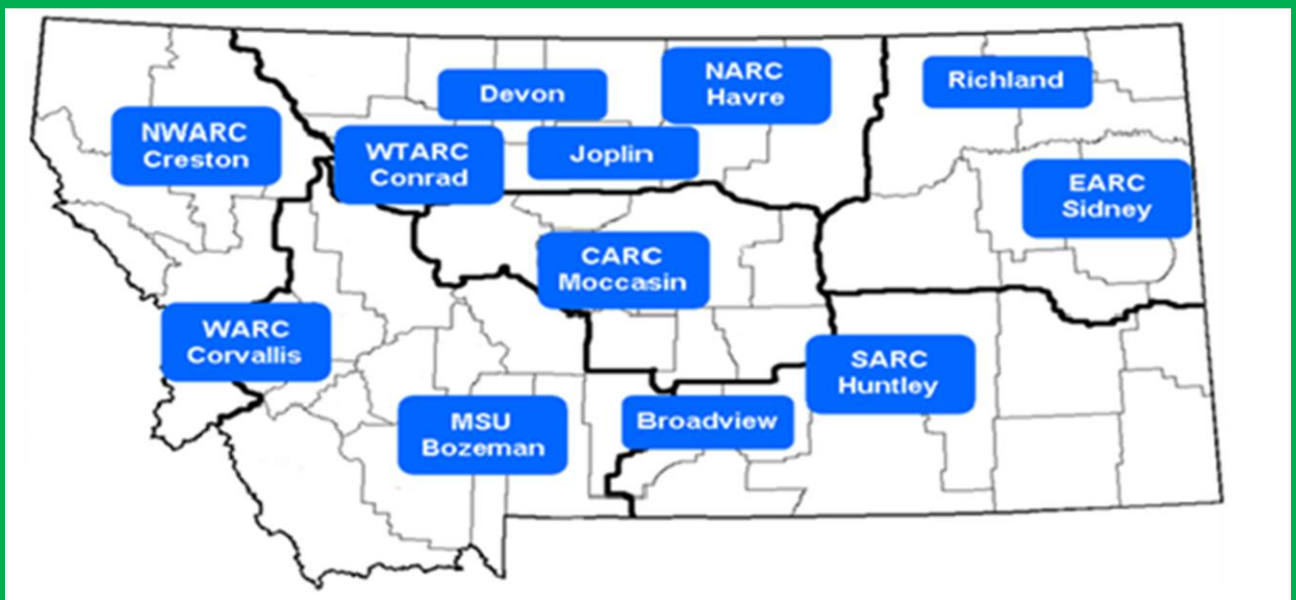
2020 Montana Cool-Season Spring Pulse Variety Evaluation Annual Report

Prepared By:

William Franck, Sooyoung Franck and Chengci Chen



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ACKNOWLEDGEMENT

The Montana State University Eastern Agricultural Station in Sidney, MT coordinates an annual variety evaluation for cool season spring pulse crops (dry pea, lentil and chickpea) at multiple locations across the state of Montana. In 2020, funding for this project was obtained from the Montana Agricultural Experiment Station, the USA Dry Pea and Lentil Council, and testing fees from private entities submitting varieties and experimental lines for evaluation. The results provided in this report reflect the efforts of a large team of individuals from the Montana State University Agricultural Experiment Stations, Montana State University Extension, industrial partners from the seed industry and cooperating producers across the state. The following list provides contact information for many of the individuals involved in the 2020 variety evaluation.

Montana State University

Chengci Chen
Superintendent/Professor
Eastern Ag. Research Center
1501 North Central Ave, Sidney, MT 59270
(406) 433-2208, cchen@montana.edu

Frankie Crutcher
Assistant Professor
Eastern Ag. Research Center
1501 North Central Ave, Sidney, MT 59270
(406) 433-2208, frankie.crutcher@montana.edu

William Franck
Research Scientist
Eastern Ag. Research Center
1501 North Central Ave, Sidney, MT 59270
(406) 433-2208, william.franck@montana.edu

Sooyoung Franck
Research Associate
Eastern Ag. Research Center
1501 North Central Ave, Sidney, MT 59270
(406) 433-2208, sooyoung.franck@montana.edu

Patrick Carr
Superintendent/Associate Professor
Central Ag. Research Center
52583 US Hwy 87 Moccasin, MT 59462
(406) 423-5421, Patrick.carr@montana.edu

Simon Fordyce
Research Associate
Central Ag. Research Center
52583 US Hwy 87 Moccasin, MT 59462
(406) 423-5421, simon.fordyce@montana.edu

Kent McVay
Associate Professor
Southern Ag. Research Center
748 Railroad Hwy Huntley, MT 59037
(406) 348-3400, kmcvay@montana.edu

Qasim Khan
Research Scientist
Southern Ag. Research Center
748 Railroad Hwy Huntley, MT 59037
(406) 348-3400, qkhan@montana.edu

Kevin McPhee
Professor, Pulse Breeder
Plant Science and Plant Pathology,
Bozeman, MT 59717
(406) 994-5156; kevin.mcphee@montana.edu

Peggy Lamb
Research Scientist
Northern Ag. Research Center
3710 Assiniboine Road Havre, MT 59501
(406) 265-6115, plamb@montana.edu

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

Inga Hawbaker
Daniels County Extension Agent
106 Railroad Ave East
Scobey, MT 59263
(406) 487-2861, inga.hawbaker@montana.edu

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

North Dakota State University

Nonoy Bandillo
Assistant Professor, Pulse Breeder
Department of Plant Science
Fargo, ND
(701) 231-8056, nonoy.bandillo@ndsu.edu

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

Tyler Kress
Pulse USA
2002 Northern Plains Drive
Bismarck, ND 58504
(701) 530-0734; tyler@pulseusa.com

Martin Hochhalter
Meridian Seeds
216553 37th St. SE, Suite 3, Mapleton, ND
(204)988 4681; mhochhalter@meridianseeds.com

Richard Roland/Cody Roland
Legume Logic
(701) 965-6058
legumel@nccray.com

Samantha Kok, Mark Kok
Valesco Genetics
PO Box 128, Plaza, ND 58771
(701) 497-3082; sam@valescogenetics.com,
mark@greatnorthernag.com

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

Producers

Richard Fulton
Richland, MT

Marvin Tarum
Richland, MT

Keith and Karen Schott
Broadview, MT

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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 this century. In an effort to improve yield and quality of these crops, the Eastern Agricultural Research Center (EARC) of Montana State University (MSU) is currently coordinating a statewide pulse crop variety evaluation project across Montana on an annual basis. For the 2020 growing season, trials were conducted at four MSU Agricultural Research Centers, the MSU-Bozeman Post Farm and two cooperating producers' fields near Broadview and Richland, Montana. The results reported herein are intended to aid producers and seed suppliers in variety selection as well as aiding the research community in variety development. 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 varieties and lines selected by stakeholder input across a broad range of Montana environments.

METHODS

Procedures and Experimental Design

Seed companies and pulse breeders with an interest in Montana pulse production were invited to submit commercial varieties or expermential lines for evaluation in 2020. 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. In addition, eight dry pea, six lentil and eight chickpea entries were selected by the EARC to serve as check varieties and were planted at all locations. In 2020 the variety evaluations were performed at six dryland locations and two irrigated locations.

Seed for all entries were sent to the EARC where each seed lot was tested for germintation. All seeds were treated with Obvius Fungicide (BASF Corporation, Research Triangle Park, NC) and Cruiser 5FS Insecticide (Syngenta Crop Protection, Inc., Greensboro, NC) prior to packaging. Seeds were packaged on a per plot basis to obtain live seed rates of 8, 12 and 4 live seeds per ft^2 for pea, lentil and chickpea, respectively. Seeds were sent to the cooperating research centers with an appropriate rhizobial inoculant to be applied at planting. Research plots were planted in a randomized complete block design with four replicates per entry. Plot size varied amongst locations and was dictated by the equipment available at each location. Management practices varied by location but were consistent with typical practices for the location. 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 before statistical analysis. Dry pea protein concentrations were determined using an Infratec NOVA (Foss, Hilleroed, Denmark). Analysis of variance was performed in R (version 4.0.3) and LSD was derived from the agricolae package (version 1.3-3) for mean comparison whenever the F-test is 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 location, collaborators and the type of crops evaluated at each location is shown in Table 1.

Table 1. Collaborators, locations and crops evaluated in 2020.

