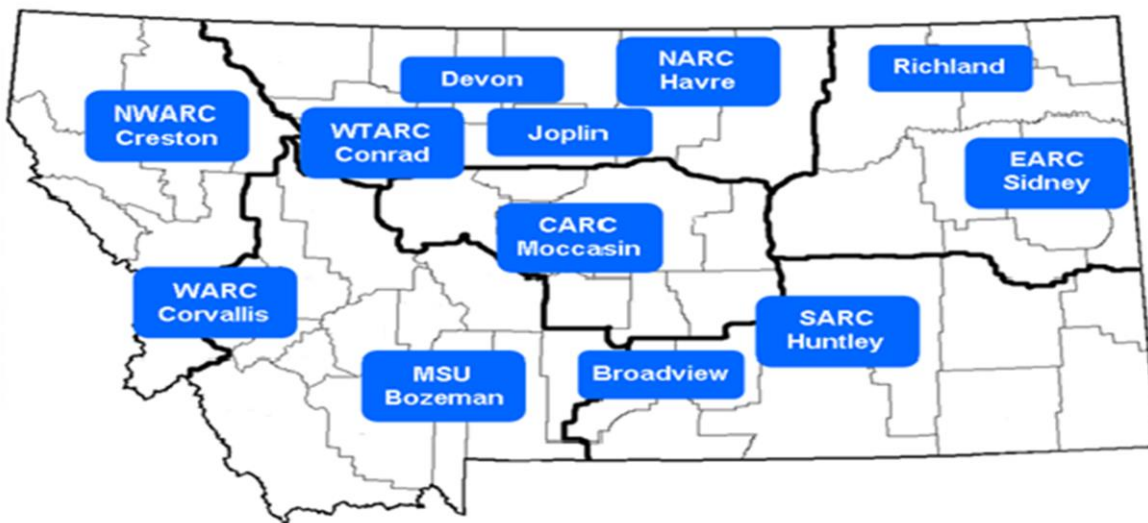


2016 Montana Cool-Season Spring Pulse Variety Evaluation Annual Report

Prepared By:

Yesuf Mohammed and Chengci Chen



Montana State University
Montana Agricultural Experiment Stations

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Montana State University	
Chengci Chen Professor, Cropping Systems Eastern Ag. Research Center 1501 North Central Ave, Sidney, MT 59270 (406) 433-2208, cchen@montana.edu	Jessica Torrion Assistant Professor Northwestern Ag. Research Center 4570 Hwy 35 Kalispell, MT 59901 (406) 755-4303, jessica.torrion@montana.edu
Yesuf Mohammed Research Scientist Eastern Ag. Research Center 1501 North Central Ave, Sidney, MT 59270 (406) 433-2208, yesuf.mohammed@montana.edu	Peggy Lamb Research Scientist Northern Ag. Research Center 3710 Assiniboine Road Havre, MT 59501 (406) 265-6115, plamb@montana.edu
Patrick Carr Associate Professor, Cropping Systems Central Ag. Research Center 52583 US Hwy 87 Moccasin, MT 59462 (406) 423-5421, Patrick.carr@montana.edu	Roger Nkoa Assistant Professor Western Triangle Ag. Research Center 9546 Old Shelby Road Conrad, MT 59425 (406) 278-7707, roger.ondoua@montana.edu
Sally Dahlhausen Research Assistant Central Ag. Research Center 52583 US Hwy 87 Moccasin, MT 59462 (406) 423-5421, Sally.Dahlhausen@montana.edu	Marty Knox Research Specialist Western Ag. Research Center 580 Quast Lane Corvallis, MT 59828 (406) 961-3025, mknox@montana.edu
Qasim Khan Post-Doc Research Associate Southern Ag. Research Center 748 Railroad Hwy Huntley, MT 59037 (406) 348-3400, qkhan@montana.edu	Kent McVay Associate Professor, Cropping Systems Southern Ag. Research Center 748 Railroad Hwy Huntley, MT 59037 (406) 348-3400, kmcvay@montana.edu

Angela Sebelius
Research Associate
Northern Ag. Research Center
3710 Assiniboine Road Havre, MT 59501
(406) 265-6115, angela.sebelius@montana.edu

Shelley Mills
Valley County Extension Agent
501 Court Square
Glasgow, MT 59230
(406) 228-6241, smills@montana.edu

North Dakota State University
Kevin McPhee
Pulse Breeder
North Dakota State University; Fargo, ND
(701) 231-8156; Kevin.McPhee@ndsu.edu

Jeff Holmes
Research Associate
Land Resources & Environmental Sciences
Bozeman, MT 59717
(406) 994-5138, jholmes@montana.edu

Bobbie Roos
Daniels County Extension Agent
106 Railroad Ave East
Scobey, MT 59263
(406) 487-2861, broos@montana.edu

University of Saskatchewan
Tom Warkentin and Brent Barlow
Pulse Breeder
(306)-966-4988
Tom.warkentin@usask.ca;
brent.barlow@usask.ca

USDA – Agricultural Research Service

George Vandemark
Research Geneticist
USDA-ARS
Pullman, WA 99164
(509) 335-7728,
George.vandemark@ars.usda.gov

Rebecca McGee
Research Geneticist
USDA-ARS
Pullman, WA 99164
(509) 335-0300,
Rebecca.mcgee@ars.usda.gov

Industries

USA Dry Pea and Lentil Council
2780 W. Pullman Road
Moscow, ID 83843
(208) 882-3023
pulse@pea-lentil.com; www.pea-lentil.com

Northern Pulse Growers Association
1710 Burnt Boat Drive
Bismarck, ND 58503
(701) 222-0128
info@northernpulse.com
www.northernpulse.com

Kurt Braunwart and Mike Wood
ProGene
860 S. Crestline Othello, WA, 99344
(509) 448-3977;
kurt@progenellc.com; mike@progenellc.com

Byron Lannoye, Mike Strand and Nicole Braun, Pulse USA
1900 Commerce Drive
Bismarck, ND 58501
(701) 530-0734; Byron@pulseusa.com

Tanya Deforest
Nodricks Norsask Seeds Ltd.
611 99th Ave Box 2169, Tisdale, SK SOE 1T0
(306) 873-4740;
Tanyadeforest.nns1@sasktel.net

Jay Hould
Big Sky Wholesale Seeds
Box 852, Shelby, MT, 59474
(406) 434-5011; bigskyseeds@3rivers.net

Shaan Tsai
Meridian Seeds
201-1475 Chevrier Blvd. Winnipeg, MB,
Canada
(204)988 4681; s.tsai@canterra.com

Richard Roland
Legume Logic
301 3rd St NW Crosby, ND 58730
(701) 965-6058; legumel@nccray.com

Kevin and Gene
Legume Matrix LLC
P.O.Box 1028, Jamestown, ND 58402
(701) 252-4757; Legume.matrix@gmail.com

Mark Kok
Great Northern Ag.
(701) 497-3082; mark@greatnorthernag.com

Will Van Roessel
Seed Net
Box 490, Bow Island, AB, CA T0K 0G0
(403)952-0913; Will@specialtyseeds.ca

Charlie Cahill
Cahill Seeds
Box 1172, 669 Highway 5, Scobey, MT 59263
(406) 783-5510; cahillseeds@nemontel.net

Producers

Richard Fulton
Richland, MT
Keith and Karen Schott
Broadview, MT

Marvin Tarum
Richland, MT

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List of Seed Suppliers

The lists of seed companies who submitted seeds for 2016 variety evaluation are shown in Table 1. The seed suppliers may be contacted if anyone is interested in getting seed or seed related information about the respective crops and varieties. This table is not exhaustive in listing seed suppliers for all varieties/entries evaluated in 2016 since most of the varieties received from breeders are not yet released (example Western Regional Variety Evaluation Trials) and lack of sufficient information.

Table 1. Some of the dry pea, lentil and chickpea varieties included in 2016 variety evaluation trials and seed suppliers

Crop	Variety/Lines	Seed supplier	Seed cotyledon color
Dry pea	AAC Carver	Meridian Seeds	Yellow
	AAC Lacombe	Seed Net	Yellow
	Abarth	Pulse USA	Yellow
	AC Agassiz	Meridian Seeds	Yellow
	AC Earlystar	Meridian Seeds	Yellow
	Aragorn	Pulse USA	Green
	Arcadia	Pulse USA	Green
	Banner	ProGene	Green
	Bridger	Great Northern Ag	Yellow
	CDC Amarillo	Meridian Seeds	Yellow
	CDC Meadow	University of Saskatchewan	Yellow
	CDC Patrick	Meridian Seeds	Green
	CDC Raezer	Meridian Seeds; Canterra Seeds	Green
	CDC Saffron	Meridian Seeds	Yellow
	CDC Treasure	Chahill Seeds	Yellow
	Cruiser	Used as check	Green
	Delta	Used as check	Yellow
	DS Admiral	Pulse USA	Yellow
	Durwood	Pulse USA	Yellow
	Ginny	ProGene	Green
	Greenwood	ProGene	Green
	Gunner	Great Northern Ag	Yellow
	Hampton	Chahill Seeds	Green
	Hyline	Great Northern Ag	Yellow
	Jetset	Meridian Seeds	Yellow
	K-2	Pulse USA	Green
	Korando	Pulse USA	Yellow
	LN 1123	Pulse USA	Green
	Majestic	Legume Logic	Yellow
	Majoret	Pulse USA	Green
	MP 1907	Legume Logic	Yellow
	Mystique	Pulse USA	Yellow
	Navarro	Great Northern Ag	Yellow
	Nette 2010	Pulse USA	Yellow
	Salamanca	Great Northern Ag	Yellow
	Spider	Great Northern Ag	Yellow
	SW Marquee	Legume Logic	Yellow
	SW Midas	Pulse USA	Yellow
	Viper	Pulse USA	Green
Lentil	CDC Maxim	Pulse USA	Small red
	CDC Invincible	Pulse USA	Small green
	CDC Imi-Green	Pulse USA	Medium green
Chickpea	CDC Orion	Meridian Seeds	Kabuli type

PROJECT DESCRIPTION AND OBJECTIVE

Project Description

Cool season spring pulse crops (pea, lentil, and chickpea) production in Montana is increasing rapidly. In order to sustain these crops production, information on varietal testing and improved agronomic management practices are needed. Those results will provide unbiased information to stakeholders to increase yield and enhance crop diversification in the State. This will have substantial contribution to achieve economic, social, and environmental sustainability.

The Eastern Agricultural Research Center (EARC) of Montana State University (MSU) is currently coordinating a series of Statewide and Western Regional dry pea, lentil and chickpea variety evaluation trials across Montana. This project is designed to work together with pulse breeders and researchers from Montana State University, North Dakota State University, USDA-ARS Pullman, WA, Saskatchewan University, Canada, private seed companies and pulse growers. In 2016, the trials were conducted at seven Agricultural Research Centers and Bozeman Post Farm of MSU plus two cooperating producers' fields near Broadview and Richland, Montana. This annual report contains the results of those evaluations and summary from multiple years. The report is available to stakeholders free of charge to promote crop diversification and pulse production in Montana State.

Objective

The objective of these trials was to evaluate spring dry pea, lentil and chickpea commercial varieties and experimental lines for adaptability and yield potential across Montana State.

