

## YELLOW BEAN

Yellow beans are a market class of dry beans that feature a yellow seed coat. The varieties from CDC in this class are CDC Sol (registered in 2010) and 4510-3-1 (supported for registration in 2018).

### CDC Sol

Over 10 years of testing in the Co-op and regional narrow row variety trials in Saskatchewan, CDC Sol yielded 104% of the check variety CDC Pintium under irrigation and 95% under dryland conditions. It has a large seed size (399 g/1000 seeds) and a determinate bush growth habit. It has relatively late maturity and as such, is suited to longer growing seasons in the Prairie Provinces. CDC Sol has also been tested in the Alberta wide row trials for 16 years. In these trials, it had the largest seed size (407 g/1000 seeds) as compared to the yellow bean varieties AAC Y012 and AACY015.

Type	Variety	Years Tested <sup>1</sup>	-- Yield (% CDC Pintium) --		Days to Flower	Maturity Rating <sup>2</sup>	% Pod Clearance	Seed Weight (g/1000)	Growth Habit
			Irrigation	Dryland					
Pinto	<b>CDC Pintium</b>	<b>16</b>	<b>100</b>	<b>100</b>	<b>50</b>	<b>E</b>	<b>85</b>	<b>350</b>	<b>I</b>
	Island	10	120	110	55	M	79	355	II
	CDC Marmot	8	109	108	50	E	80	367	I
	CDC WM-2	11	116	106	52	E	79	365	II
Black	CDC Blackstrap	7	119	116	53	M	85	195	II
	CDC Jet	16	100	97	58	L	85	170	II
	CDC Superjet	6	125	107	58	L	85	170	II
Yellow	<b>CDC Sol</b>	<b>10</b>	<b>104</b>	<b>95</b>	<b>55</b>	<b>L</b>	<b>78</b>	<b>399</b>	<b>I</b>

Source: Saskatchewan Variety of Grain Crops 2017, Saskatchewan Advisory Council on Grain Crops

There is currently 435,200 lbs of certified seed available. CDC Sol is protected by UPOV '78



## **CDC 4510-3-1**

4510-3-1 was tested in the Short Season Narrow Row Dry Bean Cooperative registration trials in 2016 and 2017. It is superior to CDC Sol in terms of quality (much better colour) and yield (129% of CDC Sol).

The plants are upright and determinate, and mature a few days ahead of CDC Sol. They are taller than CDC Sol which probably contributes to the slightly higher pod clearance score. White mold scores were slightly better than CDC Sol. The post cooking scores were similar to CDC Sol and the canning results were similar to CDC Sol with the exception of colour which was better than CDC Sol.

### **4510-3-1 Trait Summary**

#### **Strengths**

- Much higher yielding than the check CDC Sol (129%)
- Much better seed coat colour pre- and post- processing

#### **Neutral Traits**

- Canning and cooking scores similar to CDC Sol
- 2 days earlier than the check

#### **Weaknesses**

- Susceptible to anthracnose like CDC Sol



**Comparison of 4510-3-1 and CDC Sol showing the improved color**

CDC 4510-1-3 is protected by UPOV'91. Seed multiplication is at the pre-breeder stage.

Table 1: Two year agronomic performance data from the 2016-2017 Short Season Narrow Row Dry Bean Co-operative Trials in western Canada

Line	Market class	[6] [7] Yield (kg/ha)			% of Check CDC Sol	[5] [7] Days to flower			[6] [7] Days to mature		
		2016	2017	Mean		2016	2017	Mean	2016	2017	Mean
Pintium	Pinto	2534	2645	2594		50	53	52	91	96	94
CDC Sol	Yellow	2698	2620	2656	100	50	53	52	100	100	100
<b>4510-3-1</b>	<b>Yellow</b>	<b>3378</b>	<b>3445</b>	<b>3414</b>	<b>129</b>	<b>49</b>	<b>52</b>	<b>51</b>	<b>97</b>	<b>98</b>	<b>98</b>

Line	Market class	[5] [5] Pod clearance (%)			[2] Height (cm)	[4] [4] Seed weight (g/1000)			[4] [1] Lodging		
		2016	2017	Mean	2016	2016	2017	Mean	2016	2017	Mean
Pintium	Pinto	80	75	78	36	365	351	358	1.7	2.3	1.8
CDC Sol	Yellow	71	77	74	33	446	408	427	1.4	1.7	1.5
<b>4510-3-1</b>	<b>Yellow</b>	<b>74</b>	<b>80</b>	<b>77</b>	<b>37</b>	<b>443</b>	<b>410</b>	<b>427</b>	<b>1.3</b>	<b>2.0</b>	<b>1.4</b>

**Table 2a.** Anthracnose data for entries in the 2017 Short Season Narrow Row Dry Bean Co-operative Trial in Western Canada.

