2023 Montana Cool-Season Spring Pulse Variety Evaluation Annual Report

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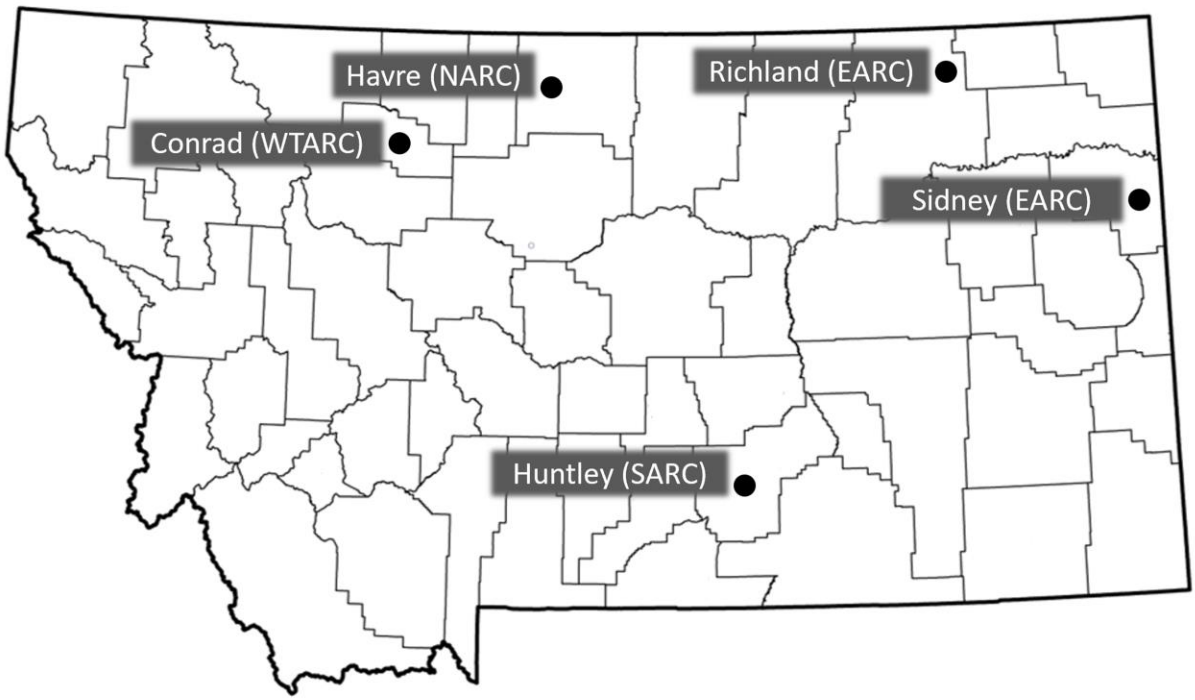

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Table of Contents

ACKNOWLEDGEMENT

The Montana State University Eastern Agricultural Research 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 2023, 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 entries 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. The following list provides contact information for many of the individuals involved in the 2023 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 dozen years the Montana State University Agricultural Experiment Stations have conducted annual pulse crop variety evaluations across the state of Montana to assist in improving yield and quality of these crops. The Montana State University Eastern Agricultural Research Center (EARC) in Sidney, MT is currently coordinating these efforts. In 2023, 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 targeting the major pulse growing regions of the state.

METHODS

Procedures and Experimental Design

Eight dry pea, ten lentil and thirteen 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 experimental lines for evaluation in 2023. 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. Crops were planted at four dryland locations (Conrad, Havre, Huntley, and Richland) and one irrigated location (Sidney).

Seeds for all entries were tested for germination 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 commercial 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 for pea samples by near-infrared spectroscopy **(**NIR) at the EARC in Sidney. Analysis of variance was performed in R (version 4.2.1) and Fisher's LSD was performed from the agricolae package (version 1.3-5) 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 2023.

Location	Collaborator	Irrigation	Crops evaluated at location			Observations
			Pea	Lentil	Chickpea	
Conrad	WTARC	No	X	X	X	Lentils lost to herbicide damage and weed pressure
Havre	NARC	No	X	X	X	Chickpea trial compromised and Lentil trial lost to herbicide damage
Huntley	SARC	No	X	X	X	Lentils lost to herbicide damage
Richland	EARC	No	X	X	X	Hail damage to peas and wildlife damage to chickpeas
Sidney	EARC	Yes	X	X	X	Mild grasshopper damage to lentils

†EARC = Eastern Agricultural Research Center, NARC = Northern Agricultural Research Center, SARC = Southern Agricultural Research Center, WTARC = Western Triangle Agricultural Research Center, 'X' indicates the collaborator participated for the specific crop variety evaluation in 2023.