Location	Collaborator	Irrigation	Crops evaluated at location			Observations
			Pea	Lentil	Chickpea	
Bozeman Post Farm	PSPP	No	X	X	X	
Broadview	SARC	No	X			
Havre	NARC	No	X	X	X	Ascochyta damage on chickpeas
Huntley Dryland	SARC	No	X	X	X	Peas and Lentils lost to grasshoppers, Ascochyta damage on chickpeas
Huntley Irrigated	SARC	Yes	X	X	X	Chickpeas lost to Ascochyta
Moccasin	CARC	No	X	X	X	Ascochyta damage on chickpeas
Richland	EARC	No	X	X	X	Ascochyta damage on chickpeas
Sidney Irrigated	EARC	Yes	X	X	X	

†CARC = Central Agricultural Research Center, EARC = Eastern Agricultural Research Center, PSPP = Plant Sciences and Plant Pathology, NARC = Northern Agricultural Research Center, SARC = Southern Agricultural Research Center, 'X' indicates the collaborator participated for the specific crop variety evaluation in 2020.

List of Varieties

Table 2 includes the list of varieties and experimental lines evaluated in 2020. 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 and North Dakota State University pulse crop breeding programs.

Table 2. Dry pea, lentil and chickpea entries included in 2020 variety evaluation trials.

Crop	Entry	Seed color/size	Maturity
Dry Pea	AAC Asher	Yellow	Early/Medium
	AAC Carver	Yellow	Early
	AAC Chrome	Yellow	Medium
	AAC Comfort	Green	Medium
	AAC Profit	Yellow	Medium/Late
	AC Agassiz	Yellow	Medium
	AC Earlystar	Yellow	Early
	Aragorn	Green	Medium
	Bluemoon	Green	
	CDC Amarillo	Yellow	Medium
	CDC Dakota	Yellow	Medium
	CDC Greenwater	Green	Medium
	CDC Inca	Yellow	Medium
	CDC Saffron	Yellow	Medium
	CDC Spectrum	Yellow	Medium
	CDC Striker	Green	Medium
	Daytona	Green	Medium/Late
	Delta	Yellow	Medium
	DL Apollo	Yellow	Medium
	DS-Admiral	Yellow	Medium
	Durwood	Yellow	Medium
	Empire	Green	Late
	Fairway	Green	
	Ginny 2	Green	
	Goldenwood	Yellow	
	Hampton	Green	Medium
	Hyline	Yellow	Medium
	Jetset	Yellow	Medium
	Korando	Yellow	Early
	LG Amigo	Yellow	Early/Medium
	LG Sunrise	Yellow	Medium
	Majestic	Yellow	
	Majoret	Green	Medium
	MS-19YP3	Yellow	
	ND Dawn	Yellow	Early
	NDP100144G	Green	
	NDP160028	Green	
	Nette 2010	Yellow	Early/Medium

Table 2. Continued

Crop	Entry	Seed color/size	Maturity
Dry Pea	Orchestra	Yellow	
	Pro 093-7410	Yellow	
	Pro 133-6243	Yellow	
	Pro 141-6258	Green	
	Pro 143-6220	Yellow	
	Pro 143-6230	Yellow	
	Pro 153-7409	Yellow	
	Pro 171-7665	Green	
	PSO877MT457	Green	
	PSO877MT632	Yellow	
	Salamanca	Yellow	Early
	Shamrock	Green	Early
	Yellowstone	Yellow	
Lentil	Avondale	Medium Green	Medium
	CDC Greenstar	Large Green	Medium/Late
	CDC Impala CL	Small Red	Early
	CDC Impress CL	Medium Green	
	CDC Imvincible CL	Small green	Early
	CDC Kermit	Small Green	Late
	CDC Maxim CL	Small Red	Early/Medium
	CDC Richlea	Medium Green	Medium
	CDC Viceroy	Small Green	Early/Medium
	NDL090170L	Large Green	
	NDL090185R	Medium Green	
	NDL120600R	Medium Green	
	Sage	Small Green	
Chickpea	CDC Frontier	Kabuli type	Late
	CDC Leader	Kabuli type	Medium
	CDC Orion	Kabuli type	Late
	CDC Palmer	Kabuli type	Medium/Late
	Kasin	Kabuli type	
	Myles	Desi type	
	Nash	Kabuli type	
	ND Crown	Kabuli type	
	Royal	Kabuli type	
	Sawyer	Kabuli type	
	Sierra	Kabuli type	

Precipitation and Cultural Practices

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

Table 3. Site characteristics for each trial location

	Bozeman	Havre (NARC)	Huntley (SARC)	Moccasin (CARC)	Richland	Sidney (EARC)
Soil Type	Bozeman Silt Loam	Telstad clay loam & Hillon clay loam	Lohmiller Silty Clay Loam	Danvers-Judith Clay loam	Farnuf Loam	Savage Silty Clay Loam
Elevation	4775	2699	3022	4250	2950	2200
Seasonal Precipitation (April - August) (in)	6.5	5.6	8.6	8.6		5.1
Average Precipitation (April - August) (in)		8.0	7.9	10.2		9.6
Irrigation (in)			3.5			3.6

Table 4. Major agronomic management practices for each location in 2019

Pea Trials						
Location	**Tillage**	**Seeding Date**	**Harvest Date**	**Previous Crop**	**Fertilizer**	**Pesticide Applications**
Bozeman	No-Till	4/28	8/19	Barley	None	Sharpen @ 1 oz/ac; Prowl @ 24 oz/ac
Broadview	No-Till	4/10	8/13	Spring Wheat	None	
Havre	No-Till	4/22	7/28	Winter Wheat	None	Quiz @ oz/ac; Basagran @ 8 oz/ac; Mustang Max @ 4 oz/ac
Huntley Irrigated	No-Till	4/21	8/6	Spring Wheat	None	RT3 @ 32 fl oz/ac, Prowl @ 32 fl oz/ac & Outlook @ 16 oz/ac on 4/20
Moccasin	No-Till	4/28	8/5	Barley	20-30-20-10 @ 50 lb/ac	RT3 @ 32 fl oz/ac pre-plant; Grizzly Too @ 1.9 fl oz/ac
Richland	No-Till	5/6	8/18	Spring Wheat	None	RT3 @ 32 fl oz/ac, anthem flex @ 3.5 oz/ac & Intensity @ 6 oz/ac
Sidney	Conventional	4/23	7/31	Sugarbeet	None	Outlook @ 12 oz/ac Premergence

Table 4. Continued

Lentil Trials						
Location	**Tillage**	**Seeding Date**	**Harvest Date**	**Previous Crop**	**Fertilizer**	**Pesticide Applications**
Bozeman	No-Till	4/28	8/19	Barley	None	Sharpen @ 1 oz/ac; Prowl @ 24 oz/ac
Havre	No-Till	4/24	8/2	Winter Wheat	None	Quiz @ oz/ac
Huntley Irrigated	No-Till	4/21	8/6	Spring Wheat	None	RT3 @ 32 fl oz/ac, Prowl @ 32 fl oz/ac & Outlook @ 16 oz/ac on 4/20
Moccasin	No-Till	4/28	8/6	Barley	20-30-20-10 @ 50 lb/ac	RT3 @ 32 fl oz/ac pre-plant
Richland	No-Till	5/6	8/27	Spring Wheat	None	RT3 @ 32 fl oz/ac, anthem flex @ 3.5 oz/ac & Intensity @ 6 oz/ac
Sidney	Conventional	4/23	8/6	Sugarbeet	None	Outlook @ 12 oz/ac Premergence

Chickpea Trials						
Location	**Tillage**	**Seeding Date**	**Harvest Date**	**Previous Crop**	**Fertilizer**	**Pesticide Applications**
Bozeman	No-Till	4/28	9/16	Barley	None	Sharpen @ 1 oz/ac; Prowl @ 24 oz/ac
Havre	No-Till	5/4	8/18	Winter Wheat	None	Quiz @ oz/ac
Huntley Dryland	No-Till	4/20	8/19	Spring Wheat	None	RT3 @ 32 oz/ac, Prowl @ 32 oz/ac & Outlook @ 16 oz/ac on 4/20
Moccasin	No-Till	5/13	9/3	Barley	20-30-20-10 @ 50 lb/ac	RT3 @ 32 oz/ac pre-plant; Tricor DF @ 4 oz/ac
Richland	No-Till	5/6	9/3	Spring Wheat	None	RT3 @ 32 fl oz/ac, anthem flex @ 3.5 oz/ac & Intensity @ 6 oz/ac
Sidney	Conventional	4/23	8/26	Sugarbeet	None	Outlook @ 12 oz/ac Premergence; Miravis Top @ 14 oz/ac on 6/24 and 7/15

RESULTS

Dry Pea Variety Evaluation in 2020

Fifty one dry pea varieties and experimental lines (34 yellow and 17 green) were evaluated in 2020 at seven locations, two of which were irrigated. One additional dryland location at Huntley was lost to grasshoppers prior to harvest. Eleven entries of pea (four yellow and seven green) including advanced breeding lines and check varieties selected by the EARC were tested at all locations. The remaining 40 entries were tested only at locations requested by the seed supplier. The data collected and presented includes grain yield, seed protein, thousand kernel weight, test weight, plant height and number of days to flowering consistent with previous years. As in the past, results are presented in two groups based on cotyledon color (yellow and green).

