

Dry Pea, Lentil, Chickpea, and Winter Legume Breeding 2013 Progress Report



Prepared by the
Grain Legume Genetics and Physiology Research Unit
U.S. Department of Agriculture
Agricultural Research Service
Pullman, WA 99164

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Acknowledgements

We would like to acknowledge the financial support of the USA Dry Pea and Lentil Council to the USDA-ARS Grain Legume Genetics and Physiology Research Unit.

We also would like to thank Washington State University for providing field space and support at the Spillman Agronomy Farm.

Personnel, Cooperators and Cooperating Growers

Personnel

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Jim Myers, Oregon State Univ.	Corvallis, OR
Howard Nelson, Central Wash. Grain Growers	Wilbur, WA

Cooperating Growers

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Kyle Morscheck	Genesee, ID
Warren Neal	Garfield, WA
Joe Schmitz	Rosalia, WA
Brian Silflow	Kendrick, WA
Brian Tiegs	Fairfield, WA

2013 PROGRESS REPORT

The 2013 Pacific Northwest growing season was significantly drier than average. Precipitation recorded at the WSU Spillman Research Farm from 1 October 2012 to 31 September 2013 was approximately 16.9 inches, which is nearly 3.5 inches less than normal for that period. Mid-spring was especially dry with March and May receiving only about 34 and 44% of normal precipitation. During July and August only 33% of the typical precipitation fell in Pullman. Summer time temperatures were moderate and it was very dry. Timely rains on 2 June and 19-25 June provided sufficient moisture to set a good crop. During the 2012-2013 Winter, there was average snow cover and moderate temperatures. Soil moisture levels were low going into the spring. The moderate summer temperatures allowed good pollination, seed set and pod fill. Monthly average high and low temperatures very closely paralleled the historical averages. Overall, seed yields were average in our trials in 2013.

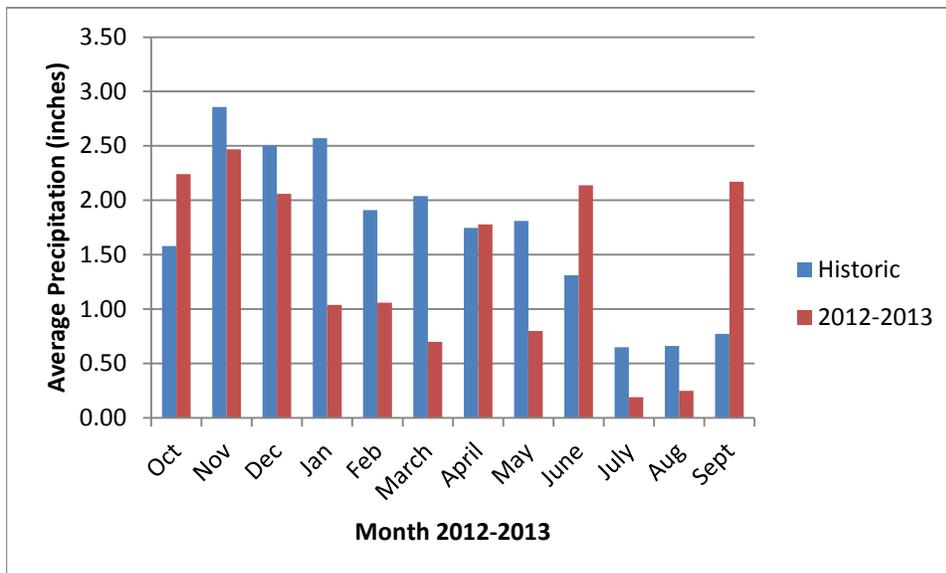


Figure 1. Monthly Precipitation at Pullman, WA. Historical (1940-2005) and 2013 Averages. (Historical data from Western Regional Climate Center, www.wrcc.dri.edu; 2013 data from WSU AgWeatherNet www.weather.wsu.edu).

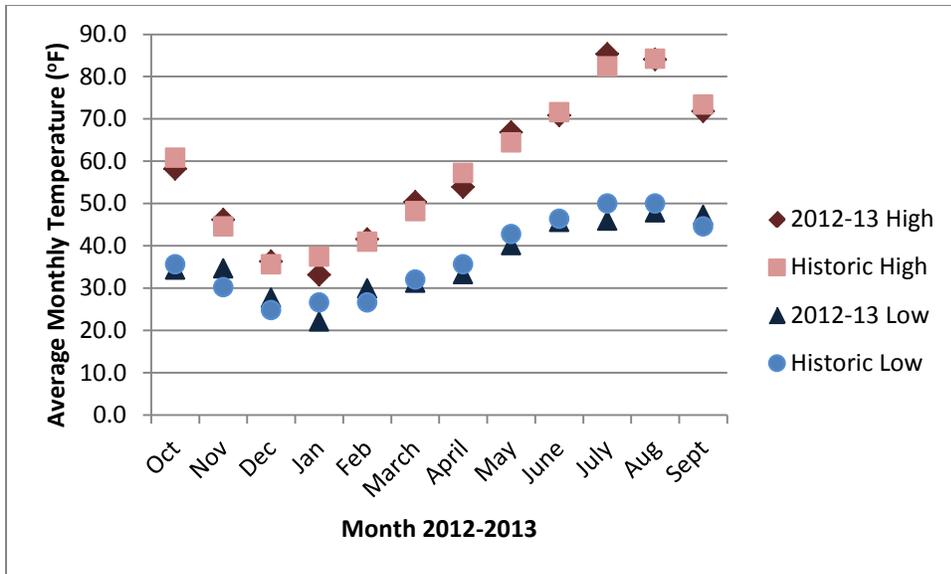


Figure 2. Monthly Temperatures at Pullman, WA. Historical (1940-2005) and 2013 Averages. (Historical data from Western Regional Climate Center, www.wrcc.dri.edu; 2013 data from WSU AgWeatherNet www.weather.wsu.edu).

Prior to planting, all seeds were treated with Maxim 4FS 1(0.9 oz/cwt), Apron XL LS (.61oz/cwt), Mertec LSP (3.0oz/cwt), Molybdenum (as sodium molybdate) (16g/cwt) and Cruiser (30ml/cwt). All advanced and preliminary yield trials were planted in a RCB design with plots 1.4 m x 4.9 m. Target population density for spring peas was 8 seeds/ft². Weed control in the spring planted fields was accomplished using Sencor (6 oz/acre) and Lorox (1.25lbs/acre) applied post-plant, pre-emergence. Due to the very dry spring, herbicides were not adequately activated and weed control was less than optimal. Insecticides, Mustang (4 oz/acre), Dimethoate (1 pt/acre) and Warrior (2 oz/ac) were applied as required to control aphids, pea leaf weevils and pea seed weevils. Data were analyzed with the Nearest Neighbours module of Agrobases (Agronomix Software, Inc., Winnipeg, MB).

MENTION OF TRADE NAMES OR COMMERCIAL PRODUCTS IN THIS REPORT IS SOLELY FOR THE PURPOSE OF PROVIDING SPECIFIC INFORMATION AND DOES NOT IMPLY RECOMMENDATIONS OR ENDORSEMENTS BY THE U.S. DEPARTMENT OF AGRICULTURE

SPRING PEA BREEDING

In 2013, 30 advanced breeding lines and four check varieties (Aragorn, Ariel, Banner and Columbian) of green peas were evaluated in the advanced yield trials. Identical trials were planted at the Washington State University Spillman Farm (Pullman, WA) (29 April 2013), Fairfield, WA (26 April 2013), Genesee, ID (3 May 2013) and Dayton, WA (3 April 2013). The Genesee trial was abandoned due to herbicide drift. Mean yields at the harvested locations were: Spillman 2504 kg/ha; Fairfield 2133 kg/ha; Dayton 1591 kg/ha. Seed weight of the checks ranged from 17.7g/100 seeds (Ariel) to 20.3g/100 seeds (Banner). Seed weight of the advanced lines ranged from 17.7 to 26.4g/100 seeds. The earliest check to flower, Columbian, flowered in 46 days; the earliest breeding line, PS10100575, flowered in 56 days. Aragorn and Ariel, the earliest checks to reach harvest maturity, matured in 90 days; the earliest breeding lines, PS10100148, PS10100178 and PS10100205 reached harvest maturity in approximately 88 days.

Eight breeding lines and four check varieties (Universal, DS Admiral, Delta and Carousel) of yellow peas were evaluated in the yellow pea advanced yield trials. Identical trials were planted at the Washington State University Spillman Farm (Pullman, WA) (29 April 2013), Fairfield, WA (26 April 2013) and Genesee, ID (3 May 2013). The Genesee trial was abandoned due to herbicide drift. The mean yield at the two harvested locations was: Pullman 2560 kg/ha and Fairfield 2855 kg/ha. Across all locations, yields of the checks were: DS Admiral 2634 kg/ha; Delta 2546 kg/ha; Universal 2946 kg/ha and Carousel 2866 kg/ha. The yields of the advanced lines ranged from 2466 kg/ha to 2872 kg/ha. Across all locations, the highest yielding breeding lines PS08101004, out-yielded Delta by 12%. Seed weight of the check varieties ranged from 19.9g/100 seeds (Delta) to 22.3g/100 seeds (DS Admiral). Seed weight of the advanced lines ranged from 20.7g/100 seeds (PS08101021) to 25.6g/100 seeds (PS08100950). The earliest advanced breeding line, PS08101022, flowered slightly later (57 days) than did the early check, Universal (56 days). PS08101022 reached physiological maturity in 89 days; the earliest checks, Universal and Delta matured in 86 days.

In response to interest from stakeholder groups, we have resumed the Marrowfat pea trials and breeding efforts. In 2013, 21 breeding lines and one check, Supra were planted in a preliminary trial at Pullman, WA. Yield of Supra was 2602 kg/ha. The yields of the breeding lines ranged from 1182 to 2640 kg/ha.

The breeding lines were evaluated for resistance to Fusarium wilt, Race 1 in Pullman, WA, Aphanomyces root rot in Kendrick, ID and Pea Enation Mosaic Virus in Corvallis, OR. Selected advanced breeding lines were also evaluated for reaction to Pea Enation Mosaic Virus and Bean Leaf Roll Virus using viruliferous aphids by Dr. Lyndon Porter (USDA-ARS, Prosser, WA).

Potential product quality of the green pea breeding lines was assessed visually. All entries in the green pea advanced yield trials were subjected to a simulated high temperature, high humidity bleach test. All entries in the green and yellow advanced yield trials were subjected to cooking quality tests and will be evaluated for nutritional quality by Dr. Dil Thavarajah (NDSU, Fargo, ND).

POTENTIAL SPRING VARIETY RELEASES

2013 was the fourth year in the advanced trials for the two sister lines PS05100735 and PS05100736. These breeding lines have consistently had top yields in the USDA-ARS trials and the Washington State Variety Trials, the Idaho State Variety Trials and the Western Regional Trials. Both lines are resistant to both Pea Enation Mosaic Virus (PEMV) and Bean Leaf Roll Virus (BLRV). Resistance to PEMV and BLRV has previously not been available in field peas. PS05100736 has extremely high levels of resistance to BLRV. The data in Table 1 provide comparisons of the performance of PS05100736 with Aragorn, Ariel and Banner. This line has been provisionally named 'Hampton', to recognize Dr. Richard Hampton, Professor (emeritus), Oregon State University. Dr Hampton is a plant pathologist who did much early work on PEMV and BLRV in peas. Breeder seed of Hampton was increased in New Zealand (2012-2013) and at Spillman Farm (2013). Approximately 200 lbs was sent to New Zealand in October 2013 for foundation seed increase.

Table 1. Comparison of the performance of PS05100736 with three commercial varieties in 29 location-years.

Entry	FW R1	PM	PEMV	BLRV	Days to Flr	Days to Mat	Vine Length (cm)	Plnt Ht (cm)	PHI	Sd Wt (g/100sd)	Yield (kg/ha)
Hampton	R	R	R	R	62	93	68	59	0.88	20.6	2281
Aragorn	R	R	S	S	60	90	72	66	0.92	20.2	2012
Ariel	R	R	S	S	61	90	70	64	0.91	17.7	2027
Banner	S?	S	S	S	59	91	82	70	0.86	20.3	2054

Agronomic Data for the Advanced Green Pea Yield Trial (1301)

Name	FW 1	PM	PEMV	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	# Repr Nodes	100 Seed Weight -g-
Aragorn	R	S	S	59.7	90.3	16.0	3.0	42.8	37.5	0.88	71.7	65.8	0.92	3.2	20.2
Ariel	R	S	S	61.0	90.0	15.0	2.0	45.2	36.2	0.80	70.0	63.8	0.91	3.3	17.7
Banner	S	S	S	59.0	91.0	13.0	4.0	51.7	42.8	0.83	82.3	70.5	0.86	3.2	20.3
Columbian L1	R	S	S	45.7	93.7	10.0	1.0	46.3	13.5	0.29	111.2	25.5	0.23	4.8	19.6
PS03101445	R	R	S	60.3	91.0	15.3	2.0	47.2	40.2	0.85	76.3	62.7	0.83	3.2	20.3
PS05100120	R	R	R	62.7	93.7	17.2	2.0	47.0	40.2	0.85	75.5	65.2	0.86	3.5	20.6
PS05100735	R	R	R	62.0	92.3	13.0	3.0	45.7	40.0	0.87	73.2	66.0	0.90	3.8	18.7
PS05100736	R	R	R	61.7	93.0	18.2	2.0	45.7	38.3	0.85	68.2	59.2	0.88	3.2	20.6
PS05100840	R	R	S	62.0	92.3	15.0	2.0	41.5	30.8	0.75	65.3	52.2	0.80	4.2	22.6
PS07100471	R	R	S	62.0	91.0	18.5	2.0	46.2	41.8	0.91	72.3	62.8	0.87	3.8	19.2
PS08100133	R	R	R	60.3	91.0	14.3	2.0	42.0	38.2	0.91	66.2	61.7	0.93	3.0	21.8
PS08100218				62.7	93.7	14.7	2.0	40.2	31.3	0.78	67.3	52.3	0.78	4.0	22.0
PS08100582	R	R	S	61.3	93.3	16.0	4.0	47.8	41.0	0.85	74.7	65.7	0.88	3.3	20.1
PS09100034		R		61.7	91.7	16.2	2.0	49.5	40.3	0.82	74.2	62.3	0.84	3.3	22.3
PS09100052		R	S	62.0	91.7	16.2	2.0	58.7	49.7	0.86	85.7	73.5	0.86	3.0	22.1
PS09100123		S		61.7	96.3	14.0	2.0	44.2	32.5	0.75	68.8	54.3	0.79	4.3	22.6
PS10100004				62.7	96.3	13.8	2.0	39.8	35.3	0.89	70.7	59.0	0.85	4.0	22.1
PS10100037				62.0	93.7	15.7	2.0	40.7	34.8	0.85	69.2	53.5	0.80	4.2	19.6
PS10100041				61.7	92.3	15.7	1.0	45.3	34.7	0.77	66.2	54.0	0.82	3.5	18.3
PS10100144				62.3	93.0	14.0	2.0	51.0	40.7	0.80	78.3	65.3	0.83	3.8	20.6
PS10100146				62.3	90.3	17.2	3.0	62.8	50.2	0.80	80.2	74.3	0.93	2.0	26.4
PS10100148				62.0	88.7	14.5	3.0	40.5	34.0	0.84	69.0	55.0	0.80	3.3	22.5
PS10100155				59.7	91.7	13.3	3.0	38.2	28.5	0.77	62.0	48.2	0.78	2.8	19.2
PS10100158				61.7	92.3	15.2	2.0	43.5	36.0	0.84	71.0	63.0	0.89	4.0	17.7
PS10100178				61.7	88.7	14.5	2.0	44.7	40.8	0.92	78.2	66.7	0.85	4.5	22.0
PS10100187				62.3	91.7	17.8	2.0	57.3	43.5	0.76	84.2	66.5	0.79	3.3	22.3
PS10100192				62.3	90.3	15.8	2.0	49.3	37.0	0.75	70.7	62.2	0.88	3.5	21.7
PS10100205				61.3	88.0	18.7	2.0	53.0	45.5	0.86	79.8	65.0	0.81	3.3	20.9
PS10100370				60.7	91.0	15.2	3.0	48.8	42.3	0.87	78.8	68.7	0.88	4.5	22.1

FW 1 = Fusarium Wilt Race 1; R = resistant; S = susceptible. PM = Powdery Mildew; R = resistant; S = susceptible. PEMV = Pea Enation Mosaic Virus; R = resistant; S = susceptible. Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.

Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.

Repr Nodes = average number of reproductive nodes on a plant. Agronomic data are means of three replications at Pullman, WA. Planting Date: 04/29/2013 Harvest Date: 08/07/2013

Location Yield Summary for the Advanced Green Pea Yield Trial (1301)

Name	Leaf Type	Vine Type	Dayton Seed Yield kg/ha	Fairfield Seed Yield kg/ha	Genesee Seed Yield kg/ha	Garfield Seed Yield kg/ha	Pullman Seed Yield kg/ha	Mean Seed Yield kg/ha	% of Aragon
PS03101445	-	-	1951.6	2473.6	N/A	N/A	3012.7	2479.3	112
PS05100735	-	-	2192.0	2142.3	N/A	N/A	2914.9	2416.4	109
PS05100736	-	-	1838.8	2402.9	N/A	N/A	2989.0	2410.2	109
PS10100158			1679.9	2850.7	N/A	N/A	2662.3	2397.6	109
Greenwood	-	-	1744.0	2701.4	N/A	N/A	2658.3	2367.9	107
PS08100582	-	-	1511.3	2349.1	N/A	N/A	3225.6	2362.0	107
PS08100133	-	-	1496.5	2410.5	N/A	N/A	2944.9	2284.0	103
Pro-091-7137	-	-	1588.4	2577.0	N/A	N/A	2629.1	2264.8	102
Pro 081-7161			1539.6	2652.9	N/A	N/A	2572.7	2255.1	102
Ariel	-	-	1776.8	2499.7	N/A	N/A	2475.7	2250.7	102
PS09100052	-	-	1561.0	2286.1	N/A	N/A	2878.5	2241.9	101
Banner	-	-	1578.8	2540.7	N/A	N/A	2550.2	2223.2	101
PS10100370	-		1712.5	2297.7	N/A	N/A	2640.4	2216.9	100
PS10100412	-		1896.2	2185.1	N/A	N/A	2564.3	2215.2	100
Aragon	-	-	1704.2	2281.7	N/A	N/A	2611.8	2199.2	100
PS10100144	-	-	1743.8	2325.7	N/A	N/A	2378.1	2149.2	97
PS07100471	-	-	1870.8	1722.5	N/A	N/A	2853.7	2149.0	97
PS10100004	-		1582.6	1717.9	N/A	N/A	2916.3	2072.3	94
PS09100034	-	-	1522.3	2078.0	N/A	N/A	2572.3	2057.5	93
PS10100379			1931.5	1858.5	N/A	N/A	2376.6	2055.5	93
PS10100178			1494.2	2114.6	N/A	N/A	2456.9	2021.9	91
PS10100381			1499.2	2048.5	N/A	N/A	2474.8	2007.5	91
PS10100205			1864.4	1668.8	N/A	N/A	2412.2	1981.8	90
PS10100401	-		1568.8	2191.8	N/A	N/A	2121.3	1960.6	89
PS10100187			1593.6	2184.6	N/A	N/A	2087.4	1955.2	88
PS10100037	-	-	1577.6	1987.0	N/A	N/A	2284.9	1949.8	88
PS08100218	-	-	1471.1	2277.2	N/A	N/A	2021.7	1923.3	87
PS05100120	-	-	1533.5	1628.7	N/A	N/A	2548.5	1903.6	86
Columbian L1	+	+	1456.3	2153.6	N/A	N/A	2075.8	1895.2	86
PS10100575	-		978.9	2170.4	N/A	N/A	2488.1	1879.1	85
PS05100840	-	-	1625.0	1533.5	N/A	N/A	2467.3	1875.3	85
PS10100155	-		1269.4	2084.7	N/A	N/A	2167.6	1840.6	83
PS09100123	-	-	1565.8	1915.5	N/A	N/A	2024.3	1835.2	83
PS10100041	-		1429.6	1858.1	N/A	N/A	2186.1	1824.6	82
PS10100192			1272.1	1676.8	N/A	N/A	2111.2	1686.7	76
PS10100146	-		965.7	1637.6	N/A	N/A	2329.8	1644.4	74
PS10100148			1283.7	1451.7	N/A	N/A	1977.1	1570.8	71
GRAND MEAN			1591.1	2133.4	N/A	N/A	2504.3	2076.3	
CV			11.2	16.7	N/A	N/A	11.8	13.8	
LSD			290.0	582.8	N/A	N/A	483.1	223.9	

Leaf Type: + = normal leaf; - = afila or semi-leafless.
Vine Type: + = tall vine; - = short vine.
Yield data are means of three replications at each location.

Agronomic and Yield Data for the Marrowfat Dry Pea Observation Nursery (1305MF)

Name	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	# Repr Nodes	100 Seed Weight ..g..	Seed Yield kg/ha	% of Carousel
PS12100094	62.0	94.0	19.0	2.0	48.5	36.5	0.75	81.0	54.0	0.67	5.0	30.6	2640.0	101
SUPRA	61.0	97.0	14.0	2.0	44.0	34.5	0.78	65.0	60.0	0.92	4.5	32.7	2602.2	100
PS12100016	60.0	94.0	19.5	2.0	58.0	43.0	0.74	81.0	62.0	0.77	4.0	33.6	2485.3	95
PS12100133	58.0	94.0	14.5	2.0	39.0	28.5	0.73	64.0	46.5	0.73	4.0	37.2	2441.7	93
PS12100030	62.0	97.0	15.0	2.0	41.5	38.0	0.92	70.5	56.5	0.80	4.5	34.6	2394.1	92
PS12100033	58.0	90.0	15.5	2.0	42.0	21.0	0.50	80.0	37.5	0.47	6.0	26.9	2379.4	91
PS12100015	58.0	92.0	12.5	2.0	44.0	40.5	0.92	67.0	61.5	0.92	3.0	32.8	2324.2	89
PS12100128	58.0	94.0	16.5	2.0	39.0	37.0	0.95	71.0	56.5	0.80	4.5	30.7	2271.1	87
PS12100027	60.0	94.0	14.5	2.0	50.0	35.0	0.70	77.5	54.0	0.70	5.5	32.0	2202.6	84
PS12100019	61.0	97.0	19.0	2.0	42.5	22.5	0.53	95.0	39.0	0.41	6.0	29.4	2188.0	84
PS12100132	62.0	94.0	17.0	2.0	49.0	41.0	0.84	68.0	64.0	0.94	3.0	35.7	2179.9	83
PS12100017	60.0	94.0	17.0	2.0	49.0	39.5	0.81	64.0	59.0	0.92	3.5	31.2	2171.4	83
PS12100031	61.0	92.0	15.5	2.0	46.0	36.5	0.79	66.0	63.5	0.96	4.0	26.4	2013.0	77
PS12100129	58.0	92.0	16.0	2.0	54.0	47.0	0.87	78.5	68.0	0.87	3.5	33.7	1960.3	75
PS12100018	60.0	96.0	20.0	2.0	53.5	43.0	0.80	87.5	65.0	0.74	5.5	28.8	1928.2	74
PS12100125	61.0	96.0	12.5	2.0	28.5	25.5	0.89	61.0	43.5	0.71	5.0	32.2	1906.3	73
PS12100014	60.0	92.0	17.0	2.0	40.0	31.5	0.79	58.5	50.5	0.86	4.0	31.2	1862.7	71
PS12100126	61.0	97.0	18.5	2.0	37.0	21.0	0.57	71.5	34.0	0.48	4.5	32.6	1694.6	65
PS12100127	56.0	90.0	15.5	2.0	49.5	30.0	0.61	68.0	49.0	0.72	2.5	32.8	1608.4	61
PS12100021	60.0	101.0	18.5	2.0	57.5	33.5	0.58	82.5	57.0	0.69	5.5	29.4	1575.1	60
PS12100130	58.0	90.0	14.5	2.0	43.5	25.5	0.59	73.5	40.0	0.54	5.0	34.8	1182.0	45
PS12100131	56.0	90.0	16.5	2.0	48.0	35.5	0.74	77.5	56.5	0.73	5.5	28.1	820.5	31
GRAND MEAN	59.5	93.9	16.3	2.0	45.6	33.9	0.75	73.1	53.5	0.74	4.4	31.7	2037.7	
CV	2.9	2.9	12.9	2.0	15.0	21.4	17.40	12.2	17.8	20.78	21.6	8.5	21.7	
LSD														

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.
 Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.
 Repr Nodes = average number of reproductive nodes on a plant. Planting Date: 04/30/2013 Harvest Date: 08/09/2013

Mean Yields of the Advanced Green Pea Yield Trial, 2009-2013

Name	Leaf Type	Vine Type	2013	2012	2011	2010	2009
			kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Ariel	-	-	2250	2073	2072	1474	1964
Columbian L1	+	+	1895	1734	1544	1254	1611
PS03101445	-	-	2479	2487	2190	1627	2157
PS05100120	-	-	1903	2517	2301	1753	2130
PS05100735	-	-	2416	2606	2438	1669	2071
PS05100736	-	-	2410	2668	2433	1746	2148
PS05100840	-	-	1875	2363	2147	1626	2271
Aragorn	-	-	2199	2206	2209	1416	2024
Banner	-	-	2223	2483	2096	1587	1883
PS07100471	-	-	2149	2545	2193	1760	
PS08100582	-	-	2362	2587	2380		
PS08100133	-	-	2284	2703	2268		
PS08100218	-	-	1923	2449			
PS09100034	-	-	2057	2441			
PS09100052	-	-	2241	2535			
PS09100123	-	-	1835	2416			
PS10100144	-	-	2149	2509			
PS10100146	-	-	1644				
PS10100401	-	-	1960				
PS10100155	-	-	1840				
PS10100041	-	-	1824				
PS10100037	-	-	1949	2478			
PS10100575	-	-	1879				
PS10100004	-	-	2072				
PS10100148	-	-	1570				
PS10100158	-	-	2397				
PS10100178	-	-	2021				
PS10100187	-	-	1955				
PS10100192	-	-	1686				
PS10100205	-	-	1981				
PS10100370	-	-	2216				
PS10100379	-	-	2055				
PS10100381	-	-	2007				
PS10100412	-	-	2215				
Pro-091-7137	-	-	2264	2637			
Greenwood	-	-	2367	2513			
C.V.			13.8	10.0	11.6	12.0	11.5
LSD			223.	145.	264.	201.	190.

Leaf Type: + = normal leaf, - = afila or semi-leafless type.

Plant Type: + = tall plant type, - = short plant type.

Yield data are means of three reps per location, 4 locations per year.

Agronomic Data for the Advanced Yellow Pea Yield Trial (1302)

Name	FW 1	PM	PEMV	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height	Pod Ht Maturity	Pod Ht Index	Vine Length	Canopy Height	Plant Ht Index	# Repr Nodes	100 Seed Weight
								..cm..	..cm..	..cm..	..cm..	..g..			
Carousel	R	S	S	59.0	89.0	14.0	2.0	46.8	42.2	0.90	67.2	61.3	0.91	3.0	23.3
DS ADMIRAL	R	R	S	63.0	89.7	15.7	2.0	50.3	43.8	0.87	71.8	68.0	0.95	4.2	22.3
Delta	R	S	S	60.3	86.3	15.0	1.0	38.0	31.2	0.82	58.5	49.0	0.84	3.0	19.9
PS07100925	R	R	S	61.0	90.3	14.0	2.0	38.3	30.7	0.79	53.5	48.3	0.90	3.3	23.2
PS08100950				63.0	91.0	14.8	2.0	42.7	32.2	0.76	63.8	53.8	0.84	4.0	25.6
PS08101004	R	R	S	62.3	94.3	14.5	1.0	44.0	37.5	0.86	68.5	58.3	0.85	4.3	22.2
PS08101021				63.0	91.7	15.3	2.0	47.5	26.8	0.56	67.2	44.8	0.68	3.3	20.7
PS08101022	S	R	S	57.0	89.3	15.2	2.0	43.0	33.5	0.78	72.2	58.5	0.82	3.5	23.3
Pro 103-7402				56.3	89.7	15.7	1.0	46.5	37.3	0.80	69.2	59.3	0.86	3.7	21.4
Pro 793				57.7	88.7	14.5	2.0	42.2	35.2	0.85	62.5	55.8	0.89	2.3	26.4
Pro 822				57.0	89.7	13.2	2.0	47.3	40.3	0.85	74.3	61.8	0.83	3.8	23.9
Universal	R/S	S	S	55.7	86.3	16.2	1.0	44.2	34.7	0.79	75.2	57.8	0.77	4.8	20.8
GRAND MEAN				59.6	89.6	14.8	1.6	44.2	35.4	0.80	66.9	56.4	0.85	3.6	22.7
CV				1.9	2.0	12.7	27.	10.0	14.2	12.12	7.8	12.0	11.89	28.5	3.1
LSD				1.9	3.0	3.2	0.7	7.5	8.5	0.16	8.8	11.4	0.17	1.7	1.2

