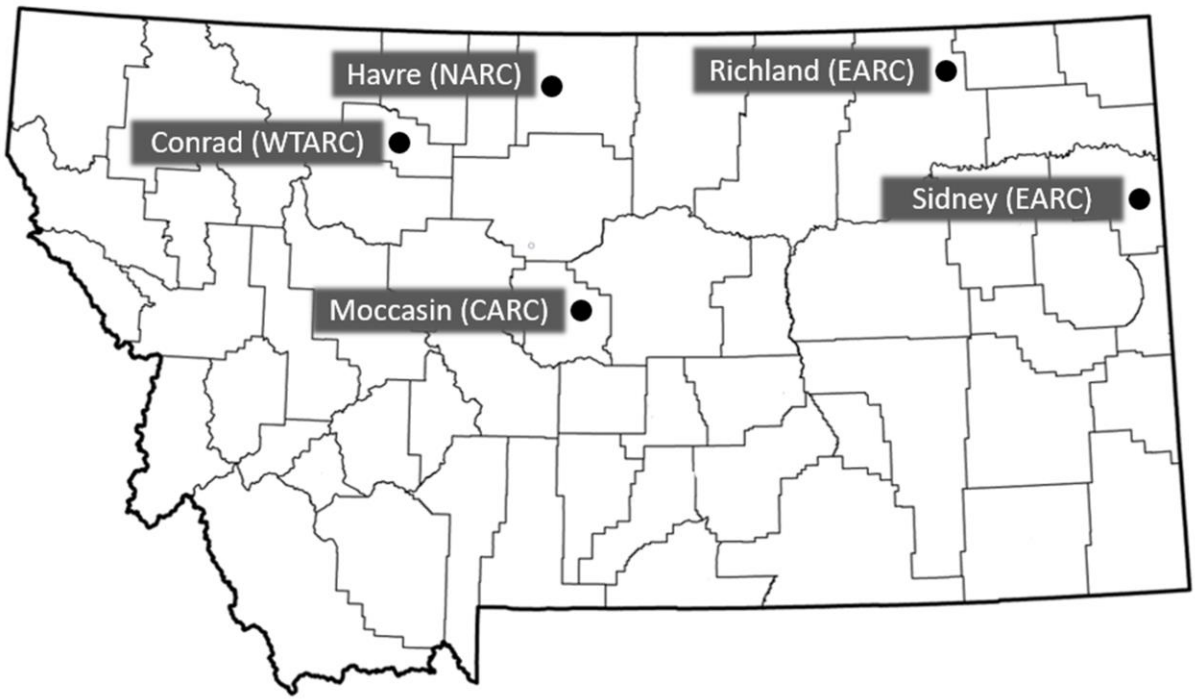

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ACKNOWLEDGEMENT

The Montana State University Eastern Agricultural Station in Sidney, MT coordinates an annual variety evaluation for cool season spring pulse crops (dry pea, lentil and chickpea) at multiple locations across the state of Montana. In 2021, funding for this project was obtained from the Montana Agricultural Experiment Station, the USA Dry Pea and Lentil Council, and testing fees from private entities submitting varieties and experimental lines for evaluation. The results provided in this report reflect the efforts of a large team of individuals from the Montana State University Agricultural Experiment Stations, Montana State University Extension, industrial partners from the seed industry and cooperating producers across the state. The following list provides contact information for many of the individuals involved in the 2021 variety evaluation.

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PROJECT DESCRIPTION AND OBJECTIVE

Project Description

Cool season spring pulse crop (dry pea, lentil and chickpea) acreage in Montana has increased more than 10 fold in the past two decades. For more than a decade the Montana State University Agricultural Experiment Stations have conducted annual pulse crop variety evaluations across the state of Montana in an effort to improve yield and quality of these crops. The Montana State University Eastern Agricultural Research Center (EARC) in Sidney, MT is currently coordinating these efforts. In 2021, trials were conducted at four MSU Agricultural Research Centers and a cooperating producer's field south of Richland, Montana in the northeast corner of the state. The results reported herein are intended to aid producers, seed suppliers, breeders and the research community in variety development, selection and deployment. The report is available both in print and electronic formats and can be found at:
(http://agresearch.montana.edu/earc/annualreports.html).

Objective

The objective of this project is to evaluate yield and seed quality parameters for dry pea, lentil and chickpea cultivars and lines selected by stakeholder input across a broad range of Montana environments.

METHODS

Procedures and Experimental Design

Eight dry pea, seven lentil and nine chickpea entries were selected by the EARC to trial at all locations. In addition, seed companies and pulse breeders with an interest in Montana pulse production were invited to submit cultivars or expermential lines for evaluation in 2021. Locations available for evaluation were indicated in the invitation letter and the selection of locations for each entry to be evaluated was determined by the submitting party. Dry peas were planted at four dryland locations and one irrigated location. Lentils and chickpeas were planted at three dryland locations and one irrigated location.

Seed for all entries were tested for germintation and treated with Obvius Fungicide (BASF Corporation, Research Triangle Park, NC) and Cruiser 5FS Insecticide (Syngenta Crop Protection, Inc., Greensboro, NC). Seeds were packaged on a per plot basis to obtain live seed rates of 8, 12 and 4 live seeds per ft^2 for pea, lentil and chickpea, respectively. Seeds were sent to the cooperating research centers with an appropriate rhizobial inoculant to be applied at planting. Research plots were planted in a randomized complete block design with four replicates per entry. Plot size varied amongst locations and was dictated by the equipment available at each location. Management practices vary by location but are consistent with typical practices for that region. In season measurements and harvest data were collected by each cooperating center and sent to the EARC for analysis. Grain yield data was adjusted to 13% moisture content to facilitate comparison across locations. Dry pea protein concentrations were determined by near-infrared spectroscopy **(**NIR) at the individual research centers. Analysis of variance was performed in R (version 4.0.3) and Fisher's LSD was performed from the agricolae package (version 1.3-3) for mean comparison whenever the F-test was significant at $P<0.05$.