Yellow dry pea grain yield

Yellow dry pea mean grain yield for the different locations ranged from 2717 lb/ac at Broadview to 4685 lb/ac under irrigation at Huntley (Table 5). The Richland and Havre locations had excellent yields. Yields at the remaining locations were average to slightly above average. Significant yield differences were observed amongst the entries at all locations except Bozeman and Huntley (Irrigated).

Yellow dry pea protein content

Protein content is presented in Table 6. The mean protein content by location varied from 21.5% at Sidney under irrigation to 26.1% at Bozeman. Average protein content at Bozeman was 4.5% higher in 2020 compared to 2019. Historically, Mocassin and Richland have been the locations best suited protein production in dry peas and this trend held in 2020 (with the exception of Bozeman).

Yellow dry pea thousand kernel weight (TKW)

TKW's were collected from five locations and ranged from 227 to 251 grams per thousand kernels (Table 7). Significant differences for entries within a location were observed for all locations examined.

Yellow dry pea test weight

Test weight data was recorded for all locations and location mean test weights ranged from 61.5 lb/bu (Havre) to 65.7 lb/bu (Moccasin) (Table 8). Test weights were considerably lower at Havre than at other locations which all averaged 64-66 lb/bu.

Yellow dry pea plant height

Mean plant heights ranged from 50 cm (Bozeman) to 83 cm (Richland) (Table 9). Multiple varieties averaged more than 90 cm at Richland. The combination of tall plants and heavy pod loads did result in some lodging at Richland creating harvest losses that suppressed the yield of some varieties. Significant differences for entries within a location were observed for all locations except Bozeman.

Yellow dry pea days to flowering

The number of days to flowering were recorded for all trials located at a research center (Table 10). Consistent with previous years Sidney had the shortest mean time to flowering at 54 days and Moccasin the longest at 63 days (Table 10). Time to flowering was 12 days shorter at Moccasin in 2020 relative to 2019.

Green dry pea grain yield

The mean grain yield for green pea ranged from 2276 lb/ac at Broadview to 4353 lb/ac at Huntley under irrigation (Table 11). As with yellow peas, yields were very good at Richland and Havre with yields at Richland exceeding those of the irrigated locations in many instances. Significant differences for entries within a location were observed for all locations except Richland.

Green dry pea protein content

Green pea protein content is presented in Table 12. The mean protein content by location varied from 22.6% at Sidney to 26% at Bozeman. Average protein contents for green peas are generally higher than that of yellow peas and this was true in 2020 at all locations. Protein contents were also higher in 2020 relative to 2019 at all locations.

Green dry pea thousand kernel weight (TKW)

TKW's were collected from five locations in 2020 and ranged from 217 to 245 grams per thousand kernels (Table 13). Significant differences for entries within a location were observed for all locations examined.

Green dry pea test weight

Mean test weights for green pea ranged from 61.1 lb/bu to 65.6 lb/bu (Table 14). Test weights were consistent with 2019 results for all locations except Havre which produced lighter test weights in 2020. The differences in test weight among entries were significant within a location for all locations.

Green dry pea plant height

Mean plant heights ranged from 50 cm at Havre to 83 cm at Huntley and Richland (Table 15).

Green dry pea days to flowering

Mean days to flower ranged from 55 days at Sidney to 64 days at Bozeman (Table 16). Time to flowering was 11 days shorter at Moccasin in 2020 relative to 2019, consistent with the trend observed for yellow peas.

Summary

Pea yield and seed protein levels varied greatly amongst locations. Abundant moisture in May and June resulted in exceptionally high yields at Richland and Havre. Pea yields at Richland were similar to those at the irrigated locations of Sidney and Huntley. Interestingly, the Richland site produced these high yields without sacrificing protein content. Protein contents were nearly identical at Richland between 2019 and 2020 even though yields were considerably greater in 2020 (49% yield increase for yellow peas and a 60% yield increase for green peas). Furthermore, amongst the varieties planted in common at the Richland, Sidney (irrigated) and Huntley (irrigated) locations, the Richland yields rivaled Huntley and generally exceeded Sidney while producing protein levels definitively higher than either of the irrigated locations. These observations stress the importance of the growing environment on pea seed protein levels and indicate that high yields in pea can be achieved without sacrificing protein content.

Table 5. Yellow Dry Pea Grain Yield (lb/ac) - 2020 Montana Statewide Variety Evaluation

Yellow Pea Variety/Line	Bozeman (PSPP)	Broadview (SARC)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
AAC Asher						5079	
AAC Carver			3563		3210	5209	
AAC Chrome			3733			5068	
AAC Profit			3363				
AC Agassiz			3262		2856	4538	
AC Earlystar			3699		3206	5151	
CDC Amarillo			3602		2768	4824	
CDC Dakota						4372	
CDC Inca			3543		2665	4742	
CDC Saffron			3444		2621	4721	
CDC Spectrum			3556		2381	4647	
Delta	2767	2840	3356	4601	2924	3674	4305
DL Apollo			3367			4847	
DS-Admiral	2730	3154	3632	5022	2989	4717	4468
Durwood			3195			4359	
Goldenwood			3352			4029	
Hyline			3444			4881	
Jetset			3627		3014	4759	
Korando			3257			4548	
LG Amigo			3529			4520	
LG Sunrise			3664			4735	
Majestic						4429	
MS-19YP3			3698			4746	
ND Dawn	2997	2734	3611	4854	2917	4514	4602
Nette 2010			3499			4831	
Orchestra						5194	
Pro 093-7410			3427			4865	
Pro 133-6243			3525			4738	
Pro 143-6220			3458			3546	
Pro 143-6230			3486			4266	
Pro 153-7409			3198			3898	
PSO877MT632	2961	2138	3277	4264	2403	3901	3729
Salamanca			3474			4348	
Yellowstone			3326				
Mean	**2864**	**2717**	**3472**	**4685**	**2830**	**4593**	**4276**
P-value	**0.4335**	**0.0230**	**0.0209**	**0.1932**	**0.0164**	**<0.0001**	**<0.0001**
LSD	**NS**	**605.9**	**321.9**	**NS**	**488.2**	**595.0**	**253.6**
CV(%)	**9.5**	**14.3**	**6.6**	**10.3**	**12.0**	**9.0**	**3.7**

Table 6. Yellow Dry Pea Protein (%) - 2020 Montana Statewide Variety Evaluation

Yellow Pea Variety/Line	Bozeman (PSPP)	Broadview (SARC)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
AAC Asher						24.0	
AAC Carver			21.2		21.3	22.6	
AAC Chrome			21.8			23.3	
AAC Profit			22.3				
AC Agassiz			22.0		23.6	24.2	
AC Earlystar			21.4		23.1	22.5	
CDC Amarillo			22.2		22.5	23.4	
CDC Dakota						26.6	
CDC Inca			22.5		25.5	24.5	
CDC Saffron			22.2		22.6	24.7	
CDC Spectrum			23.0		24.8	25.0	
Delta	27.3	22.7	23.2	21.4	23.9	24.5	21.3
DL Apollo			23.0			25.0	
DS-Admiral	25.0	21.1	22.5	21.7	21.8	23.5	20.9
Durwood			22.7			24.4	
Goldenwood			23.0			26.2	
Hyline			21.6			22.8	
Jetset			23.2		23.7	24.8	
Korando			23.3			25.4	
LG Amigo			23.1			24.1	
LG Sunrise			21.7			23.1	
Majestic						24.6	
MS-19YP3			22.1			24.2	
ND Dawn	25.0	23.7	22.1	21.5	23.8	23.2	21.3
Nette 2010			22.2			23.4	
Orchestra						25.8	
Pro 093-7410			21.2			22.7	
Pro 133-6243			22.4			24.5	
Pro 143-6220			22.7			25.2	
Pro 143-6230			23.1			25.3	
Pro 153-7409			22.0			24.8	
PSO877MT632	27.0	23.6	24.0	23.5	24.9	26.0	22.6
Salamanca			22.7			24.5	
Yellowstone			22.6				
Mean	**26.1**	**22.7**	**22.4**	**22.0**	**23.4**	**24.3**	**21.5**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**0.8**	**0.9**	**0.9**	**1.1**	**1.0**	**0.5**	**0.4**
CV(%)	**1.9**	**2.7**	**2.9**	**3.4**	**2.9**	**1.4**	**1.2**