Precipitation and Management 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)	Huntley (SARC)	Richland	Sidney (EARC)
Soil Type	Scobey-Kevin Clay Loam	Hillon Clay Loam	Lohmiller Silty Clay	Farnuf Loam	Savage Silty Clay Loam
Elevation (ft)	3700	2723	3000	2975	2200
Seasonal Precipitation (April - August) (in)	5.6	7.2	12.1	7.0+*	10.3
Average Precipitation (April - August) (in)	8.4	6.1	8.4	8.5*	9.6
Irrigation (in)					2.0

* Data from Opheim, MT weather station US00246238 approximately 12 miles from trial location, data for May 2023 is unavailable

Table 3. Major agronomic management practices for each location in 2023

Location	Tillage	Seeding to Harvest Dates	Previous Crop	Fertilizer	Pesticide Applications
Pea Trials					
Conrad		5/2 to 8/16		11-52-0 @ 40 lb/a	
Havre	No-Till	4/25 to 7/24	Spring Wheat	None	None
Huntley		5/5 to 8/15			Spartan @ 4 oz/a & RT3 @ 32 oz/a on 5/2
Richland	No-Till	5/17 to 8/9	Spring Wheat	None	Fall-Valor, Spring-RoundUp/Sharpen
Sidney	Conv.	4/25 to 7/27	Sugar beet	None	Panther @ 2 oz/a on 10/19/22; Varisto @ 21 oz/a, and Cleanse @ 6 oz/a on 5/31
Lentil Trials					
Richland	No-Till	5/18 to 8/24	Spring Wheat	None	Fall-Valor, Spring-RoundUp/Sharpen
Sidney	Conv.	4/26 to 7/29	Sugar beet	None	Panther @ 2 oz/a on 10/19/22; Outlook @ 10 oz/a on 4/26
Chickpea Trials					
Conrad		5/2 to 8/17		11-52-0 @ 40 lb/a	
Havre	No-Till	5/3 to 8/16	Spring Barley	None	None
Huntley		5/5 to 8/31			Spartan @ 4 oz/a & RT3 @ 32 oz/a on 5/2
Richland	No-Till	5/18 to 9/13	Spring Wheat	None	Fall-Valor, Spring-RoundUp/Sharpen
Sidney	Conv.	4/26 to 8/16	Sugar beet	None	Panther @ 2 oz/a on 10/19/22; Outlook @ 10 oz/a on 4/26: Miravis Top at 13.7 oz/a on 6/16 & 7/16; and Miravis Neo at 14 oz/a on 7/1

List of Varieties

Table 4 includes the list of varieties and experimental lines evaluated in 2023. 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 2023 variety evaluation trials.

Crop	Entry	Seed color/size	Maturity
Dry Pea	5206	Yellow	
	6087-11	Yellow	
	6124-7	Yellow	
	6138-1	Yellow	
	6232-4	Green	
	AAC Beyond	Yellow	Early
	AAC Carver	Yellow	Early
	AAC Chrome	Yellow	Medium
	AAC Julius	Yellow	
	AAC Profit	Yellow	Medium/Late
	Aragorn	Green	Medium
	B202318	Green	
	Banner	Green	
	Boost	Yellow	
	CDC Inca	Yellow	
	CDC Spectrum	Yellow	Medium
	CP5222Y	Yellow	
	CP5244Y	Yellow	
	DS-Admiral	Yellow	Medium
	Fairway	Green	
	Ginny 2	Green	
	Goldenwood	Yellow	
	Hampton	Green	Medium
	Hyline	Yellow	
	LG Sunrise	Yellow	

Table 4. Continued

Crop	Entry	Seed color/size	Maturity
Dry Pea	LGPN4184	Yellow	
	LGPN4185	Yellow	
	MS ProStar	Yellow	
	MS Winterberry	Yellow	
	MS-22G1	Green	
	ND Dawn	Yellow	Early
	NDP140510Y	Yellow	
	NDP150231Y	Yellow	
	NDP150412G	Green	
	Orchestra	Yellow	
	Passion (Pro 141-6258)	Green	
	Payback	Yellow	
	PG 8318	Green	
	PG 8927	Yellow	
	PG Cash	Yellow	
	Pizzazz	Yellow	
	Pro 143-6230	Yellow	
	Pro 171-7665	Green	
	Pro 173-7406	Yellow	
	Pro 181-7124	Green	
	PS17100008	Yellow	
	PS17100022	Yellow	
	Salamanca	Yellow	Early
	Shamrock	Green	Early

Table 4. Continued

Crop	Entry	Seed color/size	Maturity
Lentil	Avondale	Medium Green	Medium
	CDC Greenstar	Large Green	
	CDC Impala CL	Small Red	Early
	CDC Impress CL	Medium Green	
	CDC Imvincible CL	Small Green	
	CDC Kermit	Small Green	
	CDC Maxim CL	Small Red	
	CDC Richlea	Medium Green	Medium
	CDC Viceroy	Small Green	Early/Medium
	LC14600088R	Medium Green	
	NDL090170L	Large Green	
	NDL090185R	Medium Green	
	NDL090204R	Medium Green	
	Sage	Small Green	
Chickpea	CDC Sunset (2510-2)	Desi	
	CDC Anna	Desi	Medium
	CDC Consul	Desi	Medium/Late
	CDC Cory	Desi	
	CDC Frontier	Kabuli	Late
	CDC Leader	Kabuli	Medium
	CDC Orion	Kabuli	Late
	CDC Palmer	Kabuli	Medium/Late
	Kasin	Kabuli	
	Myles	Desi	
	Nash	Kabuli	
	ND Crown	Kabuli	
	NDC160236	Kabuli	
	New Hope	Kabuli	
	Royal	Kabuli	
	Sawyer	Kabuli	
	Sierra	Kabuli	

RESULTS

Dry Pea Variety Evaluation in 2023

Forty-nine dry pea varieties and experimental lines (35 yellow and 14 green) were evaluated in 2023 at five locations. Five yellow pea and two green pea cultivars were selected as check varieties and tested at all locations. Five experimental lines originate from university and government breeding programs. The remaining entries are cultivars and breeding lines from private entities and were tested at locations requested by the seed supplier. Results are presented in two groups based on cotyledon color (yellow and green).