		2016 SSNR								2017 SSNR							
		Race 73				Race 105				Race 73				Race 105			
Cultivar	Class	Test #1		Test #2		Test #1		Test #2		Test #1		Test #2		Test #1		Test #2	
		Est.	Rank	Est.	Rank	Est.	Rank	Est.	Rank	Est.	Rank	Est.	Rank	Est.	Rank	Est.	Rank
Pintium	PT	0.0	ac	1.5	ac	0.0	abcd	0.0	abcd	1.0	ac	0.6	a	0.0	abcd	0.1	abcd
Island	PT	5.0	bd	6.8	bd	6.5		4.7	abd	7.5	bd	4.0		4.3	abd	6.0	
CDC WM-2	PT	1.1	ac	0.8	ac	0.8	abd	0.1	abcd	0.4	ac	0.3	a	0.7	abcd	0.2	abcd
CDC Jet	BK	9.0	bd	9.0	bd	9.0	c	5.4		9.0	bd	6.4	bd	9.0	c	8.8	
Envoy	NA	0.0	ac	0.0	ac	9.0	c	9.0	c	0.0	ac	0.0	a	9.0	c	9.0	
CDC Sol	YE	9.0	bd	7.7	bd	8.0		7.3		9.0	bd	6.1	bd	7.7		8.4	
3568-1	CR	0.0	ac	0.7	ac	0.0	abcd	0.0	abcd	0.0	ac	0.0	a	0.1	abcd	0.0	abcd
4510-3-1	YE	8.3	bd	8.9	bd	7.9		5.7		9.0	bd	6.9	bd	8.0		8.5	
4510-3-3	YE	8.8	bd	9.0	bd	8.6	c	6.5		9.0	bd	6.3	bd	6.8		4.8	abd
4622CBB-1	YE	4.5	bd	2.3	ac	2.0	abd	2.5	abd	3.8	abcd	5.0	bd	2.3	abd	3.0	abcd
NN11-2	PT/SD	0.1	ac	1.8	ac	1.0	abd	0.0	abcd	1.9	ac	0.0	a	0.0	abcd	0.3	abcd
4610CBB-1-2	PT/SD	0.3	ac	0.8	ac	0.6	abd	0.0	abcd	0.9	ac	0.0	a	0.0	abcd	0.0	abcd
1st year entries deleted																	
Num DF		26		26		26		26		20		20		20		20	
Den DF		54		52		52		54		42		40		40		42	
F Value		18		18.22		20.69		19.56		32		6.42		22.78		19.00	
Pr>F		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001	
LSD(0.05)		2.6		2.6		2.5		2.5		1.9		3.4		2.1		2.3	
Dunnetts Test																	
a = significantly different than AC Pintoba									c = significantly different than Othello								
b = significantly different than Envoy									d = significantly different than Dresden								
PT = pinto; PT/SD = slow darkening pinto; BK = black; NA = navy; YE = yellow; CR = carioca																	

**Table 2b.** White mold data for entries in the 2017 Short Season Narrow Row Dry Bean Co-operative Trial in Western Canada.

White Mold Data					
Name	Type	2016		2017	
		Incidence (%)	Index (1-4)	Incidence (%)	Index (1-4)
Pintium	Pinto	54	1.7	17.8	1.3
Island	Pinto	22	1.2	12.6	1.2
CDC WM-2	Pinto/SD	46	1.5	19.5	1.3
CDC Jet	Black	16	1.2	15.3	1.2
Envoy	Navy	45	1.5	16.2	1.3
CDC Sol	Yellow	57	1.7	29.2	1.4
3568-1	Carioca	50	1.6	11.4	1.2
4510-3-1	Yellow	35	1.4	25.4	1.3
4510-3-3	Yellow	47	1.6	20.9	1.3
4622CBB-1	Yellow	39	1.4	18.7	1.3
NN11-2	Pinto/SD	40	1.5	15.7	1.2
1st year entries deleted					
	CV	24.8	11.1	56.9	13.2
	LSD	11.8	0.2	11.8	0.2
Severity index (1-4): 1 = healthy, 4 = dead					
Pinto/SD = slow darkening pinto					

**Table 3a.** Cooking Quality Evaluation of Select Dry Bean Lines in the 2017 Short Season Narrow Row Dry Bean Cooperative Trial in Western Canada.

ID_Name	Class	100-SD WT (g)	Cooking Test					
			16 hour soak			20 min at 95°C		
			Hard Seed (%)	Partial Hydration (%)	HC	Hard Seed (%)	Partial Hydration (%)	HC
Pintium	Pinto	36.6	36.6	3.4	1.8	0.0	3.6	2.5
Island	Pinto	37.0	57.6	8.1	1.6	0.0	4.7	2.3
CDC WM-2	Pinto/SD	37.5	6.0	0.8	2.2	0.0	0.1	2.6
CDC Sol	Yellow	41.6	27.9	8.5	1.9	0.0	5.8	2.4
4510-3-1	Yellow	41.8	28.0	15.7	1.8	0.0	4.8	2.4
LSD 5%		2.0	7.4	4.6	0.1	0.0	5.0	0.1

**Cooking Quality Traits:**

- **Hard seed (%):** Two hundred seeds were soaked in de-ionized water at room temperature(21°C) for 16h (overnight) and cooked for 20min at 95°C. Percentage hard seed was determined before and after cooking. Percentage partially hydrated seed was determined before and after cooking.
- **Hydration coefficient before cooking (HC):** HC before cooking (i.e., after soaking) was determined as: seed weight after soaking/weight of dry seed.
- **Hydration coefficient after cooking (HC):** HC after cooking was determined as: seed weight after cooking/weight of dry seed.

