

PROGRESS REPORT

2013 Western Regional Cool Season Food Legume Evaluation Trials

INITIATED _____ CURRENT YEAR: 2013 TERMINATING YEAR _____

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Cool season grain legumes including chickpea (*Cicer arietinum* L.), lentil (*Lens culinaris* Medik.) and pea (*Pisum sativum* L.) are integral components of cereal-based cropping systems in the Pacific Northwest and North Central US, including MT and ND. Over the past 20 years the area of cool season food legumes harvested in the North Central US has increased dramatically. Currently the North Central US is responsible for approximately 80% of the peas and lentils produced in the US. Although chickpeas are predominately produced in the US Pacific Northwest, there is a continued interest in developing chickpeas that can be successfully grown in the North Central US.

Promising breeding lines need to be evaluated in multiple locations in both the Pacific Northwest and North Central US to identify specific areas of adaptation for different lines. Limited success has been made in developing varieties of cool season legumes adapted to the diverse environments of Montana and the Northern Plains based on initial selections done in the Pacific Northwest. Varieties adapted to WA and ID often mature late in MT and ND. In addition, disease pressure is typically more severe in the Northern Plains. The objective of this study was to evaluate cool season food legume cultivars and breeding lines developed by the USDA-ARS, Pullman, WA and NDSU breeding programs for yield and other agronomic traits across several locations in MT and ND. Only advanced breeding lines that have exhibited promising performance across multiple locations or years in WA and ID are included in the Western Regional Yield Trials.

North Dakota Western Regional Trials

Pea Yield Trials:

In 2013 Western Regional Trials were conducted for peas in North Dakota at Minot, Hettinger and Williston. A total of sixteen entries were tested that included three yellow pea cultivars (Agassiz, DS Admiral, and CDC Meadow), two ARS yellow pea breeding lines, 3 green pea cultivars (Cooper, Aragorn, and CDC Striker) and 8 ARS green pea breeding lines. The highest average yield was observed at Williston (3176 lb/ac), followed by Hettinger (2936 lb/ac) and Minot (2396 lb/ac). Significant differences between entries for yield were only observed at Minot. The highest yielding entries across all locations were the yellow pea cultivars CDC Meadow and Agassiz, followed by the green pea breeding lines PS08101004 and PS07100471. Agassiz (2894 lb/ac) had the highest yield at Minot and CDC Striker (1977 lb/ac) had the lowest. At Williston the green pea cultivar Cooper had the highest yield (3837 lb/ac) and the yellow pea cultivar DS Admiral had the lowest yield (2369 lb/ac). At Hettinger the green pea breeding line PS08101004 (3274 lb/ac) had the highest yield and the lowest yield (2674 lb/ac) was observed for the yellow pea breeding line PS07100925.

Pea Seed Size and Other Developmental Traits:

The weight of 1000 seeds (gm), days to mature and bloom length were determined for all entries at Minot. Significant differences were observed among entries for all three traits. The green pea cultivar Aragorn has the longest bloom length (21.0 days) and another green pea cultivar, Cooper, had the shortest bloom length. The earliest maturing entries were the yellow pea cultivars DS Admiral and CDC Meadow, both of which matured in approximately 70 days. The latest maturing entries were the green pea cultivar Cooper and the green pea breeding line PS08100582, both of which required approximately 77 days to mature. The highest weight of 1000 seeds were observed for Cooper (231 g) and the yellow pea breeding line PS07100925 (218 g) and the lowest were seen with the green pea breeding lines PS07100470 (165 g) and PS08100582 (168 g).

Yield of green (G) and yellow (Y) pea breeding lines and cultivars evaluated across three locations in North Dakota for the 2013 Western Regional Yield Trials.

Entry	Yield (lb/ac)			Grand Mean
	Minot	Williston	Hettinger	
Agassiz (Y)	2894	3425	2959	3093
DS Admiral (Y)	2710	2369	2898	2659
CDC Meadow	2670	3436	3185	3097
(Y)	2646	3091	2998	2911
PS08101022 (Y)	2589	3389	2674	2884
PS07100925 (Y)	2555	3360	2960	2958
PS07100471 (G)	2364	3275	2731	2790
PS05100736 (G)	2320	3407	3274	3000
PS08101004 (G)	2313	3306	2995	2871
PS08100582 (G)	2311	2883	2935	2710
PS07100470 (G)	2293	3837	2762	2964
Cooper (G)	2256	2604	2943	2601
PS08100133 (G)	2226	3073	2771	2690
Aragorn (G)	2142	2934	2960	2679
PS03101445 (G)	2075	3337	3113	2842
PS05100840 (G)	1977	3095	2827	2633
CDC Striker (G)	2396	3176	2936	2802
Location Mean	415	828	406	
LSD ($\alpha = 0.1$)				

Important Agronomic Traits of pea breeding lines and cultivars evaluated at Minot, ND for the 2013 Western Regional Yield Trials.