Results of the 2023 dry pea variety evaluations are presented in Tables 5-10 for yellow peas and Tables 11-16 for green peas. Reported data include yield, protein, thousand kernel weight, test weight, plant height at harvest and days to flowering. Three-year yield and protein averages for 2021 through 2023 are presented for those entries with three years of data. Protein averages are only presented for the Richland and Sidney locations as these data were collected on a single instrument employing the same protein prediction model.

Irrigated yellow pea yields in Sidney averaged 5422 lb/a in 2023. Two inches of water was applied to this trial during two one-inch irrigations in June. Seasonal rainfall was less than one inch above normal. Flowering initiated about ten days early at this location following a warm May. A cool June facilitated excellent crop development and an early harvest. Only one yellow pea entry (PS17100008) and one green pea entry (Aragorn) experienced significant lodging resulting in yield loss (due to pigeon feeding). The remaining entries stood up well under significant pod loads. However, some entries were beginning to lean prior to harvest and no significant wind or hail events were experienced.

Spring snowstorms delayed planting of the Richland trial until May 17th which is two to three weeks later than normal. This was followed by a dry June and July. However, pea yields were better than expected given the circumstance with yellow peas averaging 2198 lb/a. The trial received four inches of rain at the very end of July. Included were two thunderstorms bringing wind and some hail. These storms occurred as the pea trial was approaching physiological maturity and final dry down. Earlier maturing varieties sustained significant shatter loss. Later maturing varieties were much less affected. Data from this trial should be evaluated with this occurrence in mind.

Table 5. Yellow Dry Pea Grain Yield (lb/a) with three-year averages in parentheses

Yellow Pea Variety/Line	Conrad 2023	Havre 2023 (3 yr avg)		Huntley 2023	Richland 2023 (3 yr avg)		Sidney 2023 (3 yr avg)	
5206	1591	2360			2354			
6087-11	1572	2037					5311	
6124-7	1638	1926					5463	
6138-1	1371	2254					5472	
AAC Beyond	1695	2067			2287			
AAC Carver	1576	2093	(1918)	3454	2347	(2113)	5989	
AAC Chrome	1601	2311	(1909)		2341	(2264)		
AAC Julius	1662	2226	(1947)		2184	(2176)		
AAC Profit	1669	2116	(1703)		2450	(2185)	5957	
Boost	1867	2383			2507			
CDC Inca	1291	1889		3179	2854		5523	
CDC Spectrum	1800	2094	(1854)		2384	(2152)		
CP5222Y	1838	2322		3357	1919		5701	
CP5244Y	1627	2423		3250	1603		5762	
DS-Admiral	1651	2383	(1833)	2938	2016	(1946)	5300	(3901)
Goldenwood			(1644)		1821	(1956)		
Hyline	1967	2476			1978			
LG Sunrise	1552	2359		3267	1859		5234	
LGPN4184	1756	2262					5750	
LGPN4185	1587	2130					5662	
MS ProStar	1600	2261			2038			
MS Winterberry					2390			
ND Dawn	1477	2631	(2076)	3407	2088	(2070)	5349	(4054)
NDP140510Y	1747	2322		2901	2470		5489	
NDP150231Y	1496	2152		3079	2437		5258	
Orchestra	1788	2571	(1872)	3110	2123	(1857)	5875	(4442)
Payback					1910			
PG 8927	1498	2237		2888	2452		5356	
PG Cash	1924	2352		2942	2425		5498	
Pizzazz	1827	2712	(2166)		2090	(2063)		
Pro 143-6230	1910	2217	(1824)		1875	(1744)		
Pro 173-7406	1617	2556			1914			
PS17100008	1828	2813	(2091)	3401	2225	(1965)	3325	
PS17100022	1737	2854	(2192)	3276	2389	(2149)	5461	
Salamanca	2086	2343	(2018)		2277	(2047)		
Mean	**1683**	**2317**		**3175**	**2198**		**5422**	
P-value	**0.1**	**<0.0001**		**0.7**	**<0.0001**		**<0.0001**	
LSD	**NS**	**231**		**NS**	**317**		**914**	
CV (%)	**17.6**	**7.1**		**14.7**	**10.3**		**11.9**	

Table 6. Yellow Dry Pea Protein (% Dry Matter Basis) with three-year averages in parentheses