METHODS

Procedures and Experimental Design

The Eastern Agricultural Research Center invited individual private seed companies and breeders to submit varieties and entries of dry pea, lentil and chickpea for 2016 evaluation. Available locations for evaluations were indicated in the invitation letter. All sites were dry land except three irrigated sites (Corvallis, Huntley and Sidney). The Western Regional variety evaluations were organized by the breeders at Pullman, WA and Fargo, NDSU. The coordinating center treated all the seeds with fungicides (Apron MAXX[®] RTU, Syngenta Crop Protection, Inc.) to protect fungal diseases. Furthermore, the seeds were additionally treated with thiamethoxam insecticide (Cruiser MAXX[®], Syngenta Crop Protection, Inc.) to minimize pea leaf weevil damage. Seeds were packaged per plot at EARC, and shipped to testing sites together with appropriate rhizobium inoculant. The seed rates were 8, 12 and 5 live seeds per ft² for pea, lentil and chickpea, respectively. The experiments were carried out in randomized complete block design with four replications in most of the locations. Plot size varied from site to site depends on land availability and machinery used for seeding and harvesting. Best management practices were employed using available resources at each site. The researchers at the respective sites recorded plant density, plant height, days to flowering, grain yield, test weight, grain moisture content and thousand kernel weights for most of the sites and submitted the data to the coordinating office. In addition, the coordinating center received subsamples from the collaborators for further quality analysis. Grain yield data was adjusted to 13% moisture content before statistical analysis. Analysis of variance were done using GLM of SAS statistical package (SAS 9.4). The protected LSD ($\alpha = 0.05$) procedure was used to differentiate treatment means.

Collaborators and Experimental Locations

The type and number of these pulse crops and varieties evaluated at the different sites varied from site to site depending on the interest of seed suppliers and availability of resources at the respective sites. The collaborating research sites, location and type of crop they evaluated in 2016 are shown in Table 2.

Site Information and Agronomic Management Practices

Precipitation, site information and agronomic management practices for the respective sites are summarized in Tables 3 and 4.

Table 2. Summary table showing collaborators and locations participated in 2016 spring pulse variety evaluation trials.

Collaborators [†]	Location	Conditions	Pea	Lentil	Chickpea	Observations
CARC	Moccasin	Dry land	X	X	X	
EARC	Richland	Dry land	X	X	X	
EARC	Sidney	Irrigated	X	X	X	
EARC	Sidney	Dry land	X	X	X	
LRES	Bozeman	Dry land	X	X		
NARC	Havre	Dry land	X	X		
NWARC	Creston	Dry land	X	X		
SARC	Broadview	Dry land	X	X		Hail damage
SARC	Huntley	Dry land	X	X	X	Hail damage
SARC	Huntley	Irrigated	X	X	X	Hail damage
WARC	Corvallis	Irrigated	X	X	X	
WTARC	Conrad	Dry land	X	X	X	

[†]CARC = Central Agricultural Research Center, EARC = Eastern Agricultural Research Center, LRES = Land Resources and Environmental Sciences, NARC = Northern Agricultural Research Center, NWARC = Northwest Agricultural Research Center, SARC = Southern Agricultural Research Center, WARC = Western Agricultural Research Center, WTARC = Western Triangle Agricultural Research Center.

Precipitation

The total amount of precipitation received from April 1, 2016 to Aug 31, 2016 varied from site to site. The summary is shown in Table 3. Among the different sites, Corvallis received very low precipitation during this growing period but Sidney received the highest rainfall.

Table 3. Growing season and long term average precipitation and irrigation amount applied for each location

	Bozeman (LRES)	Conrad (WTARC)	Corvallis (WARC)	Creston (NWARC)	Havre (NARC)	Huntley (SARC)	Moccasin (CARC)	Sidney (EARC)
Seasonal precipitation (inch) (April – Aug, 2016)	6.02	8.68	4.53	9.01	13.47	8.09	9.83	19.11
Site Average (inch)		8.52	2.57	9.33	8.03	8.79	10.73	15.54
Irrigation applied (inch)			7" (0.6" every week after planting)			2.5" total for pea one time; and for lentil and chickpea three times each time 1.5" with total of 4.5"		0.88, 1.5, 1.25, 0.75 and 1.45" in May 17, June 10, 11, 16 and 24, respectively

Agronomic practices

The previous crops, seeding and harvesting dates, fertilization and weed management were different for the different testing sites. The summary of these practices and soil types by location are shown in Table 4.

Table 4. Major site information and agronomic management practices by location

	Bozeman (LRES)	Conrad (WTARC)	Corvallis (WARC) Irri.	Creston (NWARC)	Sidney dry and Irri. (EARC)	Havre (NARC)	Huntley (SARC)	Moccasin (CARC)	Richland
Tillage		Chemical fallow	Culti-roller	Conventional	Conventional	No-till	No till	No till	No till
Soil Type	Amsterdam silt loam		Burnt Fork Loam	Creston silt loam	Williams clay loam	Hilton Clay Loam		Judith clay	
Elevation (ft)	4800	3710	3600	2900	2200	2712	2725	4243	2950
Pea Trials									
Dates:									
Seeding		Apr. 22	Apr. 26	Apr. 22	Apr. 8 dry and Apr. 21 irri.	Apr. 21 statewide and 22 western regional	April 4, 8 and 22 for B.view, dryland and irri., respectively.	April. 8	May 3
Harvest	July 26	Aug. 30 and 31,	Sep. 26	Aug. 22	July 19 dry and July 29 irri.	July 26	Jul 18, 19 and Aug. 8 for irri., dryland and B.view respectively.	Aug. 1	Aug. 25
Previous crop			Barley	Barley	Cereals for irri. and fallow for dryland	Spring wheat	Cereal for irri. and fallow for dryland	Winter wheat	Chemical fallow
Fertilizer					44-0-0	None	None	None	None
Herbicides and insecticide		Prowl H ₂ O @3 pints/acre	Glyphosate at 1.7qt/ac and Prowl H ₂ O 1.7 qt/ac and Assure II at 10.5oz/ac Sevin 1.5 qrts/ac for pea weevils	May 18, 2016: Pursuit 2 oz/A + Basagran 16 oz/A + NIS 1qt/100 gal+2.5gal/100 gal 28%UAN June 3, 2016: Basagran 2 pt/A + Crop oil 1 pt/A + 4 pt/A 28%UAN June 23/2016:	Prowl H ₂ O at 3pt/ac and Assure II at 12 fl oz/ac.	Prowl H ₂ O; 2 pt/ac and Mustang Maxx, 4 oz/ac	RT3 24 oz/ac + 2pt Prow/ac	RT3 (18 fl oz/ac); Assure II (10 fl oz/ac); Prowl (32 fl oz/ac); RT3 (12 fl oz/ac); Warrior II (1.5 fl oz/ac); Assure II (12 fl oz/ac); Base Camp (10 fl oz/ac); Base Camp (16 fl oz/ac); RT3 (20 fl oz/ac	Roundup and ProwlH ₂ O
Lentil Trials									
Dates:									
Seeding		Apr. 27	Apr. 26	Apr. 22	Apr 11 dry and Apr 22 irri.	Apr. 22 statewide and May 3 western	April. 4-8	Apr. 8	May 4
Harvest		Sep. 10	Sep. 26	Aug. 29	Aug. 8 dry and irri.	Aug. 4	Aug. 8-16	Aug. 1	Oct. 14

Previous crop			Barley	Barley	Same as pea	Spring wheat	Barley	Winter wheat	Chemical fallow
Fertilizer			No		44-0-0	None			
Herbicides and insecticide		Prowl H ₂ O @3 pints/acre	Prowl H ₂ O; Assure II; Sevin XLR	Dimetric (metribuzin) 1/3 lb/A in June 27, 2016	Same as pea	Prowl H ₂ O; 2 pt/ac and Mustang Maxx, 4 oz/ac	RT3 24 oz/ac + 2pt Prowl/ac	Same as pea	Same as pea
Chickpea Trials									
Dates:									
Seeding		Apr. 26	Info was not available for this report	Not Applicable	April 12 dryland and April 22 irri.	Not Applicable	Apr. 21 and 22 for irri. and dryland, respectively.	Apr. 11,	May 4
Harvest		Sep. 10		Not Applicable	Aug. 17 dryland and Sep. 19 irri.	Not Applicable	Aug. 23 and 24 for dryland and irri., respectively	8/17/2016 (1 rep), 8/23/2016 (2 reps)	Oct. 15
Previous				Not Applicable	Same as pea	Not Applicable	Fallow for dryland and barely for irri.	Winter wheat	Fallow
Fertilizer				Not Applicable	Same as pea	Not Applicable			
Herbicides and insecticide		Prowl H ₂ O @3 pints/acre		Not Applicable	Same as pea	Not Applicable	RT3 24 oz/ac + 2pt Prowl/ac	RT3 (18 fl oz/ac); Assure II (10 fl oz/ac); Prowl (32 fl oz/ac); RT3 (12 fl oz/ac); Base Camp (10 fl oz/ac); Base Camp (16 fl oz/ac); RT3 (20 fl oz/ac)	Same as pea

RESULTS

The results presented in this report include from Statewide and Western Regional dry pea, lentil and chickpea variety evaluation trials. First, results from dry pea (yellow and green) are presented followed by lentil and chickpea. Unusual hail at Huntley resulted in serious damage to peas, lentils and chickpea variety trials particularly in dryland site. Therefore, there was no data for chickpea from the dryland site. At Corvallis site, data for chickpea were not ready for these report due to late harvest. At Richland site, there was severe disease and deer damage to lentil and chickpea variety trials. In some cases, some varieties yield almost nil for some plots due to sever disease pressure as result of late wet condition. In addition, the chickpea yield was very low at Richland site due to cold weather at the time of grain filling. At Conrad site, the trials were not randomized. We suggested to use randomization for the next season even if things looks homogenous from the soil point of view. With this brief introduction, the results are presented as follows.

Dry Pea

Statewide Dry Pea Variety Evaluation

A total of 53 dry pea varieties/entries (33 yellow and 20 green) (both commercial varieties and experimental lines) were evaluated in 2016 at 12 sites (Bozeman, Broadview, Conrad, Corvallis, Creston, Havre, Huntley dryland and Huntley irrigated, Moccasin, Richland and Sidney dryland and irrigated) across Montana State. Three of these sites (Huntley, Corvallis and Sidney) were irrigated. Some varieties submitted by private companies on a fee basis were tested at select locations only. Some entries from the pea line advancement trial were included in the statewide pea variety trial. The most common data collected and presented include grain yield, thousand kernel weight, test weight, plant height and number of days to flowering. However, only grain yield (bottom line) was consistently collected in the different testing sites. We suggest other researchers to strictly follow the research protocol to make it easier for comparison of entries across environments for the different parameters. The dry pea results are reported into two groups based on cotyledon color (yellow and green).

Yellow pea grain yield

Yellow pea grain yield varied greatly from site to site due to probably differences in environmental conditions and management practices. Mean grain yield for yellow pea for the different locations ranged from 659 lb/ac at Broadview to 5541 lb/ac at Richland (Table 6). The extremely low yields recorded at Broadview and Huntley Dryland were due to hail damage at flowering stage. Application of supplemental irrigation showed that the yield was increased by 966 lb/ac at Huntley irrigated compared with Huntley dryland. This may indicate the contribution of irrigation to recover from stress such as hail damage. Average yellow pea yields were 2320 lb/ac at Bozeman, 659 lb/ac at Broadview, 4039 lb/ac at Conrad, 2692 lb/ac with irrigation at Corvallis, 5414 lb/ac at Creston, 2438 lb/ac at Havre, 692 lb/ac Huntley (dryland), 1658 lb/ac Huntley irrigated, 1445 lb/ac at Moccasin, 5541 lb/ac at Richland, 3924 lb/ac Sidney dryland and 4158 lb/ac at Sidney irrigated (Table 6). The grain yields from irrigated sites (Huntley and Sidney) were substantially higher than yields from their respective dryland sites. This demonstrated the possibility to increase grain yield of pea with supplemental irrigation.