List of collaborators and locations

The type of crop (pea, lentil and chickpea) and number of entries for each of these crops evaluated at the different locations varied from location to location depending on the interest of seed suppliers and availability of resources at the respective location. The list of locations, collaborators and the type of crops evaluated at each location is shown in Table 1.

Table 1. Collaborators, locations and crops evaluated in 2021.

Location	Collaborator	Irrigation	Crops evaluated at location			Observations
			Pea	Lentil	Chickpea	
Conrad	WTARC	No	X	X	X	
Havre	NARC	No	X	X	X	Wildlife damage to peas
Moccasin	CARC	No	X			
Richland	EARC	No	X	X	X	Wildlife damage to chickpeas
Sidney (Irrigated)	EARC	Yes	X	X	X	

†CARC = Central Agricultural Research Center, EARC = Eastern Agricultural Research Center, NARC = Northern Agricultural Research Center, WTARC = Western Triangle Agricultural Research Center, 'X' indicates the collaborator participated for the specific crop variety evaluation in 2021.

Precipitation and Cultural Practices

Precipitation, site information and agronomic management practices for the respective locations are summarized in Tables 2 and 3.

Table 2. Site characteristics for each trial location

	Conrad (WTARC)	Havre (NARC)	Moccasin (CARC)	Richland	Sidney (EARC)
Soil Type	Scobey-Kevin Clay Loam	Telstad clay loam & Hillon clay loam	Danvers-Judith Clay loam	Farnuf Loam	Savage Silty Clay Loam
Elevation (ft)	3700	2699	4250	2950	2200
Seasonal Precipitation (April - August) (in)	4.5	5.3	8.9	4.8*	5.0
Average Precipitation (April - August) (in)	8.0	8.0	10.5	8.5*	9.6
Irrigation (in)					4.2

* Data from Opheim, MT weather station US00246238 approximately 12 miles from trial location

Table 3. Major agronomic management practices for each location in 2021

Location	Tillage	Seeding Date	Harvest Date	Previous Crop	Fertilizer	Pesticide Applications
Pea Trials						
Conrad	Conventional	5/9	9/2	Spring Wheat	11-52-0 at 20 lb/a	
Havre	No-Till	4/13	7/21	Spring Barley	None	Mustang Maxx at 4 oz/a
Moccasin	No-Till	4/29	8/2	Barley	20-30-20-10 at 50 lb/a	Grizzly Too at 2 oz/a, Raptor at 4 oz/a, Basagran at 16 oz/a
Richland	No-Till	4/22	8/11	Durum	None	
Sidney	Conventional	5/4	8/4	Sugar beet	None	Outlook at 12 oz/a preemergence, Varisto at 21 oz/a
Lentil Trials						
Conrad	Conventional	5/8	8/26	Spring Wheat	11-52-0 at 20 lb/a	
Havre	No-Till	4/13	8/6	Spring Barley	None	Quiz at 10 oz/a
Richland	No-Till	4/23	8/12	Durum	None	
Sidney	Conventional	5/3	8/4	Sugar beet	None	Outlook at 12 oz/a preemergence
Chickpea Trials						
Conrad	Conventional	5/9	9/2	Spring Wheat	11-52-0 at 20 lb/a	
Havre	No-Till	4/27	10/5	Spring Barley	None	Quiz at 10 oz/a, Headline at 9 oz/a
Richland	No-Till	4/23	8/12	Durum	None	
Sidney	Conventional	5/4	8/16	Sugar beet	None	Outlook at 12 oz/a preemergence, Tough at 20 oz/a, Miravis Top at 13.7 oz/a and Miravis Top at 14 oz/a

List of Varieties

Table 4 includes the list of varieties and experimental lines evaluated in 2021. Additional information for these entries can be obtained by contacting the respective seed suppliers listed in the acknowledgements section. Entries listed in this table include varieties requested by seed suppliers, varieties selected as check varieties by the Montana Agricultural Experiment Station and experimental lines from the Montana State University, North Dakota State University and USDA-ARS pulse crop breeding programs.

Table 4. Dry pea, lentil and chickpea entries included in 2021 variety evaluation trials.

Crop	Entry	Seed color/size	Maturity
Dry Pea	AAC Asher	Yellow	Early/Medium
	AAC Carver	Yellow	Early
	AAC Chrome	Yellow	Medium
	AAC Julius	Yellow	
	AAC Profit	Yellow	Medium/Late
	Aragorn	Green	Medium
	Banner	Green	
	CDC Greenwater	Green	Medium
	CDC Inca	Yellow	Medium
	CDC Saffron	Yellow	Medium
	CDC Spectrum	Yellow	Medium
	Cronos	Yellow	
	DL Apollo	Yellow	Medium
	DL GrowPro	Yellow	
	DS-Admiral	Yellow	Medium
	Empire	Green	Late
	Fairway	Green	
	Flute	Yellow	
	Ginny 2	Green	
	Goldenwood	Yellow	
	Hampton	Green	Medium
	Hyline	Yellow	Medium
	Kite	Yellow	
	Korando	Yellow	Early
	LG Stunner	Yellow	Medium

