

MEMORANDUM

TO: *Prairie Recommending Committee for Pulse and Special Crops*
FROM: K.E. Bett, A. Vandenberg, S. Banniza, T.D. Warkentin, B. Tar'an, B. Barlow, S. Ife, T. Prado, D. de Silva, S. Wagenhoffer, and J. Horner
Crop Development Centre, University of Saskatchewan,
Saskatoon, Saskatchewan S7N 5A8
DATE: February 1, 2018
SUBJECT: Request for Support for Registration of Carioca Bean Line 3568-1

Cariocas are a market class of bean consumed in great quantities in Brazil. They are slightly smaller than pintos and the pattern is similar to a pinto but striped rather than spotted (see figure 1). Carioca bean line 3568-1 was evaluated in the SSNR Cooperative Trial for 3 years: 2015-2017. As there are no other cariocas grown in western Canada we compared it to CDC WM-2 and CDC Pintium. Line 3568-1 has a slow darkening seed coat that was introgressed from CDC WM-1. To the best of our knowledge this would be the first SD carioca to enter the market which would allow Canadian growers to wait until the Brazilian crop has run out before selling. Selections were made in conjunction with a Brazilian member of the field crew.

This line was derived from a cross between the Brazilian cultivar BRS Requite and a CDC breeding line 2498bT. The breeding line was from a cross between 1533-15 (aka CDC WM-1) and a carioca breeding line. The final cross was done in the summer of 2006.

Yield was between CDC Pintium and CDC WM-2, the plants are upright and indeterminate, and the seed size is slightly smaller than the pinto checks. It is a bit later maturing than the checks (100 days) but was no later than CDC Sol in the Co-op trials. It is tolerant to both races of anthracnose tested, like the pinto checks. White mold scores were as good or better than the checks.



Figure 1: Direct comparison of 3568-1, CDC WM-2 and CDC Pintium

Strengths

Slow darkening seed coat

New market class for western Canadian growers

Tolerant to both races of anthracnose tested

Better cooking scores – lower % hard seed and better HC - than CDC Pintium or CDC WM-2

Neutral Traits

Yield similar to CDC Pintium and CDC WM-2

Canning data were as good or better than CDC Pintium and CDC WM-2

Seed size smaller than the pinto – in line with what is expected of a carioca

Weaknesses

Later maturity and lower pod clearance than CDC Pintium or CDC WM-2

Performance Data

See accompanying Tables for agronomic, cook/canning data, and disease reactions

Table 1: Three year agronomic performance data for the 2015-2017 Short Season Narrow Row Dry Bean Co-operative Trial "A" in Western Canada

| Market Class | Line | Yield(kg/ha) | | | | % of Pintium | Days to flower | | | | Days to mature | | | | Pod Clearance (%) | | | | Plant Height (cm) | | |
|--------------|--------------------|--------------|------|------|------|--------------|----------------|------|------|------|----------------|------|------|------|-------------------|------|------|------|-------------------|------|------|
| | | 2015 | 2016 | 2017 | Mean | | 2015 | 2016 | 2017 | Mean | 2015 | 2016 | 2017 | Mean | 2015 | 2016 | 2017 | Mean | 2015 | 2016 | Mean |
| Pinto | CDC Pintium | 2842 | 2534 | 2645 | 2681 | 100 | 47 | 50 | 53 | 51 | 94 | 91 | 96 | 94 | 80 | 80 | 75 | 78 | 40 | 36 | 38 |
| Pinto/SD | CDC WM-2 | 3042 | 3605 | 2611 | 3060 | 114 | 49 | 49 | 54 | 51 | 97 | 96 | 97 | 97 | 76 | 72 | 97 | 83 | 43 | 40 | 42 |
| Carioca | 3568-1 | 2834 | 3185 | 2774 | 2918 | 109 | 52 | 54 | 57 | 55 | 101 | 99 | 101 | 100 | 73 | 66 | 78 | 72 | 39 | 40 | 40 |

Bold indicates check variety

[] Indicates number of sites

| Market Class | Line | Seed Weight (g/1000) | | | | Lodging (1-5) | | | |
|--------------|--------------------|----------------------|------|------|------|---------------|------|------|------|
| | | 2015 | 2016 | 2017 | Mean | 2015 | 2016 | 2017 | Mean |
| Pinto | CDC Pintium | 381 | 365 | 351 | 366 | 1.7 | 1.7 | 2.3 | 1.8 |
| Pinto/SD | CDC WM-2 | 376 | 393 | 375 | 381 | 1.9 | 1.8 | 2.3 | 1.9 |
| Carioca | 3568-1 | 278 | 299 | 287 | 288 | 2.1 | 2.3 | 2.3 | 2.2 |