Yellow pea thousand kernel weight (TKW)

In 2016, only few testing sites recorded TKW and difficult to make conclusion. From the collected information, the highest was recorded from Moccasin site (249 g /1000 seeds) (Table 7).

Yellow pea test weight

Test weight data were recorded in most of the sites as shown in Table 8. The lowest mean test weight was recorded in Huntley (dryland) and the maximum was recorded at Broadview site (Table 8).

Yellow pea plant height

Mean plant height ranged from 18 cm to 100 cm. The lowest mean plant height was recorded from Corvallis site and the highest was recorded from Richland site (Table 9). Those entries that are tall and upright are important for harvesting. In addition, they produce more residue that will be left in the field after harvest. This will have substantial contribution to improve soil health.

Yellow pea days to flowering

Days to flowering data were recorded for most of the locations. From those locations, the mean number of days to flowering was longer at Moccasin (76 days) compared to other sites (Table 10). Moccasin also had longer time to flower in 2013, 2014 and 2015 compared with other sites.

Green pea grain yield

Some characteristics of the green pea entries are shown in Table 11. The mean grain yield for green pea ranged from 562 lb/ac to 5166 lb/ac. The average yields for green pea were 2162 lb/ac at Bozeman, 562 lb/ac at Broadview, 4003 lb/ac at Conrad, 2258 lb/ac at Corvallis with irrigation, 4717 lb/ac at Creston, 2265 lb/ac at Havre, 667 lb/ac at Huntley (dryland), 1579 lb/ac at Huntley (irrigated), 1303 lb/ac at Moccasin, 5166 lb/ac at Richland, 3571 lb/ac at Sidney dryland and 3917 at Sidney with irrigation (Table 12). The mean grain yield both for green and yellow pea was higher at Richland site than other locations.

Green pea thousand kernel weight (TKW)

TKW data for green pea was recorded only for few sites and ranged from 210 gm per 1000 seeds to 227 gm per 1000 seeds (Table 13).

Green pea test weight

The mean test weight for green pea ranged from 58.08 lb/bu to 66.24 lb/bu. The details are shown in Table 14.

Green pea plant height

Mean plant height ranged from 17 cm to 101 cm (Table 15). Similar to yellow pea, the mean green pea plant height was shorter at Corvallis.

Green pea days to flowering

The mean number of days to flower ranged from 56 days to 76 days at Moccasin (Table 16). Similarly, in 2014, the mean number of days to flowering was longer at Moccasin compared with other sites. The higher elevation in Moccasin have might resulted in lower temperature and slow growth thus taking more time to flower.

Summary

In 2016, the mean grain yield both for yellow and green pea was higher at Richland than other sites. Compared to all yellow pea varieties, the maximum mean grain yield (6845 lb/ac) was recorded from variety Nette 2010 at Creston. Similarly, the green color variety Viper resulted in maximum grain yield (6085 lb/ac) at Richland compared with other green color varieties. We found significant yield differences among varieties at several locations (Tables 6 and 12). On average, yellow pea varieties yielded 8% more grain yield than green pea. Several varieties have performed well in certain sites. However, none of the varieties consistently out yielded in all sites. In other words, the variety that resulted in maximum mean grain yield varied from location to location. This might suggest the importance of considering the release of site specific variety, due to the diverse ecologies of Montana, for better agronomic performances and economic returns.

Table 5. Yellow Dry Pea Variety Sources and Characteristics

Variety*	Size	Maturity	Height	Breeding Program	Release Date
AC Agassiz	M	Late	Mod	AC	2007
Bridger	M	Mod	Mod	LL	2011
CDC Treasure	M		Tall	CDC	2009
Delta	M	Mod	Short		1995
DS Admiral	L	Mod	Tall		2000
Gunner					
Jetset	L	Late	Mod		
Korando	L	Late	Mod		
Montech 4152	ML	Mod	Tall	LIMG	2009
Montech 4193	M	Mod	Mod	LIMG	
Mystique	L	Late	Mod		
Navarro	VL	Early	Mod		
Nette 2010					
Pro 127-2	M	Mod	Mod	PG	
Pro 793	VL	Early	Short	PG	
Salamanca					
Spider	L	Mod	Tall	LL	2008
SW Midas	M	Mod	Mod	SW	2004
Torch					
Trapeze	VL	Late	Short	SW	2010

CDC = Crop Development Centre, University of Saskatchewan; AC = Agriculture Canada; LL = Legume Logic; PG = ProGene Plant Research; LIMG = Limagrain, Nederland; SW = Svalöf-Weibull. *Because some of the breeding entries have not been registered and released as varieties and lack of information for other varieties, this table does not contain complete information for all entries tested.

Table 6. Montana Statewide Dry Yellow Pea Variety Evaluation – Grain Yield (lb/ac) in 2016.

Yellow pea variety/line	Bozeman	Broadview	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley* (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)	Sidney (Irri.)
AAC Carver			2985			2501			1468	5691	4101	5138
AAC Lacombe			2984			2575			1554		4494	4729
AC Earlstar	2509	884	4852	3148	5297	2164	877	1704	1285	5228	3953	4883
Abarth	2601	915	3841			2924	423	1193	1335	5940	4156	4051
Agassiz	2385		3863	3535	6274	2537			1545	5538	3915	5321
Bridger	2191	518	4223	2382	5201	2065	536	1296	1275	5791	3865	4474
CDC Amarillo		446	3960	2920	5623	2372	887	2042	1713	5451	4006	5347
CDC Saffron	2297	850	4367	3245	5520	2979	847	1798	1569	6043	4172	4887
CDC Treasure	2100	303	3434	2466	5576	2132	878	1895	1293	5560	4006	4756
DS Admiral	2229	461	3239	3005	5699	2562	716	1911	1428	5166	3591	4643
Delta	2265	734	3933	2519	5143	2132	829	1535	1405	5459	3628	4352
Durwood	2369	740	3988			2616	717	2068	1817	5694	3986	4591
Gunner			4606			2455	894	1558	1514	5767		
Hyline		605	3929			2475	702	1860	1341	5397		
Jetset	2560	471	3350	3066	5570	2636	851	1511	1422	6102	3812	4111
Korando		823	4394		5053	2462	521	1493	1303	5797	3851	4479
MP 1907											4596	5681
Majestic						2592			1595	6041		
Mystique										5704	3717	4036
Navarro	2167	788	4283	2555	4364	2305	467	1142	1279	5769	3765	3825
Nette 2010	2398	798	5329	3240	6845	2508	594	1814	1469	6486	4038	4458
PSO826MT460	2249	846	4286	1308	5286		309	1784	1480	4724	3791	3955
PSO826MT492	1937			1942	3488		389	890	1241		3993	5231
PSO877MT632	2540	908	3330	1860	5709	2347	553	2040	1470	3625	2921	4105
Pro 093-7410			4758	2583		2444			1427	5656		
Pro 143-6220						2018				4860		
Pro 143-6236						2317				4853		
Pro 822							524	1432				
SW Marquee										5434		
SW Midas										5112	3715	4381
Salamanca		589	4191		5954	2566	930	1680	1476	6154		
Spider		401	4666		5204	2259	874	2044	1392	5428		
Universal Yellow					5214							
Mean	2320	659	4039	2692	5414	2438	692	1658	1445	5541	3924	4617
P-Value	0.0329	<0.0001	0.0001	0.0001	<0.0001	<0.0001	0.0009	<0.0001	<0.0001	<0.0001	0.0004	<0.0001
LSD (0.05)	291	172	1072	745	816	286	262	282	225	800	536	663
CV (%)	8.64	18.46	18.78	19.59	10.66	8.31	26.83	12.04	11.03	10.27	9.67	10.15

Table 7. Montana Statewide Dry Yellow Pea Variety Evaluation –Thousand Kernel Weight (g) in 2016

Yellow pea variety/line	Bozeman	Broadview	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)	Sidney (Irri.)
AAC Carver						238			251			
AAC Lacombe						267			281			
AC Earlystar				233	216	211			235			
Abarth						258			271			
Agassiz				255	229	223			240			
Bridger				238	222	218			233			
CDC Amarillo				220	221	227			243			
CDC Saffron				231	252	237			244			
CDC Treasure				222	223	205			229			
DS Admiral				234	241	234			244			
Delta				215	250	227			229			
Durwood						234			245			
Gunner						234			252			
Hyline						241			252			
Jetset				252	247	239			236			
Korando					262	258			274			
MP 1907												
Majestic						239			256			
Mystique												
Navarro				282	276	273			286			
Nette 2010				262	250	226			245			
PSO826MT460				260	250				246			
PSO877MT492				234	229				240			
PSO877MT632				226	234	224			241			
Pro 093-7410				211		202			243			
Pro 143-6220						215						
Pro 143-6236						205						
Pro 822												
SW Marquee												
SW Midas												
Salamanca					254	249			258			
Spider					241	239			258			
Universal Yellow					242							
Mean				238	241	232			249			
P-Value				<0.0001	<0.0001	<0.0001			<0.0001			
LSD (0.05)				20.6	10	7.2			11.4			
CV (%)				6.11	2.94	2.17			3.22			

Table 8. Montana Statewide Dry Yellow Pea Variety Evaluation – Test Weight (lb/bu) in 2016

Yellow pea variety/line	Bozeman	Broadview	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)	Sidney (Irri.)
AAC Carver			64.10			62.00			66.98	64.25	64.28	63.00
AAC Lacombe			62.78			60.98			65.58		65.00	63.35
AC Earlystar	64.96	66.43	64.03	61.02	64.05	61.58	58.83	64.13	66.83	64.28	64.05	62.35
Abarth	65.26	65.23	62.95			61.38	59.70	63.20	66.23	63.65	64.28	62.30
Agassiz	64.53		60.33	60.95	62.70	61.30			66.10	63.03	64.13	62.42
Bridger	65.67	66.73	61.35	61.72	64.70	62.18	61.70	63.70	67.40	64.70	64.55	62.98
CDC Amarillo		66.08	64.00	61.88	64.63	61.43	61.00	63.30	66.25	64.55	64.48	63.20
CDC Saffron	65.27	66.33	61.05	61.83	65.08	61.90	58.00	61.60	66.40	64.20	64.78	63.30
CDC Treasure	65.97	64.78	63.55	62.10	64.75	62.18	57.07	63.55	67.25	65.45	64.78	63.85
DS Admiral	64.33	66.58	61.90	61.85	63.98	61.53	58.20	63.70	66.45	64.35	63.50	62.60
Delta	65.57	66.33	62.18	61.92	63.85	61.93	56.43	62.30	67.10	63.63	64.20	62.05
Durwood	65.40	66.38	63.08			61.70	58.70	64.45	67.23	63.98	64.05	62.50
Gunner			65.20			61.43	62.67	63.63	66.60	64.15		
Hyline		66.63	65.35			61.80	61.03	62.43	66.33	64.35		
Jetset	65.70	67.18	60.53	61.60	64.70	61.18	61.00	62.35	66.75	64.55	64.13	62.45
Korando		65.70	60.63		64.13	61.18	57.93	62.68	66.28	63.75	62.75	61.65
MP 1907											64.53	63.85
Majestic						61.60			66.38	64.55		
Mystique										63.18	63.70	62.66
Navarro	65.46	65.83	62.88	60.25	64.48	61.15	57.20	62.45	66.10	64.20	63.78	62.38
Nette 2010	66.13	67.13	64.93	62.67	65.80	61.70	58.63	63.00	67.63	65.23	64.75	63.42
PSO826MT460	64.33	65.73		60.43	63.13		61.50	63.80	65.73	62.00	63.20	62.07
PSO826MT492	64.93		61.33	61.47	63.43		60.30	62.30	66.80		64.27	
PSO877MT632	65.67	66.27	63.60	61.07	63.63	61.97	58.70	64.27	66.60	64.17	63.67	61.90
Pro 093-7410			64.05	62.02		61.50			66.85	64.58		
Pro 143-6220						61.43				64.50		
Pro 143-6236						61.68				64.05		
Pro 822							58.37	65.13				
SW Marquee										64.48		
SW Midas										64.18	64.42	63.15
Salamanca		65.30	64.27		64.05	61.45	60.47	57.08	67.10	64.05		
Spider		66.18	62.83		63.73	61.58	62.23	64.50	66.00	63.80		
Universal Yellow					63.48							
Mean	65.27	66.16	62.84	61.52	64.16	61.58	59.42	62.97	66.60	64.15	64.16	62.76
P-Value	0.0004	0.6595	0.2640	0.0035	<0.0001	0.0586	0.6776	0.3465	0.0004	<0.0001	<0.0001	<0.0001
LSD (0.05)	0.78	Ns	Ns	1.14	0.89	Ns	Ns	Ns	0.86	0.82	0.82	0.72
CV (%)	0.71	2.02	4.05	1.32	0.98	0.80	5.50	4.79	0.92	0.90	0.90	0.81