Yellow Pea Variety/Line	Havre 2023	Richland 2023 (3 yr avg)		Sidney 2023 (3 yr avg)	
5206	26.8	24.5			
6087-11	28.7			25.5	
6124-7	28.8			24.5	
6138-1	28.2			26.0	
AAC Beyond	27.7	24.6			
AAC Carver	25.0	23.2	(23.4)	21.2	
AAC Chrome	26.4	23.6	(24.2)		
AAC Julius	28.3	23.9	(25.1)		
AAC Profit	27.2	24.0	(25.1)	24.7	
Boost	26.5	25.0			
CDC Inca	27.5	24.1		23.8	
CDC Spectrum	28.5	24.4	(25.3)		
CP5222Y	26.4	23.3		26.2	
CP5244Y	26.4	24.1		24.1	
DS-Admiral	25.7	24.0	(24.0)	23.6	(23.6)
Goldenwood		27.3	(27.0)		
Hyline	25.4	23.0			
LG Sunrise	26.1	23.3		21.8	
LGPN4184	26.6			25.6	
LGPN4185	26.9			25.5	
MS ProStar	26.7	25.3			
MS Winterberry		23.9			
ND Dawn	24.9	24.0	(24.0)	22.7	(23.2)
NDP140510Y	25.5	23.9		22.7	
NDP150231Y	28.9	24.5		26.5	
Orchestra	26.9	26.0	(27.3)	27.6	(28.0)
Payback		25.3			
PG 8927	27.2	24.2		25.2	
PG Cash	27.1	24.8		25.6	
Pizzazz	25.5	24.0	(25.1)		
Pro 143-6230	26.4	23.9	(25.1)		
Pro 173-7406	24.7	23.9			
PS17100008	25.2	23.6	(24.3)	24.1	
PS17100022	26.1	23.9	(25.4)	24.8	
Salamanca	26.1	23.0	(25.0)		
Mean	**26.7**	**24.2**		**24.6**	
P-value	**<0.0001**	**<0.0001**		**<0.0001**	
LSD	**1.1**	**0.8**		**0.7**	
CV (%)	**2.9**	**2.3**		**1.9**	

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

Yellow Pea Variety/Line	Havre	Richland	Sidney
5206	206	216	
6087-11	198		249
6124-7	210		273
6138-1	214		249
AAC Beyond	193	187	
AAC Carver	203	217	256
AAC Chrome	208	220	
AAC Julius	184	209	
AAC Profit	216	228	253
Boost	204	219	
CDC Inca	209	219	251
CDC Spectrum	207	219	
CP5222Y	239	269	303
CP5244Y	204	225	262
DS-Admiral	211	237	255
Goldenwood		165	
Hyline	220	221	
LG Sunrise	212	230	247
LGPN4184	205		265
LGPN4185	209		277
MS ProStar	212	227	
MS Winterberry		185	
ND Dawn	210	244	258
NDP140510Y	189	206	224
NDP150231Y	183	194	234
Orchestra	235	264	313
Payback		162	
PG 8927	225	234	284
PG Cash	211	234	292
Pizzazz	253	301	
Pro 143-6230	205	206	
Pro 173-7406	222	236	
PS17100008	227	255	285
PS17100022	219	243	302
Salamanca	227	237	
Mean	**212**	**224**	**267**
P-value	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**8.9**	**9.3**	**9.7**
CV (%)	**3.0**	**3.0**	**2.6**

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

Yellow Pea Variety/Line	Conrad	Havre	Huntley	Richland	Sidney
5206	64.1	61.6		65.3	
6087-11	64.8	60.6			64.1
6124-7	65.1	61.0			64.3
6138-1	65.2	60.5			65.2
AAC Beyond	65.2	61.3		64.8	
AAC Carver	65.4	61.9	64.4	64.6	64.4
AAC Chrome	65.5	61.3		64.8	
AAC Julius	64.8	61.5		64.7	
AAC Profit	64.6	60.8		65.1	63.5
Boost	64.9	61.1		64.3	
CDC Inca	65.6	61.4	64.4	65.3	64.6
CDC Spectrum	64.6	60.9		64.8	
CP5222Y	65.5	61.8	63.7	66.2	64.7
CP5244Y	66.1	61.9	64.6	66.2	65.3
DS-Admiral	63.8	61.4	63.6	65.0	64.4
Goldenwood				66.4	
Hyline	65.8	61.2		64.7	
LG Sunrise	65.3	61.4	63.7	65.2	64.5
LGPN4184	65.2	61.3			64.2
LGPN4185	64.7	61.1			64.0
MS ProStar	65.0	61.2		64.3	
MS Winterberry				64.7	
ND Dawn	64.5	60.6	63.2	65.3	64.7
NDP140510Y	65.7	62.0	64.7	65.3	64.6
NDP150231Y	66.1	61.8	64.6	64.8	64.2
Orchestra	65.9	62.2	64.4	66.2	64.0
Payback				65.9	
PG 8927	64.2	60.8	63.2	65.1	63.9
PG Cash	66.1	61.6	64.4	65.6	64.5
Pizzazz	66.0	62.0		66.5	
Pro 143-6230	65.3	61.2		64.0	
Pro 173-7406	64.5	61.6		65.2	
PS17100008	64.7	61.6	63.6	66.5	64.5
PS17100022	66.2	62.4	64.3	66.5	66.2
Salamanca	65.3	61.6		64.6	
Mean	**65.2**	**61.4**	**64.1**	**65.3**	**64.5**
P-value	**<0.0001**	**<0.0001**	**0.02**	**<0.0001**	**<0.0001**
LSD	**0.6**	**0.3**	**1.0**	**0.5**	**0.6**
CV (%)	**0.7**	**0.4**	**1.1**	**0.5**	**0.6**