FW 1 = Fusarium Wilt Race 1; R = resistant; S = susceptible. PM = Powdery Mildew; R = resistant; S = susceptible. PEMV = Pea Enation Mosaic Virus; R = resistant; S = susceptible. Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage. Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage. Repr Nodes = average number of reproductive nodes on a plant. Agronomic data are means of three replications at Pullman, WA. Planting Date: 04/29/2013 Harvest Date: 08/09/2013

Location Yield Summary for the Advanced Yellow Pea Yield Trial (1302)

Name	Leaf Type	Vine Type	Fairfield Seed Yield	Genesee Seed Yield	Garfield Seed Yield	Pullman Seed Yield	Mean Seed Yield	% of Carousel
			kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	
Universal	-	-	3355.7	N/A	N/A	2538.1	2946.9	102
PS08101004	-	-	2672.3	N/A	N/A	3072.1	2872.2	100
Carousel	-	-	2742.7	N/A	N/A	2990.4	2866.6	100
PS08100950	-	-	2614.9	N/A	N/A	3113.2	2864.1	99
Pro 822	-	-	3104.9	N/A	N/A	2354.2	2729.6	95
Pro 103-7402	-	-	3023.5	N/A	N/A	2335.2	2679.4	93
PS07100925	-	-	2617.4	N/A	N/A	2691.4	2654.4	92
DS ADMIRAL	-	-	2721.8	N/A	N/A	2547.5	2634.7	91
PS08101022	-	-	2664.0	N/A	N/A	2582.3	2623.2	91
Pro 793	-	-	3127.4	N/A	N/A	2101.0	2614.2	91
Delta	-	-	3164.7	N/A	N/A	1929.1	2546.9	88
PS08101021	-	-	2455.1	N/A	N/A	2477.2	2466.2	86
GRAND MEAN			2855.3	N/A	N/A	2560.9	2708.1	
CV			7.1	N/A	N/A	7.4	7.2	
LSD			345.0	N/A	N/A	325.2	191.5	

Mean Yields of the Advanced Yellow Pea Yield Trial, 2009-2013

Name	Leaf Type	Vine Type	2013	2012	2011	2010	2009
			kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Universal	-	-	2946	2560	2571	1942	2124
Delta	-	-	2546	2430	2130	1568	1781
Carousel	-	-	2866	2847	2252	1629	2192
DS ADMIRAL	-	-	2634	2404	2033	1765	2053
PS07100925	-	-	2654	3005	2707		
PS08100950	-	-	2864				
PS08101004	-	-	2872	2915	2452		
PS08101021	-	-	2466				
PS08101022	-	-	2623	2651	2318		
Pro 822		-	2729	2869			
Pro 793		-	2614	2974			

Leaf Type: + = normal leaf, - = afila or semi-leafless type.

Plant Type: + = tall plant type, - = short plant type

Yield data are means of three reps per location, 4 locations per year.

Agronomic and Yield Data for the Preliminary Green Dry Pea Yield Trial (1303)

Name	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height	Pod Ht Maturity	Pod Ht Index	Vine Length	Canopy Height	Plant Ht Index	# Repr Nodes	100 Seed Weight	Seed Yield	% of Aragon
					.cm.	.cm.		.cm.	.cm.			.g.	kg/ha	
Aragon	59.0	87.7	15.5	4.0	47.7	41.5	0.87	79.0	68.5	0.87	2.8	20.3	2889.2	100
PS10100558	61.7	91.7	15.5	3.0	58.0	44.3	0.77	82.3	65.8	0.81	2.3	21.8	2677.8	92
PS10100295	61.7	93.3	14.5	2.0	61.7	55.5	0.90	96.5	80.5	0.84	3.5	21.1	2583.2	89
PS10100280	62.0	91.7	16.2	5.0	48.8	33.5	0.69	80.3	58.2	0.73	1.7	20.9	2549.0	88
PS10100325	61.7	92.3	16.0	3.0	58.8	38.0	0.64	88.2	65.5	0.75	2.7	22.0	2526.2	87
PS10100264	62.0	94.0	23.5	2.0	46.3	34.7	0.75	76.3	56.5	0.74	3.2	21.0	2516.9	87
PS10100530	62.3	92.3	14.7	4.0	44.8	37.8	0.84	70.8	62.2	0.88	1.7	23.2	2490.4	86
Banner	59.0	89.3	13.3	2.0	48.0	43.2	0.90	83.7	71.7	0.87	4.8	19.5	2475.0	85
PS10100184	60.3	87.7	17.8	4.0	49.8	36.7	0.74	78.5	61.5	0.78	2.0	21.7	2412.0	83
PS08100709	59.7	89.3	17.2	3.0	51.3	46.7	0.91	75.8	67.0	0.88	2.0	23.0	2353.6	81
PS10100406	61.7	92.3	15.3	3.0	54.2	48.2	0.89	88.2	74.0	0.84	3.8	19.3	2328.5	80
PS10100355	62.3	96.3	13.3	2.0	51.2	44.3	0.87	78.0	66.3	0.86	4.0	20.4	2309.8	79
PS10100377	62.3	92.3	14.2	5.0	47.0	41.2	0.88	83.3	65.5	0.78	1.8	19.5	2225.8	77
PS10100145	62.3	92.3	14.3	2.0	60.2	56.2	0.93	88.3	81.8	0.93	4.0	24.9	2180.9	75
PS10100131	60.3	91.0	15.7	2.0	52.8	44.0	0.84	83.3	67.7	0.81	3.2	22.8	2169.8	75
PS10100012	61.3	93.0	14.7	2.0	45.3	31.0	0.68	66.0	55.2	0.84	2.8	22.4	2135.3	73
GRAND MEAN	61.2	91.6	15.7	2.9	51.6	42.2	0.82	81.1	66.7	0.83	2.9	21.5	2426.4	
CV	1.0	2.1	32.6	46.2	7.4	13.6	10.80	8.3	11.5	11.66	34.2	3.6	8.8	
LSD	1.0	3.2	8.5	2.3	6.3	9.5	0.15	11.3	12.8	0.16	1.6	1.3	359.3	

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.
 Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.
 Repr Nodes = average number of reproductive nodes on a plant. Agronomic data are means of three replications at Pullman, WA. Planting Date: 04/29/2013 Harvest Date: 08/07/2013

Agronomic and Yield Data for the Yellow Dry Pea Preliminary Yield Trial (1304)

Name	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height	Pod Ht Maturity	Pod Ht Index	Vine Length	Canopy Height	Plant Ht Index	# Repr Nodes	100 Seed Weight	Seed Yield
					.cm.	.cm.		.cm.	.cm.			.g.	kg/ha
Carousel	58.0	89.3	16.5	2.0	58.8	42.2	0.72	75.3	66.2	0.88	2.3	23.0	2614.3
PS10100207	58.7	91.3	14.2	2.0	51.3	43.0	0.84	78.2	66.5	0.85	4.5	22.4	2390.9
Universal	55.0	85.7	14.5	2.0	45.5	41.0	0.90	69.2	62.5	0.90	3.2	20.3	2376.2
PS10100535	58.0	90.0	12.2	1.0	37.3	30.0	0.81	62.3	55.0	0.88	4.0	20.6	2255.1
GRAND MEAN	57.4	89.0	14.3	1.8	48.2	39.0	0.82	71.2	62.5	0.88	3.5	21.5	2409.1
CV	1.0	1.0	12.1	15.7	6.3	9.8	12.18	6.8	4.9	6.76	16.3	2.3	4.6
LSD	1.1	1.8	3.4	0.5	6.1	7.6	0.20	9.7	6.2	0.12	1.1	1.0	232.8

Agonomic and Yield Data for the Green Dry Pea Observation Nursery (1305G)

Name	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	# Repr Nodes	100 Seed Weight ..g..	Seed Yield kg/ha	% of Aragon
PS12100005	60.0	90.0	14.0	2.0	53.0	48.5	0.92	85.0	72.0	0.85	4.0	18.8	3224.2	124
PS12100057	61.0	92.0	13.0	2.0	38.5	34.5	0.90	61.0	58.0	0.95	5.0	22.8	2880.5	110
PS12100096	60.0	90.0	20.0	2.0	55.0	45.5	0.83	84.5	68.5	0.81	5.0	19.1	2857.9	110
Banner	58.0	90.0	11.0	1.0	60.5	46.5	0.77	79.5	68.0	0.86	4.0	19.2	2813.5	108
PS12100107	58.0	92.0	13.5	2.0	54.5	45.0	0.83	83.5	76.0	0.91	4.0	21.9	2769.4	106
PS12100121	60.0	90.0	16.5	2.0	56.5	46.0	0.81	88.5	76.5	0.86	4.0	22.6	2717.9	104
PS12100095	61.0	90.0	16.0	2.0	47.0	43.5	0.93	72.0	63.5	0.88	5.0	17.4	2667.7	102
PS12100011	63.0	94.0	16.5	2.0	62.5	46.0	0.74	96.0	65.0	0.68	5.5	19.6	2604.6	100
Aragon	58.0	88.0	14.0	2.0	47.5	43.0	0.91	80.0	67.0	0.84	4.0	19.9	2596.6	100
PS12100100	61.0	96.0	14.5	2.0	38.5	36.0	0.94	59.0	53.5	0.91	3.5	20.6	2587.1	99
PS12100035	61.0	92.0	18.5	2.0	55.5	51.5	0.93	76.5	71.5	0.93	3.0	19.6	2568.7	98
PS12100105	62.0	92.0	15.5	2.0	48.0	41.0	0.85	80.5	65.5	0.81	5.5	19.4	2533.3	97
PS12100001	60.0	92.0	15.0	2.0	55.0	42.0	0.76	81.5	63.5	0.78	3.5	21.6	2512.8	96
PS12100032	58.0	88.0	16.5	2.0	35.5	33.5	0.94	66.0	55.5	0.84	5.0	25.9	2429.3	93
PS12100119	62.0	95.0	18.0	2.0	50.0	39.0	0.78	83.0	68.0	0.82	7.5	19.4	2407.6	92
PS12100087	62.0	90.0	17.5	2.0	41.0	39.0	0.95	62.0	57.0	0.92	2.5	19.9	2373.7	91
PS12100058	62.0	92.0	14.0	2.0	42.0	37.0	0.88	70.5	64.0	0.91	2.0	16.5	2365.8	91
PS12100118	62.0	94.0	18.0	2.0	53.5	45.5	0.85	76.5	67.5	0.88	2.5	21.6	2349.9	90
PS12100120	56.0	90.0	14.0	2.0	40.5	37.0	0.91	66.5	60.5	0.91	5.5	19.5	2345.1	90
PS12100040	61.0	90.0	17.0	2.0	58.0	40.0	0.69	72.5	59.5	0.82	2.5	21.0	2320.3	89
PS12100034	60.0	90.0	19.5	2.0	68.0	58.0	0.85	98.5	78.5	0.80	3.5	21.1	2316.4	89
PS12100106	61.0	90.0	15.0	2.0	47.0	41.0	0.87	70.5	61.5	0.87	6.5	20.2	2242.1	86
PS12100039	58.0	88.0	12.5	2.0	41.5	30.0	0.72	67.5	50.5	0.75	4.0	22.4	2223.9	85
PS12100098	56.0	85.0	15.5	2.0	47.5	40.0	0.84	81.0	60.0	0.74	4.5	20.8	2168.3	83
PS12100013	61.0	90.0	10.5	2.0	42.0	40.0	0.95	76.0	62.5	0.82	4.0	21.4	2167.3	83
PS12100054	56.0	94.0	13.0	2.0	43.5	39.0	0.90	74.5	67.0	0.90	4.0	21.0	2149.7	82
PS12100045	61.0	87.0	17.5	2.0	45.0	39.5	0.88	68.0	60.5	0.89	3.5	23.3	2073.0	79
PS12100122	56.0	90.0	16.0	2.0	52.0	42.5	0.82	86.0	69.0	0.80	4.5	18.7	1995.7	76

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.

Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.

Repr Nodes = average number of reproductive nodes on a plant. Planting Date: 04/30/2013 Harvest Date: 08/09/2013

LENTIL BREEDING

In 2013, identical advanced lentil yield trials were planted at Pullman, WA and Fairfield, WA. The green seed coat, yellow cotyledon market classes were divided into three groups: Eston Types: small seed weight (mean seed weight = 3.9g/100 seeds); Richlea Types: medium seed weight (mean seed weight = 6.0g/100 seeds); and Laird Types: large seed weight (Mean seed weight = 7.3g/100 seeds. Pardina Types (Spanish Brown) have small seeds (mean seed weight = 4.5g/100 seeds) with yellow cotyledons and brown seed coats. The Turkish Red Types have small seeds (mean seed weight = 4.0g/100 seeds) with red/orange cotyledons and brown seed coats. The Zero Tannin Types have medium-large seeds (mean seed weight = 5.3g/100 seeds) with any color cotyledon and clear seed coats. The 2013 lentil Advanced Yield Trials were planted at the Washington State University Spillman Farm (Pullman, WA)(30 April 2013) and Fairfield, WA (26 April 2013).

The 2013 small green seeded (Eston) advanced yield trial had four entries and two checks, Athena and Eston. The mean yields at Pullman were 1505 kg/ha, at Fairfield 1834 kg/ha. The best performing breeding line, LC08600005E has seed weight of 4.7g/100 seeds compared to Eston and Athena seed weights of 3.3g/100 and 4.0 g/100 seeds, respectively. Across all

locations, it yielded 14% more than Eston and 13% more than Athena. Its seed weight is probably too large for this market class and it will be moved to the medium green market class trials for future testing. LC01602273E had an average yield of 1676 kg/ha across both locations. Its seed weight in 2013 was 3.7 g/100 seeds, which was between the seed weights of Athena and Eston.

The medium green seeded (Richlea) advanced yield trial had five entries and two checks, Richlea and Merrit. The average yield at Pullman was 1456 kg/ha and at Fairfield average yield was 1762kg/ha. Avondale (LC01602300R) has performed well in previous years and performed very well in the Washington and Idaho state wide trials. It is broadly adapted to the Palouse region of Idaho and Washington and to NE Montana. It is highly resistant to Stemphylium Blight. It is slightly taller (38.7cm) than Richlea (37.4cm) at harvest and had similar days to maturity. Its seed weight is 5.9g/100 seeds, compared to Richlea's 5.3g/100 seeds. Breeder seed was transferred to the Washington State Crop Improvement Association in 2012. Foundation seed was produced near Pullman in 2013 and a second increase of foundation seed was sent to New Zealand in October 2013. We anticipate the return of that seed in March 2014. An application for PVP was submitted in October 2013.