Table 9. Montana Statewide Dry Yellow Pea Evaluation – Plant Height (cm) in 2016

Yellow pea variety/line	Bozeman	Broadview	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)	Sidney (Irri.)
AAC Carver			58			60			52	103	69	60
AAC Lacombe			52			62			48		70	71
AC Earlstar	63		57	20	109	54	41	70	46	114	63	64
Abarth	55		58			61	38	73	42	96	64	61
Agassiz	54		50	19	114	56			41	95	59	53
Bridger	52		47	18	88	50	41	58	39	102	58	61
CDC Amarillo			56	25	93	57	47	76	49	107	69	72
CDC Saffron	48		57	16	89	54	36	63	43	98	66	60
CDC Treasure	60		74	19	105	56	47	72	47	100	62	59
DS Admiral	59		59	18	102	57	47	76	46	103	59	57
Delta	45		58	13	87	46	35	62	35	94	61	47
Durwood	64		70			58	40	87	54	108	72	65
Gunner			55			61	41	73	49	104		
Hyline			56			57	36	71	47	103		
Jetset	57		59	17	98	59	43	72	48	99	62	66
Korando			58		100	52	46	70	41	102	61	57
MP 1907											60	69
Majestic						58			46	109		
Mystique										110	64	72
Navarro	55		58	17	88	50	40	70	42	103	60	54
Nette 2010	53		63	18	96	54	39	67	41	94	63	62
PSO826MT460	41			14	88		26	62	40	94	62	43
PSO826MT492	51		56	17	91		33	52	42		52	60
PSO877MT632	52		50	14	100	54	36	60	44	97	65	27
Pro 093-7410			54	17		47			43	95		
Pro 143-6220						56				100		
Pro 143-6236						48				86		
Pro 822							37	71				
SW Marquee										99		
SW Midas										90	59	58
Salamanca			47		106	62	45	74	47	100		
Spider			57		112		47	76	45	102		
Universal Yellow					89							
Mean	54		57	18	98	56	40	69	45	100	63	59
P-Value	<0.0001		<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.2567	0.0695	<0.0001
LSD (0.05)	3.6		5.1	3.6	14.8	7.1	5.7	8.6	5	Ns	Ns	9.9
CV (%)	4.05		6.31	14.43	10.71	8.98	10.11	8.75	9.49	12.32	10.99	11.84

Table 10. Montana Statewide Dry Yellow Pea Variety Evaluation – Number of Days to Flowering in 2016

Yellow pea variety/line	Bozeman	Broadview	Conrad*	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)	Sidney (Irri.)
AAC Carver			67			60			77		70	58
AAC Lacombe			68			62			79		71	57
AC Earlystar			65	63	62	58			76		68	55
Abarth			64			59			75		68	56
Agassiz			65	61	65	60			76		70	58
Bridger			64	59	63	58			75		67	55
CDC Amarillo			65	63	66	61			78		70	58
CDC Saffron			66	65	65	61			78		70	57
CDC Treasure			64	63	62	58			75		69	55
DS Admiral			65	63	63	60			76		68	56
Delta			62	63	60	57			75		67	57
Durwood			64			58			76		70	57
Gunner			66			59			76			
Hyline			65			60			76			
Jetset				63	64	60			75		70	55
Korando			58		63	55			73		66	57
MP 1907											70	58
Majestic						59			78			
Mystique											70	58
Navarro			58	55	61	55			74		65	56
Nette 2010			60	55	59	57			75		66	57
PSO826MT460			64	58	59				74		68	58
PSO826MT492				55	59				74		68	56
PSO877MT632			65	58	61	57			75		67	58
Pro 093-7410			61	57		58			75			
Pro 143-6220						61						
Pro 143-6236						58						
Pro 822												
SW Marquee												
SW Midas											70	57
Salamanca			64		65	59			76			
Spider			66		66	60			77			
Universal Yellow					59							
Mean			64	60	62	59			76		68	57
P-Value			<0.0001	<0.0001	<0.0001	<0.0001			<0.0001		<0.0001	<0.0001
LSD (0.05)				3.7	1.7	0.9			1.63		2.3	1.5
CV (%)				4.37	1.88	1.10			1.52		2.42	1.88

*There was no flowering date difference for a variety between reps. That means, a variety flower the same date in the different replications.

Table 11. Green Pea Variety Sources and Characteristics

Variety*	Size	Maturity	Height	Breeding	Release
Aragorn	M	Mod	Mod	PG	2006
Arcadia	M	Mod	Short		2009
Banner	M	Early	Tall	PG	2007
Bluemoon	VL	Late	Short		
CDC Striker	L	Mod	Mod	CDC	2002
Cruiser	S	Mod	Tall	PG	2002
Daytona	VL	Late	Short		
Greenwood					
K2	M	Mod	Mod	LL	2005
Majoret	M	Mod	Short	SW	1994
PS07ND0190	M	Late	Tall	NDSU	
Shamrock					
Viper	L	Late	Mod		

PG = ProGene Plant Research; CDC = Crop Development Centre, University of Saskatchewan; LL = Legume Logic; NDSU = North Dakota State University; LIMG = LImagrain, Netherlands; SW = Svalöf-Weibull.

*Because some of the breeding entries have not been registered and released as varieties and lack of information for other varieties, this table does not contain complete information for all entries tested and no inclusive.

Table 12. Montana Statewide Dry Green Pea Variety Evaluation – Grain Yield (lb/ac) in 2016.

Green pea variety/line	Bozeman	Broadview	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)	Sidney (Irri.)
Aragon	1948		4939	1911	4404	1720			1204	5036	2966	3507
Arcadia	2029	604	4838			2479	541	1691	1186	5865	3783	5277
Banner			3706			2224			1308			
CDC Patrick			2944			2303			1393	4703	3733	4737
CDC Raezer			2764			2135			1335	4778	3707	3825
Cruiser	2001		2923	2632	4737	2008			1155	5291	3294	4218
Ginny		512	3696			2402	739	1484	1294	5697		
Greenwood	1957		3863	2639	5128	2121			1361	5406	3795	4440
Hampton	2407	669	3923	2269	5083	2797	773	1884	1444	4023	3630	4103
K2											3468	4161
LN 1123	2189	750	4089			2695	751	1638	1372	5846	3656	2068
Majoret	2067	282	2367	1710	5024	2459	693	1300	1265	4897	3819	4406
PS0877MT457	2325	536			4952		747	1395	1416	5330	3275	4470
PSO826MT190	2171	586	4386	2919	4764	2125	869	1691	1174	5100	3579	3484
PSO877MT076	2350	884	4231	2337	4540	2356	412	2421	1426	3797	3701	3110
PSO877MT499	2067	422	4670	2041	3557	2016	523	1317	1239	5456	3681	2440
Pro 131-6221			5106									
Pro 131-7123			4730			2455	720					
Pro 131-7125			4643			2221						
Viper	2439	447	3636			1976	532	1105	1294	6085	3477	3963
Mean	2162	562	4003	2258	4717	2265	667	1579	1303	5166	3571	3917
P-value	0.0211	0.0007	0.0004	0.0404	0.0621	<0.0001	0.0454	<0.0001	0.0008	<0.0001	0.4467	<0.0001
LSD (0.05)	275	167	1173	720	Ns	286	217	234	184	603	Ns	562
CV (%)	9.02	21.11	20.71	22.56	13.21	8.94	23.02	10.49	10.01	8.14	12.22	10.13

Table 13. Montana Statewide Dry Green Pea Variety Evaluation – Thousand Kernel Weight (TKW in g) in 2016

Green pea variety/line	Bozeman	Broadview	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)	Sidney (Irri.)
Aragon				226	224	204			222			
Arcadia						206			216			
Banner						199			223			
CDC Patrick						184			201			
CDC Raezer						219			236			
Cruiser				223	221	203			208			
Ginny						211			218			
Greenwood				207	215	199			215			
Hampton				241	226	223			241			
K2												
LN 1123						229			236			
Majoret				219	235	232			239			
PS0877MT457					235				244			
PSO826MT190				221	219	208			231			
PSO877MT076				210	201	209			225			
PSO877MT499				250	230	222			227			
Pro 131-6221												
Pro 131-7123												
Pro 131-7125												
Viper						189			253			
Mean				225	223	210			227			
P-value				0.1070	<0.0001	<0.0001			<0.0001			
LSD (0.05)				Ns	8.6	5.6			11.9			
CV (%)				7.04	2.73	1.89			3.73			

Table 14. Montana Statewide Dry Green Pea Variety Evaluation – Test Weight (lb/bu) in 2016

Green pea variety/line	Bozeman	Broadview	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)	Sidney (Irri.)
Aragon	63.60		64.20	61.05	63.25	61.48			65.08	64.25	63.35	62.10
Arcadia	64.27	65.95	64.35			61.78	61.80	66.18	66.88	64.15	61.18	62.50
Banner			62.63			61.85			66.65			
CDC Patrick			64.77			61.43			66.55	64.20	63.88	62.13
CDC Raezer			64.55			61.10			66.10	64.33	63.48	62.82
Cruiser	63.40		63.25	61.60	63.35	61.00			65.23	64.08	64.35	62.33
Ginny		66.20	64.73			61.30	55.10	65.45	66.73	64.30		
Greenwood	65.00		64.35	63.07	64.53	62.18			66.45	64.83	64.70	63.37
Hampton	63.87	64.83	63.88	60.00	62.65	60.88	57.87	60.88	65.53	63.20	63.83	61.38
K2											63.70	62.60
LN 1123	66.13	67.18	61.73			61.75	58.03	65.65	67.18	64.00	64.20	62.60
Majoret	64.70	62.93	62.20	62.20	64.03	61.43	59.37	63.58	66.83	65.08	64.50	62.63
PS0877MT457	63.87	65.40			62.57		59.43	62.83	65.57	63.37	62.67	62.33
PSO826MT190	64.60	65.43	61.00	62.75	63.87	61.17	60.00	63.43	65.60	63.47	63.47	61.77
PSO877MT076	63.90	65.15	62.17	61.80	62.60	60.80	55.50	61.43	66.17	63.53	63.43	61.90
PSO877MT499	65.03	64.40	62.80	60.27	63.73	62.23	58.33	62.60	66.50	64.17	63.70	61.50
Pro 131-6221			63.43									
Pro 131-7123			62.95				57.53					
Pro 131-7125			63.45									
Viper	65.17	65.65	62.90			60.63	56.27	62.58	66.60	64.33	63.75	62.15
Mean	64.46	65.31	63.38	61.49	63.42	61.40	58.08	63.56	66.24	64.10	63.84	62.28
P-value	<0.0001	0.1413	0.1608	0.0403	0.0010	<0.0001	0.5899	0.2464	<0.0001	<0.0001	0.0127	0.3568
LSD (0.05)	0.79	Ns	Ns	1.47	0.74	0.52	Ns	Ns	0.31	0.55	0.88	Ns
CV (%)	0.73	2.41	2.52	1.69	0.82	0.60	6.47	4.63	0.67	0.59	0.98	1.44