Table 9. Yellow Dry Pea Plant Height at Maturity (cm)

Yellow Pea Variety/Line	Conrad	Huntley	Richland	Sidney
5206	64		67	
6087-11	53			77
6124-7	50			72
6138-1	53			77
AAC Beyond	46		56	
AAC Carver	60	85	66	67
AAC Chrome	45		48	
AAC Julius	55		60	
AAC Profit	58		56	73
Boost	64		56	
CDC Inca	53	79	74	69
CDC Spectrum	51		60	
CP5222Y	62	80	56	62
CP5244Y	62	86	55	67
DS-Admiral	59	81	61	60
Goldenwood			37	
Hyline	55		57	
LG Sunrise	62	88	64	72
LGPN4184	63			66
LGPN4185	59			65
MS ProStar	46		54	
MS Winterberry			32	
ND Dawn	56	74	58	64
NDP140510Y	62	80	61	66
NDP150231Y	57	78	62	65
Orchestra	64	83	54	66
Payback			38	
PG 8927	70	69	62	71
PG Cash	64	79	63	66
Pizzazz	61		58	
Pro 143-6230	58		55	
Pro 173-7406	52		56	
PS17100008	44	78	47	57
PS17100022	70	86	41	72
Salamanca	69		69	
Mean	**58**	**80**	**56**	**50**
P-value	**<0.0001**	**0.8000**	**<0.0001**	**<0.0001**
LSD	**10.3**	**NS**	**8**	**1**
CV (%)	**12.7**	**16.3**	**10.5**	**1.5**

Table 10. Yellow Dry Pea Days to Flowering

Yellow Pea Variety/Line	Conrad	Havre	Huntley	Sidney
5206	57	52		
6087-11	57	56		55
6124-7	57	54		53
6138-1	57	55		52
AAC Beyond	57	52		
AAC Carver	56	51	55	49
AAC Chrome	57	50		
AAC Julius	57	51		
AAC Profit	57	53		52
Boost	57	53		
CDC Inca	57	52	55	53
CDC Spectrum	57	53		
CP5222Y	55	48	53	49
CP5244Y	55	48	54	48
DS-Admiral	55	49	54	49
Goldenwood				
Hyline	56	51		
LG Sunrise	53	49	54	49
LGPN4184	57	51		50
LGPN4185	55	49		48
MS ProStar	57	52		
MS Winterberry				
ND Dawn	56	50	53	49
NDP140510Y	57	52	55	49
NDP150231Y	57	53	58	51
Orchestra	56	50	54	49
Payback				
PG 8927	57	51	54	51
PG Cash	55	50	54	49
Pizzazz	50	47		
Pro 143-6230	56	51		
Pro 173-7406	55	49		
PS17100008	55	49	52	49
PS17100022	57	51	55	49
Salamanca	56	50		
Mean	**56**	**51**	**54**	**50**
P-value	**<0.0001**	**<0.0001**	**0.0090**	**<0.0001**
LSD	**1.0**	**0.9**	**2.5**	**1**
CV (%)	**1.3**	**1.2**	**3.2**	**1.5**

Table 11. Green Dry Pea Grain Yield (lb/a) with three-year averages in parentheses

Green Pea Variety/Line	Conrad 2023	Havre 2023 (3 yr avg)		Huntley 2023	Richland 2023 (3 yr avg)		Sidney 2023 (3 yr avg)	
6232-4	1334	2239					5418	
Aragorn	1974	2413	(1951)	2941	1683	(1834)	997	(2196)
B202318	1852	2549			1825			
Banner	1632	2276			1709			
Fairway	1524	1993	(1807)		2007			
Ginny 2	1664	2371	(1908)		1919	(1795)		
Hampton	1766	2365	(1822)	2887	2175	(2016)	5042	(3219)
MS-22G1	1843	2569			2656			
NDP150412G	1641	2257		2936	1700		5233	
Passion	1839	2422	(1900)		1826			
PG 8318		2155			2773	(2182)		
Pro 171-7665	1546	2229	(1931)		1443			
Pro 181-7124	1756	2795			1782			
Shamrock	1524	2291	(1732)		2194			
Mean	**1684**	**2352**		**2921**	**1976**		**4173**	
P-value	**0.06**	**<0.0001**		**1.0**	**<0.0001**		**<0.0001**	
LSD	**NS**	**234**		**NS**	**349**		**722**	
CV (%)	**15.1**	**7.0**		**15.8**	**12.3**		**11.2**	

Table 12. Green Dry Pea Protein (% Dry Matter Basis) with three-year averages in parentheses

Green Pea Variety/Line	Havre 2023	Richland 2023 (3 yr avg)		Sidney 2023 (3 yr avg)	
6232-4	27.4			22.6	
Aragorn	26.6	24.6	(25.0)	25.3	(24.9)
B202318	25.2	21.9			
Banner	25.2	21.7			
Fairway	28.7	25.6			
Ginny 2	26.1	24.1	(24.6)		
Hampton	26.6	26.1	(26.8)	25.9	(26.5)
MS-22G1	26.7	24.4			
NDP150412G	28.3	26.3		26.7	
Passion	24.8	23.1			
PG 8318	25.3	24.6	(24.8)		
Pro 171-7665	25.3	23.0			
Pro 181-7124	26.8	24.0			
Shamrock	27.2	25.4			
Mean	**26.4**	**24.2**		**25.1**	
P-value	**<0.0001**	**<0.0001**		**<0.0001**	
LSD	**1.3**	**1.1**		**0.5**	
CV (%)	**3.5**	**3.1**		**1.3**	