Bold indicates check variety

[] Indicates number of sites

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

| | | 2015 SSNR | | | | | | | | 2016 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 |
| CDC Pintium | PT | 0.3 | ac | 0.8 | ac | 0.0 | abcd | 0.1 | abcd | 0.0 | ac | 1.5 | ac | 0.0 | abcd | 0.0 | abcd |
| CDC WM-2 | PT/SD | 1.3 | ac | 1.3 | a | 0.0 | abcd | 0.3 | abcd | 1.1 | ac | 0.8 | ac | 0.8 | abd | 0.1 | abcd |
| 3568-1 | CR | 0.3 | ac | 0.0 | ac | 0.0 | abcd | 0.0 | abcd | 0.0 | ac | 0.7 | ac | 0.0 | abcd | 0.0 | abcd |
| AC Pintoba | PT | 9.0 | bd | 9.0 | bcd | 9.0 | c | 9.0 | | | | | | | | | |
| Othello | PT | 8.8 | bd | 4.6 | abd | 5.4 | abd | 8.5 | | | | | | | | | |
| Dresden | NA | 0.3 | ac | 0.0 | ac | 9.0 | c | 9.0 | | | | | | | | | |
| Num DF | | 20 | | 20 | | 20 | | 20 | | 26 | | 26 | | 26 | | 26 | |
| Den DF | | 40 | | 40 | | 40 | | 40 | | 54 | | 52 | | 52 | | 54 | |
| F Value | | 15.13 | | 18.24 | | 35.59 | | 33.48 | | 18.44 | | 18.22 | | 20.69 | | 19.56 | |
| Pr>F | | <0.0001 | | <0.0001 | | <0.0001 | | <0.0001 | | <0.0001 | | <0.0001 | | <0.0001 | | <0.0001 | |
| LSD(0.05) | | 2.7 | | 2.4 | | 1.8 | | 1.9 | | 2.6 | | 2.6 | | 2.5 | | 2.5 | |

Dunnets Test

a = significantly different than AC Pintoba
 b = significantly different than Envoy
 c = significantly different than Othello
 d = significantly different than Dresden
 PT = pinto; PT/SD = slow darkening pinto; NA = navy; CR = carioca;

| 2017 SSNR | | | | | | | |
|-----------|------|---------|------|----------|------|---------|------|
| Race 73 | | | | Race 105 | | | |
| Test #1 | | Test #2 | | Test #1 | | Test #2 | |
| Est. | Rank | Est. | Rank | Est. | Rank | Est. | Rank |
| 1.0 | ac | 0.6 | a | 0.0 | abcd | 0.1 | abcd |
| 0.4 | ac | 0.3 | a | 0.7 | abcd | 0.2 | abcd |
| 0.0 | ac | 0.0 | a | 0.1 | abcd | 0.0 | abcd |
| 9.0 | bd | 8.8 | bd | 9.0 | c | 9.0 | |
| 8.5 | bd | 4.1 | abd | 5.0 | abd | 7.2 | |
| 0.0 | ac | 0.0 | a | 9.0 | c | 8.4 | |
| 20 | | 20 | | 20 | | 20 | |
| 42 | | 40 | | 40 | | 42 | |
| 32.43 | | 6.42 | | 22.78 | | 19.00 | |
| <0.0001 | | <0.0001 | | <0.0001 | | <0.0001 | |
| 1.9 | | 3.4 | | 2.1 | | 2.3 | |

Table 3. White Mold data for 3568-1 in the 2015-2017 Short Season Narrow Row Dry Bean Co-operative Trial in western Canada

| White Mold Data | | | | | | | |
|-----------------|----------|---------------|-------------|---------------|-------------|---------------|-------------|
| | | 2015 | | 2016 | | 2017 | |
| Name | Type | Incidence (%) | Index (1-4) | Incidence (%) | Index (1-4) | Incidence (%) | Index (1-4) |
| Pintium | Pinto | 47 | 1.7 | 54 | 1.7 | 17.8 | 1.3 |
| CDC WM-2 | Pinto/SD | 65 | 2 | 46 | 1.5 | 19.5 | 1.3 |
| 3568-1 | Carioca | 48 | 1.8 | 50 | 1.6 | 11.4 | 1.2 |
| CV | | 22.8 | 13.6 | 24.8 | 11.1 | 56.9 | 13.2 |
| LSD | | 13.0 | 0.3 | 11.8 | 0.2 | 11.8 | 0.2 |

Severity index (1-4): 1 = healthy, 4 = dead
 Pinto/SD = slow darkening pinto

Table 3. 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 |
| 3568-1 | Carioca | 29.1 | 0.0 | 0.0 | 2.2 | 0.0 | 0.0 | 2.6 |
| Pintium | Pinto | 36.6 | 36.6 | 3.4 | 1.8 | 0.0 | 3.6 | 2.5 |
| CDC WM-2 | Pinto/SD | 37.5 | 6.0 | 0.8 | 2.2 | 0.0 | 0.1 | 2.6 |
| 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 4. 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) | Canning Test | | | | | | | | | | | | | |
|---------------|----------|---------------|--------------|----------------|-----------------|------------------|---------------------|------------|------|-------|---------------|-------|-------|-------------------------------|----------|----------------------|
| | | | HC (16 hr) | HC (3 m, 93°C) | Drained Wt. (%) | Matting (1 to 4) | Appearance (1 to 4) | Dry colour | | | Canned colour | | | Texture (Firmness) (Kg force) | Work (J) | Slope to Peak (N/mm) |
| | | | | | | | | L* | a* | b* | L* | a* | b* | | | |
| 3568-1 | Carioca | 29.1 | 2.2 | 2.3 | 65.1 | 3.7 | 4.0 | 78.01 | 5.44 | 14.96 | 41.08 | 8.83 | 14.99 | 27.0 | 7.8 | 15.6 |
| 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 |
| 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 |
| 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:

- Means are from two locations and three replications per location.
- 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 (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-1. Work (J) refers to the area under the Firmness curve.

Slope to peak (N/mm) refers to the slope of the Firmness curve.