Table 15. Montana Statewide Dry Green Pea Variety Evaluation – Plant Height (cm) in 2016

Green pea variety/line	Bozeman	Broadview	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)	Sidney (Irri.)
Aragon	48		48	16	87	57			43	108	57	44
Arcadia	42		41			47	31	57	36	97	58	47
Banner			51			51			42			
CDC Patrick			54			58			46	94	59	59
CDC Raezer			68			55			49	100	69	58
Cruiser	52		61	18	89	52			41	103	54	51
Ginny			53			50	36	66	39	107		
Greenwood	47		53	18	85	52			39	84	60	47
Hampton	47		54	14	85	53	37	66	35	93	57	31
K2											59	54
LN 1123	51		54			57	44	72	42	99	64	66
Majoret	53		54	18	92	54	46	67	43	89	58	50
PS0877MT457	57				111		41	76	44	107	58	49
PSO826MT190	52		54	18	109	60	46	71	49	114	60	69
PSO877MT076	55		52	19	108	60	28	67	39	107	55	52
PSO877MT499	55		51	18	82	51	43	66	40	114	62	42
Pro 131-6221			50									
Pro 131-7123			52				35					
Pro 131-7125			50									
Viper	59		53			52	40	66	46	105	65	51
Mean	52		53	17	93	53	39	67	42	101	60	51
P-value	<0.0001		<0.0001	0.5487	0.0124	0.0006	0.0100	0.0009	<0.0001	0.2576	0.2683	0.0013
LSD (0.05)	5.4		3.6	Ns	16.8	6.3	7.5	6.9	5.42	Ns	Ns	13.8
CV (%)	6.26		4.78	16.13	12.79	8.39	13.69	7.23	9.16	12.75	11.51	19.11

Table 16. Montana Statewide Dry Green Pea Variety Evaluation – Number of Days to Flowering in 2016

Green pea variety/line	Bozeman	Broadview	Conrad*	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)	Sidney (Irri.)
Aragon			64	55	60	58			75		67	54
Arcadia						59			77		69	55
Banner			64			56			71			
CDC Patrick						61			77		70	58
CDC Raezer			64			59			77		70	57
Cruiser			64	55	61	59			76		69	55
Ginny			65			58			75			
Greenwood			66	61	60	58			75		70	56
Hampton				63	66	61			77		71	57
K2											66	57
LN 1123						61			79		69	57
Majoret				63	65	61			78		69	55
PS0877MT457					59				74		65	55
PSO826MT190			64	63	63	59			77		69	57
PSO877MT076			64	63	64	59			77		67	58
PSO877MT499			66	55	59	56			73		65	56
Pro 131-6221			65									
Pro131-7123			65									
Pro131-7125			66									
Viper			66			61			75		67	55
Mean			65	60	62	59			76		68	56
P-value			<0.0001	0.0034	<0.0001	<0.0001			<0.0001		0.0008	0.0047
LSD (0.05)				4.0	1.6	0.8			1.4		2.7	1.62
CV (%)				5.14	1.78	0.99			1.29		2.79	2.03

*There was no flowering date difference for a variety between reps. That means, a variety flower the same date in the different replications.

Multi-Year and Multi-Location Statewide Dry Pea Variety Evaluation Summary

Multi-year (2009-2016) Summary:

The multi-year grain yield data for different varieties and locations are shown in Table 17. One of the problem with this multi-year data is that every year variety changed and make it difficult for comparison purpose to calculate the mean for a variety across years. This is because the interest of seed companies to test their varieties change every year in terms of submitting type of varieties and selecting testing sites. However, this table may provide some information for those interested in the magnitude of yield change across years for only those few varieties submitted every year.

Table 17. Montana Statewide Dry Pea Variety Evaluation – 2009-2016 Multi-Year Grain Yield Summary (lb/ac)

Varieties	Bozeman								Conrad							
	2009	2010	2011	2012	2013	2014	2015	2016	2009	2010	2011	2012	2013	2014	2015	2016
Yellow Pea																
AC Agassiz				905	1857	2492	1384	2385			2867	2746	1519	2876		3863
Bridger			2476	1085	1763	2464		2191			3259	2793	1741	2212		4223
Delta	2158	3118	2105	1011	1779		1564	2265	3996	869	2832	2526	1641			3933
DS Admiral	2486	3439	2206	910	1910	2665	1569	2229	3607	1212	3070	2204	1638	2795		3239
Montech 4152			2378	1074	2019	2444					3066	3116	1862	3456		
Spider			2188	1037	1971					1100	2664	2426	1748	3492		4666
SW Midas	2018	3436	2382	1048	1780	2396			3620	1212	2774	2674	1846	3216		
Yellow Ave*	2193	3277	2246	1008	1883	2452	1577	2320	3789	1181	2853	2745	1741	2723		4039
Green Pea																
Arcadia			2378	966	1978	2349	1101	2029			3178	2281	1718	3346		4838
CDC Striker	2343	2585	2081	918	1502	2283	1385		3189	1147	2632	2254	1812	2017		
Cruiser	2247	3041	2152	872	1731	2101		2001	3154	965	2746	2002	1488	2995		2923
K2			2018	962	1500					1304	2622	2246	1713	2619		
Majoret	2218	3008	2039	961	1705	2255	1110	2067	3345	1623	2382	2407	1607	2469		2367
Stirling	2031	3288	2184	1088					3932	926	2651	2746				
Green Ave*	2246	2934	2123	961	1709	2312	1370	2162	3307	1164	2581	2373	1704	1177		4003
Trial Mean [§]	2214	3145	2177	986	1811	2385	1504	2250	3585	1174	2702	2577	1734	2798		4023
LSD (0.05)[§]	310	639	NS	144	NS	NS	70	288	479	298	NS	NS	483	NS		1110
CV (%)[§]	10	14	7	10	11	14	16	9.04	8	18	14	29	20	32		19.51

*Average values brought from Tables 6 and 12 for yellow and green pea, respectively. [§]Indicate results when both green and yellow dry peas combined and analyzed together.

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Table 17. Statewide Dry Pea Variety Evaluations – 2009 – 2016 Multi-year Grain Yield Summary (lb/ac)...continued

Varieties	Corvallis								Creston							
	2009	2010	2011	2012	2013	2014	2015	2016	2009	2010	2011	2012	2013	2014	2015	2016
Yellow Pea																
AC Agassiz				2812	1902	1066	2169	3535				2282		4868	1172	6274
Bridger			1862	3170	2525	1593		2382				3747	4440	4632		5201
Delta	3276	3671	1674	2987	2594		2410	2519				3352	4020		889	5143
DS Admiral	2882	2941	1770	2518	2385	1622	2396	3005				3468	1065	5018	1192	5699
Montech 4152			1946	2899	2096	1395						4017	4346	5009		
Spider			2155	2899	1503							3657	4440	4890		5204
SW Midas	2828	4029	1998	3064	2333	1495						3340	3912	4888		
Yellow Ave*	3057	3590	1865	2907	2306	1350	2405	2692				3494	4404	5016	1144	5414
Green Pea																
Arcadia			2272	3029	2704	1295	2499					3545	4701	4283	1155	
CDC Striker	3144	3068	1866	2375	2053	1354	1960					3126	3391	3934	1137	
Cruiser	3046	3144	1967	2562	1543	1384		2631				2763	3150	4605		4737
K2			1894	2470	2000							2982	3418			
Majoret	3278	3812	1641	2447	1439	1570	2136	1710				3082	4303	4430	1243	5024
Stirling	3144	3525	1475									3278				
Green Ave*	3173	3313	1750	2630		1380	2327	2258				3129	3907	4462	1142	4717
Trial Mean [§]	3101	3483	1801	2779	2203	1362	2376	2551				3326	4215	4814	1098	5193
LSD (0.05) [§]	627	495	NS	1057	950	NS	NS	733				598	498	710	393	888
CV (%) [§]	14	10	23	14	30	17	31	20.32				12.59	8.36	10.43	25.32	12.10

*Average values brought from Tables 6 and 12 for yellow and green pea, respectively. [§]Indicate results when both green and yellow dry peas combined and analyzed together.

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Table 17. Statewide Dry Pea Variety Evaluations – 2009 – 2016 Multi-year Grain Yield Summary (lb/ac)...continued

Varieties	Havre								Huntley (Dry)							
	2009	2010	2011	2012	2013	2014	2015	2016	2009	2010	2011	2012	2013	2014	2015	2016
Yellow Pea																
AC Agassiz			2236	1965	2027	2215	1479	2537				1965		1144	1616	
Bridger			2149	1837	2127	1920	1561	2065			2360	1975	2687	892	1447	536
Delta	2446	3600	2139	2222	1700		1793	2132	2542	2517	1904	1414	2648		1635	829
DS Admiral	2331	3325	2102	1798	2008	2592	1897	2562	2669	2743	2128	1261	2840	1223	1733	716
Montech 4152		3505	2266	2146	1828	2056					2337	1491	2637	1103		
Spider			2071	1903	1734	1953	1526	2259			2283	1220	2710	1012	1547	874
SW Midas	2314	3348	2111	1729	2033	2100			2329	2760	2106	1855	2745	1151		
Yellow Ave*	2340	3495	2173	2039	2032	2228	2199	2438	2591	2773	2065	1630	2707	1126	1644	692
Green Pea																
Arcadia			2405	1930	2598	1817	1782	2479			2224	1639		956	1617	541
CDC Striker	2154	3222	2012	1953	1571	1833	1528		2417	2556	1568	1128		986	1541	
Cruiser	2254	3194	2286	1735	1669	1856		2008	2520	2575	1998	1232	2566	991		
K2			1576	1463	1650	1773					2092	1525		821		
Majoret	2352	3451	1612	1685	2193	2105	1822	2459	2501	2945	1660	1331		1128	1307	693
Stirling	2327	3274	1915	2122					2633	2874	1527	1942				
Green Ave*	2252	3241	1987	1874	2011	2080	1806	2265	2471	2632	1729	1482	2442	1042	1581	667
Trial Mean [§]	2306	3397	2069	1968	2022	2170	1776	2370	2545	2719	1878	1556	2634	1096	1623	683
LSD (0.05) [§]	290	325	NS	309	447	294	285	284	274	NS	NS	NS	300	295	NS	245
CV (%) [§]	9	7	13	11	14	10	11	8.47	8	12	20	29	8	19	15	25.32

*Average values brought from Tables 6 and 12 for yellow and green pea, respectively. [§]Indicate results when both green and yellow dry peas combined and analyzed together.