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

Green Pea Variety/Line	Havre	Richland	Sidney
6232-4	192		244
Aragorn	190	224	228
B202318	180	222	
Banner	173	224	
Fairway	166	180	
Ginny 2	195	217	
Hampton	188	221	238
MS-22G1	195	216	
NDP150412G	175	190	226
Passion	189	231	
PG 8318	197	209	
Pro 171-7665	200	245	
Pro 181-7124	206	236	
Shamrock	196	211	
Mean	**189**	**217**	**234**
P-value	**<0.0001**	**<0.0001**	**0.04**
LSD	**8.8**	**10**	**13**
CV (%)	**3.3**	**3.4**	**3.7**

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

Green Pea Variety/Line	Conrad	Havre	Huntley	Richland	Sidney
6232-4	66.1	61.1			64.9
Aragorn	64.8	60.1	64.6	63.4	63.1
B202318	65.5	61.7		66.3	
Banner	65.7	61.3		65.8	
Fairway	64.4	60.4		63.5	
Ginny 2	64.8	61.0		65.0	
Hampton	64.6	60.8	64.1	64.0	62.7
MS-22G1	66.2	61.6		64.5	
NDP150412G	66.6	62.7	65.0	66.4	64.3
Passion	65.3	60.9		65.2	
PG 8318		61.2		65.9	
Pro 171-7665	65.1	61.3		65.8	
Pro 181-7124	64.3	60.2		64.5	
Shamrock	67.2	62.1		66.3	
Mean	**65.4**	**61.2**	**64.6**	**65.1**	**63.8**
P-value	**<0.0001**	**<0.0001**	**0.4**	**<0.0001**	**<0.0001**
LSD	**0.4**	**0.4**	**NS**	**0.5**	**0.6**
CV (%)	**0.5**	**0.5**	**1.3**	**0.5**	**0.6**

Table 15. Green Dry Pea Plant Height at Maturity (cm)

Green Pea Variety/Line	Conrad	Huntley	Richland	Sidney
6232-4	58			76
Aragorn	53	83	52	60
B202318	64		55	
Banner	61		53	
Fairway	51		51	
Ginny 2	53		52	
Hampton	49	68	52	57
MS-22G1	58		58	
NDP150412G	55	84	53	59
Passion	50		47	
PG 8318			70	
Pro 171-7665	55		52	
Pro 181-7124	54		51	
Shamrock	59		53	
Mean	**55**	**78**	**54**	**63**
P-value	**0.1**	**0.1**	**0.03**	**0.004**
LSD	**NS**	**NS**	**10.4**	**9.5**
CV (%)	**12.5**	**11.9**	**13.5**	**9.8**

Table 16. Green Dry Pea Days to Flowering

Green Pea Variety/Line	Conrad	Havre	Huntley	Sidney
6232-4	57	57		56
Aragorn	54	47	56	48
B202318	51	46		
Banner	49	46		
Fairway	57	52		
Ginny 2	55	49		
Hampton	56	51	55	49
MS-22G1	57	50		
NDP150412G	55	51	54	49
Passion	52	48		
PG 8318		54		
Pro 171-7665	54	48		
Pro 181-7124	55	49		
Shamrock	57	54		
Mean	**55**	**50**	**55**	**51**
P-value	**<0.0001**	**<0.0001**	**0.3**	
LSD	**1.9**	**0.7**	**NS**	
CV (%)	**2.4**	**1.0**	**2.5**	

Lentil Variety Evaluation in 2023

The 2023 lentil variety evaluation included 14 lentil entries (two small red lentils and twelve green lentils with small, medium, and large green entries represented). Results of the 2023 lentil variety evaluations are presented in Tables 17-19. Reported data include yield, thousand kernel weight, test weight, plant height at harvest and days to flowering. Three-year averages for 2021 through 2023 are presented for entries with three years of data. Lentil trials planted at Conrad, Havre, and Huntley were all lost to herbicide damage and/or weed pressure.

Irrigated lentil yields in Sidney were excellent. Warm temperatures in May followed by cooler than average temperatures in June allowed for favorable crop development and an early harvest. Grasshoppers were more prevalent in the 2023 Sidney trial than in 2022. However, harvest concluded prior to the occurrence of significant damage.

A late planting and a lack of rainfall in June and July resulted in a poor lentil crop at Richland. Four inches of rain at the end of July also caused the green up of most but not all entries. These entries also initiated a second round of flowering and pod set in early to mid-August. The crop was harvested prior to the maturation of seed from the second round of pod set to prevent shatter loss of the earlier matured seed.