Table 4. Continued

Crop	Entry	Seed color/size	Maturity
Dry Pea	LG Sunrise	Yellow	Medium
	M 122	Yellow	
	MS-20GP5	Green	
	MS-20YP4	Yellow	
	ND Dawn	Yellow	Early
	NDP100144G	Green	
	Orchestra	Yellow	
	Peregrine	Yellow	
	Pizzaz	Yellow	
	Pro 141-6258	Green	
	Pro 143-6220	Yellow	
	Pro 143-6230	Yellow	
	Pro 153-7409	Yellow	
	Pro 171-7665	Green	
	Pro 174-7148	Yellow	
	Pro 181-7124	Green	
	PS07100925	Yellow	
	PS08101022	Yellow	
	PS0877MT457	Green	
	PS0877MT632	Yellow	
	PS16100107	Yellow	
	PS16N20003	Yellow	
	PS17100008	Yellow	
	PS17100022	Yellow	
	PS17100239	Yellow	
	PS17100240	Yellow	
	Salamanca	Yellow	Early
	SG-L 8318Z	Green	
	SG-L 8963	Yellow	
	SG-L 9086	Yellow	
	Shamrock	Green	Early
	Spider	Yellow	Early

Table 4. Continued

Crop	Entry	Seed color/size	Maturity
Lentil	Avondale	Medium Green	Medium
	CDC Dazil CL	Small Red	
	CDC Impala CL	Small Red	Early
	CDC Impress CL	Medium Green	
	CDC Richlea	Medium Green	Medium
	CDC Viceroy	Small Green	Early/Medium
	LC08600005E	Small Green	
	LC14600088R	Medium Green	
	NDL120600R	Medium Green	
	Sage	Small Green	
Chickpea	2510-2	Desi type	
	Anna	Desi type	
	CDC Consul	Desi type	
	CDC Cory	Desi type	
	CDC Frontier	Kabuli type	Late
	CDC Leader	Kabuli type	Medium
	CDC Orion	Kabuli type	Late
	CDC Palmer	Kabuli type	Medium/Late
	Kasin	Kabuli type	
	Myles	Desi type	
	ND Crown	Kabuli type	
	New Hope	Kabuli type	
	Royal	Kabuli type	
	Sawyer	Kabuli type	
	Sierra	Kabuli type	

RESULTS

Dry Pea Variety Evaluation in 2021

Fifty seven dry pea varieties and experimental lines (42 yellow and 15 green) were evaluated in 2021 at five locations. Four yellow pea and two green pea cultivars were selected as check varieties and tested at all locations. Eleven experimental lines originate from university and government breeding programs. The remaining entries are cultivars and breeding lines from private entities and were tested only at locations requested by the seed supplier. Results are presented in two groups based on cotyledon color (yellow and green).

Results of the 2021 dry pea variety evaluations are presented in Tables 5-10 for yellow peas and Tables 6-10 for green peas. Reported data include yield, protein, thousand kernel weight, test weight, plant height at harvest and days to flowering. Three year averages for 2019 through 2021 are presented for the Havre, Moccasin, and Richland locations for entries with three years of data. Statistical analyses (analysis of variance) were performed for each parameter measured at a given location except in instances of abundant missing data. Two replicates of the pea trial at Havre were severely damaged by gophers and therefore no statistical analysis was performed. In this instance, the data presented is an average of 2, 3 or 4 replicates from unaffected plots varying by entry.

Yields for the 2021 growing season were low for all tested locations ranging from 2644 lb/a at Sidney to 1240 lb/a at Richland. Growing season precipitation values at the four dryland locations were 56 to 85 percent of normal in 2021. The Havre, Moccasin and Richland locations received below normal precipitation for the 2020 calendar year as well. Yields under irrigation in Sidney were negatively impacted due to early and prolonged heat. Overall, yields were very similar for green and yellow peas.

Seed protein levels were higher in 2021 relative to the past two seasons. The combination of heat and drought across much of the state might have resulted in higher protein. In 2021, protein measurements were conducted at the individual research centers in contrast to 2020 where all measurments were conducted at the EARC. Therefore, caution is advised when comparing protein values across locations due to differences in instrumentation. All locations averaged more than 25 percent protein for both green and yellow peas. Individual entries ranged from 23 percent to 30 percent protein. Average yellow pea protein at the Havre location was five percentage points higher in 2021 than 2020 and 2019. Part of this gain can be attributed to the addition of higher

protein breeding lines to the 2021 trial. However, cultivars trialed in all three years were three to four percentage points higher at Havre in 2021 as well. On the other hand, average yellow pea protein at the Richland location gained only a single percentage point relative to 2020 and 2019 with many cultivars producing nearly identical protein across the three years. Interestingly, yellow pea yields at Richland in 2021 were reduced 60 percent relative to 2019 and 75 percent relative to 2020 with very small changes in observed seed protein levels.

Table 5. Yellow Dry Pea Grain Yield (lb/a) with Three Year Averages in parentheses