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Table 17. Statewide Dry Pea Variety Evaluations – 2009 – 2016 Multi-year Grain Yield Summary (lb/ac)...continued

Varieties	Joplin								Moccasin							
	2009	2010	2011	2012	2013	2014	2015	2016	2009	2010	2011	2012	2013	2014	2015	2016
Yellow Pea																
AC Agassiz									2855	1123	1100	559	2220	2287	1545	
Bridger			773	1387					2981	1160	1064	1826	2176		1275	
Delta		2491	775	1454					1177	3139	963	1313	1899		2644	1405
DS Admiral		2236	1012	1299					1158	2642	999	1295	1835	2213	2731	1428
Montech 4152			1040	1679					2533	1018	1084	1791	2176			
Spider			908	1202					2572	1005	1252	1750	2069	2702	1392	
SW Midas		2371	1060	1702					903	2603	1031	1165	1557	2019		
Yellow Ave*		2365	969	1454					1058	2796	992	1241	1678	2165	2654	1445
Green Pea																
Arcadia			1142	2017							978	1186	1655	2010	2333	1186
CDC Striker		2016	606	1517					1066	2427	774	1193	1753	2156	2212	
Cruiser		2162	977	1517					1001	2680	988	1123	1502	1860		1155
K2			748	1457						2436	851	1457	1259	1780		
Majoret		2514	465	1688					1091	2608	848	1027	1584	2054	2867	1265
Stirling		2630	1257	1854					1136	2907	838	1392				
Green Ave*		2259	790	1686					1091	2665	887	1200	1594	2029	2505	1303
Trial Means [§]		2324	870	1570					1071	2754	934	1224	1640	2113	2603	3160
LSD (0.05) [§]		562	NS	NS					208	203	120	NS	291	245	412	1023
CV (%) [§]		17	46	23					12	5	9	16	13	8	11	22.89

*Average values brought from Tables 6 and 12 for yellow and green pea, respectively. [§]Indicate results when both green and yellow dry peas combined and analyzed together.

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Table 17. Statewide Dry Pea Variety Evaluations – 2009 – 2016 Multi-year Grain Yield Summary (lb/ac)...continued

Varieties	Richland								Sidney dryland							
	2009	2010	2011	2012	2013	2014	2015	2016	2009	2010	2011	2012	2013	2014	2015	2016
Yellow Pea																
AC Agassiz			2224	3242	4107	1359	1596	5538				1619		2436		3915
Bridger		3295	2494	3878	3323	1145	1875	5791			2998	1249		1983		3865
Delta	2015	3226	1501	3706	3573		1923	5459	1887	3105	2662	1464				3628
DS Admiral	2018	3264	1664	3564	3645	1153	1735	5166	1757	3016	2517	1158		2693		3591
Montech 4152			1809	3409	3786	1216					2463	1586		2521		
Spider		2731	1910	1252	3959	1296	1859	5428			2504	1297				
SW Midas	1435	2321	2166	2983	3873	1034		5112	1511	3639	2589	1571		2909		3715
Yellow Ave*	1855	2999	1855	3566	3807	1200	1908	5541	1884	3489	2502	1421		2604		3924
Green Pea																
Arcadia			1494	3143	3777	1182	2273	5865			2772	1302		2575		3783
CDC Striker	1918	2976	1732	3270	2914	1125	1652		1988	3408	2212	1122		2594		
Cruiser	1797	2642	1684	3010	3289	998		5291	1806	2820	2223	1202		2440		3294
K2		2721	1772	3476	2803					2751	2296	1435				3468
Majoret	2221	2981	1653	3078	3022	1275	1873	4897	2080	3342	2233	1336				3819
Stirling	1565	2566	1493	3725					1658	3052	2601	2041				
Green Ave*	1927	2798	1628	3410	3440	1127	1907	5166	1898	3104	2341	1406		2515		3571
Trial Mean [§]	1882	2922	1729	3501	3622	1172	1908	5416	1964	3341	1659	1414		2569		3784
LSD (0.05) [§]	577	NS	289	NS	777	NS	NS	737	301	792	NS	465		NS		572
CV (%) [§]	21	13	10	16	15	30	17	9.62	9	9	14	20		13		10.69

*Average values brought from Tables 6 and 12 for yellow and green pea, respectively. [§]Indicate results when both green and yellow dry peas combined and analyzed together.

Table 18. Claims and/or Resistance of Commercial Pea Varieties

(This table is claims made by the breeding programs and/or commercial dealers and is not based on research conducted by MAES or EARC).

Variety*	Powdery Mildew Resistant ¹	Lodging Resistant ²	Height	<i>Fusarium</i> Resistance ³	Bleach Resistant ⁴	Maturity
AC Agassiz	X	X				
Aragorn		X			X	Med
Arcadia	X	X				Early
Banner		X				Early
Bluemoon	X	X	Tall			Med
Bridger	X	X	Tall			Early
CDC Striker			Med			Med
CDC Treasure	X	X				
Cruiser		X		X		Med
Daytona	X	X	Tall			Med
Delta				X		
DS Admiral	X	X				Early
Jet Set	X	X				Med
K2	X	X			X	Early
Korando						Early
Majoret		X				Med
Montech 4152			Tall			
Navarro	X	X				Early
Spider	X	X				Med
SW Midas	X	X				Early
Trapeze	X	X	Med			Early

¹Varieties exhibit above average resistance to Powdery Mildew; ²Varieties have above average resistance to lodging;

³Varieties are resistant to *Fusarium*; ⁴Varieties are resistant to bleaching; *Because some of the breeding entries have not been registered and released as varieties and lack of information for others, this table is not complete and inclusive.

Western Regional Dry Pea Variety Evaluation

The Western Regional dry pea variety evaluation trial was conducted at two locations (Havre and Richland). The trial consisted of six yellow and seven green dry pea advanced breeding lines and varieties at Havre site; and 11 yellow and seven green dry pea advanced breeding lines and varieties at Richland site. Most of the advanced breeding lines and varieties were obtained from the USDA-ARS Grain Legume Genetics and Physiology Program in Pullman, Washington.

The yellow pea average yield was 2936 lb/ac at Havre and 4938 lb/ac at Richland (Tables 19 - 20). Similarly, the average green pea yield was 2932 lb/ac at Havre and 4892 lb/ac at Richland (Tables 19 - 20). For the respective testing site, the mean grain yields for yellow and green pea were almost the same.

Table 19. Western Regional Dry Pea Variety Evaluation – Havre, MT in 2016

Variety/lines	Adjusted grain yield (lb/ac)	No. of days to flowering	Plant height (cm)	TKW (gm)	Test wt (lb/bu)
Yellow					
DS Admiral	2689	57	52	238	60.85
PS07100925	3005	57	36	242	60.70
PS081004	3227	58	42	247	60.73
PS08101022	2901	54	46	240	61.58
PS12100111	3075	56	37	219	61.93
SS-41	2722	60	40	179	60.90
<i>Mean</i>	2936	57	42	228	61.11
<i>P-value</i>	0.0097	<0.0001	0.0108	<0.0001	0.0045
<i>LSD (0.05)</i>	327	0.8	7	5.4	0.58
<i>C.V (%)</i>	7.40	0.88	12.40	1.68	0.68
Green					
Hampton	3069	60	38	226	60.80
PS03101445	2982	58	38	216	60.78
PS05100840	3029	60	33	234	60.30
PS08100133	3017	59	41	220	60.95
PS10100131	2430	57	43	227	60.65
PS10100158	2904	60	38	191	60.83
PS10100558	3091	59	45	216	61.08
<i>Mean</i>	2932	59	39	219	60.77
<i>P-value</i>	0.0024	<0.0001	0.0239	<0.0001	0.5357
<i>LSD (0.05)</i>	257	0.9	7	5.80	Ns
<i>C.V (%)</i>	5.91	0.99	12.82	1.81	0.76

Table 20. Western Regional Dry Pea Variety Evaluation – Richland, MT in 2016

Variety/lines	Adjusted grain yield (lb/ac)	Plant height (cm)	TKW (gm)	Test wt (lb/bu)
Yellow				
DS Admiral	4554	97		64.00
PS07100925	4971	90		64.08
PS081004	5291	104		63.70
PS08101022	5616	99		63.65
PS12100111	4941	87		64.93
PS14100068	5024	88		64.85
PS14100069	4797	99		64.08
PS1514BNZ244	5251	92		63.03
PS1514BNZ300	4269	89		64.48
PS1514BNZ400	5042	87		64.33
SS-41	4565	89		63.00
Mean	4938	93		64.01
P-value	0.0010	0.1574		0.0010
LSD (0.05)	524	Ns		0.85
C.V (%)	7.35	9.88		0.93
Green				
Hampton	4706	91		62.98
PS03101445	5399	93		64.33
PS05100840	4813	79		63.53
PS08100133	5161	95		63.85
PS10100131	4071	89		63.80
PS10100158	4872	89		63.98
PS10100558	5228	101		63.85
Mean	4892	90		63.75
P-value	0.0005	0.0775		0.0592
LSD (0.05)	450	Ns		Ns
C.V (%)	6.20	9.54		0.80

Lentil

Statewide Lentil Variety Evaluation

The Statewide lentil variety evaluation trial was conducted at 10 sites. The tested entries include three medium green, 3 small green and 2 small red lentils with a total of eight entries.

Lentil grain yield

Substantial yield differences were recorded from site to site. The mean grain yield for the different locations ranged from 295 lb/ac to 2894 lb/ac (Table 22). Average lentil yields were 1315 lb/ac at Bozeman, 2636 lb/ac at Conrad, 1066 lb/ac at Corvallis, 2894 lb/ac at Creston, 2869 lb/ac at Havre, 295 lb/ac at Huntley (dry), 1489 lb/ac at Huntley (irrigated), 1326 lb/ac at Moccasin, 1567 lb/ac at Richland and 2200 lb/ac at Sidney dryland. The differences in grain yield among varieties within a site were significant in most cases (Table 22).

Lentil TKW

Thousand kernel weight (TKW) data were measured at two locations only (Table 23). These TKW mean data showed significance differences among varieties for a location (Table 23).

Lentil test weight

Test weight varied from site to site. The test weight of the varieties within a site were significant for all sites except Huntley irrigated (Table 24). The mean test weight ranged from 57.86 lb/bu measured at Conrad to 65.26 lb/bu recorded at Bozeman (Table 24).

Lentil plant height

The mean plant height ranged from 33 cm recorded at Bozeman to 61 cm at Creston (Table 25). Plant height differences among varieties in a site were significant in some of the sites.

Lentil number of days to flowering

The number of days to flowering ranged from 60 to 76 days (Table 26). Recording the number of days to flowering was reported to be difficult for lentil in some of the testing sites since lentil keeps on flowering depends on soil moisture availability even during harvesting. Like dry pea, the longest flowering date was recorded from Moccasin compared with other sites.

Table 21. Lentil Variety Sources and Characteristics

Variety*	Type	Maturity ¹	Breeding Program ²	Release Date
Large Green				
CDC Greenland	Green	Mod	CDC	2006
Merrit	Green			
Riveland	Green			
Medium Green				
Avondale	Green			
CDC Richlea	Green			
Imi-Green	Green			
Impress CL	Green			
Essex				
NDL080141				
Small Green				
Eston	Green			
LC07ND055E	Green			
NDLO90298E	Green			
Viceroy	Green			
Small Red				
Crimson	Red	Mod	USDA	1990
CDC Impact	Red			
CDC Impala CL	Red			
CDC Red Coats	Red			
CDC Redberry	Red	Mod	CDC	2004
NDL090413T	Red	Late	NDSU	
Spanish Brown				
Morena	brown			
Pardina	brown			

¹Compared to trial means; ² Refers to developer: CDC = Crop Development Centre, University of Saskatchewan; NDSU = North Dakota State University; USDA = USDA-ARS Grain Legume Genetics and Physiology Research.

*Because some of the breeding entries have not been registered and released as varieties and companies did not provide detail variety information. Therefore, the variety characteristics in this table is not complete and inclusive.