Table 17. Lentil Grain Yield (lb/a) with three-year averages in parentheses

Lentil	Richland		Sidney	
Variety/Line	**2023**	**(3 yr avg)**	**2023**	**(3 yr avg)**
Avondale	950	(1035)	3579	(2631)
CDC Greenstar	767		2924	
CDC Impala CL	620	(911)	3085	(2441)
CDC Impress CL	759	(957)	3177	(2526)
CDC Imvincible CL	725		3244	
CDC Kermit	790		3496	
CDC Maxim CL	805		3357	
CDC Richlea	1069	(1080)	3394	(2645)
CDC Viceroy	644	(893)	2985	(2578)
LC14600088R	985	(1153)	3707	
NDL090170L	930			
NDL090185R	784		3340	
NDL090204R	601		2593	
Sage	846	(1129)	2387	(2068)
Mean	**807**		**3174**	
P-value	**0.02**		**0.007**	
LSD	**257**		**648**	
CV (%)	**22.3**		**14.3**	

Table 18. Lentil Thousand Kernel Weight (g) & Test Weight (lb/bu)

	TKW (g)		Test Weight (lb/bu)	
Lentil Variety/Line	**Richland**	**Sidney**	**Richland**	**Sidney**
Avondale	45.5	50.8	61.7	63.3
CDC Greenstar	65.4	72.8	57.4	60.4
CDC Impala CL	19.9	30.5	64.7	65.3
CDC Impress CL	50.2	52.9	59.6	62.3
CDC Imvincible CL	28.9	32.9	63.6	64.6
CDC Kermit	28.3	30.8	63.6	65.3
CDC Maxim CL	35.1	42.2	62.6	64.3
CDC Richlea	48.1	54.6	60.6	61.7
CDC Viceroy	29.1	33.2	63.9	65.0
LC14600088R	51.2	60.3	60.5	62.3
NDL090170L	67.9		59.6	
NDL090185R	48.2	53.7	60.8	62.1
NDL090204R	51.1	54.2	61.6	63.8
Sage	32.3	36.8	63.1	64.4
Mean	**43.4**	**46.6**	**61.6**	**63.4**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**2.2**	**1.6**	**0.6**	**0.4**
CV (%)	**3.6**	**2.4**	**0.6**	**0.4**

Table 19. Lentil Plant Height (cm) & Days to Flowering

	Plant Height (cm)		Days to Flowering
Lentil Variety/Line	**Richland**	**Sidney**	**Sidney**
Avondale	34	37	49
CDC Greenstar	38	34	52
CDC Impala CL	30	37	55
CDC Impress CL	35	35	51
CDC Imvincible CL	34	35	54
CDC Kermit	30	38	57
CDC Maxim CL	33	37	50
CDC Richlea	32	35	50
CDC Viceroy	28	34	55
LC14600088R	35	36	50
NDL090170L	36		
NDL090185R	35	36	50
NDL090204R	32	34	58
Sage	32	30	48
Mean	**33**	**35**	**52**
P-value	**0.06**	**0.05**	**<0.0001**
LSD	**NS**	**3.9**	**1.5**
CV(%)	**11.8**	**7.7**	**2.0**

Chickpea Variety Evaluation in 2023

The 2023 statewide chickpea variety evaluation included seventeen entries (12 Kabuli type and five Desi type). Included were 16 cultivars and 1 breeding line. Data are presented for four dryland locations and one irrigated location in Tables 20-24. Average yield for the three-year period, 2021 through 2023, is presented for those entries that were trialed in all three years.

Irrigated chickpea yields in Sidney fell between 2021 and 2022 yields. As with peas and lentils, chickpeas flowered earlier than usual in Sidney. Ascochyta blight was managed with three fungicide applications beginning at flowering in mid-June. A fourth fungicide application may have benefited the crop as yields of the most sensitive cultivars ranked at the bottom of the trial.

Yields in Richland were average but better than expected following a late planting date and a lack of rainfall in June and July. Chickpea entries in Richland were selectively grazed by jackrabbits and antelope with cultivar 'Royal' being most affected. The Richland location also received four inches of rain at the end of July resulting in an extension of the flowering period for most entries. This delayed harvest to mid-September and made for challenging harvest conditions. Pods set from these later flowers were mostly devoid of seed and contributed little to yield.

Table 20. Chickpea Grain yield (lb/a) with three-year averages in parentheses

Chickpea Variety/Line	Conrad 2023	Havre 2023 (3 yr avg)		Huntley 2023	Richland* 2023 (3 yr avg)		Sidney 2023 (3 yr avg)	
CDC Anna	1009	918	(1454)	1658	1633	(1366)	4092	(3810)
CDC Consul	1100	1052		1708	1677	(1217)	3717	(3844)
CDC Cory	932	1248		1954	1742	(1334)	4244	(3949)
CDC Frontier	1356	1154	(1291)	1775	1893	(1355)	4234	(4062)
CDC Leader	968	1317	(1112)	1982	1614	(1229)	4227	(3965)
CDC Orion	1124	1462	(1432)	1875	1811	(1138)	4165	(4093)
CDC Palmer	1118	1317	(1351)		1761	(1411)		
CDC Sunset	877	1145		1572	1194	(890)	3846	(3974)
Kasin	951	1075	(1245)		1061	(968)		
Myles	1027	1053	(1307)	2037	1277	(1380)	3459	(3292)
Nash	656	852		956	1204		3046	
ND Crown	1110	1319	(1172)	1831	1690	(1244)	3852	(3667)
NDC160236	1426	1554		1956	1777		4275	
New Hope	863	937			1088	(496)		
Royal	742	1029	(1093)	1237	426	(223)	3079	(3425)
Sawyer	841	1141	(1194)	1645	1596	(915)	3336	(3384)
Sierra	686	423	(739)	948	1133	(489)	2878	(3287)
Mean	**985**	**1117**		**1652**	**1446**		**3746**	
P-value	**<0.0001**	**<0.0001**		**<0.0001**	**<0.0001**		**<0.0001**	
LSD	**252**	**190**		**400**	**322**		**337**	
CV (%)	**18.0**	**10.2**		**17.0**	**15.7**		**6.3**	

*Note: Antelope damage at Richland was observed throughout the growing season and was entry specific with the most significant damage on cultivar ‘Royal’.