The large green seeded (Laird) advanced yield trial had 11 entries and four checks, Pennell, Merrit, Riveland and Brewer. The average yields were: Pullman: 1495 kg/ha and Fairfield: 1406 kg/ha. Yields at Fairfield were uncharacteristically low. The yield of 6 of the breeding lines was greater than Merrit, the most widely grown check. Seed weight of the breeding lines ranged from 6.3 to 8.0 g/100 seeds compared to Merrit 6.2g/100 seeds. The canopy height of the breeding lines at harvest ranged from 34.2 cm to 39 cm compared to Merrit 38.3cm and Brewer 33.7cm. The breeding lines also had desirable plant height indices, indicating a strong upright, non-lodging growth habit. The breeding objectives of this class of lentils include improving seed shape to minimize seed damage during harvest and processing.

The Spanish Brown (Pardina) advanced yield trial had 16 entries and two checks, Pardina and Morena. Mean yield at Pullman was 1869 kg/ha and 1667 kg/ha at Fairfield. As in 2012, two sister lines, LC08600116P, LC08600113P were the top yielders in 2013. They also were very high yielding in 2010 and 2011. LC08600113P had an average yield of 1908 kg/ha and LC08600116P had an average yield of 1982 kg/ha, compared to Pardina 1535 kg/ha. The plant height of the two lines (35.7cm and 35.0cm, respectively) is also greater than Pardina (28.7cm) and not significantly different from Morena (38.5cm). In 2013, the seed weights of

LC08600113P and LC08600116P P were 4.1g/100 seeds and 4.9g/100 seeds, respectively. Morena and Pardina both had seed weights equal to 4.0g/100 seeds. The seed weights of both LC08600113 and LC08600116 are large for this market class. We are sending samples out to various handlers and marketers to determine if they fit in the Spanish Brown Market Class. Breeder seed has been made of LC08600113P. Breeding objectives of this class of lentils continues to include improved height and standability and increased yield.

The 2012 Turkish Red advanced yield trials contained nine entries and one check, Crimson. This trial was planted only at Pullman where the average seed yields were 1534kg/ha, which was approximately 200kg/ha more than in 2012. All the retained breeding lines had seed weights that ranged from 3.6-4.7g/100 seeds, which are larger than Crimson (3.4g/100 seeds). Acceptability of larger seed size is yet to be determined. We will continue to make improvements in yield and maintain taller, erect plant architecture.

The 2013 Zero Tannin advanced yield trials had six entries and two checks, Shasta and Cedar. This trial was also planted only at Pullman. One entry, LC99602585RZ has red cotyledons, the other five have yellow cotyledons. Average yields were 1407 kg/ha, which was approximately 200kg/ha less than 2012. The zero tannin lentils have relatively large seed weight (average = 5.7g/100 seeds in 2013) and tend to be tall (average height at maturity was 36cm) and have good lodging tolerance. They are typically late maturing (average days to harvest = 105.2) and the pods drop and shatter more readily than other lentil classes. Consequently, the primary breeding objectives for this class is to make them earlier maturing and to decrease the tendency for pod drop and shatter.

New Variety Releases

Avondale (LC01602300R) has been a top performer in the medium green lentil advanced trials since 2004, the Western Regional Trials since 2006 and in the Washington and Idaho State Variety Trials since 2011. It has a seed weight is similar to Richlea (approximately 5g/100 seeds) and it has yielded an average of 1320 kg/ha over more than 50 location years of advanced trials. This represents a yield increase of approximately 10% over Richlea (Table 4.). Pre-breeder seed was made in 2010 and increased in 2011 and transferred to Washington State Crop Improvement Association in 2012. In 2013, foundation seed was jointly made by WSCIA and USDA-ARS. Seed of Avondale was sent to New Zealand in October 2013 for another round of seed increase.

Table 4. Comparison of the performance of Avondale (LC01602300R) with Richlea in 50 location-years.

Entry	Canopy Ht (cm)	Days to Mat	Plant Ht Index	Seed Size (g/100 sds)	Yield (kg/ha)
Avondale	34.4	97.5	0.95	4.9	1319
Richlea	33.4	96.5	0.91	5.2	1197

Agronomic and Yield Data for the Large Yellow Type Lentil Preliminary Yield Trial (1354)

Name	Days to Flower	Days to Maturity	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	100 Seed Weight ..g..	Seed Yield kg/ha
LC11600361R	60.3	95.0	2.0	25.3	18.8	0.75	51.0	36.3	0.71	4.5	1804.8
LC11600362R	61.0	97.0	2.0	22.5	18.7	0.83	49.2	42.5	0.87	4.6	1737.7
LC11600323L	59.0	103.0	2.0	22.7	16.7	0.75	45.7	39.0	0.86	6.3	1736.9
LC11600330L	59.0	105.0	2.0	17.2	10.7	0.64	41.5	36.3	0.88	7.2	1722.3
LC09600481L	60.7	106.0	2.0	22.7	17.5	0.78	53.2	44.7	0.85	6.5	1680.2
Richlea	61.7	103.0	2.0	21.8	15.2	0.72	44.2	38.5	0.88	4.9	1644.0
LC11600370R	61.0	103.0	1.0	22.5	16.5	0.74	47.8	41.5	0.87	4.6	1606.1
LC11600228L	58.7	98.0	2.0	18.5	14.3	0.77	43.0	36.3	0.85	6.1	1602.4
LC11600342L	56.7	100.0	2.0	18.8	15.3	0.81	45.5	41.5	0.92	5.1	1583.2
LC11600193L	56.0	96.0	2.0	20.7	13.8	0.68	47.3	36.2	0.76	6.2	1573.6
LC09600361L	57.3	102.0	2.0	22.3	16.5	0.76	48.5	41.7	0.87	7.0	1570.6
LC11600199L	61.0	105.0	2.0	24.5	15.0	0.61	52.7	34.2	0.65	7.2	1570.2
LC11600369R	60.7	104.0	2.0	20.8	15.2	0.73	44.2	40.5	0.92	4.9	1546.1
LC11600380L	60.7	105.0	2.0	24.8	15.0	0.61	53.5	40.7	0.77	7.2	1536.8
Riveland	60.0	102.0	2.0	23.0	14.7	0.64	48.3	40.2	0.84	6.8	1528.0
Merit	57.3	101.0	2.0	18.3	13.5	0.74	46.2	42.7	0.92	6.4	1523.9
LC11600298L	59.0	100.0	2.0	19.7	14.3	0.73	44.7	38.3	0.87	6.8	1520.5
LC09600366L	56.0	101.0	2.0	20.7	14.3	0.69	50.5	40.3	0.80	6.3	1519.5
LC11600360L	60.0	97.0	2.0	23.2	16.3	0.70	49.5	43.5	0.88	5.1	1514.4
LC11600299L	57.3	104.0	2.0	18.3	14.8	0.81	41.4	36.8	0.89	7.0	1497.9
LC11600324L	57.3	102.0	2.0	17.2	13.7	0.79	45.2	40.3	0.89	6.2	1398.6
LC11600343L	56.0	98.0	2.0	18.0	13.7	0.77	42.5	34.0	0.82	6.0	1327.6
LC11600348L	56.0	95.0	1.0	18.2	10.0	0.59	39.5	29.3	0.74	5.8	1191.8
LC11600288L	58.0	100.0	2.0	21.3	15.3	0.73	45.0	39.3	0.87	7.3	1179.8
GRAND MEAN	58.7	100.9	1.8	20.9	14.9	0.72	46.6	38.9	0.84	6.0	1546.5
CV	1.8	1.8	18.4	13.0	17.0	18.92	10.0	10.0	10.26	5.9	8.3
LSD	1.7	3.0	0.5	4.5	4.2	0.23	7.7	6.4	0.14	0.6	211.3

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.
 Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the green plant height at the green pod stage.
 Agronomic data are means of three replications at Pullman, WA. Planting Date: 04/30/2013 Harvest Date: 08/16/2013

Agronomic Data for the Eston Type Lentil Advanced Yield Trial (1351E)

Name	Days to Flower	Days to Maturity	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	100 Seed Weight ..g..
Athena	61.3	97.0	2.0	19.3	14.8	0.77	36.5	32.2	0.88	4.0
Eston	58.0	95.0	2.0	16.7	11.2	0.67	36.3	30.8	0.85	3.3
LC01602273E	61.0	96.0	2.0	14.7	10.2	0.70	36.2	26.8	0.74	3.7
LC08600005E	60.7	100.0	2.0	16.8	14.0	0.84	40.8	37.7	0.92	4.7
LC09600054E	57.3	96.0	2.0	15.7	11.0	0.70	37.7	31.5	0.84	4.0
LC09600066E	56.7	98.0	2.0	13.8	10.5	0.77	35.5	30.0	0.86	3.9
GRAND MEAN	59.1	96.9	2.0	16.1	11.9	0.74	37.1	31.5	0.85	3.9
CV	1.3	1.9	11.4	10.5	11.7	17.27	8.4	6.4	7.61	5.3
LSD	1.4	3.4	0.4	3.0	2.5	0.23	5.7	3.7	0.12	0.3

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.
 Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.
 Agronomic data are means of three replications at Pullman, WA. Planting Date: 04/30/2013 Harvest Date: 08/14/2013

Location Yield Summary for the Eston Type Lentil Advanced Yield Trial (1351E)

Name	Pullman Seed Yield kg/ha	Fairfield Seed Yield kg/ha	Mean Seed Yield kg/ha	% of Eston kg/ha
LC08600005E	1620.8	2015.1	1818.0	114
LC09600054E	1616.3	1814.1	1715.2	108
LC01602273E	1481.5	1871.4	1676.5	105
LC09600066E	1295.5	1950.3	1622.9	102
Athena	1627.4	1594.2	1610.8	101
Eston	1402.6	1764.0	1583.3	100
GRAND MEAN	1507.3	1834.8	1671.1	
CV	8.4	5.7	7.0	
LSD	235.9	195.0	116.7	

Yield data are means of three replications at each location.

Mean Yields of the Eston Type Lentil Advanced Yield Trial, 2009-2013

Name	2013	2012	2011	2010	2009
	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Athena	1610				
Eston	1583	1083	1291	1350	1143
LC01602273E	1676	1319	1429	1676	1271
LC08600005E	1817	1316	1574	1622	
LC09600054E	1715	1206	1450		

Yield data are means of three reps per location, 4 locations per year.

Agronomic Data for the Richlea Type Lentil Advanced Yield Trial (1352R)

Name	Days to Flower	Days to Maturity	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	100 Seed Weight ..g..
Merit	56.7	103.0	2.0	19.8	14.7	0.75	43.3	38.3	0.89	6.5
Richlea	61.7	104.0	2.0	17.8	13.3	0.76	38.0	33.0	0.87	5.3
Avondale	61.3	104.0	2.0	15.8	13.8	0.87	39.5	35.8	0.91	4.9
LC06601616R	61.7	103.0	2.0	19.7	14.2	0.72	44.5	38.3	0.86	6.4
LC07600151R	58.3	98.0	2.0	19.8	17.2	0.87	43.2	39.7	0.92	5.8
LC07600553R	60.3	102.0	2.0	16.8	13.7	0.82	39.2	33.5	0.85	6.1
LC09600183R	61.0	102.0	3.0	23.5	16.2	0.69	46.5	40.0	0.86	6.4
GRAND MEAN	60.1	102.1	2.2	19.0	14.7	0.78	42.0	36.9	0.88	5.9
CV	1.7	2.8	22.0	11.7	10.5	8.11	4.6	6.9	3.76	3.6
LSD	1.8	5.1	0.9	3.9	2.7	0.11	3.4	4.5	0.06	0.3

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.
 Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the green plant height at the green pod stage.
 Agronomic data are means of three replications at Pullman, WA. Planting Date: 04/30/2013 Harvest Date: 08/16/2013

Location Yield Summary for the Richlea Type Lentil Advanced Yield Trial (1352R)

Name	Pullman Seed Yield kg/ha	Fairfield Seed Yield kg/ha	Mean Seed Yield kg/ha	% of Richlea kg/ha
LC07600151R	1909.9	1776.2	1843.1	118
LC07600553R	1564.2	2094.8	1829.5	117
LC06601616R	1539.2	1634.1	1586.7	102
Avondale	1203.9	1945.7	1574.8	101
Richlea	1304.9	1805.9	1555.4	100
LC09600183R	1414.0	1676.8	1545.4	99
Merit	1258.6	1404.1	1331.4	85
GRAND MEAN	1456.3	1762.5	1609.4	
CV	13.9	9.8	11.7	
LSD	360.0	309.0	186.2	

Yield data are means of three replications at each location.

Mean Yields of the Richlea Type Lentil Advanced Yield Trial, 2009-2013

Name	2013	2012	2011	2010	2009
	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Richlea	1555	1612	1642	1734	1501
Merit	1331	1429	1271	1757	1432
Avondale	1574	1568	1804	1700	1562
LC06601616R	1586	1512	1632	1696	1482
LC07600151R	1843	1572	1754	1749	
LC07600553R	1829	1520	1487	1773	
C.V.	11.7	6.0	13.3	16.8	13.4
LSD	186.	70.8	258.	309.	167.

Yield data are means of three reps per location, 4 locations per year.

Agronomic Data for the Laird Type Lentil Advanced Yield Trial (1352L)

Name	Days to Flower	Days to Maturity	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	100 Seed Weight ..g..
Brewer	56.0	98.0	2.0	18.2	10.5	0.58	40.8	33.7	0.82	5.5
LC06601734L	60.0	104.0	2.0	18.2	15.3	0.84	42.0	38.2	0.91	6.9
LC07600376L	63.0	103.0	2.0	25.8	18.8	0.74	46.8	33.8	0.73	6.9
LC07600378L	63.3	103.0	2.0	26.8	20.3	0.76	43.5	39.3	0.91	6.9
LC07600524L	60.7	103.0	2.0	16.3	12.7	0.79	40.5	37.0	0.91	7.1
LC07600536L	60.3	104.0	2.0	22.7	17.2	0.75	42.0	36.7	0.88	6.6
LC07600541L	61.0	102.0	2.0	24.3	18.7	0.77	45.8	39.0	0.85	6.3
LC0860B123L	58.0	102.0	2.0	16.5	13.8	0.85	40.2	36.3	0.90	8.0
LC0860B130L	58.0	102.0	2.0	16.5	13.5	0.81	42.0	36.0	0.86	7.0
LC09600408L	58.7	102.0	2.0	19.0	14.3	0.76	38.5	34.2	0.89	7.0
LC09600410L	58.7	97.0	2.0	17.2	13.3	0.78	35.5	31.7	0.89	7.3
LC09600476L	56.0	101.0	2.0	16.3	11.3	0.70	41.0	33.2	0.81	6.4
Merit	57.3	102.0	2.0	18.2	13.8	0.76	42.7	38.3	0.90	6.2
Pennell	61.3	98.0	2.0	21.8	14.0	0.66	42.3	35.8	0.85	5.4
Riveland	58.7	102.0	2.0	21.3	16.0	0.76	44.7	40.8	0.91	6.6
GRAND MEAN	59.4	101.5	2.0	19.9	14.9	0.75	41.8	36.2	0.87	6.6
CV	2.4	1.7	16.3	12.2	16.8	15.72	5.7	8.6	8.96	6.3
LSD	2.3	2.9	0.5	4.0	4.1	0.20	4.0	5.2	0.13	0.7

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.
 Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.
 Agronomic data are means of three replications at Pullman, WA. Planting Date: 04/30/2013 Harvest Date: 08/14/2013

Location Yield Summary for the Laird Type Lentil Advanced Yield Trial (1352L)

Name	Pullman Seed Yield kg/ha	Garfield Seed Yield kg/ha	Fairfield Seed Yield kg/ha	Mean Seed Yield kg/ha	% of Merit kg/ha
LC07600378L	1790.0	N/A	1499.1	1644.6	114
Pennell	1631.2	N/A	1532.3	1581.8	110
LC09600410L	1463.7	N/A	1670.6	1567.2	109
LC07600524L	1627.2	N/A	1505.8	1566.5	109
Riveland	1574.1	N/A	1558.6	1566.4	109
LC07600376L	1614.0	N/A	1444.0	1529.0	106
LC07600541L	1606.8	N/A	1438.0	1522.4	106
LC09600408L	1401.4	N/A	1526.0	1463.7	101
Merit	1464.1	N/A	1407.6	1435.9	100
LC07600536L	1482.6	N/A	1266.6	1374.6	95
LC0860B123L	1263.8	N/A	1434.7	1349.3	93
LC09600476L	1443.1	N/A	1226.5	1334.8	92
Brewer	1380.8	N/A	1234.5	1307.7	91
LC06601734L	1257.2	N/A	1331.4	1294.3	90
LC0860B130L	1432.7	N/A	1027.1	1229.9	85
GRAND MEAN	1495.5	N/A	1406.8	1451.1	
CV	11.2	N/A	16.7	14.1	
LSD	282.8	N/A	394.2	197.9	

Yield data are means of three replications at each location.