Entry	Bloom length (days)	Days to Mature	1000 seed weight (g)
Agassiz (Y)	17.8	74.3	203
DS Admiral (Y)	18.8	70.3	211
CDC Meadow (Y)	18.3	70.5	175
PS08101022 (Y)	19.3	73.3	207
PS07100925 (Y)	16.3	75.5	218
PS07100471 (G)	18.0	75.3	157
PS05100736 (G)	16.8	76.5	168
PS08101004 (G)	18.5	75.3	203
PS08100582 (G)	17.8	77.3	168
PS07100470 (G)	14.3	76.5	165
Cooper (G)	11.3	77.5	231
PS08100133 (G)	16.0	73.8	176
Aragorn (G)	21.0	71.8	171
PS03101445 (G)	18.3	72.5	178
PS05100840 (G)	14.3	76.3	192
CDC Striker (G)	14.5	72.3	170
Trait Mean	16.9	74.3	187
LSD ($\alpha = 0.1$)	1.5	1.3	6.7

Lentil Yield Trials:

In 2013 Western Regional Trials were conducted for lentils at three locations in North Dakota (Hettinger, Williston, and Carrington). The trials evaluated 24 entries including 14 cultivars and 10 breeding lines, which representing all major lentil market classes. The average yield across all entries was greater at Hettinger (2283 lb/ac) than Williston (1885 lb/ac). Significant differences between entries for yield were observed at both locations. In general, entries did not perform consistently across different locations. However, the small red cultivar CDC Red Rider and the small green breeding line LC07ND055E, were exceptions, being ranked among the top four highest yielding entries at each location. Small green and small red lentil cultivars and breeding lines tended to have higher yields than large green breeding lines and cultivars.

Yield of lentil breeding lines and cultivars evaluated in North Dakota for the 2013 Western Regional Yield Trials.

Entry	Seed Type	Hettinger (lb/ac)	Williston (lb/ac)	Grand Mean
LC07ND202T	Small Red	3148	1673	2410
CDC Red Rider	Small Red	3134	2169	2652
CDC Viceroy	Small Green	3046	2000	2523
LC07ND055E	Small Green	2951	2121	2536
CDC Rosetown	Small Red	2942	2035	2489
CDC Redberry	Small Red	2919	1935	2427
LC01602273E	Small Green	2839	1769	2304
LC08600113P	Spanish Brown	2738	1784	2261
LC01602062T	Small Red	2689	1633	2161
LC07ND082E	Small Green	2543	1718	2131
Morena	Spanish Brown	2478	1920	2199
CDC Lemay	French Green	2394	1949	2172
Eston	Small Green	2273	1603	1938
Avondale	Medium Green	2171	1916	2044
Essex	Small Green	2171	2187	2180
LC07ND165T	Small Red	1950	1977	1964
CDC Rouleau	Small Red	1927	1810	1869
CDC Richlea	Medium Green	1890	2122	2006
CDC Greenland	Large Green	1789	2011	1900
LC0860B130L	Large Green	1672	1663	1668
Riveland	Large Green	1580	1821	1701
LC06601734L	Large Green	1471	1831	1651
Pennell	Large Green	1457	2061	1759
LC0860B123L	Large Green	625	1530	1078
Location Mean		2283	1885	
LSD ($\alpha = 0.1$)		426	342	

Chickpea Yield Trials:

In 2013 Western Regional Trials were conducted on chickpea at Williston, Hettinger, and Carrington. Entries included four advanced café kabuli breeding lines and four check café kabuli cultivars, Sawyer, Sierra, CDC Luna and CDC Frontier. ANOVA indicated that differences in yield between entries were significant at both locations. The average yield among all entries at Williston (1431 lb/ac) was higher than at Hettinger (828 lb/ac). The rankings of the top five yielding entries was the same for both locations. CDC Frontier had the highest yield at both locations. In general, entries that produced small or medium size seeds had higher yields than entries that produced large seed, with this observation being most apparent at Hettinger.

Yield of chickpea breeding lines and cultivars evaluated in North Dakota for the 2013 Western Regional Yield Trials.