Table 7. Yellow Dry Pea Thousand Kernel Weight (g) - 2020 Montana Statewide Variety Evaluation

Yellow Pea Variety/Line	Bozeman (PSPP)	Havre (NARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
AAC Asher				274	
AAC Carver		246	227	247	
AAC Chrome		255		245	
AAC Profit		250			
AC Agassiz		237	213	248	
AC Earlystar		224	221	228	
CDC Amarillo		239	215	233	
CDC Dakota				201	
CDC Inca		238	221	240	
CDC Saffron		255	229	263	
CDC Spectrum		246	232	249	
Delta	249	251	235	258	233
DL Apollo		234		240	
DS-Admiral	274	251	241	256	235
Durwood		238		257	
Goldenwood		182		183	
Hyline		251		259	
Jetset		250	246	254	
Korando		275		285	
LG Amigo		240		245	
LG Sunrise		244		248	
Majestic				270	
MS-19YP3		237		250	
ND Dawn	246	251	225	252	235
Nette 2010		252		252	
Orchestra				288	
Pro 093-7410		230		236	
Pro 133-6243		297		306	
Pro 143-6220		234		232	
Pro 143-6230		225		227	
Pro 153-7409		251		264	
PSO877MT632	236	234	221	237	215
Salamanca		258		276	
Yellowstone		293			
Mean	**251**	**246**	**227**	**250**	**229**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0001**
LSD	**8.7**	**7.8**	**7.5**	**9.0**	**6.6**
CV(%)	**2.2**	**2.3**	**2.3**	**2.5**	**1.8**

Table 8. Yellow Dry Pea Test Weight (lb/bu) – 2020 Montana Statewide Variety Evaluation

Yellow Pea Variety/Line	Bozeman (PSPP)	Broadview (SARC)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
AAC Asher						64.6	
AAC Carver			61.8		65.7	64.9	
AAC Chrome			61.1			64.2	
AAC Profit			60.9				
AC Agassiz			60.6		64.9	64.2	
AC Earlystar			61.4		65.1	64.7	
CDC Amarillo			61.4		66.2	64.8	
CDC Dakota						66.3	
CDC Inca			61.3		66.2	64.9	
CDC Saffron			61.7		66.0	65.0	
CDC Spectrum			60.7		65.8	64.3	
Delta	65.1	64.7	62.2	65.6	66.4	65.0	64.8
DL Apollo			61.8			65.2	
DS-Admiral	65.2	64.8	62.0	66.5	66.1	65.3	65.3
Durwood			61.6			64.6	
Goldenwood			62.2			64.9	
Hyline			61.3			64.8	
Jetset			61.6		64.6	64.2	
Korando			61.6			65.0	
LG Amigo			60.7			63.7	
LG Sunrise			61.9			65.3	
Majestic						65.0	
MS-19YP3			62.8			66.4	
ND Dawn	63.3	64.0	60.6	65.3	65.0	63.8	64.5
Nette 2010			62.1			65.2	
Orchestra						65.0	
Pro 093-7410			61.6			64.9	
Pro 133-6243			62.6			65.0	
Pro 143-6220			60.7			63.6	
Pro 143-6230			60.8			63.8	
Pro 153-7409			61.6			63.7	
PSO877MT632	65.2	64.6	61.5	64.6	66.1	64.8	63.3
Salamanca			61.4			64.8	
Yellowstone			62.1				
Mean	**64.7**	**64.5**	**61.5**	**65.5**	**65.7**	**64.7**	**64.5**
P-value	**<0.0001**	**0.0409**	**<0.0001**	**0.0016**	**<0.0001**	**<0.0001**	**0.001**
LSD	**0.4**	**0.5**	**0.6**	**0.8**	**0.5**	**0.5**	**0.7**
CV(%)	**0.4**	**0.5**	**0.6**	**0.7**	**0.5**	**0.6**	**0.7**

Table 9. Yellow Dry Pea Plant Height (cm) - 2020 Montana Statewide Variety Evaluation

Yellow Pea Variety/Line	Bozeman (PSPP)	Broadview (SARC)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
AAC Asher						76	
AAC Carver			56		75	86	
AAC Chrome			51			82	
AAC Profit			55				
AC Agassiz			51		77	78	
AC Earlystar			56		82	88	
CDC Amarillo			62		79	91	
CDC Dakota						85	
CDC Inca			57		77	93	
CDC Saffron			50		65	81	
CDC Spectrum			54		62	83	
Delta	46	64	39	65	58	80	61
DL Apollo			56			89	
DS-Admiral	52	73	52	81	71	85	71
Durwood			61			89	
Goldenwood			43			70	
Hyline			51			80	
Jetset			55		70	84	
Korando			52			81	
LG Amigo			48			77	
LG Sunrise			60			93	
Majestic						88	
MS-19YP3			54			86	
ND Dawn	52	64	47	76	71	81	73
Nette 2010			54			79	
Orchestra						93	
Pro 093-7410			48			85	
Pro 133-6243			46			81	
Pro 143-6220			49			79	
Pro 143-6230			48			81	
Pro 153-7409			46			76	
PSO877MT632	52	71	39	80	62	75	61
Salamanca			55			86	
Yellowstone			46				
Mean	**50**	**68**	**51**	**75**	**71**	**83**	**67**
P-value	**0.5391**	**0.1983**	**<0.0001**	**0.0005**	**<0.0001**	**<0.0001**	**0.0004**
LSD	**NS**	**NS**	**6.3**	**6.2**	**6.5**	**9.3**	**4.6**
CV(%)	**14.1**	**10.0**	**8.7**	**5.3**	**6.4**	**7.8**	**4.3**

Table 10. Yellow Dry Pea Days to Flowering - 2020 Montana Statewide Variety Evaluation

Yellow Pea Variety/Line	Bozeman (PSPP)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Sidney Irrigated (EARC)
AAC Asher					
AAC Carver		58		64	
AAC Chrome		58			
AAC Profit		59			
AC Agassiz		58		63	
AC Earlystar		56		63	
CDC Amarillo		61		65	
CDC Dakota					
CDC Inca		59		64	
CDC Saffron		59		65	
CDC Spectrum		59		65	
Delta	62	53	57	62	53
DL Apollo		57			
DS-Admiral	63	55	57	62	53
Durwood		57			
Goldenwood		63			
Hyline		58			
Jetset		57		63	
Korando		53			
LG Amigo		57			
LG Sunrise		53			
Majestic					
MS-19YP3		54			
ND Dawn	64	58	60	64	54
Nette 2010		54			
Orchestra					
Pro 093-7410		55			
Pro 133-6243		53			
Pro 143-6220		58			
Pro 143-6230		57			
Pro 153-7409		53			
PSO877MT632	63	55	58	63	54
Salamanca		55			
Yellowstone		53			
Mean	**63**	**56**	**58**	**63**	**54**
P-value	**0.1596**	**<0.0001**	**0.0242**	**<0.0001**	**0.0080**
LSD	**NS**	**1.3**	**2.5**	**0.8**	**0.5**
CV(%)	**1.1**	**1.6**	**2.8**	**0.9**	**0.6**

Table 11. Green Dry Pea Grain Yield (lb/ac) - 2020 Montana Statewide Variety Evaluation

Green Pea Variety/Line	Bozeman (PSPP)	Broadview (SARC)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
AAC Comfort			3566			4815	
Aragorn	2538	2621	3184	4114	2632	3886	3926
Bluemoon						4194	
CDC Greenwater			3325			4333	
CDC Striker	1348	1267	3503	3887	2414	4018	3864
Daytona			3333			4867	
Empire			3555			4277	
Fairway			3606				
Ginny 2			3534			4031	
Hampton	2692	2312	3324	4781	2608	4773	4368
Majoret	1758	1657	3754	4191	2628	3962	4024
NDP100144G	3107	1969	3449	4313	2294	4469	4063
NDP160028	3061	2979	3401	5007	3112	4548	4667
Pro 141-6258			3784			4043	
Pro 171-7665			3688				
PSO877MT457	2535	3123	3151	4179	2780	4252	3837
Shamrock			3591			4204	
Mean	**2434**	**2276**	**3484**	**4353**	**2638**	**4300**	**4107**
P-value	**<0.0001**	**<0.0001**	**0.0019**	**0.0437**	**0.0490**	**0.1**	**<0.0001**
LSD	**441.4**	**398.8**	**306.8**	**711.9**	**479.9**	**NS**	**280.1**
CV(%)	**12.3**	**11.9**	**6.2**	**11.1**	**12.3**	**10.9**	**4.6**