Mean Yields of the Laird Type Lentil Advanced Yield Trial, 2009-2012

Name	2013	2012	2011	2010	2009
	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Brewer	1307	1395	923.	1586	1291
Merit	1435	1366	1091	1757	1432
Pennell	1581	1375	1174		
Riveland	1566	1465	1045	1717	1261
LC06601734L	1294	1529	1223	1905	1457
LC07600376L	1529	1496	1479	1712	
LC07600378L	1644	1452			
LC07600524L	1566	1469	1223	1682	
LC07600536L	1374	1404	1392	1643	
LC07600541L	1522	1502	1361		
LC0860B123L	1349	1297	1169		
LC0860B130L	1229	1554	1193		
LC09600408L	1463				
LC09600410L	1567				
C.V.	14.1	10.2	13.5	16.8	13.4
LSD	198.	113.	170.	309.	167.

Yield data are means of three reps per location, 4 locations per year.

Agronomic Data for the Pardina Type Lentil Advanced Yield Trial (1351P)

Name	Days to Flower	Days to Maturity	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	100 Seed Weight ..g..
Pardina	59.3	94.0	2.0	14.8	8.5	0.59	34.7	28.7	0.83	4.0
Morena	60.3	102.0	2.0	17.5	13.3	0.76	46.8	38.5	0.83	4.0
LC08600109P	58.7	95.0	2.0	12.8	10.5	0.82	37.2	32.5	0.88	4.2
LC08600113P	59.7	100.0	2.0	21.0	13.7	0.65	42.7	35.7	0.84	4.1
LC08600114P	59.0	98.0	2.0	14.7	11.3	0.81	39.2	32.8	0.84	4.5
LC08600115P	60.3	100.0	2.0	23.0	11.8	0.55	47.2	33.2	0.71	4.8
LC08600116P	61.0	102.0	2.0	20.3	13.0	0.67	48.3	35.0	0.74	4.9
LC09600507P	60.3	100.0	2.0	18.5	11.0	0.60	41.7	32.7	0.79	4.2
LC10600221P	59.7	98.0	2.0	17.3	12.8	0.75	44.0	34.2	0.78	4.2
LC10600231P	58.7	98.0	2.0	17.5	14.0	0.78	43.3	37.7	0.88	4.6
LC10600260P	62.7	103.0	2.0	23.3	17.0	0.73	47.3	36.5	0.78	4.0
LC10600494P	60.3	102.0	2.0	15.8	12.8	0.82	40.8	37.8	0.93	4.2
LC10600649P	62.3	102.0	2.0	25.8	17.2	0.68	46.0	37.3	0.82	4.5
LC10600675P	60.7	101.0	3.0	26.5	16.3	0.62	47.8	37.0	0.77	4.4
LC10600712P	62.0	100.0	2.0	24.5	17.2	0.70	48.2	37.8	0.79	4.5
LC10600732P	61.0	101.0	2.0	24.0	17.0	0.71	46.3	38.2	0.83	4.6
LC10600742P	61.0	100.0	2.0	19.3	12.7	0.65	44.8	31.8	0.71	4.5
LC10600753P	61.7	97.0	2.0	24.0	17.0	0.72	47.7	34.2	0.72	4.3
GRAND MEAN	60.4	99.6	2.0	20.0	13.7	0.70	44.1	35.0	0.80	4.3
CV	1.8	1.8	17.8	15.9	16.4	19.89	8.1	8.6	10.13	5.6
LSD	1.9	3.1	0.6	5.2	3.7	0.23	5.9	5.0	0.13	0.4

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.
 Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.
 Agronomic data are means of three replications at Pullman, WA. Planting Date: 04/30/2013 Harvest Date: 08/14/2013

Location Yield Summary for the Pardina Type Lentil Advanced Yield Trial (1351P)

Name	Pullman Seed Yield kg/ha	Fairfield Seed Yield kg/ha	Mean Seed Yield kg/ha	% of Pardina kg/ha
LC08600116P	2132.3	1832.0	1982.2	129
LC08600113P	1918.0	1899.8	1908.9	124
LC09600507P	1886.1	1903.2	1894.7	123
LC10600231P	2006.2	1692.7	1849.5	120
LC08600115P	1876.4	1817.2	1846.8	120
LC10600494P	1825.8	1844.4	1835.1	119
LC10600260P	2000.6	1652.4	1826.5	118
LC10600675P	2076.9	1542.1	1809.5	117
LC08600109P	1742.4	1871.7	1807.1	117
LC10600732P	1867.5	1744.6	1806.1	117
LC10600649P	1962.9	1502.3	1732.6	112
LC10600753P	1857.2	1556.0	1706.6	111
LC10600221P	1749.8	1636.8	1693.3	110
LC08600114P	1763.0	1595.8	1679.4	109
LC10600712P	1914.1	1442.1	1678.1	109
Morena	1644.9	1653.8	1649.4	107
LC10600742P	1760.8	1418.5	1589.7	103
Pardina	1659.5	1410.6	1535.1	100
GRAND MEAN	1869.1	1667.5	1768.3	
CV	6.2	7.6	6.9	
LSD	195.0	212.7	118.2	

Yield data are means of three replications at each location.
Check variety = Pardina

Mean Yields of the Pardina Type Lentil Advanced Yield Trial, 2009-2013

Name	2013	2012	2011	2010	2009
	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Pardina	1535	1407	1214	1399	1443
Morena	1649	1225	1196	1477	1507
LC08600109P	1807	1428	1223	1542	
LC08600113P	1908	1525	1374	1721	
LC08600114P	1679	1401	1221	1598	
LC08600115P	1846	1470	1373	1455	
LC08600116P	1982	1584	1435	1494	
LC09600507P	1894	1405	1319		
LC10600221P	1693	1403			
LC10600231P	1849				
LC10600260P	1826	1447			
LC10600675P	1809				
LC10600712P	1678	1491			
LC10600732P	1806				
LC10600494P	1835				
LC10600649P	1732				
LC10600742P	1589				
C.V.	6.9	10.3	13.3	13.0	10.5
LSD	118.	111.	175.	218.	137.

Yield data are means of three reps per location, 4 locations per year.

Agronomic and Yield Data for the Turkish Type Lentil Yield Trail (1351T)

Name	Days to Flower	Days to Maturity	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	100 Seed Weight ..g..	Seed Yield kg/ha
LC05600043T	59.7	93.0	2.0	20.8	15.8	0.77	44.0	29.2	0.74	4.1	1817.8
LC01602062T	56.7	92.0	2.0	14.7	11.3	0.77	38.2	30.2	0.81	4.4	1587.9
Crimson	60.7	91.0	2.0	19.0	13.7	0.74	34.7	25.5	0.70	3.4	1542.4
LC09600545T	56.7	90.0	2.0	14.7	12.0	0.84	34.5	30.4	0.85	3.6	1516.0
LC09600142T	58.0	92.0	2.0	14.5	11.7	0.80	37.2	31.7	0.83	4.0	1455.7
LC09600037T	60.0	92.0	2.0	16.5	11.7	0.70	39.7	35.4	0.87	4.3	1430.5
LC0860B085T	56.7	93.0	2.0	13.2	10.0	0.77	34.5	31.2	0.91	4.7	1385.5
GRAND MEAN	58.3	91.8	2.0	16.1	12.3	0.77	37.5	30.5	0.82	4.0	1533.6
CV	2.2	1.8	19.4	15.5	14.3	14.40	9.7	13.7	14.87	8.0	13.7
LSD	2.2	2.9	0.7	4.4	3.1	0.20	6.5	9.3	0.22	0.7	462.3

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.
 Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the green plant height at the green pod stage.
 Agronomic data are means of three replications at Pullman, WA.
 Planting Date: 04/30/2013 Harvest Date: 08/14/2013

Location Yield Summary for the Pardina Type Lentil Advanced Yield Trial (1351P)

Name	Pullman Seed Yield kg/ha	Fairfield Seed Yield kg/ha	Mean Seed Yield kg/ha	% of Pardina kg/ha
LC08600116P	2132.3	1832.0	1982.2	129
LC08600113P	1918.0	1899.8	1908.9	124
LC09600507P	1886.1	1903.2	1894.7	123
LC10600231P	2006.2	1692.7	1849.5	120
LC08600115P	1876.4	1817.2	1846.8	120
LC10600494P	1825.8	1844.4	1835.1	119
LC10600260P	2000.6	1652.4	1826.5	118
LC10600675P	2076.9	1542.1	1809.5	117
LC08600109P	1742.4	1871.7	1807.1	117
LC10600732P	1867.5	1744.6	1806.1	117
LC10600649P	1962.9	1502.3	1732.6	112
LC10600753P	1857.2	1556.0	1706.6	111
LC10600221P	1749.8	1636.8	1693.3	110
LC08600114P	1763.0	1595.8	1679.4	109
LC10600712P	1914.1	1442.1	1678.1	109
Morena	1644.9	1653.8	1649.4	107
LC10600742P	1760.8	1418.5	1589.7	103
Pardina	1659.5	1410.6	1535.1	100
GRAND MEAN	1869.1	1667.5	1768.3	
CV	6.2	7.6	6.9	
LSD	195.0	212.7	118.2	

Yield data are means of three replications at each location.
Check variety = Pardina

Mean Yields of the Turkish Red Type Lentil Advanced Yield Trial, 2009-2013

Name	2013	2012	2011	2010	2009
	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Crimson	1542	1161	1291	777.	1218
LC01602062T	1587	1319	1307	929.	1217
LC05600043T	1817	1411	1399	996.	1160
LC0860B085T	1385	1367	1204	890.	
LC09600142T	1455	1388	1567		
LC09600545T	1516	1325	1546		
LC09600037T	1430	1636	1775		
C.V.	13.8	9.9	16.7	13.7	18.0
LSD	375.	230.	445.	171.	341.

Yield data are means of three reps per location.

Agronomic and Yield Data for the Zero Tannin Type Lentil Yield Trial (1361)

Name	Days to Flower	Days to Maturity	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	100 Seed Weight ..g..	Seed Yield kg/ha
LC06600939YZ	60.3	108.0	2.0	20.8	13.8	0.67	46.7	39.3	0.84	5.5	1708.7
Shasta	56.7	107.0	2.0	14.3	12.0	0.84	42.3	38.2	0.90	5.7	1539.3
Cedar	58.3	103.0	2.0	16.7	11.0	0.67	39.7	33.7	0.85	5.1	1482.6
LC06600930YZ	58.7	106.0	2.0	20.5	13.0	0.64	46.5	40.0	0.86	5.4	1477.3
LC07600224YZ	57.3	103.0	2.0	15.5	12.8	0.83	41.0	37.5	0.91	6.6	1312.0
LC04600415YZ	59.0	106.0	2.0	16.5	13.0	0.79	39.5	36.2	0.92	6.7	1306.6
LC99602585RZ	58.0	103.0	2.0	13.3	11.0	0.83	36.7	30.8	0.84	4.3	1303.2
LC04600389YZ	59.7	107.0	2.0	17.7	13.2	0.75	40.5	35.8	0.89	6.7	1128.1
GRAND MEAN	58.5	105.2	1.9	16.9	12.4	0.75	41.6	36.4	0.88	5.7	1407.2
CV	2.1	2.5	10.4	9.7	8.2	9.19	5.7	6.0	5.13	3.9	9.4
LSD	2.2	4.7	0.3	2.8	1.8	0.12	4.1	3.8	0.08	0.4	238.1

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.
 Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the green plant height at the green pod stage.
 Agronomic data are means of three replications at Pullman, WA.
 Planting Date: 04/30/2013 Harvest Date: 08/16/2013

Mean Yields of the Zero Tannin Type Lentil Advanced Yield Trial, 2009-2013

Name	2013	2012	2011	2010	2009
	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Shasta	1539	1612	1455	778.	1188
LC99602585RZ	1303	1811	1499	704.	988.
Cedar	1482	1556	1416	825.	1275
LC04600389YZ	1128	1643	1355	613.	1005
LC04600415YZ	1306	1623	1455	666.	884.
LC06600930YZ	1477	1746	1567	755.	947.
LC06600939YZ	1708	1519	1698	918.	1107
LC07600224YZ	1312	1693	1358	823.	1242
C.V.	9.4	9.4	10.0	11.3	16.0
LSD	238.	272.	319.	124.	281.

Yield data are means of three reps per location.

AUTUMN-SOWN LEGUMES

We have been ramping up the winter legume breeding program since 2010. Prior to 2010, the program was very small and the emphasis was on development of Turkish Red lentils and non-food quality peas. Significant advances were made in improving cold tolerance and plant habit. Since 2010, the programs have been expanded and now the objectives are more focused on development of food quality green and yellow peas and Spanish Brown and Small and Medium Green lentils. We are systematically incorporating alleles from superior spring varieties and breeding lines into cold hardy backgrounds. The segregating nurseries have more tripled in size and the yield trials have also grown.