Table 21. Chickpea Test Weight (lb/bu)

Chickpea Variety/Line	Conrad	Havre	Huntley	Richland	Sidney
CDC Anna	61.1	61.9	61.6	60.2	64.1
CDC Consul	61.9	61.1	61.6	60.7	64.4
CDC Cory	59.6	62.0	58.2	57.8	61.8
CDC Frontier	60.6	62.1	64.3	60.8	65.0
CDC Leader	59.5	60.7	63.2	61.4	63.7
CDC Orion	58.3	60.1	61.9	59.4	62.7
CDC Palmer	59.4	60.6		60.8	
CDC Sunset	60.9	61.5	59.7	59.5	63.6
Kasin	61.4	63.5		61.4	
Myles	57.2	58.9	60.4	58.4	61.4
Nash	57.4	59.5	60.9	58.2	62.3
ND Crown	59.9	61.1	63.5	60.6	64.1
NDC160236	59.7	60.8	63.0	60.7	64.3
New Hope	59.4	60.6		60.0	
Royal	58.7	59.5	61.5	57.8	62.4
Sawyer	59.4	61.7	62.8	60.5	62.6
Sierra	58.0	59.8	61.7	58.8	61.5
Mean	**59.6**	**60.9**	**61.7**	**59.9**	**63.1**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**0.6**	**0.8**	**0.7**	**1.1**	**0.6**
CV (%)	**0.7**	**0.8**	**0.8**	**1.3**	**0.6**

Table 22. Chickpea Seed Size (% greater than 8.73 mm)

Chickpea Variety/Line	Richland	Sidney
CDC Anna	0.8	0
CDC Consul	15.9	0.1
CDC Cory	13.3	0.1
CDC Frontier	42.2	1.4
CDC Leader	48.3	17.6
CDC Orion	69.7	40.9
CDC Palmer	66.4	
CDC Sunset	12.9	0.4
Kasin	7.0	
Myles	0	0
Nash	81.3	72.1
ND Crown	72.9	38.3
NDC160236	71.2	7.9
New Hope	44.2	
Royal	72.3	73.1
Sawyer	54.9	16.9
Sierra	80.1	63.4
Mean	**44.3**	**23.7**
P-value	**<0.0001**	**<0.0001**
LSD	**9.6**	**4.9**
CV (%)	**15.2**	**14.4**

Table 23. Chickpea Plant Height (cm)

Chickpea Variety/Line	Conrad	Huntley	Richland	Sidney
CDC Anna	33.7	61.5	40.3	54.3
CDC Consul	38.1	65.0	47.3	53.8
CDC Cory	36.8	63.5	46.3	52.8
CDC Frontier	34.3	60.3	45.0	55.8
CDC Leader	31.8	55.8	39.8	44.3
CDC Orion	37.5	61.3	36.5	45.5
CDC Palmer	32.4		41.0	
CDC Sunset	38.7	68.3	49.8	56.5
Kasin	43.2		56.0	
Myles	32.4	58.5	36.8	49.5
Nash	32.4	60.0	45.8	48.3
ND Crown	38.7	68.8	54.3	55.5
NDC160236	39.4	64.8	45.0	57.8
New Hope	41.3		51.8	
Royal	35.6	60.8	36.8	49.5
Sawyer	34.3	65.3	40.5	46.3
Sierra	33.7	62.0	40.5	43.5
Mean	**36.1**	**62.5**	**44.3**	**50.9**
P-value	**<0.0001**	**0.0008**	**<0.0001**	**0.0001**
LSD	**4.4**	**5.5**	**5.5**	**6.6**
CV (%)	**8.6**	**6.1**	**8.7**	**9.0**

Table 23. Chickpea Days to Flowering

Chickpea Variety/Line	Conrad	Havre	Huntley	Sidney
CDC Anna	51	51	56	51
CDC Consul	54	49	59	52
CDC Cory	56	53	59	52
CDC Frontier	55	50	59	52
CDC Leader	54	48	57	52
CDC Orion	48	44	55	51
CDC Palmer	50	47		
CDC Sunset	55	52	59	52
Kasin	57	52		
Myles	48	49	52	51
Nash	56	52	59	52
ND Crown	53	49	57	52
NDC160236	55	51	60	52
New Hope	56	51		
Royal	57	52	61	53
Sawyer	52	49	58	52
Sierra	56	50	60	53
Mean	**54**	**50**	**58**	**52**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**2.2**	**2.2**	**1.6**	**0.7**
CV(%)	**2.9**	**2.7**	**1.9**	**0.9**

FUTURE PLANS

The EARC will continue to lead the statewide variety evaluations in the coming years provided 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.

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