Table 12. Green Dry Pea Protein (%) - 2020 Montana Statewide Variety Evaluation

Green Pea Variety/Line	Bozeman (PSPP)	Broadview (SARC)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
AAC Comfort			23.1			24.1	
Aragorn	25.7	23.0	23.0	24.1	23.5	24.8	22.6
Bluemoon						24.4	
CDC Greenwater			22.4			23.6	
CDC Striker	27.0	25.4	23.7	24.3	24.3	25.2	22.5
Daytona			22.7			23.9	
Empire			23.3			24.8	
Fairway			23.4				
Ginny 2			22.1			25.1	
Hampton	27.6	25.1	24.2	23.5	23.7	25.4	22.3
Majoret	27.0	24.5	23.8	23.1	24.7	25.4	22.3
NDP100144G	25.4	24.7	23.3	23.2	24.7	24.9	22.8
NDP160028	24.7	24.2	22.2	22.4	23.6	24.1	21.6
Pro 141-6258			21.5			24.4	
Pro 171-7665			21.5				
PSO877MT457	27.5	25.1	24.5	25.9	24.3	26.1	24.2
Shamrock			22.6			23.8	
Mean	**26**	**24.6**	**22.9**	**23.8**	**24.1**	**24.7**	**22.6**
P-value	**<0.0001**	**0.0012**	**<0.0001**	**<0.0001**	**0.0117**	**<0.0001**	**<0.0001**
LSD	**0.9**	**1.0**	**0.9**	**1.0**	**0.8**	**0.6**	**0.6**
CV(%)	**2.2**	**2.7**	**2.8**	**2.9**	**2.2**	**1.5**	**1.9**

Table 13. Green Dry Pea Thousand Kernel Weight (g) - 2020 Montana Statewide Variety Evaluation

Green Pea Variety/Line	Bozeman (PSPP)	Havre (NARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
AAC Comfort		278		269	
Aragorn	230	224	217	236	201
Bluemoon				264	
CDC Greenwater		239		244	
CDC Striker	241	253	230	251	238
Daytona		274		279	
Empire		229		232	
Fairway		200			
Ginny 2		230		244	
Hampton	232	237	219	239	217
Majoret	236	242	225	248	229
NDP100144G	214	211	193	198	196
NDP160028	201	221	206	235	216
Pro 141-6258		227		233	
Pro 171-7665		247			
PSO877MT457	252	249	241	253	224
Shamrock		254		250	
Mean	**229**	**238**	**219**	**245**	**217**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**4.7**	**6.8**	**10.5**	**8.6**	**6.4**
CV(%)	**1.4**	**2.0**	**3.3**	**2.4**	**2.0**

Table 14. Green Dry Pea Test Weight (lb/bu) - 2020 Montana Statewide Variety Evaluation

Green Pea Variety/Line	Bozeman (PSPP)	Broadview (SARC)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
AAC Comfort			60.3			64.4	
Aragorn	62.3	63.8	60.4	65.1	63.7	63.2	62.9
Bluemoon						64.1	
CDC Greenwater			60.9			64.8	
CDC Striker	64.3	64.7	61.5	65.1	66.5	64.8	65.1
Daytona			61.2			64.3	
Empire			61.5			66.3	
Fairway			60.3				
Ginny 2			61.1			63.7	
Hampton	63.3	64.2	60.3	65.0	65.5	63.5	63.6
Majoret	64.4	64.8	61.3	65.1	66.6	64.5	65.8
NDP100144G	64.1	64.0	61.0	64.4	65.1	63.8	64.3
NDP160028	66.2	65.9	61.9	65.9	67.1	66.3	66.0
Pro 141-6258			61.6			64.6	
Pro 171-7665			62.0				
PSO877MT457	63.6	63.9	61.0	64.4	65.0	63.6	63.3
Shamrock			61.6			66.3	
Mean	**64.0**	**64.5**	**61.1**	**65.0**	**65.6**	**64.6**	**64.4**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**0.0774**	**<0.0001**	**<0.0001**	**0.0007**
LSD	**0.6**	**0.4**	**0.6**	**1.0**	**0.4**	**0.6**	**1.4**
CV(%)	**0.6**	**0.4**	**0.7**	**1.0**	**0.4**	**0.6**	**1.5**

Table 15. Green Dry Pea Plant Height (cm) – 2020 Montana Statewide Variety Evaluation

Green Pea Variety/Line	Bozeman (PSPP)	Broadview (SARC)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
AAC Comfort			49			90	
Aragorn	44	73	42	74	67	75	64
Bluemoon						78	
CDC Greenwater			54			91	
CDC Striker	56	68	52	77	69	87	65
Daytona			42			80	
Empire			71			94	
Fairway			47				
Ginny 2			49			74	
Hampton	43	63	42	73	64	70	62
Majoret	60	67	48	79	68	80	67
NDP100144G	68	90	61	106	87	93	71
NDP160028	49	72	58	83	74	82	69
Pro 141-6258			39			73	
Pro 171-7665			46				
PSO877MT457	48	70	47	92	80	87	70
Shamrock			54			90	
Mean	**53**	**72**	**50**	**83**	**73**	**83**	**67**
P-value	**0.001**	**0.0005**	**<0.0001**	**<0.0001**	**0.0001**	**<0.0001**	**0.1**
LSD	**11.2**	**9.7**	**5.2**	**8.0**	**8.4**	**9.7**	**NS**
CV(%)	**14.4**	**9.2**	**7.3**	**6.5**	**7.9**	**7.9**	**7.0**

Table 16. Green Dry Pea Days to Flowering - 2020 Montana Statewide Variety Evaluation

Green Pea Variety/Line	Bozeman (PSPP)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Sidney Irrigated (EARC)
AAC Comfort		62			
Aragorn	61	53	55	62	53
Bluemoon					
CDC Greenwater		60			
CDC Striker	64	59	61	64	57
Daytona		57			
Empire		60			
Fairway		59			
Ginny 2		56			
Hampton	65	58	60	63	54
Majoret	63	59	59	64	55
NDP100144G	69	61	62	66	57
NDP160028	66	59	60	64	56
Pro 141-6258		53			
Pro 171-7665		54			
PSO877MT457	63	53	52	61	52
Shamrock		60			
Mean	**64**	**58**	**58**	**63**	**55**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**2.9**	**1.1**	**2.5**	**0.8**	**1.4**
CV(%)	**3.1**	**1.3**	**3.0**	**0.9**	**1.7**

Lentil Variety Evaluation in 2020

A total of 13 lentil entries were evaluated at six locations with nine entries tested at all locations. One additional dryland location at Huntley was lost to grasshoppers prior to harvest.

Lentil grain yield

The mean grain yield varied from 1202 lb/ac to 3181 lb/ac (Table 17). The differences in grain yield among entries within a location was significant for five of the seven locations. The Richland location had an average yield greater than any year dating back to 2011 and the Havre location recorded its 2nd highest average lentil yield over the same time span. The variety Avondale was the highest yielding variety at Richland and produced the highest yield recorded for any lentil variety in the past ten years of this trial within the locations tested this year.

Lentil TKW

Thousand kernel weights (TKW) were obtained for all entries at five locations (Table 18). The mean TKW ranged from 40.3 g per 1000 seeds at Havre to 48.9 g per 1000 seeds recorded at Sidney. TKWs were significantly different for different classes of lentils within a location for all locations.

Lentil test weight

The mean test weight ranged from 59.8 lb/bu at Moccasin to 64.1 lb/bu at Richland (Table 19). The test weight differences among entries within a location were significant for all locations.

Lentil plant height

The mean plant height ranged from 28 cm at Moccasin to 43 cm at Huntley (Table 20). Plant height differences among entries within a location were only significant for two locations.

Lentil number of days to flowering

The mean number of days to flowering ranging from 55 days at Sidney to 63 days recorded at three locations (Table 21). In 2020, the days to flowering interval was shorter than that observed for 2019 but consistent with prior years.