The main segregating nurseries and preliminary yield trials are grown at the Spillman Farm. The advanced yield trials are typically planted at four locations: Spillman Farm, Dayton, WA, Garfield, WA and Genesee, ID. In 2013-2014, there were approximately 1200 entries in the winter pea nursery, 450 entries in the winter lentil nursery and 200 entries in the winter chickpea nursery. There were 30 entries in the advanced winter pea and 15 entries in the winter lentil yield trials. The WSU and MSU Variety Testing Programs each have yield trials with elite pea and lentil varieties planted at Dusty, WA and Moccasin, MT, respectively

2012-2013 was a good year for the winter pulse variety trials and nurseries. As with most of the Palouse region, weed control was less than ideal as herbicides were not effectively incorporated by timely rains. Winter survival was good. On 2 June, 2013, when the plots were in full bloom, there was a brief, but intense hail storm hit Spillman Farm. It did a considerable amount of damage to the lentils and, especially, the peas. Blooms and about the top 25% of the plants were damaged and/or destroyed. Due to the lack of effective weed control, very dry conditions and the hail storm, the winter pulses did not yield as much as they usually do. However, as Table 1, shows, even in a mediocre year, the autumn-sown pulses will still out-yield spring sown ones.

The winter pea and lentil advanced yield trials were planted at Tekoa, Garfield and Pullman, Washington between 30 September and 3 October 2012. The food quality winter peas all have clear seed coats, a clear hilum and white flowers. The food quality trials had 15 breeding lines and two checks, Specter and Windham. The mean seed yields were: Tekoa 3447 kg/ha; Garfield 2327 kg/ha and Pullman 2134 kg/ha. Averaged across all locations, the highest yielding line was PS0017018W (3596kg/ha). As in 2012, PS0230F210 had the highest yield in Tekoa (4059 kg/ha). PS0017018W had the highest yield at Garfield (3797 kg/ha) and PS03101269W had the highest yield at Pullman (3276 kg/ha). Austrian Winter Peas have pigmented seed coats and are typically (although not always) characterized by very long vines and small seeds. The Austrian Winter Pea advanced yield trials contained six entries and two checks, Granger and Melrose. The mean seed yields were: Tekoa 3112 kg/ha; Garfield 2131 kg/ha and Pullman 2041 kg/ha.

The winter lentil advanced yield trials were planted at the same time and locations as the advanced winter pea yield trials. There were 19 entries and one check, Morton, in the trials.

Average yield of the trials was: Garfield 1724 kg/ha; Tekoa 3680 kg/ha and Pullman 3817 kg/ha.

The WSU and MSU Variety Testing Programs each have yield trials with elite winter pea and winter lentil varieties planted at Dusty, WA and Moccasin, MT, respectively. They also have segregating F₄ populations to evaluate and select for types well suited to the different regions. The bulk populations are typically spring x winter crosses that have been screened and selected only for cold tolerance.

AUTUMN-SOWN PEA GERmplasm AND VARIETY RELEASES

In September 2012, we registered, as germplasm, an autumn-sown pea with food quality characteristics, PS03101269W (J Plant Registrations 6(3):354-357). In 2013 an autumn-sown pea variety, 'Lynx' (PS05300180W) was registered (J Plant Registrations 7(3):261-264). A PVP application has been filed for Lynx.

Mean Yields of the Advanced Winter Lentil Yield Trial, 2009-2013

Name	2013	2012	2011	2010	2009
	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Morton	3768	4761	5823		2905
LC05600004WT	3551	4312	4703		2418
LC05600512WT	3303	4684	4904		3193
LC1060F0005W	3079	4209			
LC1160W0017W	3955				
LC1160W0020W	3909				
LC1160W0026W	4386				
LC1160W0030W	3697				
LC1160W0031W	4410				
LC1160W0036W	3235				
LC1160W0038W	4011				
LC1160W0039W	3740				
LC1160W0041W	4160				
LC1160W0048W	4006				
LC1160W0068W	3329				
LC1160W0071W	4000				
LC1160W0072W	3653				
LC1160W0073W	3894				
LC1160W0078W	4287				
LC1160W0080W	3970				
C.V.	7.4	15.8	8.9	8.9	18.5
LSD	464.	1067	737.	737.	608.

Yield data are means of three reps per location.

Agronomic Data for the Advanced Winter Pea Yield Trial (1322)

Name	FW 1	PM	PEMV	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	# Repr Nodes
Specter	R	S	S	241	287	15.5	2.0	61.0	16.5	0.27	97.7	41.3	0.42	4.7
Windham	R	S	S	237	280	15.5	2.0	27.8	21.2	0.76	49.2	37.0	0.76	3.8
PS0017018W	R	S	S	246	292	18.0	1.0	73.3	15.7	0.25	99.8	33.7	0.34	3.5
PS0230F092	R	S	S	242	289	16.2	1.0	22.8	11.2	0.48	41.5	28.7	0.69	4.2
PS0230F210	R	S	S	237	292	16.2	2.0	72.3	18.0	0.25	106.3	29.8	0.29	4.0
PS03101269W	R	S	S	246	292	16.8	2.0	71.2	22.7	0.32	110.7	50.8	0.46	3.8
PS05300180W	R	S	S	240	288	15.3	2.0	23.3	16.0	0.71	54.0	33.5	0.62	5.8
PS05300234W	R	S	S	236	286	13.2	1.0	24.7	12.7	0.51	51.2	30.2	0.59	4.0
PS06300008W				242	292	13.0	2.0	42.0	20.2	0.50	88.7	40.0	0.46	5.7
PS06300024W			S	234	279	13.5	1.0	23.5	15.5	0.66	47.8	35.2	0.74	3.2
PS06300028W				247	293	17.3	2.0	40.8	12.7	0.34	68.7	29.2	0.43	5.2
PS07300047W		R	S	241	287	17.0	2.0	28.7	19.7	0.68	47.3	40.7	0.87	3.7
PS07300136W			S	250	293	15.1	2.0	33.7	18.3	0.54	56.8	40.1	0.69	5.4
PS07300150W				241	291	17.0	1.0	65.3	19.3	0.30	112.2	48.0	0.43	5.0
PS09300104W				247	290	22.8	2.0	38.3	12.7	0.33	55.3	34.5	0.63	3.8

FW 1 = Fusarium Wilt Race 1; R = resistant; S = susceptible. PM = Powdery Mildew; R = resistant; S = susceptible. PEMV = Pea Enation Mosaic Virus; R = resistant; S = susceptible. Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage. Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage. Repr Nodes = average number of reproductive nodes on a plant. Agronomic data are means of three replications at Pullman, WA. Planting Date: 10/03/2012 Harvest Date: 07/24/201

Location Yield Summary for the Advanced Winter Pea Yield Trial (1322)

Name	Rosalia Seed Yield	Garfield Seed Yield	Dayton Seed Yield	Pullman Seed Yield	Mean Seed Yield	% of Windham
	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	
PS0017018W	4059.1	3797.8	N/A	2933.0	3596.6	181
PS0230F210	4223.2	3238.3	N/A	2110.8	3190.8	160
PS05300234W	3409.1	3765.1	N/A	2132.0	3102.1	156
PS07300047W	3766.1	2509.5	N/A	2895.3	3057.0	154
PS03101269W	3239.2	2447.5	N/A	3276.4	2987.7	150
PS06300028W	4228.0	1931.8	N/A	2205.1	2788.3	140
PS06300024W	3585.0	2577.9	N/A	2194.3	2785.7	140
PS06300008W	4183.5	1913.2	N/A	1885.0	2660.6	134
PS07300150W	3969.4	1908.7	N/A	1974.0	2617.4	131
Specter	3593.0	2061.1	N/A	1855.3	2503.1	126
PS09300104W	3070.0	2402.2	N/A	1765.8	2412.7	121
PS05300180W	2685.5	1995.0	N/A	1897.0	2192.5	110
Windham	2712.4	1239.7	N/A	2000.1	1984.1	100
PS07300136W	2755.8	1626.4	N/A	1455.7	1946.0	98
PS0230F092	2235.9	1497.6	N/A	1437.7	1723.7	86
GRAND MEAN	3447.6	2327.4	N/A	2134.5	2636.5	
CV	15.5	36.4	N/A	22.5	24.3	
LSD	894.8	1419.2	N/A	804.5	503.1	

Yield data are means of three replications at each location.

Mean Yields of the Advanced Winter Pea Yield Trial, 2009-2013

Name	Leaf Type	Vine Type	2013	2012	2011	2010	2009
			kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
PS0017018W	+	+	2933	4792	6750	1549	4635
PS0230F092	-	-	1437	3771	4540	2624	2650
PS0230F210	+	+	2110	4340	6414		3621
Specter	-	+	1855	5384	7076	2003	1292
Windham	-	-	2000	4742	6324	2729	2826
PS03101269W	-	+	3276	4401	5694	1616	3560
PS05300180W	-	-	1897	5042	5141	1330	2472
PS05300234W	-	-	2132	5015	5877	2705	3382
PS06300008W	-	+	1885	4095	5334		
PS06300024W	-	-	2194				
PS06300028W	-	-	2205				
PS07300047W	-	-	2895	5568			
PS07300136W	-	-	1455				
PS07300150W	-	+	1974	4860			
PS09300104W			1765				
C.V.			22.5	12.4	16.2	17.0	25.4
LSD			804.	1167	1569	620.	1451

Leaf Type: + = normal leaf, - = afila or semi-leafless type.

Plant Type: + = tall plant type, - = short plant type.

Yield data are means of three reps per location, 4 locations per year.

Agronomic and Yield Data for the Winter Dry Pea Preliminary Yield Trial (1323)

Name	Leaf Type	Vine Type	FW 1	PM	PEMV	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height	Pod Ht Maturity	Pod Ht Index	Vine Length	Canopy Height	Plant Ht Index	# Repr Nodes	100 Seed Weight	Seed Yield
										..cm..	..cm..		..cm..	..cm..			..g..	kg/ha
PS11300289W						243.0	286.3	20.5	2.0	35.2	12.7	0.37	55.5	25.7	0.49	3.7	18.2	3850.1
PS11300087W						236.7	283.0	17.5	2.0	38.2	27.5	0.72	64.8	47.5	0.74	4.2	15.4	3742.2
PS11300240W						236.7	287.0	15.5	2.0	34.3	27.2	0.80	57.0	43.2	0.76	4.0	16.2	3140.7
PS11300287W						253.3	284.0	20.8	2.0	35.7	22.7	0.64	54.8	37.5	0.69	3.5	14.7	2769.6
PS07300047W	-	-		R	S	241.7	287.0	16.3	2.0	33.2	24.7	0.75	50.3	41.3	0.83	4.3	13.7	2691.2
PS11300201W						239.7	286.3	13.8	1.0	31.8	26.7	0.84	53.3	43.0	0.82	3.8	17.1	2596.8
PS07300125W	-	-			S	243.0	284.0	16.8	2.0	32.8	20.7	0.63	57.2	38.2	0.68	4.5	16.0	2583.3
PS11300199W						239.7	288.3	18.0	2.0	32.0	22.8	0.71	54.3	37.7	0.72	4.7	16.9	2530.6
PS11300042W						235.3	284.7	17.2	2.0	29.5	19.3	0.66	52.5	34.8	0.67	3.7	13.5	2458.0
PS11300282W						243.0	288.3	15.5	2.0	36.3	23.3	0.63	64.7	41.2	0.64	4.7	16.7	2431.8
PS06300132W	-	-				242.3	288.3	13.8	2.0	28.7	18.2	0.64	56.7	40.0	0.72	4.8	15.6	2390.5
PS11300040W						236.3	281.0	17.0	1.0	32.0	24.7	0.76	51.2	42.0	0.82	3.0	12.5	2371.5
PS11300279W						243.7	287.0	18.0	2.0	32.2	19.5	0.60	63.5	36.0	0.57	4.5	15.5	2345.8
PS11300041W						237.7	284.7	14.5	2.0	26.8	16.2	0.62	45.8	31.5	0.70	4.3	14.2	2329.0
PS11300039W						241.0	286.3	16.0	1.0	32.7	22.0	0.66	53.3	38.7	0.74	3.5	13.5	2148.5
PS10300025W						236.7	282.7	14.8	2.0	32.3	20.7	0.64	53.2	38.0	0.73	4.7	14.4	1918.6
PS06300060W	-	-			S	237.3	283.3	14.2	2.0	29.0	22.3	0.79	44.8	34.3	0.77	3.2	13.9	1898.7
PS09300107W						241.0	282.7	13.7	2.0	24.8	10.0	0.42	46.7	27.0	0.60	4.2	12.5	1895.8
PS11300290W						245.7	290.3	19.3	2.0	56.0	13.7	0.25	94.2	38.3	0.43	3.3	18.2	1873.3
Specter	-	+	R	S	S	242.3	288.7	17.3	2.0	71.0	13.2	0.18	102.2	47.7	0.46	4.2	11.4	1770.2
PS10300014W						249.0	290.7	21.0	2.0	47.5	16.3	0.34	64.0	41.2	0.64	3.3	15.2	1729.7
PS11300288W						238.0	282.7	23.7	2.0	43.0	15.0	0.38	61.7	30.5	0.51	3.3	17.2	1729.2
PS11300139W						239.0	286.3	19.0	2.0	34.3	17.5	0.50	59.2	31.3	0.53	5.7	13.2	1717.6
PS11300189W						247.0	286.3	19.2	2.0	28.0	22.2	0.80	43.0	33.8	0.80	3.7	13.3	1634.6
Windham	-	-	R	S	S	236.7	280.3	17.0	2.0	30.7	18.7	0.63	53.8	33.3	0.63	3.3	13.4	1613.3
PS11300200W						240.3	284.7	17.7	1.0	32.7	23.2	0.71	55.5	40.3	0.73	4.5	16.2	1490.5
PS11300060W						237.0	278.7	13.8	2.0	27.7	11.8	0.43	50.5	28.0	0.56	3.7	10.7	1230.6

Leaf Type: + = normal leaf, - = afila or semi-leafless. Vine Type: + = tall vine; - = short vine.

FW 1 = Fusarium Wilt Race 1; R = resistant; S = susceptible. PM = Powdery Mildew; R = resistant; S = susceptible. PEMV = Pea Enation Mosaic Virus; R = resistant; S = susceptible.

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.

Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.