Yellow Pea Variety/Line	Conrad	Havre		Moccasin		Richland		Sidney Irrigated
AAC Asher		1043				1281	(3297)	
AAC Carver		1365	(2313)	1469	(2461)	1262	(3215)	
AAC Chrome	2773	1171				1661	(3442)	
AAC Julius	2634	1381				1550		
AAC Profit	2637	1167	(2134)			1308		
CDC Inca		1060	(2193)	1303	(2088)	1170	(3040)	
CDC Saffron		1342	(2330)	1315	(2056)	1207	(3148)	
CDC Spectrum		1288	(2199)	1153	(1835)	1502	(3071)	
Cronos	892	1338				624		
DL Apollo		1171	(2196)			1204	(3051)	
DL Grow Pro		1217		1257		1137		
DS-Admiral	1880	1338	(2254)	1174	(2140)	1371	(3108)	2529
Flute		1210				1419		
Goldenwood	3061	1171				1541		
Hyline	2856							
Kite	1424	1475				896		2631
Korando	1813	1430	(2312)	1336		1078	(3013)	2589
LG Stunner		1308				1133		
LG Sunrise		1121	(2335)			1495	(3025)	
M 122						921		
MS-20YP4		1486		1160		1655		
ND Dawn	2071	1255	(2288)	1474	(2224)	1385	(3112)	2643
Orchestra	2271	1242		1334		927		2922
Peregrine	2569	1103				1259		2604
Pizzaz	2333	1489				1290		
Pro 143-6220	1664	1179				1285		
Pro 143-6230	1794	1209				975		
Pro 153-7409	1924	1321						
Pro 174-7148	2944							
PS07100925	1201	1236				1257		
PS08101022	1842	1493				1184		
PS0877MT632	2297	1446	(2176)	1342	(1883)	1344	(2604)	2882
PS16100107	1772	1506				1361		
PS16N20003	2214	1664				1590		
PS17100008	1704	1335				933		
PS17100022	3299	1610				1488		
PS17100239	2506	1322				1418		
PS17100240	2607	1230				1016		
Salamanca	2181	1502	(2357)	1465		1125	(2868)	2627
SG-L 8963						666		
SG-L 9086						1255		
Spider	2638	1117				1271		
Mean	**2207**	**1294**		**1315**		**1242**		**2678**
P-value	**0.2543**			**0.4178**		**<0.0001**		**0.5744**
LSD	**NS**			**NS**		**404**		**NS**
CV(%)	**41.9**			**17.0**		**23.2**		**9.6**

Table 6. Yellow Dry Pea Protein* (%)

Yellow Pea Variety/Line	Conrad	Havre	Moccasin	Richland	Sidney Irrigated
AAC Asher		25.2		24.3	
AAC Carver		25.6	24.4	23.5	
AAC Chrome	24.8	25.9		24.2	
AAC Julius	27.1	28.2		25.1	
AAC Profit	26.4	26.3		25.3	
CDC Inca		28.4	25.3	25.2	
CDC Saffron		25.3	25.1	25.1	
CDC Spectrum		27.3	25.9	25.8	
Cronos	28.9	28.4		27.8	
DL Apollo		28.3		27.3	
DL Grow Pro		28.4	25.4	27.6	
DS-Admiral	25.3	26.3	25.4	23.7	24.2
Flute		26.8		25.8	
Goldenwood	25.2	27.6		27.9	
Hyline	24.4				
Kite	25.0	24.3		24.6	24.7
Korando	25.9	26.9	25.0	26.7	25.9
LG Stunner		27.6		26.4	
LG Sunrise		26.7		23.4	
M 122				27.0	
MS-20YP4		27.8	25.6	25.1	
ND Dawn	26.0	25.9	24.6	24.1	23.9
Orchestra	26.6	28.7	25.6	28.5	28.5
Peregrine	24.2	26.3		23.5	23.8
Pizzaz	25.3	27.5		25.9	
Pro 143-6220	26.2	27.2		24.7	
Pro 143-6230	26.1	27.2		25.1	
Pro 153-7409	26.2	26.8			
Pro 174-7148	25.4				
PS07100925	26.0	25.5		24.1	
PS08101022	24.1	25.5		23.7	
PS0877MT632	26.1	27.3	25.1	26.1	25.8
PS16100107	27.6	29.6		27.6	
PS16N20003	26.3	27.5		26.5	
PS17100008	26.0	25.1		24.2	
PS17100022	25.4	28.2		26.0	
PS17100239	25.3	28.6		25.8	
PS17100240	26.2	30.0		27.6	
Salamanca	25.6	27.4	24.2	26.5	26.0
SG-L 8963				26.1	
SG-L 9086				23.0	
Spider	26.7	27.7		26.0	
Mean	**25.9**	**27.1**	**25.1**	**25.6**	**25.3**
P-value	**<0.0001**		**<0.0001**	**<0.0001**	**<0.0001**
LSD	**1.6**		**0.6**	**0.8**	**0.6**
CV(%)	**3.8**		**1.6**	**2.4**	**1.3**

*Note: Protein measurements for each location were obtained from the responsible research center. Caution is advised comparing protein values across locations as some variation between instruments is expected.

Table 7. Yellow Dry Pea Thousand Kernel Weight (g)

Yellow Pea Variety/Line	Havre	Moccasin	Richland	Sidney Irrigated
AAC Asher	193.1		252.6	
AAC Carver	188.5	210.8	238.1	
AAC Chrome	188.8		236.7	
AAC Julius	181.4		231.2	
AAC Profit	203.8		235.8	
CDC Inca	166.2	196.0	208.3	
CDC Saffron	198.3	204.5	241.9	
CDC Spectrum	191.0	207.3	228.3	
Cronos	233.5		253.6	
DL Apollo	168.5		214.1	
DL Grow Pro	235.0	253.8	270.9	
DS-Admiral	198.5	225.3	230.1	240.2
Flute	169.5		201.9	
Goldenwood	169.1		173.7	
Hyline				
Kite	208.5		246.3	256.9
Korando	215.8	243.8	259.8	265.7
LG Stunner	180.9		215.3	
LG Sunrise	188.0		218.5	
M 122			261.6	
MS-20YP4	203.8	227.0	228.3	
ND Dawn	187.8	218.0	241.7	240.1
Orchestra	201.0	237.0	241.1	272.1
Peregrine	203.0		239.8	235.4
Pizzaz	232.5		286.3	
Pro 143-6220	180.3		212.3	
Pro 143-6230	177.5		208.9	
Pro 153-7409	209.0			
Pro 174-7148				
PS07100925	198.3		239.8	
PS08101022	203.7		248.5	
PS0877MT632	177.5	208.3	220.9	222.8
PS16100107	218.3		260.0	
PS16N20003	217.3		238.3	
PS17100008	206.8		231.4	
PS17100022	216.5		241.0	
PS17100239	190.4		239.5	
PS17100240	165.0		225.6	
Salamanca	200.8	229.0	235.2	243.8
SG-L 8963			228.2	
SG-L 9086			231.6	
Spider	200.0		242.1	
Mean	**194.3**	**221.7**	**234.8**	**247.1**
P-value		**<0.0001**	**<0.0001**	**<0.0001**
LSD		**10.5**	**12.4**	**12.0**
CV(%)		**3.3**	**3.8**	**2.8**