Table 22. Montana Statewide Lentil Variety Evaluations – Grain Yield (lb/ac) in 2016

Variety/lines	Bozeman	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)*	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)
Large Green										
Medium Green										
Avondale	1238	2226	927	2992	3170	133	1203	1445	1678	2315
CDC Richlea	1522	3288	1299	2674	2991	315	1988	1513	1346	2325
CDC Imi-Green	1121	1491	1095	2215	2507	110	1576	1154	1035	1851
Small Green										
CDC Invincible CL	1175	3033	1219	2740	2993	414	1718	1354	1204	2353
Eagle	1000	2310	1334	3318	2478	509	1150	1256	1799	2425
CDC Viceroy	1276	3059	789	3020	3160	280	1201	1324	1673	2392
Small Brown										
Small Red										
CDC Impala CL	1955	2986	828	3044	2678	312	1659	1313	1589	1694
CDC Redcoats	1236	2701	1041	3153	2979	291	1418	1248	2214	2253
Mean	1315	2636	1066	2894	2869	295	1489	1326	1567	2200
P-Value	<0.0001	<0.0001	0.0513	0.0043	0.0005		0.3438	0.0477	<0.0001	0.6894
LSD (0.05)0	217	550	Ns	460	301		Ns	233	231	Ns
CV (%)	9.43	14.20	32.99	10.80	7.14		23.06	11.97	10.05	25.70

*Results from Huntley dryland are from one replication only.

Table 23. Montana Statewide Lentil Variety Evaluations – Thousand Kernel Weight (TKW) (in g) in 2016

Variety/lines	Bozeman	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)
Large Green										
Medium Green										
Avondale			46	43	53					
CDC Richlea			52	46	56					
CDC Imi-Green			57	54	59					
Small Green										
CDC Invincible CL			33	31	30					
Eagle			38	35	41					
CDC Viceroy			34	31	31					
Small Brown										
Small Red										
CDC Impala CL			31	29	29					
CDC Redcoats			40	38	38					
Mean			41.3	38.3	42.1					
P-Value			<0.0001	<0.0001	<0.0001					
LSD (0.05)			2.1	1.9	1.8					
CV (%)			3.63	3.48	2.96					

Table 24. Montana Statewide Lentil Variety Evaluations – Test Weight (lb/bu) in 2016

Variety/lines	Bozeman	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley* (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)
Large Green										
Medium Green										
Avondale	64.17	58.52	61.30	62.25	62.80	61.10	58.30	62.90	62.32	62.97
CDC Richlea	63.90	57.63	60.40	61.25	61.80	60.60	57.50	62.65	65.67	61.88
CDC Imi-Green	63.70	48.75	59.42	61.03	62.05	60.80	58.25	61.98	57.50	62.00
Small Green										
CDC Invincible CL	66.30	60.00	63.80	64.45	64.18	63.70	61.40	64.65	64.45	63.10
Eagle	65.10	57.40	63.40	63.50	64.05	63.70	59.00	64.33	64.55	64.05
CDC Viceroy	66.47	61.25	63.93	64.33	64.50	63.70	61.30	65.08	64.65	64.90
Small Brown										
Small Red										
CDC Impala CL	66.70	61.20	64.38	65.18	65.28	64.30	62.85	65.43	65.60	63.80
CDC Redcoats	65.73	58.10	62.97	64.03	64.10	63.60	60.10	64.93	65.67	64.68
Mean	65.26	57.86	62.34	63.25	63.59	62.59	59.84	63.99	63.13	63.42
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		0.1136	<0.0001	<0.0001	0.0146
LSD (0.05)	0.56	3.01	0.84	0.39	0.34		Ns	0.76	1.39	1.78
CV (%)	0.49	3.63	0.96	0.42	0.37		2.59	0.80	1.50	1.98

*Results from Huntley dryland are from one replication only.

Table 25. Montana Statewide Lentil Variety Evaluations – Plant Height (cm) in 2016

Variety/lines	Bozeman	Conrad	Corvallis (Irri.)	Creston	Havre	Huntley (Dry)*	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)
Large Green										
Medium Green										
Avondale	33		14	55	38	34	39	31	48	27
CDC Richlea	28		16	61	36	31	36	28	48	29
CDC Imi-Green	37		19	66	43	25	36	37	59	29
Small Green										
CDC Invincible CL	32		16	57	31	30	37	26	43	24
Eagle	34		15	62	33	27	31	27	39	26
CDC Viceroy	35		13	65	34	24	38	27	46	28
Small Brown										
Small Red										
CDC Impala CL	31		16	59	32	32	37	26	42	26
CDC Redcoats	33		16	59	33	27	27	29	51	26
Mean	33		15	61	35	29	35	29	47	27
P-Value	0.0746		0.0061	0.0942	0.0004		0.0450	<0.0001	0.0127	0.5706
LSD (0.05)	Ns		1.9	Ns	4.1		7.8	1.3	8.9	Ns
CV (%)	7.99		9.17	12.97	8.16		9.49	3.08	12.90	14.06

*Results from Huntley dryland are from one replication only.

Table 26. Montana Statewide Lentil Variety Evaluations – Number of Days to Flowering in 2016

Variety/lines	Bozeman	Conrad	Corvallis [‡] (Irri.)	Creston*	Havre	Huntley (Dry)	Huntley (Irri.)	Moccasin	Richland	Sidney (Dry)
Large Green										
Medium Green										
Avondale		65	71	80	58			74		66
CDC Richlea		63	71	80	59			75		67
CDC Imi-Green		65	71	80	59			76		67
Small Green										
CDC Invincible CL		64	71	80	61			77		67
Eagle		64	71	80	58			75		67
CDC Viceroy		66	71	80	61			77		68
Small Brown										
Small Red										
CDC Impala CL		63	71	80	62			77		67
CDC Redcoats		66	71	80	61			76		68
Mean		64	71	80	60			76		67
P-Value		0.0048			<0.0001			<0.0001		0.5053
LSD (0.05)		3.5			0.7			1		Ns
CV (%)		3.71			0.80			0.95		1.81

[‡]All varieties in all replications flower the same day.*All varieties in all replications flower the same day.

Multi-Year and Multi-Location Statewide Lentil Variety Evaluation Summary

Table 27. Statewide Lentil Variety Evaluations – 2009 – 2016 Multi-year grain yield summary (lb/ac)

Variety	Bozeman								Conrad							
	2009	2010	2011	2012	2013	2014	2015	2016	2009	2010	2011	2012	2013	2014	2015	2016
Small Green																
Essex		2111	1538	462		1839			3248	436	2842	1823		1865		
Medium Green																
Brewer		1855	1340	528					2272	381	2034	1120				
CDC Richlea		2266	1534	569	1400	1911	1113	1522	2831	623	2307	1800	1698	1752	665	3288
Avondale		2224	1578	685	1745	1919	1083	1238	3113	687	2284	1696	1501	1597	535	2226
Large Green																
Merrit		2064	1360	607		1444			2183	385	2151	1243		1744		
Riveland		1825	1558	567		1736			2127	324	1821	1464		1616		
Small Red																
Crimson		1999	1281	588	1424	1725			1921	544	1762	1543	1039	1590		
CDC Redberry		982	1400		1348	1700			2234	833	2318	1338	1351	1869		
Mean		1953	1476	560	1363	1723	974	1315	2451	533	2227	1496	1460	1682	716	2636
LSD (0.05)		382	138	98	167	NS	NS	217	559	214	NS	NS	236	NS	NS	550
CV (%)		14	7	12	8	19	14	9	14	28	21	25	11	24	60	14
Variety	Corvallis								Creston							
	2009	2010	2011	2012	2013	2014	2015	2016	2009	2010	2011	2012	2013	2014	2015	2016
Small Green																
Essex	2224	1087		536		450			2395	2464	2091	1409		1299		
Medium Green																
Brewer	940	964		405					2460	2164	1464	1250				
CDC Richlea	2552	973		893	1330	471	1735	1299	2831	2150	1873	1625	1303	1753	969	2674
Avondale	2495	1052		837	1387	528	1421	927	3016	2626	2024	1790	1244	1625	925	2992
Large Green																
Merrit	1411	690		394		536			2829	1954	1730	1038		1094		
Riveland	1353	430		552		340			2478	1898	1547	1310		710		
Small Red																
Crimson	1629	1095		838	951	365			2082	2259	2095	1245	1238	1021		
CDC Redberry	2411	1059		706	795	540			2326	2346	2090		1816	1851		
Mean	1802	860		700	1155	511	1366	1066	2522	2164	1822	1345	1347	1409	911	2894
LSD (0.05)	395	348		354	222	NS	NS	NS	448	456	NS	421	279	136	NS	460
CV (%)	15	28		36	13	35	32	33	12	15	22	22	14	28	26	11

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Table 27. Statewide Lentil Variety Evaluations – 2009 – 2016 Multi-year Grain Yield Summary (lb/ac)...continued

Variety	Havre								Huntley (Dry)							
	2009	2010	2011	2012	2013	2014	2015	2016	2009	2010	2011	2012	2013	2014	2015	2016*
Small Green																
Essex	1654	3119	1838			2131			2103	464	784	569		843		
Medium Green																
Brewer	1173	2487	1024	1121					494	425	402	583				
CDC Richlea	1546	2853	1743	830	1530	1649	1081	2991	1603	569	873	734	1585	699	987	315
Avondale	1807	2790	1385	874	1483	1808	1046	3170	1916	926	877		1767	718	1274	133
Large Green																
Merrit	1331	2868	1127	977		1306			947	466	717	523		499		
Riveland	1368	2463	968	1033		1282			1814	399	717	727		557		
Small Red																
Crimson	1072	2343	1705	902	625	1685			1629	738	458	607	1683	578		
CDC Redberry	1217	2592	904	846	760	1440			2411	684	819	620	1956	412		
Mean	1399	2736	1362	830	1123	1557	912	2869	1397	573	672	614	1690	650	1100	295
LSD (0.05)	302	340	299	179	173	352	27	301	NS	272	NS	167	NS	141	NS	
CV (%)	15	9	10	15	11	15	7	7	43	33	54	19	16	15	17	
Variety	Joplin								Moccasin							
	2009	2010	2011	2012	2013	2014	2015	2016	2009	2010	2011	2012	2013	2014	2015	2016
Small Green																
Essex		2491	726	2521						1743		2036	918	809	1713	
Medium Green																
Brewer		2236	350	2027						1768	730	756				
CDC Richlea		2371	616	1919						2062	1100	958	1904	1672	952	1513
Avondale			581	2421						1944	903	955	1859	1440	751	1445
Large Green																
Merrit		2549	546	2127						1890	771	838		1258		
Riveland			247	2303						1805	926	827		1519		
Small Red																
Crimson		2162	774	1479						1919	911	907	1403	1087		
CDC Redberry		1973	785	1717						1642	764		1491	1456		
Mean		2324	624	2077						1906	888	833	1538	1383	754	1326
LSD (0.05)		562	NS	NS						NS	NS	144	320	248	NS	233
CV (%)		17	44	20						11	24	12	15	13	27	12

*Yield is low due to hail damage and results are only from one replication.

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Table 27. Statewide Lentil Variety Evaluations – 2009 – 2016 Multi-year Grain Yield Summary (lb/ac)...continued

Variety	Richland								Sidney (Dry)							
	2009	2010	2011	2012	2013	2014	2015	2016	2009	2010	2011	2012	2013	2014	2015	2016
Small Green																
Essex	1181	1752	1097	1705		441			1768	2251	1737	458		1057		
Medium Green																
Brewer	939	1324	581	1882					1103	1423	1061	184				
CDC Richlea	1596	1562	1077	1874	1914	755	1138	1346	1699	1959	1594	530		1170		2325
Avondale	1284	1850	1398	2041	2193	582	1075	1678	1653	2169	1774	453		982		2315
Large Green																
Merrit	1098	1435	880	1710		371			1407	1350	1418	222		704		
Riveland	1013	1571	836	1712		398			1387	1564	1413	401		821		
Small Red																
Crimson	1308	1222	859	1734	1573	287			836	1924	981	261		947		
CDC Redberry	1296	1390	933	1743	1582	524			1332	2186	1604	448		867		
Mean	1200	1537	945	1666	1896	479	999	1567	1351	1835	1444	371		938		2200
LSD (0.05)	288	294	392	332	603	206		231	260	390	434	NS		165		NS
CV (%)	17	11	25	12	22	31		10		13	17	42		12		26

Western Regional Lentil Variety Evaluation

The Western Regional lentil variety trial was conducted at two sites (Havre and Richland). The trial consisted of 20 entries, three commercially available and 17 advanced breeding lines from the USDA-ARS Grain Legume Genetics and Physiology Program in Pullman, Washington and North Dakota State University. The average yields of lentil were 2078 lb/ac at Havre and 1045 lb/ac at Richland (Tables 28-29). The entries varied in their test weight, TKW, height and flowering date at Havre (Table 28).