Repr Nodes = average number of reproductive nodes on a plant. Agronomic data are means of three replications at Pullman, WA. Planting Date: 10/01/2011 Harvest Date: 07/30/2011

Agronomic and Yield Data for the Winter Dry Pea Observation Nursery (1325)

Name	Leaf Type	Vine Type	FW 1	PM	PEMV	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height	Pod Ht Maturity	Pod Ht Index	Vine Length	Canopy Height	Plant Ht Index	# Repr Nodes	100 Seed Weight	Seed Yield
										..cm..	..cm..		..cm..	..cm..			..g..	kg/ha
PS12300045W						249.0	292.0	20.5	1.0	54.5	10.5	0.19	92.0	34.0	0.37	5.5	15.3	2727.0
PS12300018W						254.0	294.0	24.0	2.0	45.0	23.0	0.51	67.5	49.0	0.73	4.5	15.0	2308.5
PS12300054W						247.0	287.0	18.0	2.0	34.0	26.5	0.78	51.0	39.5	0.77	4.5	13.8	1791.6
PS12300001W						237.0	287.0	15.5	1.0	34.0	28.5	0.84	50.0	40.5	0.81	3.0	12.0	1785.4
PS12300002W						241.0	289.0	15.5	1.0	32.5	24.0	0.74	56.5	37.0	0.65	5.0	12.6	1700.0
PS12300080W						245.0	289.0	17.5	1.0	60.5	27.5	0.45	127.0	56.0	0.44	6.0	16.6	1632.3
PS12300065W						250.0	287.0	19.5	2.0	45.0	27.0	0.60	59.0	44.0	0.75	4.0	16.0	1587.7
PS12300010W	+/-	-				245.0	289.0	19.5	2.0	37.0	21.0	0.57	61.0	33.0	0.54	4.0	17.2	1561.8
PS12300006W						247.0	287.0	20.5	2.0	48.0	23.5	0.49	69.0	34.5	0.50	4.5	14.3	1514.3
PS12300026W						237.0	285.0	16.5	1.0	30.0	22.5	0.75	43.5	40.0	0.92	4.0	14.4	1459.3
PS12300061W						250.0	285.0	24.5	2.0	48.5	20.5	0.42	61.0	37.5	0.61	3.0	14.4	1438.6
PS12300049W						252.0	289.0	18.5	2.0	44.5	12.0	0.27	71.0	34.5	0.49	4.0	16.5	1414.8
PS12300008W						247.0	287.0	21.5	1.0	39.5	20.0	0.51	59.5	32.5	0.55	5.0	12.6	1333.1
PS12300053W						240.0	287.0	18.5	2.0	55.5	4.5	0.08	101.5	24.5	0.24	6.0	12.5	1269.4
PS12300030W						243.0	289.0	16.0	1.0	32.5	19.0	0.58	68.0	35.0	0.51	7.0	14.8	1269.2
PS12300057W						247.0	285.0	23.0	2.0	39.5	26.0	0.66	59.0	46.0	0.78	6.5	13.1	1219.6
PS12300077W						247.0	292.0	19.0	2.0	73.0	27.0	0.37	113.5	55.5	0.49	4.5	15.8	1210.1
PS12300032W						247.0	291.0	17.5	2.0	26.5	14.5	0.55	46.5	30.5	0.66	5.0	20.2	1208.2
PS12300038W						235.0	289.0	15.0	1.0	28.5	17.5	0.61	46.0	30.5	0.66	2.5	18.4	1190.7
PS12300048W						247.0	289.0	14.0	2.0	28.5	2.0	0.07	59.5	16.5	0.28	6.0	16.5	1184.5
PS12300079W						243.0	289.0	24.5	1.0	76.0	21.0	0.28	113.0	56.5	0.50	4.0	16.4	1163.8
PS12300040W						241.0	280.0	13.5	2.0	30.5	18.5	0.61	46.0	36.5	0.79	4.0	16.2	1157.4
PS12300052W						252.0	287.0	19.5	2.0	32.5	21.0	0.65	53.0	33.5	0.63	5.5	14.6	1137.9
PS12300012W						249.0	287.0	19.0	1.0	62.5	10.5	0.17	104.5	33.5	0.32	5.5	12.5	1044.3
PS12300078W						240.0	292.0	25.0	2.0	76.5	23.5	0.31	128.0	56.5	0.44	5.5	16.5	970.8
PS12300064W						249.0	285.0	25.0	2.0	38.5	22.5	0.58	58.5	34.0	0.58	5.0	14.7	943.8
PS12300023W						241.0	285.0	13.5	2.0	27.5	14.5	0.53	50.0	30.5	0.61	5.5	15.6	934.2

Leaf Type: + = normal leaf; - = aflag or semi-leafless. Vine Type: + = tall vine; - = short vine.

FW 1 = Fusarium Wilt Race 1: R = resistant; S = susceptible; PM = Powdery Mildew: R = resistant; S = susceptible; PEMV = Pea Enation Mosaic Virus: R = resistant; S = susceptible.

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.

Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.

Repr Nodes = average number of reproductive nodes on a plant. Planting Date: 10/03/2012 Harvest Date: 08/06/2013

Agronomic Data for the Advanced Austrian Winter Pea Yield Trial (1321)

Name	FW 1	PM	PEMV	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height	Pod Ht Maturity	Pod Ht Index	Vine Length	Canopy Height	Plant Ht Index	# Repr Nodes
								..cm..	..cm..		..cm..	..cm..		
Granger	R	S	S	239.0	291.7	17.0	1.0	76.8	12.3	0.17	111.0	42.5	0.39	4.2
Melrose	S	S	S	245.0	291.0	16.3	1.0	58.3	19.2	0.35	98.8	45.2	0.48	4.0
PS07300092W			S	247.0	293.3	19.5	2.0	70.5	16.8	0.24	113.7	50.3	0.44	3.7
PS07300124W		R	S	240.3	279.3	16.8	2.0	29.8	14.5	0.53	49.0	34.2	0.71	3.0
PS09300095W				238.0	292.3	15.8	1.0	73.2	18.0	0.25	104.0	43.3	0.43	3.0
PS09300129W				240.3	293.3	14.7	2.0	54.3	12.0	0.23	91.0	42.5	0.47	3.5
PS10300031W				245.0	293.3	17.2	2.0	72.3	20.3	0.28	113.2	44.3	0.39	4.5
PS10300135W				248.3	284.7	19.2	2.0	37.2	7.8	0.22	60.0	24.5	0.42	3.2
GRAND MEAN				242.8	289.8	17.0	1.5	59.0	15.1	0.28	92.5	40.8	0.47	3.6
CV				0.4	0.8	14.3	27.8	16.9	39.2	53.84	11.7	24.7	33.47	23.6
LSD				1.7	4.3	4.2	0.7	17.4	10.4	0.27	19.0	17.6	0.27	1.5

FW 1 = Fusarium Wilt Race 1; R = resistant; S = susceptible. PM = Powdery Mildew; R = resistant; S = susceptible. PEMV = Pea Enation Mosaic Virus; R = resistant; S = susceptible. Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage. Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage. Repr Nodes = average number of reproductive nodes on a plant. Agronomic data are means of three replications at Pullman, WA. Planting Date: 10/03/2012 Harvest Date: 07/26/201

Location Yield Summary for the Advanced Austrian Winter Pea Yield Trial (1321)

Name	Rosalia Seed Yield	Garfield Seed Yield	Dayton Seed Yield	Pullman Seed Yield	Mean Seed Yield	% of Granger
	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	
PS07300092W	4159.0	2420.9	N/A	2867.0	3149.0	142
PS09300095W	3947.7	2609.1	N/A	1612.8	2723.2	122
PS09300129W	2619.8	2254.2	N/A	2536.2	2470.1	111
PS10300135W	2746.6	2163.3	N/A	2212.2	2374.0	107
PS10300031W	3042.2	2209.3	N/A	1582.4	2278.0	102
Granger	3017.0	1993.6	N/A	1637.7	2216.1	100
PS07300124W	2929.0	1719.6	N/A	1992.9	2213.8	99
Melrose	2438.4	1681.3	N/A	1890.7	2003.5	90
GRAND MEAN	3112.4	2131.4	N/A	2041.5	2428.4	
CV	7.8	18.4	N/A	17.7	13.9	
LSD	428.3	691.7	N/A	675.8	268.6	

Yield data are means of three replications at each location.

Agronomic and Yield Data for the Austrian Winter Dry Pea Preliminary Yield Trial (1324)

Name	Leaf Type	Vine Type	FW 1	PM	PEMV	Days to Flower	Days to Maturity	Flower Node	Pods/ Peduncle	Pod Height	Pod Ht Maturity	Pod Ht Index	Vine Length	Canopy Height	Plant Ht Index	# Repr Nodes	100 Seed Weight	Seed Yield
										..cm..	..cm..		..cm..	..cm..			..g..	kg/ha
PS10300120W						239.7	294.0	13.5	1.0	71.5	16.3	0.23	108.2	40.7	0.39	3.3	13.4	2963.7
PS10300068W						250.0	290.3	19.3	2.0	60.7	9.8	0.17	97.0	33.2	0.35	4.7	13.5	2720.1
PS10300134W						249.0	282.7	20.0	2.0	39.0	4.7	0.12	60.2	19.5	0.34	3.5	12.7	2659.1
Melrose	+	+	S	S	S	243.7	292.0	16.2	1.0	64.7	7.5	0.13	111.8	26.8	0.25	4.2	11.2	1936.1
PS10300121W						246.3	294.0	16.5	1.0	66.8	18.2	0.27	117.0	43.8	0.37	4.3	12.1	1842.1
PS10300118W						247.0	292.7	16.7	1.0	68.2	15.0	0.22	120.0	41.5	0.35	5.2	14.6	1824.4
Granger	-	+	R	S	S	241.0	289.7	20.8	2.0	74.3	15.0	0.20	115.0	41.0	0.36	3.5	11.8	1326.6
GRAND MEAN						245.2	290.7	17.5	1.6	63.6	12.3	0.19	104.1	35.2	0.34	4.1	12.7	2181.7
CV						0.8	0.7	16.7	26.9	12.7	52.4	49.78	15.2	28.3	33.29	22.1	8.0	18.2
LSD						3.7	3.7	5.2	0.7	14.3	11.5	0.17	28.2	17.7	0.20	1.6	1.8	713.9

Leaf Type: + = normal leaf; - = afila or semi-leafless. Vine Type: + = tall vine; - = short vine.

FW 1 = Fusarium Wilt Race 1; R = resistant; S = susceptible. PM = Powdery Mildew; R = resistant; S = susceptible. PEMV = Pea Enation Mosaic Virus; R = resistant; S = susceptible.

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.

Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.

Repr Nodes = average number of reproductive nodes on a plant. Agronomic data are means of three replications at Pullman, WA. Planting Date: 10/03/2012 Harvest Date: 07/26/2012

Agronomic Data for the Winter Lentil Advanced Yield Trial (1341)

Name	Days to Flower	Days to Maturity	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	100 Seed Weight ..g..	Seed Yield kg/ha
LC1160W0031W	251.3	293.0	2.0	21.8	15.8	0.76	49.8	40.0	0.81	3.7	4410.9
LC1160W0026W	248.0	293.0	2.0	20.3	14.8	0.75	50.8	34.8	0.69	3.6	4386.3
LC1160W0078W	248.0	294.0	2.0	16.8	14.5	0.86	45.8	36.7	0.81	3.5	4287.9
LC1160W0041W	245.7	293.0	2.0	17.8	13.5	0.76	49.7	31.7	0.64	3.9	4160.7
LC1160W0038W	249.7	293.0	2.0	20.0	14.5	0.73	48.0	33.2	0.69	4.4	4011.0
LC1160W0048W	247.0	291.0	2.0	23.8	14.8	0.68	56.8	30.7	0.54	3.9	4006.5
LC1160W0071W	243.0	292.0	2.0	16.0	14.0	0.88	47.5	35.0	0.74	3.2	4000.0
LC1160W0080W	251.3	295.0	2.0	25.2	18.8	0.76	53.8	40.0	0.75	3.3	3970.6
LC1160W0017W	254.3	295.0	2.0	24.2	19.2	0.80	52.7	38.8	0.75	3.2	3955.4
LC1160W0020W	255.0	295.0	2.0	25.3	14.7	0.58	54.8	31.2	0.57	3.2	3909.3
LC1160W0073W	245.7	291.0	2.0	15.0	13.7	0.92	42.2	32.8	0.79	3.1	3894.6
Morton	241.0	291.0	2.0	18.2	14.3	0.79	44.5	32.8	0.74	3.2	3768.0
LC1160W0039W	245.7	292.0	2.0	21.8	14.3	0.68	54.5	32.0	0.60	3.9	3740.1
LC1160W0030W	248.0	295.0	2.0	18.8	18.0	0.96	44.7	37.0	0.83	3.7	3697.0
LC1160W0072W	242.3	290.0	2.0	16.7	12.8	0.78	45.0	32.5	0.72	3.3	3653.6
LC05600004WT	238.7	295.0	2.0	21.3	13.7	0.66	51.3	38.7	0.77	3.6	3551.4
LC1160W0068W	243.7	293.0	2.0	18.5	14.3	0.79	44.3	37.3	0.84	3.5	3329.1
LC05600512WT	241.7	289.0	2.0	13.8	9.5	0.69	48.7	30.2	0.63	3.6	3303.1
LC1160W0036W	253.7	296.0	2.0	23.3	13.3	0.62	56.7	30.0	0.55	4.1	3235.0
LC1060F0005W	242.3	292.0	2.0	15.8	11.8	0.80	47.7	32.7	0.68	3.9	3079.5
GRAND MEAN	246.8	292.8	1.9	19.7	14.5	0.76	49.4	34.4	0.71	3.5	3817.5
CV	0.7	0.5	15.1	18.9	17.8	21.42	10.8	12.2	17.62	5.7	7.3
LSD	3.1	2.4	0.4	6.1	4.2	0.27	8.8	6.9	0.21	0.3	464.9

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by pod height at the green pod stage.

Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.