Table 17. Lentil Grain Yield (lb/ac) - 2020 Montana Statewide Variety Evaluation

Lentil Variety/Line	Bozeman (PSPP)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
Avondale	2306	2685	1441	2060	3433	3332
CDC Greenstar		2265			2813	
CDC Impala CL	2573	2007	1397	1794	2923	3182
CDC Impress CL	2331	2458	1257	1792	2712	3031
CDC Imvincible CL					2896	
CDC Kermit		2169			3151	
CDC Maxim CL					3102	
CDC Richlea	2880	2613	1061	1850	3189	3210
CDC Viceroy	1780	2150	1367	1957	2840	3230
NDL090170L	2029	2553	928	1623	2735	2860
NDL090185R	2491	2683	1010	1825	3338	3259
NDL120600R	2122	2096	1139	2004	2412	2887
Sage	2329	2261	1220	2280	3139	3638
Mean	**2316**	**2358**	**1202**	**1909**	**2976**	**3181**
P-value	**0.181**	**<0.0001**	**0.5662**	**<0.0001**	**<0.0001**	**0.0010**
LSD	**NS**	**208.4**	**NS**	**163.6**	**304.6**	**312.1**
CV(%)	**22.1**	**6.1**	**32.5**	**5.9**	**7.1**	**6.7**

Table 18. Lentil Thousand Kernel Weight (g) - 2020 Montana Statewide Variety Evaluation

Lentil Variety/Line	Bozeman (PSPP)	Havre (NARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
Avondale	50.8	44.2	46.8	46.9	48.7
CDC Greenstar		58.5		65.3	
CDC Impala CL	29.6	24.8	26.8	25.9	31.7
CDC Impress CL	51.5	43.8	46.0	47.0	55.3
CDC Imvincible CL				28.3	
CDC Kermit		24.3		26.2	
CDC Maxim CL				36.1	
CDC Richlea	52.4	45.1	48.4	49.2	51.3
CDC Viceroy	32.9	27.0	28.6	29.0	34.6
NDL090170L	61.6	58.3	59.5	64.2	74.3
NDL090185R	51.6	39.5	45.1	45.3	52.4
NDL120600R	52.4	44.1	48.6	50.5	55.0
Sage	39.5	33.2	32.8	35.3	36.8
Mean	**46.9**	**40.3**	**42.5**	**42.2**	**48.9**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**4.2**	**1.9**	**1.7**	**1.8**	**1.3**
CV(%)	**6.2**	**3.2**	**2.7**	**3.1**	**1.8**

Table 19. Lentil Test Weight (lb/bu) - 2020 Montana Statewide Variety Evaluation

Lentil Variety/Line	Bozeman (PSPP)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
Avondale	62.8	62.8	60.2	61.9	63.7	62.3
CDC Greenstar		60.1			61.2	
CDC Impala CL	66.1	65.9	61.7	65.3	66.4	64.9
CDC Impress CL	62.6	62.7	59.1	61.3	63.2	62.2
CDC Imvincible CL					65.6	
CDC Kermit		65.3			66.3	
CDC Maxim CL					65.3	
CDC Richlea	62.0	61.8	58.1	60.9	62.7	61.1
CDC Viceroy	65.5	65.2	63.1	64.6	65.8	64.4
NDL090170L	61.0	61.0	57.3	59.7	61.9	60.0
NDL090185R	63.2	62.9	59.8	62.0	63.5	61.8
NDL120600R	61.9	61.7	58.7	60.5	62.3	61.0
Sage	65.0	65.1	60.6	63.9	65.7	64.0
Mean	**63**	**63.1**	**59.8**	**62.2**	**64.1**	**62.4**
P-value	**<0.0001**	**<0.0001**	**0.0004**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**0.4**	**0.3**	**2.3**	**0.3**	**0.4**	**0.3**
CV(%)	**0.4**	**0.4**	**2.6**	**0.4**	**0.4**	**0.4**

Table 20. Lentil Plant Height (cm) - 2020 Montana Statewide Variety Evaluation

Lentil Variety/Line	Bozeman (PSPP)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
Avondale	41	34	40	27	40	39
CDC Greenstar		36			40	
CDC Impala CL	36	30	44	28	41	40
CDC Impress CL	40	33	43	24	37	42
CDC Imvincible CL					41	
CDC Kermit		28			36	
CDC Maxim CL					40	
CDC Richlea	42	33	44	25	40	39
CDC Viceroy	36	32	44	30	39	39
NDL090170L	39	33	44	23	41	40
NDL090185R	40	32	43	29	43	41
NDL120600R	40	35	44	31	38	43
Sage	38	27	45	35	35	38
Mean	**41**	**32**	**43**	**28**	**39**	**40**
P-value	**0.7319**	**<0.0001**	**0.7051**	**<0.0001**	**0.4**	**0.48**
LSD	**NS**	**2.4**	**NS**	**3.6**	**NS**	**NS**
CV(%)	**13.2**	**5.3**	**8.6**	**9.0**	**5.9**	**8.1**

Table 21. Lentil Days to Flowering - 2020 Montana Statewide Variety Evaluation

Lentil Variety/Line	Bozeman (PSPP)	Havre (NARC)	Huntley Irrigated (SARC)	Moccasin (CARC)	Sidney Irrigated (EARC)
Avondale	63	57	63	62	54
CDC Greenstar		59			
CDC Impala CL	66	59	64	65	60
CDC Impress CL	64	59	64	65	55
CDC Imvincible CL					
CDC Kermit		61			
CDC Maxim CL					
CDC Richlea	64	58	63	63	56
CDC Viceroy	66	61	64	64	56
NDL090170L	62	54	63	62	54
NDL090185R	64	58	63	64	54
NDL120600R	61	55	64	61	54
Sage	60	55	64	61	54
Mean	**63**	**58**	**63**	**63**	**55**
P-value	**0.002**	**<0.0001**	**0.5326**	**<0.0001**	**<0.0001**
LSD	**2.9**	**1.2**	**1.6**	**0.7**	**1.4**
CV(%)	**3.1**	**1.5**	**0.7**	**0.8**	**1.7**

Chickpea Variety Evaluation in 2020

The 2020 statewide chickpea variety evaluation included eleven varieties (ten Kabuli type and one Desi type). Results are reported for six locations. Ascochyta pressure was minimal at the irrigated Sidney location requiring only two fungicide applications as opposed to the normal three or more applications. Yields in Sidney were exceptional, especially for varieties CDC Frontier and CDC Orion. Conversely, four of the locations (Havre, Huntley, Mocassin and Richland) experienced high Ascochyta pressure due to favorable environmental conditions through the central and northern part of the state throughout the summer months. As a result, yields for those variaties lacking Ascochyta resistance are very poor at those locations. The trials at Richland also suffered deer damage which often is variety specific. Mean grain yields ranged from 864 lb/ac at Mocassin to 4497 lb/ac at Sidney and differences in mean grain yield amongst varieties were significant for all locations.

Seed size was evaluated for five locations using a sieve with 8.73 mm (22/64 in) diameter round openings (Table 23). Consistent with 2019, Bozeman had the highest percentage of seeds larger than 8.73 mm in diameter with a site average of 81%. The reduced disease pressure in 2020 at the Sidney location resulted in an increase in percentage of seeds larger than 8.73 mm in diameter relative to 2019 (39.1% in 2019 to 66.2% in 2020). As expected, the percentage of seed larger than 8.73 mm varied greatly among the varieties.

Table 22. Chickpea Grain yield (lb/ac) - 2020 Montana Statewide Variety Evaluation

Chickpea Variety/Line	Bozeman (PSPP)	Havre (NARC)	Huntley Dryland (SARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
CDC Frontier	4215	2335	1932	1192	2244	5539
CDC Leader		2443			2793	
CDC Orion	4179	2552	2163	1277	2714	5590
CDC Palmer		2446			2714	
Kasin		1739			1119	
Myles	3000	2175	1785	1419	2301	3226
Nash	3807	428	1148	106	719	4359
ND Crown	3668	2188	1797	1388	1358	4738
Royal	3580	552	1403	236	809	4380
Sawyer	3477	2006	1640	1076	1819	4252
Sierra	2970	674	1094	217	787	3888
Mean	**3612**	**1776**	**1620**	**864**	**1742**	**4497**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**483.1**	**225.7**	**314.3**	**239.5**	**533.9**	**384.2**
CV(%)	**9.1**	**8.8**	**13.3**	**18.9**	**20.9**	**5.8**

Table 23. Chickpea Seed Size (% greater than 8.73 mm) - 2020 Montana Statewide Variety Evaluation

Chickpea Variety/Line	Bozeman (PSPP)	Havre (NARC)	Moccasin (CARC)	Richland (EARC)	Sidney Irrigated (EARC)
CDC Frontier	77.0	8.9	19.8	17.3	47.0
CDC Leader		21.2		36.3	
CDC Orion	94.4	41.7	56.2	63.1	79.1
CDC Palmer		26.3		60.6	
Kasin		1.2		2.3	
Myles	0.2	0.0	0.0	0.0	0.0
Nash	99.2	65.4	85.4	82.1	90.4
ND Crown	88.4	40.3	59.1	66.1	76.7
Royal	98.8	70.2	85.0	82.9	88.7
Sawyer	90.8	20.2	60.0	45.5	60.1
Sierra	98.9	60.3	71.7	83.8	87.8
Mean	**80.9**	**32.3**	**54.7**	**49.1**	**66.2**
P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
LSD	**3.4**	**11.6**	**8.1**	**7.7**	**5.9**
CV(%)	**2.9**	**24.9**	**10.1**	**10.9**	**6.1**

FUTURE PLANS

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

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

DISCLAIMER:

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

Resistance of Pea Varieties to Rhizoctonia Root Rot — Sidney, MT

OBJECTIVE: Test the resistance of different pea varieties to *R. solani*.