Table 8. Yellow Dry Pea Test Weight (lb/bu)

Yellow Pea Variety/Line	Conrad	Havre	Moccasin	Richland	Sidney Irrigated
AAC Asher		60.2		62.6	
AAC Carver		60.2	65.4	63.7	
AAC Chrome	63.9	59.5		62.8	
AAC Julius	65.1	59.8		63.5	
AAC Profit	64.9	60.9		61.0	
CDC Inca		61.1	64.8	63.5	
CDC Saffron		60.4	65.1	62.6	
CDC Spectrum		59.5	64.9	62.0	
Cronos	64.1	60.3		62.5	
DL Apollo		61.0		64.2	
DL Grow Pro		59.9	64.6	61.6	
DS-Admiral	63.4	59.8	65.0	61.9	63.7
Flute		61.3		62.7	
Goldenwood	64.8	61.4		64.3	
Hyline	65.0				
Kite	63.7	59.7		62.7	64.2
Korando	62.8	59.5	65.3	63.8	65.2
LG Stunner		60.5		62.5	
LG Sunrise		60.1		63.9	
M 122				63.0	
MS-20YP4		60.4	65.0	61.8	
ND Dawn	63.6	60.0	64.9	62.7	64.3
Orchestra	64.3	59.9	66.0	62.2	64.2
Peregrine	65.2	60.6		63.3	64.3
Pizzaz	64.0	60.5		64.5	
Pro 143-6220	63.2	59.8		62.9	
Pro 143-6230	63.4	60.0		62.7	
Pro 153-7409	63.7	59.2			
Pro 174-7148	63.9				
PS07100925	63.9	59.3		62.8	
PS08101022	65.7	60.7		63.3	
PS0877MT632	63.8	60.6	65.3	64.9	64.8
PS16100107	63.0	59.9		63.6	
PS16N20003	64.7	61.3		65.2	
PS17100008	62.9	59.9		62.6	
PS17100022	63.9	61.7		64.5	
PS17100239	63.7	60.3		64.3	
PS17100240	63.7	60.1		62.9	
Salamanca	62.4	59.8	65.1	62.5	64.8
SG-L 8963				63.4	
SG-L 9086				62.8	
Spider	63.7	60.2		63.2	
Mean	**63.9**	**60.2**	**65.1**	**63.1**	**64.4**
P-value			**0.0003**	**<0.0001**	**0.4296**
LSD			**0.5**	**0.5**	**NS**
CV(%)			**0.5**	**0.6**	**1.2**

Table 9. Yellow Dry Pea Plant Height (cm)

Yellow Pea Variety/Line	Conrad	Havre	Moccasin	Richland	Sidney Irrigated
AAC Asher		28		37	
AAC Carver		35	37	44	
AAC Chrome	57	28		39	
AAC Julius	58	40		48	
AAC Profit	69	39		41	
CDC Inca		40	36	45	
CDC Saffron		34	30	38	
CDC Spectrum		34	30	42	
Cronos	41	43		46	
DL Apollo		40		46	
DL Grow Pro		40	38	50	
DS-Admiral	56	38	36	51	43
Flute		41		43	
Goldenwood	47	26		29	
Hyline	54				
Kite	33	28		35	38
Korando	47	41	33	43	43
LG Stunner		43		45	
LG Sunrise		35		48	
M 122				52	
MS-20YP4		42	32	48	
ND Dawn	52	33	36	45	41
Orchestra	52	34	35	43	45
Peregrine	46	30		36	33
Pizzaz	48	35		46	
Pro 143-6220	48	31		40	
Pro 143-6230	47	30		37	
Pro 153-7409	45	33			
Pro 174-7148	50				
PS07100925	32	29		35	
PS08101022	37	30		37	
PS0877MT632	49	30	32	39	48
PS16100107	57	39		43	
PS16N20003	58	45		54	
PS17100008	41	29		35	
PS17100022	68	45		56	
PS17100239	55	35		41	
PS17100240	54	30		40	
Salamanca	47	35	36	42	43
SG-L 8963				41	
SG-L 9086				51	
Spider	58	36		43	
Mean	**50**	**35**	**34**	**43**	**42**
P-value	**0.2324**		**0.0014**	**<0.0001**	**0.0042**
LSD	**NS**		**4.0**	**7.5**	**6.3**
CV(%)	**27.9**		**8.2**	**12.6**	**8.7**

Table 10. Yellow Dry Pea Days to Flowering

Yellow Pea Variety/Line	Conrad	Havre	Moccasin	Sidney Irrigated
AAC Asher		68		
AAC Carver		66	60	
AAC Chrome	58	70		
AAC Julius	58	68		
AAC Profit	57	69		
CDC Inca		69	62	
CDC Saffron		67	61	
CDC Spectrum		68	61	
Cronos	59	65		
DL Apollo		67		
DL Grow Pro		68	61	
DS-Admiral	58	67	59	52
Flute		69		
Goldenwood	57	71		
Hyline	57			
Kite	58	65		52
Korando	59	64	59	49
LG Stunner		66		
LG Sunrise		67		
M 122				
MS-20YP4		69	62	
ND Dawn	58	67	60	52
Orchestra	59	65	60	52
Peregrine	57	66		49
Pizzaz	59	64		
Pro 143-6220	58	68		
Pro 143-6230	58	67		
Pro 153-7409	58	64		
Pro 174-7148	57			
PS07100925	59	65		
PS08101022	58	64		
PS0877MT632	58	66	59	52
PS16100107	56	62		
PS16N20003	58	70		
PS17100008	57	65		
PS17100022	58	68		
PS17100239	59	69		
PS17100240	58	64		
Salamanca	59	67	60	52
SG-L 8963				
SG-L 9086				
Spider	58	68		
Mean	**58**	**67**	**60**	**51**
P-value	**0.7992**		**<0.0001**	**NS**
LSD	**NS**		**1.0**	**NS**
CV(%)	**2.5**		**1.1**	**2.5**