**Table 3b.** Canning Quality Evaluation of Select Dry Bean Lines in the 2017 Short Season Narrow Row Dry Bean Cooperative Trial in Western Canada.

ID_Name	Class	100-SD WT (g)	HC (16 hr)	HC (3 m, 93°C)	Drained Wt. (%)	Matting (1 to 4)	Appearance (1 to 4)	Canning Test			Texture (Firmness) (Kg force)	Work (J)	Slope to Peak (N/mm)			
								Dry colour						Canned colour		
								L*	a*	b*				L*	a*	b*
Pintium	Pinto	36.6	1.9	2.3	66.1	3.2	3.8	66.19	7.74	14.84	33.56	10.38	12.95	34.1	9.5	19.7
Island	Pinto	37.0	1.6	2.2	64.6	2.7	3.7	67.51	8.40	15.87	33.82	10.89	13.65	44.0	11.6	25.1
CDC WM-2	Pinto/SD	37.5	2.2	2.4	64.5	3.2	3.7	77.19	5.71	15.06	38.79	9.34	15.06	31.7	8.5	18.7
CDC Sol	Yellow	41.6	1.8	2.2	60.3	4.0	4.0	76.38	1.07	31.39	43.10	8.48	17.00	27.6	7.6	14.4
4510-3-1	Yellow	<b>41.8</b>	<b>1.8</b>	<b>2.2</b>	<b>64.9</b>	<b>4.0</b>	<b>4.0</b>	<b>76.33</b>	<b>0.64</b>	<b>37.51</b>	<b>39.19</b>	<b>9.91</b>	<b>15.86</b>	<b>22.4</b>	<b>6.1</b>	<b>11.1</b>
LSD 5%		2.00	0.08	0.05	1.61	0.46	0.31	3.03	0.55	2.17	1.00	0.42	0.52	3.30	1.23	1.71

Note: 1). Means are from two locations and three replications per location.  
2). Seed moisture content ranged between 9 and 11% for seed samples from all locations.  
-Hard seeds and low hydration coefficients during canning resulted in high matting and high appearance numbers.  
-Evidence of mechanical damage was also visible in the yellow bean lines.

### Canning Quality Traits

- **Hydration Coefficient after soaking (HC):** A predetermined amount of seed based on the bean market class was soaked for 16h in deionised water at room temperature (21°C). HC after soaking was determined as: seed weight after soaking/weight of dry seed
- **Hydration coefficient after blanching (HC):** Soaking seed was blanched for 3 min at 93°C. HC after blanching was determined as: seed weight after blanching / weight of dry weight.
- **Drained weight (%):** All bean seeds except navy bean were processed at 121°C for 20 min at 4 rpm in brine and navy bean seeds were processed at 121°C for 40min at 4rpm in tomato sauce in a 2402 Multimode R&D Retort (Allpax Products, LLC, Covington, LA). Can content was weighed and the weight of bean seed was determined after washing in tap water on a 8 mesh screen (Tyler series) positioned at a 15° angle. Percentage drain weight was determined as: (weight of bean seed / weight of can content) \* 100
- **Matting:** Matting (clumping) of seeds was assessed on a 1 to 4 scale, where 1 = none, 2 = trace, 3 = slight, and 4 = moderate.
- **Appearance:** Appearance of seeds was assessed on a 1 to 4 scale, where 1 = excellent, 2 = good, 3 = acceptable, and 4 = unacceptable.
- **Seed Colour:** Colour of dry bean seed: L\*, a\*, and b\* attributes of colour were measured on dry and processed (canned) seed using a CR-410 Chromameter (Konica Minolta Sensing Americas, Inc., Ramsey, NJ, USA).
- L\* indicates "lightness-darkness" with higher values indicate whiteness; a\* indicates "red-green" with positive values indicate redness and negative values indicate greenness; and b\* indicates "yellow-blue" with positive values indicate yellowness and negative values indicate blueness. One-hundred g of processed bean seed was used to determine colour after canning.

- **Texture:** Texture (Firmness) (kg-force) was determined by placing 100g of washed drained bean in to a standard shear compression cell (CS-1) of Texture Measurement System Touch (TMS-Touch, Food Technology Corp., Sterling, VA) and shearing them using a load cell of 255 kg-force at a rate of 0.83 cm sec<sup>-1</sup>. Work (J) refers to the area under the Firmness curve.
- Slope to peak (N/mm) refers to the slope of the Firmness curve.