Frankie Crutcher, Amber Ferda and Kevin McPhee

MATERIALS AND METHODS:

Not Irrigated
Variety: Misc.
Location: Sidney, MT
Planted: 4/30/2020
Harvested: 8/3/2020
Plot Size: 5' x 20'
Seeding Rate: 8 LS/ft²
Soil Type: Savage silty clay loam
Previous Crop: Wheat

Residual Soil N to 3 ft: 30.2 lbs/A
Residual Soil P to 6 in: 20 ppm
Applied Fertilizer: None
Irrigated (sprinkler): None
Chemical Applications: Outlook 20 fl oz/A, Roundup 20 fl oz/A, Varisto 18 fl oz/A
Precipitation April – September: 8.1 inches
Vigor and stand counts: 5/19/2020, 6/1/2020, 6/19/2020
Root disease assessment: 6/15/2020

COMMENTS: Seeds were inoculated with peat-based commercial Rhizobium N-Charge® (Verdesian Life Sciences, Cary, NC). *R. solani* AG 2-2 isolate R9 grown on barley was used to inoculate plots at planting. Seed was treated with Cruiser 5FS (1.28 fl oz/cwt) + Apron XL (0.64 fl oz/cwt). Powdery mildew was observed on some varieties close to harvest. Root assessments were done on 6/15/2020. Foliar height and biomass were taken during this time as well.

RESULTS: Significant differences were found for root severity, with the treatments containing *Rhizoctonia* having higher numbers than their counterparts without *Rhizoctonia*. Significant differences were also found for all other categories except root severity. Aragorn and Greenwood were excluded from the yield analysis, due to lodging and shattering before harvest.

Table 1: Pea Variety Responses to Rhizoctonia Root Rot

Variety	Treatment	% Root Severity[a]	% Root Severity[b]	Plants/m² [c]	Wet Weight (g)	Dry Weight (g)	Foliar Height (cm)	% Protein	Yield (Bu/A)	Powdery Mildew
Carver	None	3.13 C-E	92.92 A	94.50 A-C	108.43 A-C	20.63 AB	34.01 AB	20.45 JK	68.58 A	No
	Rhizoctonia	9.65 A-E	97.50 A	88.50 B-D	107.30 A-C	20.35 AB	35.86 A	19.58 K	64.92 AB	No
DS Admiral	None	2.31 DE	82.50 A	84.00 C-E	93.05 C-E	17.78 B-F	31.87 B-D	22.90 E-H	59.11 BC	No
	Rhizoctonia	8.33 B-E	92.72 A	84.00 C-E	91.25 C-E	17.45 B-F	29.98 C-F	22.18 GH	54.63 C-E	No
Majoret	None	4.68 C-E	100.00 A	94.50 A-C	102.98 A-D	19.55 A-C	30.05 C-F	24.13 C	50.56 D-F	Yes
	Rhizoctonia	12.70 A-C	96.15 A	93.00 A-C	103.23 A-D	19.28 A-D	26.31 G	23.35 C-F	45.57 F	Yes
Shamrock	None	5.63 B-E	92.95 A	72.00 EF	101.20 A-D	17.83 B-F	26.99 FG	23.05 D-G	51.62 C-F	Yes
	Rhizoctonia	12.43 A-C	100.00 A	61.50 F	119.40 AB	18.50 B-E	27.56 E-G	22.60 F-H	47.28 EF	Yes
Aragorn	None	3.86 C-E	95.00 A	88.50 B-D	87.88 C-E	22.78 AB	34.15 AB	24.50 BC	-	Yes
	Rhizoctonia	12.01 A-D	100.00 A	88.00 B-D	96.90 A-E	18.55 B-E	29.86 C-F	23.85 C-E	-	Yes
Hampton	None	3.73 C-E	82.50 A	104.00 A	86.03 C-E	14.05 FG	25.95 G	22.33 GH	57.54 B-D	Yes
	Rhizoctonia	18.44 A	97.50 A	81.50 C-E	74.98 E	12.55 G	21.17 H	22.68 E-H	49.94 D-F	Yes
Greenwood	None	3.78 C-E	85.68 A	93.50 A-C	102.58 A-D	17.90 B-E	30.46 C-E	21.08 IJ	-	Yes
	Rhizoctonia	11.44 A-E	100.00 A	87.50 B-D	85.53 C-E	15.93 C-G	27.00 FG	20.00 K	-	Yes
Jetset	None	2.20 E	92.17 A	100.00 AB	103.20 A-D	19.33 A-C	35.36 A	24.18 C	49.26 D-F	Yes
	Rhizoctonia	15.38 AB	95.00 A	85.50 C-E	78.30 DE	15.43 E-G	33.22 A-C	24.28 C	49.30 D-F	Yes
Bridger	None	7.45 B-E	92.50 A	86.00 CD	83.60 C-E	15.45 D-G	28.27 E-G	23.43 C-F	49.44 D-F	Yes
	Rhizoctonia	9.93 A-E	92.72 A	83.00 C-E	86.63 C-E	15.98 C-G	27.81 E-G	21.98 HI	49.16 D-F	Yes
Orchestra	None	3.55 C-E	97.50 A	76.00 DE	95.05 B-E	17.38 B-F	28.91 D-G	26.65 A	50.13 D-F	Yes
	Rhizoctonia	9.98 A-E	95.45 A	75.50 DE	121.50 A	22.53 A	30.23 C-F	25.93 AB	45.13 F	Yes
Mean		8.03	94.04	86.05	96.45	17.86	29.75	22.87	44.14	
% CV		94.69	10.30	14.98	20.87	18.89	13.94	8.34	34.25	
LSD (0.05)		9.79	NS	13.90	25.82	3.84	3.45	0.99	8.44	
Prob > F		0.2309	.2309	<.0001	.0315	.0003	<.0001	<.0001	<.0001	

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Severity: Average percent area of root covered by disease. Ten roots were evaluated for each plot.
[b]Incidence: Percent of ten plants per plot that had visible root necrosis.
[c]Number of plants per m² calculated by stand counts.

Resistance of Lentil Varieties to Rhizoctonia Root Rot — Sidney, MT

OBJECTIVE: Test the resistance of different lentil varieties to *R. solani*.

Frankie Crutcher, Amber Ferda and Kevin McPhee

MATERIALS AND METHODS:

Not Irrigated
Variety: Misc.
Location: Sidney, MT
Planted: 4/30/2020
Harvested: 8/5/2020
Plot Size: 5' x 20'
Seeding Rate: 12 LS/ft²
Soil Type: Savage silty clay loam
Previous Crop: Wheat

Residual Soil N to 3 ft: 30.2 lbs/A
Residual Soil P to 6 in: 20 ppm
Applied Fertilizer: None
Irrigated (sprinkler): None
Chemical Applications: Outlook 20 fl oz/A, Roundup 20 fl oz/A
Precipitation April – September: 8.1 inches
Vigor and stand counts: 5/19/2020, 6/1/2020, 6/19/2020
Root disease assessment: 6/15/2020

COMMENTS: Seeds were inoculated with peat-based commercial Rhizobium N-Charge® (Verdesian Life Sciences, Cary, NC). *R. solani* AG 2-2 isolate R9 grown on barley was used to inoculate plots at planting. Seed was treated with Cruiser 5FS (1.28 fl oz/cwt) + Apron XL (0.64 fl oz/cwt). Root assessments were done on 6/15/2020. Foliar height and biomass were taken during this time as well.

RESULTS: Significant differences were found for both root severity and root incidence, with the *Rhizoctonia* treatments showing more root rot than their counterparts without *Rhizoctonia*. Significant differences were also found for plants/m^2. The treatments that contained no *Rhizoctonia* had higher counts than the treatments with *Rhizoctonia*. The varieties Richlea, Viceroy, Avondale and Pennell had early pod shattering, which resulted in yield loss and were excluded from analysis for this reason.