Table 11. Green Dry Pea Grain Yield (lb/a) with Three Year Averages in parentheses

Green Pea Variety/Line	Conrad	Havre		Moccasin		Richland		Sidney Irrigated
Aragorn	2668	1250	(2018)	1247	(2049)	1280	(2675)	2240
Banner	1113	1142						
CDC Greenwater	2449	874	(2071)			1583	(2951)	
Empire	1618	1090				1078		
Fairway	2202	1243						
Ginny 2	2652	1161				909		
Hampton	2018	1155	(2239)	1060	(1916)	1207	(2807)	2798
MS-20GP5	2905	1330				1514		
NDP100144G	2338	1363				1397		2809
Pro 141-6258		1131	(2333)					
Pro 171-7665		1333						
Pro 181-7124		1460						
PS0877MT457	2314	1194	(2235)	1364	(2106)	928	(2646)	2463
SG-L 8318Z						1417		
Shamrock	2543	1139				1007		
Mean	**2284**	**1187**		**1223**		**1232**		**2577**
P-value	**0.2295**			**0.3405**		**0.0172**		**0.1186**
LSD	**NS**			**NS**		**425**		**NS**
CV(%)	**29.9**			**22.2**		**23.9**		**13.1**

Table 12. Green Dry Pea Protein* (%)

Green Pea Variety/Line	Conrad	Havre	Moccasin	Richland	Sidney Irrigated
Aragorn	24.6	25.3	25.7	25.0	25.1
Banner	23.9	26.1			
CDC Greenwater	24.8	26.3		24.0	
Empire	27.9	27.7		26.2	
Fairway	25.4	27.5			
Ginny 2	24.3	26.2		24.5	
Hampton	26.1	27.4	25.8	27.1	26.4
MS-20GP5	25.4	27.2		24.9	
NDP100144G	25.2	27.0		25.3	25.6
Pro 141-6258		24.1			
Pro 171-7665		25.6			
Pro 181-7124		25.6			
PS0877MT457	27.0	27.4	25.9	27.7	27.1
SG-L 8318Z				25.0	
Shamrock	24.9	27.1		24.9	
Mean	**25.4**	**26.5**	**25.8**	**25.4**	**26.0**
P-value	**0.0002**		**0.8853**	**<0.0001**	**0.0115**
LSD	**1.4**		**NS**	**0.8**	**1.1**
CV(%)	**3.3**		**1.7**	**2.2**	**2.2**

*Note: Protein measurements for each location were obtained from the responsible research center. Caution is advised comparing protein values across locations as some variation between instruments is expected.

Table 13. Green Dry Pea Thousand Kernel Weight (g)

Green Pea Variety/Line	Havre	Moccasin	Richland	Sidney Irrigated
Aragorn	169.8	192.3	209.0	207.4
Banner	152.3			
CDC Greenwater	190.5		224.2	
Empire	169.3		208.8	
Fairway	143.0			
Ginny 2	175.7		218.2	
Hampton	181.4	218.8	226.0	228.7
MS-20GP5	184.8		222.8	
NDP100144G	170.2		193.0	198.1
Pro 141-6258	166.5			
Pro 171-7665	180.5			
Pro 181-7124	195.0			
PS0877MT457	183.3	219.8	218.5	236.0
SG-L 8318Z			225.0	
Shamrock	178.3		235.1	
Mean	**173.9**	**210.3**	**218.1**	**217.6**
P-value		**0.0001**	**<0.0001**	**<0.0001**
LSD		**8.8**	**12.4**	**5.6**
CV(%)		**2.6**	**3.9**	**1.4**

Table 14. Green Dry Pea Test Weight (lb/bu)

Green Pea Variety/Line	Conrad	Havre	Moccasin	Richland	Sidney Irrigated
Aragorn	63.5	59.4	64.0	62.6	63.3
Banner	64.8	60.8			
CDC Greenwater	64.3	59.6		61.9	
Empire	63.9	60.8		64.3	
Fairway	64.4	60.0			
Ginny 2	64.9	60.0		63.6	
Hampton	64.4	60.4	64.8	63.3	64.2
MS-20GP5	64.2	59.7		63.1	
NDP100144G	64.0	60.7		62.9	63.6
Pro 141-6258		60.8			
Pro 171-7665		60.4			
Pro 181-7124		59.7			
PS0877MT457	63.5	60.2	65.1	62.6	64.2
SG-L 8318Z				63.5	
Shamrock	63.0	61.5		65.0	
Mean	**64.1**	**60.3**	**64.6**	**63.3**	**63.8**
P-value	**0.0004**		**0.0005**	**<0.0001**	**0.0694**
LSD	**0.7**		**0.4**	**0.5**	**NS**
CV(%)	**0.6**		**0.4**	**0.6**	**0.8**

Table 15. Green Dry Pea Plant Height (cm)