Planting Date: 10/03/2012 Harvest Date: 08/06/2013

Location Yield Summary for the Winter Lentil Advanced Yield Trial (1341)

Name	Garfield Seed Yield	Tekoa Seed Yield	Pullman Seed Yield	Mean Seed Yield	% of Morton
	kg/ha	kg/ha	kg/ha	kg/ha	
LC1160W0031W	3352.5	4597.6	4410.9	4120.3	141
LC1160W0026W	2456.5	4349.1	4386.3	3730.6	128
LC1160W0078W	1611.3	4997.1	4287.9	3632.1	124
LC1160W0048W	2619.5	3781.1	4006.5	3469.0	119
LC1160W0017W	2214.8	4137.7	3955.4	3436.0	117
LC1160W0041W	1973.1	4048.0	4160.7	3393.9	116
LC1160W0030W	2505.5	3867.2	3697.0	3356.6	115
LC1160W0039W	2354.4	3546.5	3740.1	3213.7	110
LC1160W0038W	1890.6	3716.9	4011.0	3206.2	110
LC1160W0073W	1392.0	3983.2	3894.6	3089.9	106
LC1160W0072W	1772.6	3703.6	3653.6	3043.3	104
Morton	1572.6	3400.3	3768.0	2913.6	100
LC1160W0071W	1281.8	3401.4	4000.0	2894.4	99
LC1160W0068W	1847.8	3330.9	3329.1	2835.9	97
LC05600004WT	1384.5	3456.1	3551.4	2797.3	96
LC1160W0036W	2094.3	2870.1	3235.0	2733.1	93
LC1160W0020W	916.6	3126.6	3909.3	2650.8	90
LC1160W0080W	780.2	3048.8	3970.6	2599.9	89
LC1060F0005W	216.5	3315.3	3079.5	2203.8	75
LC05600512WT	248.4	2939.0	3303.1	2163.5	74
GRAND MEAN	1724.2	3680.8	3817.5	3074.2	
CV	37.3	13.2	7.3	16.0	
LSD	1066.3	808.6	464.9	386.5	

Yield data are means of three replications at each location.
Check = Morton

Agronomic and Yield Data for the Large Kabuli Chickpea Preliminary Yield Trial (1383)

Name	Days to Flower	Days to Maturity	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	100 Seed Weight ..g..	Seed Yield kg/ha
CA11900028C	58.0	107.0	1	28.3	25.8	0.91	54.2	51.2	0.95	52.1	2632
CA0890B0581C	56.0	109.0	1	26.0	18.5	0.71	58.0	50.3	0.87	49.6	2575
CA11900031W	58.7	108.0	1	32.2	24.2	0.76	60.3	52.7	0.88	55.9	2529
CA11900050C	58.7	111.0	1	32.0	29.2	0.91	59.5	50.2	0.85	50.8	2514
CA11900064W	58.0	107.0	1	25.7	23.8	0.93	53.7	48.8	0.91	49.1	2501
CA11900113W	60.0	113.0	1	30.2	22.5	0.74	56.3	46.5	0.83	56.8	2438
CA11900088C	58.0	112.0	1	28.3	22.7	0.81	58.3	47.0	0.81	48.7	2374
CA11900139W	61.0	112.0	1	37.7	33.3	0.89	63.0	55.7	0.89	49.0	2342
CA0890B0435C	56.0	109.0	1	44.7	40.7	0.91	77.0	70.3	0.92	58.9	2318
CA11900127W	60.0	111.0	1	33.3	27.5	0.82	62.8	53.3	0.85	46.4	2259
CA0890B0103W	59.7	111.0	1	34.7	28.5	0.82	63.5	54.2	0.86	57.4	2252
Sierra	55.0	106.0	1	37.2	33.3	0.90	62.3	53.5	0.86	52.1	2239
Troy	59.3	114.0	1	24.7	22.3	0.91	54.8	47.7	0.87	56.2	2195
CA11900014C	59.3	111.0	1	26.8	23.0	0.85	57.8	52.8	0.91	56.6	2168
CA11900036W	60.0	110.0	1	33.7	26.8	0.80	61.7	53.3	0.86	57.9	2154
CA11900068W	62.8	112.0	1	39.3	29.6	0.75	59.6	54.6	0.92	44.3	1985
CA0890B0085W	61.0	114.0	1	32.2	25.8	0.80	60.5	51.5	0.86	56.9	1939
CA0890B0286C	54.8	105.0	1	24.5	19.1	0.78	53.1	44.6	0.86	16.9	1908
CA11900143C	59.3	115.0	1	45.5	41.2	0.91	69.7	62.3	0.90	48.7	1892
CA0890B0437W	58.7	116.0	1	34.3	29.3	0.85	64.5	54.7	0.85	49.7	1756
GRAND MEAN	58.7	110.5	1	32.5	27.3	0.84	60.5	52.7	0.87	50.7	2248
CV	2.0	1.3	1	10.0	13.1	9.28	8.3	4.6	9.05	3.5	5
LSD	1.9	2.5	1	5.4	5.9	0.13	8.3	4.0	0.13	2.9	205

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.
 Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.
 Rep Nodes = average number of reproducing nodes to a plant. Agronomic data are means of three replications at Pullman, WA. Planting Date: 04/30/2013 Harvest Date: 08/28/2013

CHICKPEA BREEDING

In 2013, 17 café kabuli chickpea breeding lines, three Spanish White chickpea breeding lines and four check cultivars were included in the Advanced Chickpea Yield Trials. The check cultivars included three café kabuli types ('Sawyer', 'Sierra', and 'CDC-Frontier') and PNW 1, a small round café Billybean'. Trials were planted at four locations: Dayton, WA on 3 April 2013, Genesee, ID on 3 May 2013, at Pullman, WA on 30 April 2013, and at Kendrick, ID on 5 May 2013. Prior to planting all seeds received a seed coat treatment applied at a rate of 30 ml/ kg seed. The seed treatment solution consisted of the following compounds per 1.5 liter: 20 ml Apron (fungicide); 3 ml Maxim (fungicide); 98 ml Mertect (fungicide); 15 ml Cruiser (insecticide), and 8 g Sodium Molybdenate. *Mesorhizobium ciceri* inoculant was added to each seed lot prior to planting. Three replicated plots (1.5 m x 6.1 m) were planted at a density of 44 seeds/m² for each entry at each location. A post plant/pre-emergence application of metribuzin (Sencor; 6 oz/acre) and linuron (Lorox; 1.25 lb/acre) was applied for weed control at all location. Unfortunately, the trials at Genesee and Kendrick were lost due to accidental application of herbicide during spraying of both locations to control insect pests. Gramoxone (2 pints/acre) was applied approximately 14 d before harvest at Pullman and Dayton to promote desiccation prior to harvest.

The grand mean of all entries over all locations was 1781 kg/ha (1590 lb/acre). The highest yielding location was Pullman, WA, which was harvested on 26 August 2013 with a mean yield of 2271 kg/ha (2028 lb/acre). The mean yield for the Dayton trial, harvested on 23 August 2013, was 1291 kg/ha (1153 lb/ac). Significant differences ($F = 500.9$; $\text{Prob} > F < .0001$) were observed between yields at the two locations. Yields and seed size observed at locations were compared between 2013 and 2012. The grand mean of all entries at Pullman in 2013 was 22% greater than the yield observed in 2012. Similarly, the grand mean of all entries at Dayton in 2013 was 26% the mean yield observed in 2012. The mean yields of the four check cultivars (Sawyer, Sierra, CDC-Frontier and PNW 1) in 2013 at Pullman and Dayton were 27 and 25% higher, respectively, than their mean yields in 2012. These results suggest that overall growing conditions were better in 2013 than 2012. Seed size of entries was only determined for the Pullman, WA location, where the grand mean for 100 seed weight was 51.1 g, which was very similar (99%) to the mean of 51.7 g observed in 2012. The mean seed weight of the four check cultivars (Sawyer, Sierra, CDC-Frontier and PNW 1) in 2013 was 97% of the mean weight observed for these entries in 2012. Since seed weight was similar in 2012 and 2013 but yields were much greater in 2013, this suggests that other components influenced plot yield in 2013. It is likely that greater yield in 2013 was primarily the result of more pods per plant and more seeds per pod than in 2012.

CDC-Frontier was the highest yielding entry over all locations, averaging 2090 kg/ha. The highest yielding breeding lines were CA0790B0733C (1964 kg ha⁻¹), CA0790B0547C (1956 kg ha⁻¹), and CA04900843C (1927 kg ha⁻¹). The ten entries with the highest mean yield across all locations included seven advanced kabuli café chickpea lines from the ARS breeding program, the small seeded landrace 'billybeans', and the small café kabuli cultivars CDC-Frontier and Sawyer. Although yields were much greater at Pullman than Dayton, several entries exhibited

Agronomic and Yield Data for the Large Kabuli Chickpea Advanced Yield Trial (1381)

Name	Days to Flower	Days to Maturity	Pods/ Peduncle	Pod Height ..cm..	Pod Ht Maturity ..cm..	Pod Ht Index	Vine Length ..cm..	Canopy Height ..cm..	Plant Ht Index	100 Seed Weight ..g..
Sierra	55.0	106.0	1	32.2	25.2	0.79	55.8	48.7	0.88	49.8
Sawyer	55.0	104.0	1	32.5	27.0	0.84	64.5	52.0	0.81	41.6
CDC-FRONTIER	58.7	107.0	1	36.7	28.5	0.78	56.5	48.0	0.86	39.7
Billy Beans	57.7	105.0	1	26.8	19.5	0.73	57.0	53.0	0.93	29.6
CA04900843C	58.0	108.0	1	27.7	19.5	0.71	57.7	47.7	0.83	56.6
CA0690B0250C	57.7	111.0	1	35.5	25.7	0.73	64.8	57.7	0.89	52.0
CA0690B0427C	58.0	108.0	1	29.8	25.5	0.85	60.5	49.5	0.82	51.7
CA0790B0034C	50.3	109.0	1	34.7	24.0	0.71	62.2	52.2	0.84	53.2
CA0790B0042C	55.7	107.0	1	29.2	24.5	0.84	62.0	54.8	0.89	46.5
CA0790B0043C	55.0	107.0	1	33.8	30.3	0.88	66.7	57.0	0.86	52.0
CA0790B0053C	55.0	110.0	1	32.5	26.7	0.83	66.3	57.3	0.87	55.6
CA0790B0054C	57.0	107.0	1	34.5	27.2	0.80	61.3	51.3	0.84	51.7
CA0790B0547C	56.0	109.0	1	33.3	23.2	0.71	60.7	43.5	0.72	48.8
CA0790B0549C	58.0	108.0	1	28.5	21.8	0.77	54.0	48.3	0.90	46.4
CA0790B0642C	56.0	108.0	1	25.7	22.7	0.88	57.5	47.7	0.84	59.1
CA0790B0733C	58.0	112.0	1	31.5	24.0	0.76	54.7	49.2	0.90	49.8
CA0890B0429C	57.3	111.0	1	31.0	26.0	0.84	63.7	51.2	0.81	56.6
CA0890B0085W	62.0	113.0	1	33.0	27.2	0.83	58.2	51.3	0.88	57.4
CA0890B0434C	55.0	107.0	1	27.7	23.8	0.86	55.3	49.0	0.89	52.4
CA0890B0496C	58.0	107.0	1	32.3	23.0	0.74	55.0	43.5	0.80	57.5
CA0890B0531C	55.0	107.0	1	25.5	21.0	0.82	57.7	47.8	0.83	52.8
CA0890B0551C	55.0	111.0	1	25.2	22.8	0.91	53.0	44.3	0.83	58.2
CA0890B0628W	59.3	109.0	1	27.3	19.2	0.72	50.5	41.8	0.84	52.2
CA0890B0648W	59.3	111.0	1	27.3	23.3	0.86	54.2	41.5	0.77	55.9
GRAND MEAN	56.7	108.3	1	30.5	24.2	0.80	58.7	49.5	0.85	51.1
CV	4.5	1.3	1	14.7	13.0	12.79	8.9	5.8	8.83	3.8
LSD	4.2	2.3	1	7.4	5.2	0.17	8.6	4.7	0.12	3.2

Pod height was measured at the green pod stage and at harvest maturity. Pod height index = pod height at harvest maturity divided by the pod height at the green pod stage.

Plant height was measured at the green pod stage and at harvest maturity. Plant height index = plant height at harvest maturity divided by the plant height at the green pod stage.

Rep Nodes = average number of reproducing nodes to a plant. Agronomic data are means of three replications at Pullman, WA. Planting Date: 04/30/2013 Harvest Date: 08/26/2013

Location Yield Summary for the Large Kabuli Chickpea Advanced Yield Trial (1381)

Name	Leaf Type	Seed Type	Pullman	Kendrick	Dayton	Genesee	Mean	%
			Seed Yield	of Sierra				
			kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	
CDC-FRONTIER	C	C	2692		1488		2090	121
CA0790B0733C	C	C	2564		1365		1964	114
CA0790B0547C	C	C	2469		1443		1956	113
Billy Beans		C	2418		1480		1949	113
CA04900843C	C	C	2420		1434		1927	111
Sawyer	S	C	2284		1541		1913	111
CA0790B0054C	C	C	2254		1549		1902	110
CA0790B0549C	C	C	2473		1323		1898	110
CA0690B0427C	C	C	2372		1301		1836	106
CA0790B0034C	C	C	2350		1301		1826	106
CA0890B0531C	C	C	2338		1296		1817	105
CA0790B0642C	C	C	2322		1275		1799	104
CA0890B0551C	C	C	2240		1322		1781	103
CA0890B0429C	C	C	2387		1152		1770	102
CA0790B0042C	C	C	2251		1287		1769	102
CA0790B0043C	C	C	2265		1254		1759	102
CA0690B0250C	C	C	2285		1171		1728	100
Sierra	S	C	2135		1309		1722	100
CA0890B0434C	C	C	2135		1281		1708	99
CA0890B0628W	C	W	2194		1201		1698	98
CA0790B0053C	C	C	1934		1265		1600	92
CA0890B0496C	S	C	2108		1091		1600	92
CA0890B0648W	C	W	1894		993		1444	83
CA0890B0085W	C	W	1710		852		1281	74
GRAND MEAN			2271		1291		1781	
CV			4		11		7	
LSD			174		236		121	

Leaf Type: C = compound leaf, S = simple leaf type. Seed type; W = white seed type, C = cafe seed type
Yield data are means of three replications at each location.

Mean Yields of the Large Kabuli Chickpea Advanced Yield Trial, 2009-2013

Name	Leaf Type	Seed Type	2013 kg/ha	2012 kg/ha	2011 kg/ha	2010 kg/ha	2009 kg/ha
Sierra	S	C	1722	1532	2090	767	1288
Sawyer	S	C	1913	1605	2380	908	1508
CDC-FRONTIER	C	C	2090	1928	2216		
CA04900843C	C	C	1927	1866	2434	978	1602
CA0690B0250C	C	C	1728	1725	2478	808	1644
CA0690B0427C	C	C	1836	1572	2324	693	1435
CA0790B0034C	C	C	1825	1978	2319	914	
CA0790B0042C	C	C	1769	1955	2520	984	
CA0790B0043C	C	C	1759	2012	2618	721	
CA0790B0053C	C	C	1600	1667	2242	651	
CA0790B0054C	C	C	1902	1766	2345	747	
CA0790B0547C	C	C	1956	2099			
CA0790B0549C	C	C	1898	1907	2614	866	
CA0790B0642C	C	C	1799	1846			
CA0790B0733C	C	C	1964	1917	2486	940	
CA0890B0085W	C	W	1281				
CA0890B0429C	C	C	1770	1878			
CA0890B0434C	C	C	1708				
CA0890B0496C	S	C	1599				
CA0890B0531C	C	C	1817				
CA0890B0551C	C	C	1781				
CA0890B0628W	C	W	1698				
CA0890B0648W	C	W	1443				

Leaf Type: C = Compound leaf, S = Simple leaf
 Seed Type: C = Cafe seed type, W = White seed type
 Yield data are means of three reps per location, 4 locations per year.