Table 1: Lentil Variety Responses to Rhizoctonia Root Rot

Variety	Treatment	% Root Severity[a]	% Root Incidence[b]	Plants/m² [c]	Wet Weight (g)	Dry Weight (g)	Foliar Height (cm)	Yield (Bu/A)
Richlea	None	0.00 E	0.00 E	192.00 A	48.85 AB	5.28 A	23.53 AB	-
	Rhizoctonia	11.38 A-C	40.68 AB	109.50 EF	61.75 A	7.03 A	20.77 C-F	-
Viceroy	None	0.75 E	5.28 DE	205.50 A	42.48 B	4.40 A	21.50 CD	-
	Rhizoctonia	9.59 A-D	47.41 AB	141.00 CD	53.15 AB	4.85 A	19.68 D-G	-
Maxim	None	0.25 E	5.56 DE	181.50 AB	42.85 B	4.13 A	21.38 C-E	32.51 A
	Rhizoctonia	13.94 AB	48.75 AB	92.00 FG	54.43 AB	6.13 A	19.47 E-G	27.40 B
Avondale	None	0.13 E	2.50 E	181.00 AB	54.30 AB	5.85 A	24.28 A	-
	Rhizoctonia	4.14 DE	47.58 AB	114.50 D-F	58.03 AB	6.35 A	22.10 BC	-
ND Eagle	None	0.30 E	8.06 DE	137.00 C-E	57.60 AB	6.33 A	21.20 C-E	32.61 A
	Rhizoctonia	5.80 C-E	37.07 A-C	72.00 FG	66.30 A	8.08 A	20.74 C-F	26.88 B
Pennell	None	1.13 E	12.50 C-E	155.00 BC	58.78 AB	6.58 A	20.05 D-G	-
	Rhizoctonia	6.13 C-E	46.94 AB	94.00 FG	61.45 A	7.18 A	19.77 D-G	-
CDC Redberry	None	3.94 DE	29.14 B-D	118.00 D-F	50.55 AB	5.68 A	19.71 D-G	29.19 B
	Rhizoctonia	15.29 A	61.88 A	97.00 FG	55.15 AB	6.50 A	19.21 FG	27.82 B
CDC Rosetown	None	0.13 E	2.78 DE	150.00 C	57.73 AB	6.10 A	18.96 FG	40.96 A
	Rhizoctonia	6.83 B-E	24.07 B-E	100.00 FG	56.93 AB	6.38 A	18.26 G	35.96 A
Mean		4.94	26.30	133.75	55.02	6.05	20.66	23.81
% CV		136.51	100.07	32.56	15.82	28.90	9.72	47.59
LSD (0.05)		7.24	26.56	29.58	17.62	NS	1.98	11.41
Prob > F		<.0001	<.0001	<.0001	.0005	0.1248	<.0001	<.0001

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Severity: Average percent area of root covered by disease. Ten roots were evaluated for each plot.
[b]Incidence: Percent of ten plants per plot that had visible root necrosis.
[c]Number of plants per m² calculated by stand counts.

Resistance of Chickpea Varieties to Rhizoctonia Root Rot — Sidney, MT

OBJECTIVE: Test the resistance of different chickpea varieties to *R. solani*.

Frankie Crutcher, Amber Ferda and Kevin McPhee

MATERIALS AND METHODS:

Not Irrigated
Variety: Misc.
Location: Sidney, MT
Planted: 4/30/2020
Harvested: 9/4/2020
Plot Size: 5' x 20'
Seeding Rate: 4 LS/ft²
Soil Type: Savage silty clay loam
Previous Crop: Wheat

Residual Soil N to 3 ft: 30.2 lbs/A
Residual Soil P to 6 in: 20 ppm
Applied Fertilizer: None
Irrigated (sprinkler): None
Chemical Applications: Outlook 20 fl oz/A, Roundup 20 fl oz/A, Tough 5 EC 1 pt/A
Precipitation April – September: 8.1 inches
Vigor and stand counts: 5/19/2020, 6/1/2020, 6/19/2020
Root disease assessment: 6/15/2020

COMMENTS: Seeds were inoculated with peat-based commercial Rhizobium N-Charge® (Verdesian Life Sciences, Cary, NC). *R. solani* AG 2-2 isolate R9 grown on barley was used to inoculate plots at planting. Seed was treated with Cruiser 5FS (1.28 fl oz/cwt) + Apron XL (0.64 fl oz/cwt). Root assessments were done on 6/15/2020. Foliar height and biomass were taken during this time as well. Trial was desiccated with Gramoxone (32 fl oz/A) on 08/24/2020.

RESULTS: Significant differences were found for root severity, with the susceptible control variety Sierra having the highest root severity for both treatments. There were also significant differences for plants/m² for all of the varieties compared to each treatment. The treatments without *Rhizoctonia* had a higher plants/m² than their counterparts with *Rhizoctonia*. Yield also showed significant differences. The treatments without *Rhizoctonia* yielded better than those with *Rhizoctonia*. Sierra had the lowest yield for both treatments, while Frontier yielded the best.

Table 1: Chickpea Variety Responses to Rhizoctonia Root Rot

Variety	Treatment	% Root Severity[a]	% Root Incidence[b]	Plants/m² [c]	Wet Weight (g)	Dry Weight (g)	Foliar Height (cm)	Yield (Bu/A)
CDC Frontier	None	9.13 C-F	100.00 A	38.00 A-D	103.38 FG	17.18 E-G	27.36 G-J	72.47 A
	Rhizoctonia	9.63 C-F	90.00 A	17.00 G-I	156.80 A-C	26.78 A-C	28.82 B-G	47.77 D-F
Sierra	None	9.50 C-F	95.00 A	36.50 B-D	108.13 D-G	18.18 D-G	27.87 E-J	33.00 HI
	Rhizoctonia	21.72 A	100.00 A	7.37 J	135.28 A-F	23.50 A-E	30.02 B-E	15.74 J
Myles	None	7.97 C-F	97.22 A	27.83 EF	125.95 B-G	21.65 B-G	26.15 I-K	48.41 D-F
	Rhizoctonia	13.18 B-D	100.00 A	9.45 IJ	126.10 B-G	21.45 B-G	24.82 K	27.14 I
Black Butte	None	6.38 D-F	97.50 A	43.00 AB	157.43 A-C	27.38 AB	27.93 D-J	59.52 BC
	Rhizoctonia	10.67 C-F	95.22 A	16.61 G-I	138.22 A-F	22.45 A-F	27.02 G-J	39.62 F-H
CDC Orion	None	8.11 C-F	92.17 A	39.50 A-D	112.53 D-G	18.43 D-G	28.21 C-I	62.21 BC
	Rhizoctonia	15.38 A-C	100.00 A	18.00 GH	149.40 A-D	25.45 A-D	28.89 B-G	37.53 GH
ND Crown	None	8.50 C-F	90.00 A	32.50 DE	133.60 A-G	23.13 A-E	33.69 A	60.16 BC
	Rhizoctonia	12.00 B-E	92.50 A	20.00 F-H	140.38 A-F	23.55 A-E	33.91 A	36.47 G-I
CDC Leader	None	5.00 EF	80.00 A	38.00 A-D	133.20 A-G	21.85 A-G	28.51 B-G	56.63 CD
	Rhizoctonia	19.38 AB	100.00 A	20.00 F-H	141.35 A-F	23.88 A-E	28.35 C-H	34.11 HI
CDC Palmer	None	8.52 C-F	100.00 A	42.50 A-C	135.38 A-F	22.45 A-F	30.64 B	63.12 A-C
	Rhizoctonia	12.88 B-D	95.00 A	22.50 FG	147.15 A-E	24.48 A-E	30.25 BC	41.59 F-H
CDC Alma	None	7.09 D-F	90.22 A	34.50 C-E	122.83 C-G	21.10 B-G	26.27 H-K	54.75 C-E
	Rhizoctonia	12.75 B-D	97.50 A	12.50 H-J	168.35 A	28.90 AB	27.91 E-J	32.04 HI
Black Sicilian	None	5.90 D-F	90.90 A	41.00 A-C	148.68 A-D	24.53 A-E	28.17 C-I	63.49 A-C
	Rhizoctonia	10.68 C-F	100.00 A	14.50 G-J	167.13 AB	29.55 A	27.69 F-J	39.32 F-H
CDC Anna	None	4.13 F	77.50 A	35.50 B-E	102.85 FG	14.55 G	25.91 JK	67.21 AB
	Rhizoctonia	8.68 C-F	100.00 A	13.01 H-J	127.90 A-G	19.13 C-G	27.45 G-J	39.74 F-H
Golden Dragon	None	6.03 D-F	85.00 A	45.00 A	91.83 G	15.03 FG	29.82 B-F	45.54 E-G
	Rhizoctonia	10.00 C-F	85.00 A	20.40 F-H	105.30 E-G	18.45 D-G	30.11 B-D	33.60 HI
Mean		10.13	93.78	26.88	132.46	22.21	28.57	46.29
% CV		28.18	13.34	48.33	24.92	28.18	8.82	33.56
LSD (0.05)		7.57	NS	8.40	41.92	7.89	2.18	9.96
Prob > F		.0032	.2925	<.0001	.0163	.0119	<.0001	<.0001

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Severity: Average percent area of root covered by disease. Ten roots were evaluated for each plot.
[b]Incidence: Percent of ten plants per plot that had visible root necrosis.
[c]Number of plants per m² calculated by stand counts.