Green Pea Variety/Line	Conrad	Havre	Moccasin	Richland	Sidney Irrigated
Aragorn	55	27	33	39	39
Banner	43	29			
CDC Greenwater	60	34		46	
Empire	61	53		57	
Fairway	47	30			
Ginny 2	45	29		39	
Hampton	39	26	27	35	36
MS-20GP5	61	38		49	
NDP100144G	64	45		48	53
Pro 141-6258		27			
Pro 171-7665		36			
Pro 181-7124		37			
PS0877MT457	49	33	37	45	44
SG-L 8318Z				51	
Shamrock	69	41		41	
Mean	**54**	**34**	**32**	**45**	**43**
P-value	**0.0153**		**0.0011**	**<0.0001**	**0.0007**
LSD	**15.8**		**4.0**	**7.5**	**6.0**
CV(%)	**17.2**		**7.7**	**11.5**	**7.4**

Table 16. Green Dry Pea Days to Flowering

Green Pea Variety/Line	Conrad	Havre	Moccasin	Sidney Irrigated
Aragorn	58	64	59	50
Banner	57	66		
CDC Greenwater	58	69		
Empire	57	68		
Fairway	59	67		
Ginny 2	57	66		
Hampton	60	69	61	53
MS-20GP5	58	70		
NDP100144G	57	69		57
Pro 141-6258		66		
Pro 171-7665		65		
Pro 181-7124		65		
PS0877MT457	57	64	58	49
SG-L 8318Z				
Shamrock	57	68		
Mean	**58**	**67**	**59**	**52**
P-value	**0.1343**		**0.0009**	**<0.0001**
LSD	**NS**		**1.2**	**2.0**
CV(%)	**2.4**		**1.3**	**2.0**

Lentil Variety Evaluation in 2021

In 2021, ten lentil entries were evaluated at four locations (three dryland and one irrigated). Seven entries were tested at all locations. Included in the entry list were seven cultivars and three breeding lines. Results of the 2021 lentil variety evaluations are presented in Tables 17-21. Reported data include yield, thousand kernel weight, test weight, plant height at harvest and days to flowering. Three year averages for 2019 through 2021 are presented for the Havre, Richland and Sidney locations for entries with three years of data. Three year averages are not included for Conrad as no trial was run in 2020. Lentil yields in Conrad were higher than at the other two dryland locations due to drought (Havre and Richland) and yields in Sidney were adversely affected by heat. Average yields for Havre and Richland in 2021 are amongst the lowest observed dating back to 2011.

Table 17. Lentil Grain Yield (lb/a) with Three Year Averages in parentheses

Lentil Variety/Line	Conrad	Havre		Richland		Sidney Irrigated	
Avondale	1393	798	(1733)	517	(2083)	2278	(2787)
CDC Dazil CL				620			
CDC Impala CL	1557	629		610		2104	
CDC Impress CL	1669	340	(1496)	342	(1795)	2352	(2585)
CDC Richlea	1382	950	(1717)	487	(2011)	2374	(2691)
CDC Viceroy	1274	822	(1479)	509	(1907)	2338	(2766)
LC08600005E	1349	840		691			
LC14600088R	1599	893		477			
NDL120600R	1779	570		531		2195	
Sage	1386	604	(1394)	464	(1849)	2275	(2891)
Mean	**1495**	**716**		**525**		**2274**	
P-value	**0.9853**	**<0.0001**		**0.3376**		**0.2693**	
LSD	**NS**	**88.4**		**NS**		**NS**	
CV(%)	**35.6**	**8.5**		**27.7**		**6.3**	

Table 18. Lentil Thousand Kernel Weight (g)

Lentil Variety/Line	Conrad	Havre	Richland	Sidney Irrigated
Avondale	47.0	45.5	50.1	50.4
CDC Dazil CL			32.1	
CDC Impala CL	29.0	28.4	30.5	28.0
CDC Impress CL	45.2	53.0	49.8	54.4
CDC Richlea	49.8	47.3	51.6	51.5
CDC Viceroy	36.0	31.3	32.6	32.3
LC08600005E	43.2	42.6	46.2	
LC14600088R	52.0	49.8	55.1	
NDL120600R	49.8	54.3	52.3	56.7
Sage	36.9	31.9	38.7	37.5
Mean	**43.2**	**42.7**	**43.9**	**44.4**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**4.9**	**1.7**	**2.2**	**2.0**
CV(%)	**7.8**	**2.7**	**3.4**	**2.6**

Table 19. Lentil Test Weight (lb/bu)

Lentil Variety/Line	Conrad	Havre	Richland	Sidney Irrigated
Avondale	60.3	62.1	61.8	61.3
CDC Dazil CL			63.4	
CDC Impala CL	63.1	65.8	64.2	64.8
CDC Impress CL	60.8	61.6	61.3	61.5
CDC Richlea	59.4	61.6	61.2	60.3
CDC Viceroy	62.3	65.3	63.8	64.4
LC08600005E	61.1	64.4	63.5	
LC14600088R	59.5	62.1	61.4	
NDL120600R	58.5	60.8	60.6	59.7
Sage	61.2	64.3	63.5	62.9
Mean	**60.5**	**63.1**	**62.8**	**62.1**
P-value		**<0.0001**		**<0.0001**
LSD		**0.2**		**0.7**
CV(%)		**0.2**		**0.7**

Table 20. Lentil Plant Height (cm)

Lentil Variety/Line	Conrad	Havre	Richland	Sidney Irrigated
Avondale	34	20	30	31
CDC Dazil CL			26	
CDC Impala CL	32	19	26	28
CDC Impress CL	35	23	28	29
CDC Richlea	36	21	29	30
CDC Viceroy	33	20	28	34
LC08600005E	34	20	27	
LC14600088R	36	22	29	
NDL120600R	37	24	30	32
Sage	30	17	26	26
Mean	**34**	**21**	**28**	**30**
P-value	**0.3116**	**<0.0001**	**0.2266**	**0.0059**
LSD	**NS**	**1.5**	**NS**	**3.4**
CV(%)	**11.4**	**4.9**	**8.4**	**6.5**