Table 28. Western Regional Lentil Variety Evaluation – Havre, MT in 2016

Variety/lines	Grain Yield (lb/ac) 13% Moisture	Number of days to flower	Height (cm)	TKW (g/1000 seeds)	Test wt (lb/bu)
Avondale	2517	52	32	47.0	62.05
Eston	2027	51	26	30.3	64.18
LC01602273E	2370	55	28	35.3	64.03
LC08600005E	2257	53	30	42.3	63.83
LC08600113P	2438	50	28	43.5	63.75
LC08600116P	2297	53	29	47.1	63.83
LC09600054E	2562	50	29	39.7	63.88
LC09600066E	2496	49	28	35.5	64.20
LC10600494P	2110	51	27	40.2	64.35
LC14600006P	1700	50	23	39.6	64.87
LC14600010P	1239	52	27	38.5	66.30
LC14600017P	2042	52	28	41.6	64.53
LC14600106L	2063	50	34	73.5	59.95
LC1660NZ003E	1331	51	28	27.2	66.48
NDL080187L	2168	51	27	50.9	60.33
NDL090185R	2545	54	29	39.2	61.63
NDL120423T	1807	50	26	30.2	65.50
NDL120432T	1958	53	25	30.2	65.35
NDL120480T	1535	56	27	30.5	63.70
Pardina	2004	50	25	37.0	64.65
Mean	2078	52	28	39.0	63.95
P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
LSD	265	1.1	3	1.9	0.42
C.V. (%)	9.04	1.54	7.59	3.46	0.47

Table 29. Western Regional Lentil Variety Evaluation – Richland, MT in 2016

Variety/lines	Grain Yield (lb/ac) 13% Moisture	Number of days to flower	Height (cm)	TKW (g/1000 seeds)	Test wt (lb/bu)
Avondale	1213		38		59.35
Eston	1389		44		60.60
LC01602273E	1290		42		62.07
LC08600005E	1348		44		58.68
LC08600113P	901		42		62.53
LC08600116P	1013		45		62.33
LC09600054E	1411		40		62.68
LC09600066E	1198		39		60.65
LC10600494P	813		41		57.90
LC14600006P	562		43		61.90
LC14600010P	631		43		62.25
LC14600017P	873		43		62.27
LC14600106L	929		40		56.30
LC1660NZ003E	697		40		61.50
NDL080187L	1031		39		56.00
NDL090185R	1260		46		59.03
NDL120423T	1098		43		64.25
NDL120432T	1071		41		63.13
NDL120480T	1251		40		63.00
Pardina	394		37		59.35
Mean	1045		42		60.91
P-value	<0.0007		0.5726		<0.0001
LSD	417		Ns		1.53
C.V. (%)	28.24		14.00		1.79

Chickpea

Statewide Chickpea Variety Evaluation

The statewide chickpea variety evaluation includes seven commercial varieties and one advanced lines and carried out in eight environments. The statewide chickpea variety evaluation was not planted at Bozeman site due to deer problem. The mean grain yields were 3963 Conrad, 3844 lb/ac Huntley irrigated, 3160 lb/ac Sidney dryland, 1032 lb/ac Sidney irrigated and 136 lb/ac at Richland site (Table 31).

We evaluated the seed size of chickpea varieties from statewide chickpea variety trial harvested from Sidney dryland using sieve with 8.7 mm diameter opening. The results are shown in Table 32. The variety Sierra has the highest percentage of grain size greater than 8.7 mm diameter compared with the others. The variety Sawyer and the new experimental line (BGC090017) have substantial percentage of seeds with seed size greater than 8.7 mm diameter and ranked second and third following Sierra, respectively. The seed sizes for the variety Myles (desi type) were all less than 8.7 mm diameter.

Table 30. Chickpea Variety Characteristics

Variety/lines	Type
CA0790BO043C	Large Café Kabul
CA0890BO429C	Large Café Kabul
CA0790BO547C	Large Café Kabul
CA0790BO549C	Large Café Kabul
CA0790BO733C	Large Café Kabuli
Dwelley	Large Café Kabul
Sawyer	Large Café Kabul
CDC Alma	Med/Large Kabuli
CDC Frontier	Large Kabuli
CDC Orion	Large Kabuli
Myles	Desi

Table 31. Statewide Chickpea Variety Evaluation – Yield (lb/ac) in 2016

Variety/lines	Conrad	Corvallis [‡] (Irri.)	Huntley [†] (Dryland)	Huntley (Irri.)	Moccasin*	Richland [±]	Sidney (dry)	Sidney (Irri.)
BGC090017	4538			5007		142	3427	1855
CDC Alma	3172			3012		186	3302	477
CDC Frontier	5463			4592		277	4040	1040
CDC Leader	4741			3570		155	3926	1609
CDC Orion	3662			3494		135	2120	831
Myles	3306			3379		87	3677	1504
Sawyer	3611			3801		116	2392	482
Sierra	3215			4190		10	2463	347
Mean	3963			3844		136	3160	1032
P-Value	<0.0001			0.2816		<0.0001	0.0052	<0.0001
LSD (0.05)	754			Ns		68	1022	332
CV (%)	13.45			29.50		35.31	22.89	22.77

[‡]Data was not ready for this report due to late harvest; [†]hail damage; *Pre-harvested by mistake. [±]Yield from Richland was extremely low due to disease, cool season during grain filling and deer damage.

Table 32. Mean percent of seed size of chickpea varieties with seed size greater than 8.7 mm diameter. The samples were collected from statewide chickpea variety evaluation trial, Sidney dryland, MT, 2016.

Variety	Percent of seed size > 8.7 mm (22/64) diameter
BGC090017	75.4
CDC Alma	59.7
CDC Frontier	49.3
CDC Leader	64.4
CDC Orion	48.1
Myles	0.0
Sawyer	77.6
Sierra	86.3
Mean	56.9
P-value	<0.0001
LSD (0.05)	10.8
CV	13.49

Multi-Year and Multi-Location Statewide Chickpea Variety Evaluation Summary

Table 33. Multi-Year and Multi-Location Statewide Chickpea Variety Evaluations –
2011– 2016 - Grain Yield Summary (lb/ac)

Variety	Bozeman					Conrad				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
BGC08008M										
BGC08009M										
BGC090016										
BGC090023										
CA0790B0042C										
CA0790B0547C										
CA0790B0549C										
CAO890B0427C										
CDC Alma	828	1396	1458			1946	3250	214		3172
CDC Frontier	875	1594				2103	2488			5463
CDC Orion	852	1574	1923			2090	3008	118		3662
Myles	994	1233	1821			1626	1294	476		3306
Mean*	796	1449	1734			1750	2510	269		3963
LSD (0.05)	136	145	NS			575	412	189		754
CV (%)	10	6	24			18	10	43		13
Variety	Huntley (irri.)					Moccasin				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
BGC08008M							1810			
BGC08009M							2084			
BGC090016							1719			
BGC090023							1812			
CA0790B0042C						981	1600			
CA0790B0547C							1551			
CA0790B0549C							1700			
CAO890B0427C							1807			
CDC Alma	3056	1467	3082		3012	919	1533	1036		
CDC Frontier	2745	1874		2970	4592	605	1420	1020	1337	
CDC Orion	3167	1521	3598	3191	3494	1619	1806	999	1477	
Myles	2668	2411	2979	2474	3379	964	1392	1566	1164	
Mean*	2595	1818	3219	2707	3844	830	1623	871	1155	
LSD (0.05)	526	NS	510	459	NS	304	425	307	NS	
CV (%)	12	35	9	11	29	19	18	24	21	

*Trial means include other varieties as indicated in the previous table (Table 31).

-----Continued -----

Table 34. Multi-Year and Multi-Location Statewide Chickpea Variety Evaluations –
2012– 2016 - Grain Yield Summary (lb/ac) -----Continued -----

Variety	Corvallis (irri.) ^y					Richland				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
BGC08008M							2339			
BGC08009M							3902			
BGC090016							2019			
BGC090023							2619			
CA0790B0042C	1801					201	506			
CA0790B0547C							1617			
CA0790B0549C							1227			
CA0890B0427C	1746						867			
CDC Alma	1771		734			1467	2763	599		186
CDC Frontier	1971					2488	3529	838	2020	277
CDC Orion			934			1907	2930	416	1958	135
Myles	1693		1155			1588	2641	922	1027	87
Mean*	1678		1087			1175	2363	459	1619	137
LSD (0.05)	NS		NS			577	784	245	85	68
CV (%)	22		43			29	23	37	11	35.32

^yData was not ready for this report;

Western Regional Chickpea Variety Evaluation

The Western Regional chickpea variety evaluation trial consisted of six advanced lines and two commercial varieties (Table 35). The trial was planted at Corvallis and Richland. But the trial was totally damaged at Richland site due to disease and deer problem (deer ate the pods). Therefore, the yield was variable for the different replications for a variety and was extremely low (Table 35). This problem should be taken into account while interpreting the results from this site. CDC Frontier yielded higher than the other entries at Richland site. The results from Corvallis was not ready for this report.

Table 35. Western Regional Chickpea Variety Evaluation at Corvallis Moccasin and Richland in 2016

Variety/lines	Corvallis*				Richland [‡]			
	Grain Yield (lb/ac) @ 13% moisture	TKW (g/1000 seeds)	Test wt (lb/bu)	Height (cm)	Grain Yield (lb/ac) @ 13% moisture	TKW (g/1000 seeds)	Test wt (lb/bu) [±]	Height (cm)
CA04900843C					32			
CA079080034C					12			
CA079080043C					100			
CA079080547C					9			
CA089080429C					50			
CA089080531C					38			
CDC Frontier					244			
Myles					230			
<i>Mean</i>								
<i>P-value</i>								
<i>LSD (0.05)</i>								
<i>C.V. (%)</i>								

*Data was not ready for this report. [‡]Yield was extremely low and highly variable between replications for a given variety to do statistics. This was due to disease and serious deer damage. In fact we have been told by one of the producer not to harvest it because of poor pods per plant. We presented this data on this table just to show the performance of the varieties if someone is interested in to get information under such circumstances. [±]The amount of samples were too small to measure test weight.

FUTURE PLANS

The contribution of dry pea, lentil and chickpea for cropping systems sustainability and for the State's economy is substantial. In addition, the national and international demand for these crops as source of healthy food is considerable. Therefore, this project will be continued to evaluate statewide and western regional spring dry pea, lentil and chickpea varieties and experimental lines across Montana to generate information that can help to make informed decision. In addition, research is needed to develop best management practices to increase yield and improve quality of these crops. These include but not limited to nutrient management, weed control both for conventional and organic pulse growers and enhancing biological nitrogen fixation besides developing varieties. We hope research fund, support and collaboration among researchers will continue to achieve the objective.

Note: The results and summary mentioned in this annual report are for **informational purposes only**. Inclusion and or exclusion of any commercial variety in this summary does not constitute a recommendation by MSU-MAES or EARC.

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