Entry	Seed Type	Williston (lb/ac)	Hettinger (lb/ac)	Grand Mean (lb/ac)
CDC Frontier	Small kabuli	1994	2037	2016
CDC Luna	Medium kabuli	1715	1588	1652
Sawyer	Medium kabuli	1472	1201	1337
CA0890B0427C	Large kabuli	1374	635	1005
CA0790B0042C	Large kabuli	1339	451	895
CA0790B0547C	Large kabuli	1239	143	691
CA0790B0549C	Medium kabuli	1169	205	687
Sierra	Large kabuli	1147	365	756
Location Mean		1431	828	
LSD ($\alpha = 0.1$)		445	534	

Montana Western Regional Yield Trials

Pea Yield Trials:

In 2013 Western Regional Trials were conducted in for peas at three locations in Montana (Corvallis, Moccasin, and Richland). Each trial included seven advanced green pea breeding lines and three advanced yellow pea lines, all from the ARS breeding program in Pullman, WA. The highest average yields for green peas was at Richland (3523 lb/ac), followed by Corvallis (2068 lb/ac) and Moccasin (1826 lb/ac). Green pea lines did not perform consistently across locations and significant differences in yield between green pea breeding lines were not observed at any location. The highest yielding green pea breeding lines at Corvallis, Moccasin, and Richland were PS08100133, PS081010145, and PS08100582, respectively. The highest yielding entry at any location was PS08100582, which yielded over 4000 lb/ac at Richland.

Similar to green peas, the highest average yields for yellow peas was at Richland (3838 lb/ac), followed by Corvallis (2341 lb/ac) and Moccasin (1907 lb/ac). Although significant differences in yield between yellow pea breeding lines were not observed at any location, PS08101004 had the highest yield among yellow pea entries at both Corvallis and Richland.

Pea Seed Size and Other Agronomic Traits:

Seed weight (g/1000 seeds) was determined for all entries at each location. When the entries were considered irrespective of seed color, significant differences in seed weight was observed among entries at each location. The highest mean seed weight was at Richland (251 g/1000 seeds) followed by Corvallis (234 g/1000 seeds) and Moccasin (211 g/1000 seeds), which was the same ranking observed for locations based on yield. At each location the he mean seed weight of yellow pea entries was greater than the mean weight of green pea entries. Mean weight of 1000 seeds at Richland ranged from a low of 224 g (PS07100471) to a high of 279 g (PS07100925 and PS08101022). The three largest seed sizes were observed at each location for the three yellow pea entries, while the largest seed among green pea breeding lines tended to be produced by PS08100133 and PS05100840.

The number of days until 50% flower bloom was recorded for all entries at both Corvallis and Moccasin. Significant differences between entries in days until 50% bloom were observed only at Moccasin. However, at both locations the earliest flowering entry was the yellow pea line PS08101022.

Lentil Yield Trials:

In 2013, the Western Regional Yield Trials for lentil were conducted at three locations in MT (Corvallis, Moccasin, and Richland). The trials included six ARS breeding lines and the cultivar 'Avondale', a medium size lentil with yellow cotyledons recently released by the ARS. The average yield of all entries was highest at Richland (1940 lb/ac) followed by Moccasin (1798 lb/ac) and finally, Corvallis (1362 lb/ac).

Significant differences in yield between entries were only observed at Moccasin. Rankings among entries for yield differed considerably among locations. At Corvallis the two highest yielding entries were LC01602273 (1604 lb/ac) and LC06601734L (1558 lb/ac). At Moccasin the two highest yielding entries were Avondale (2178 lb/ac) and LC06601734L (2036 lb/ac), while at Richland they were the Spanish Brown breeding line LC08600113P (2253 lb/ac) and Avondale (2074 lb/ac).

Lentil Seed Size and Other Agronomic Traits:

Seed weight was determined for lentil trials conducted at all three locations. The mean seed weight (g/1000 seed) was greatest at Corvallis (58.8 g), where the plots were grown under irrigation, while seed weights were very similar between Moccasin (54.9 g) and Corvallis (55.0 g). Significant differences between entries were observed at all three locations. The breeding lines LC0860B123L and LC0860B130L produced the largest and second largest seed respectively, at each location, while the smallest seed was consistently produced by LC01602273E. Mature plant height was measured for all entries at each location and differences between entries were not significant at any location. The new cultivar Avondale was consistently among the tallest entries at all locations. Days to 50% flower were determined for all entries at Moccasin, where no significant differences among entries was observed, with all entries reaching 50% flower within 69-71 days.

Chickpea Yield Trials:

Chickpea yield trials were conducted at Moccasin and Richland in 2013. Entries included eight breeding lines and four cultivars; the kabuli cultivars “CDC Alma”, ‘CDC Frontier’ and ‘CDC Orion’ and the desi cultivar Myles. The mean yield across all entries at Richland and Moccasin were 2363 and 1623 lb/ac, respectively. Means at Richland ranged from 3902 lb/ac (BGC08009M) to 506 lb/ac (CA0790B0042C). Means at Moccasin ranged from 2084 lb/ac (BGC08009M) to 1392 lb/ac (Myles). Significant differences in yield among entries were observed at both locations.