Table 21. Lentil Days to Flowering

Lentil Variety/Line	Conrad	Havre	Sidney Irrigated
Avondale	60	67	56
CDC Dazil CL			
CDC Impala CL	62	68	63
CDC Impress CL	61	68	60
CDC Richlea	59	65	59
CDC Viceroy	61	67	61
LC08600005E	59	65	
LC14600088R	60	65	
NDL120600R	59	66	54
Sage	60	66	54
Mean	**60**	**66**	**58**
P-value	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**1.0**	**1.3**	**2.3**
CV(%)	**1.1**	**1.4**	**2.2**

Chickpea Variety Evaluation in 2021

The 2021 statewide chickpea variety evaluation included fifteen varieties (ten Kabuli type and five Desi type) of which only one is a breeding line with the remainder being cultivars. Trials were conducted at three dryland locations and one irrigated location. Data for yield, plant height at harvest and seed size are presented in Tables 22-24. Average yield for the three year period spanning 2019 though 2021 is presented for those entries at Richland and Sidney that were trialed in all three years. Three year averages are not presented for the other locations as no trial was run at Conrad in 2020 and the 2019 Havre trial was lost to deer/antelope.

In 2021, below average yields were observed at the three dryland locations. At the Richland location, several kabuli cultivars (New Hope, Royal and Sierra) were severly damaged by antelope which is reflected in the abnormally low yields for those cultivars. Ascochyta pressure was minimal at the four tested locations. Seed size was evaluated for the Richland and Sidney locations using a sieve with 8.73 mm (22/64 in) diameter round openings. The percentage of seeds greater than 8.73 mm in diameter decreased at both locations relative to 2020.

Table 22. Chickpea Grain yield (lb/a) with Three Year Averages in parentheses

Note: Cultivars damaged by deer/antelope at Richland are marked with an asterisk

Chickpea Variety/Line	Conrad	Havre	Richland		Sidney Irrigated	
Kabuli Type						
CDC Frontier	1821	858	874	(1836)	3338	(3827)
CDC Leader	1625	502	926	(1971)	3059	
CDC Orion	1407	677	1023	(1814)	3631	(4017)
CDC Palmer	1818	1038	865	(1797)		
Kasin	1684	984	626			
ND Crown	1983	530	869	(1313)	2921	(3875)
New Hope	1347	911	290*			
Royal	741	575	100*	(611)	3086	(2709)
Sawyer	1540	900	549	(1407)	2878	(2905)
Sierra	1277	692	208*	(664)	2987	(2599)
Desi Type						
2510-2			616		3629	
Anna	1276	1411	858		3166	
CDC Consul			744		3257	
CDC Cory			1033		3291	
Myles	1448	1137	1089	(1519)	2583	
Mean	**1497**	**851**	**711**		**3149**	
P-value	**0.1661**	**<0.0001**	**<0.0001**		**0.0007**	
LSD	**NS**	**129.4**	**342.9**		**410.2**	
CV(%)	**37.5**	**10.6**	**33.9**		**7.7**	

Table 23. Chickpea Plant Height (cm)

Chickpea Variety/Line	Conrad	Havre	Richland	Sidney Irrigated
Kabuli Type				
CDC Frontier	29	19	34	35
CDC Leader	26	16	35	31
CDC Orion	27	18	32	33
CDC Palmer	28	15	34	
Kasin	39	28	42	
ND Crown	37	22	39	39
New Hope	38	21	42	
Royal	34	24	39	40
Sawyer	30	21	36	32
Sierra	32	20	39	33
Desi Type				
2510-2			34	41
Anna	27	20	37	32
CDC Consul			36	38
CDC Cory			37	36
Myles	31	19	32	32
Mean	**32**	**20**	**36**	**35**
P-value	**0.0012**	**<0.0001**	**<0.0001**	**0.0017**
LSD	**6.5**	**2.0**	**3.9**	**5.0**
CV(%)	**14.4**	**6.7**	**7.5**	**8.4**

Table 24. Chickpea Seed Size (% greater than 8.73 mm)

Chickpea Variety/Line	Richland	Sidney Irrigated
Kabuli Type		
CDC Frontier	22.9	12.0
CDC Leader	30.9	25.3
CDC Orion	44.8	55.3
CDC Palmer	36.9	
Kasin	1.6	
ND Crown	47.3	56.9
New Hope	35.2	
Royal		74.9
Sawyer	41.8	25.8
Sierra	70.1	72.1
Desi Type		
2510-2	1.1	0.5
Anna	0.1	0.0
CDC Consul	7.1	0.1
CDC Cory	2.8	0.3
Myles	0.1	0.0
Mean	**21.0**	**27.0**
P-value	**<0.0001**	**<0.0001**
LSD	**8.0**	**5.4**
CV(%)	**26.8**	**12.0**

FUTURE PLANS

The EARC will continue to lead the statewide variety evaluations in the coming years as long as there is a need from pulse growers, seed industries, breeders, and there is funding to support the effort.

Note: The data and summaries presented in this report are for **informational purposes only.** Inclusion and or exclusion of any commercial variety in this summary does not constitute a recommendation by Montana State University Agricultural Experiment Station or EARC.

DISCLAIMER:

The information given herein is supplied with the understanding that no discrimination is intended and no endorsement by the Montana Agricultural Experiment Station is implied. The results of individual trials and studies are considered to be of a **PRELIMINARY** nature and should **NOT** be considered as a product endorsement or recommendation for commercial use.