



Dry Bean Variety Trial Comparison WSU Vancouver REU & Moses Lake

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In 2003 we conducted a dry bean variety trial on-station at WSU Vancouver and on-farm in Moses Lake. The trial included varieties and breeding lines of traditional U.S. dry bean market classes.

Objectives

- To compare performance of breeding lines to commercially available varieties.
- To study and compare the results of on-station and on-farm trials.
- To encourage farmers to participate in evaluating breeding lines.
- To expand our results and impacts based on multiple locations and farmers' participation.

Materials and Methods

The on-farm trial site was located in Moses Lake in the central part of Washington where dry beans are grown on a large scale. The farmer, Mr. Don Bales, volunteered to host our on-farm trial following a niche market dry bean varieties presentation that Dr. Miles made at the Pacific Northwest Vegetable Association annual meeting in eastern Washington in November 2002. The on-farm trial included 22 entries (11 breeding lines and 11 varieties) from eight market classes: Light Red Kidney (CELRK and USWA-33), Dark Red Kidney (Montcalm, USWA-39 and H9659-37-2), Great Northern (BelNeb-RR-1), Small Red (UI-239, LeBaron and USRM-20), Black (UI-911, H9673-87 and ICB-10-5), Cranberry (Cardinal, 95:8186C, USCR-14 and USCR-15), Pinto (Othello, Burke, Montrose, USPT-73 and USPT-CBB-1), and Other (Orca). The same entries (except Montrose) were included in our much larger on-station trial (115 entries) at WSU Vancouver Research and Extension Unit (VREU).

Plant height (cm) was measured at first flower and at harvest for 10 randomly selected plants in each plot, from the base of the plant (soil surface) to the top node. Plant stand was measured at harvest as number of plants within 10 feet of row. At Moses Lake only, plant vigor was noted on July 11 on a scale of 1–9 where 1 was worst and 9 best. At both locations, plants were harvested from the center 5 feet of both rows in each plot for a total harvest area of 10 feet per plot. Whole plants were harvested, placed in burlap bags, and dried at WSU VREU in field ovens for 16 hours at 68° C, until seed moisture was approximately 12%. Ten pods were selected at random from each plot, and pod length (cm) was measured. Beans were threshed and cleaned by machine and hand, and total marketable bean weight (g/plot converted to lbs/A) was measured. One-hundred beans were randomly selected and weighed from each plot, and length and width (cm) of 25 beans were measured. Plant stand at harvest, total bean weight, weight of 100 beans, length and width of 25 beans were measured from two samples collected from the farmer's bean field (variety Black Onyx) for comparison purposes.

Results and Discussion

At Moses Lake, only plant vigor and plant stand at harvest did not differ significantly among entries (Table 1). Plant vigor for all varieties was good (mean 6.8). At Moses Lake and at WSU VREU, all other variables differed significantly among entries. Mean plant stand was good at both locations, however at WSU VREU, plant stand of Orca was significantly lower, whereas at Moses Lake it was not different from other varieties. Plant height varied at Moses Lake, a significant reduction in plant height was observed among varieties at harvest compared to first flowering; this was due to the weight of mature pods that caused plants to bend slightly.

In general, yield was greater at WSU VREU than at Moses Lake, even after taking into account plant stand differences between the two sites. Weight of 100 beans, bean length, bean width, pod length, pod width, and the average number of beans per pod did not differ between locations.

The light red kidney cultivar California Early Light Red Kidney (CELRK) is the predominant cultivar of this market class grown in Washington. It is early maturing in eastern Washington (90 days or less) and is resistant to bean common mosaic virus (BCMV), but is susceptible to beet curly top virus (BCTV). USWA-33 (a USDA-ARS/WSU line) was just approved for cultivar release as “Blush” light red kidney. This cultivar is higher yielding than CELRK and has resistance to both BCMV and BCTV, but has a later maturity (95-100 days).

Montcalm is the standard variety for the dark red kidney market class in the U.S. but it is poorly adapted to the Pacific North West (PNW). USWA-39 is being released this year by WSU/USDA-ARS as the cultivar “Fiero”. This line has better yield potential than Montcalm in Washington and has resistance to BCTV, but is about 5 days (100-103 days) later maturing than Montcalm (95-98 days). Fiero is the first dark red kidney bred specifically for production in the PNW.

The quality parameters for the kidneys market class are rigorous. The seed appearance and canning quality for the check cultivars included in this trial all have proven acceptance in the marketplace. However, please note that Blush and Fiero have not yet been tested for acceptance on a commercial scale. In small pilot tests, they have both been found to be acceptable. Therefore, it is suggested that growers and dealers first plant these new cultivars on a small scale to confirm their acceptance in the commercial marketplace.

UI-239 is the high yielding check for the small red market class and was developed by the University of Idaho. Lebaron released by USDA-ARS/WSU is an early season red (< 88 d) developed primarily for late plantings following peas or small grains in a double-cropping system. The larger seeded, high yielding small red breeding line USRM-20 from the ARS breeding program in Prosser, Washington, is undergoing advanced testing for potential cultivar release in 2005 or 2006.

UI-911 is the standard check variety in Idaho, Oregon and Washington for the black market class. H9673-97 (USDA-ARS, Prosser, WA) has higher yield potential than UI-911 and therefore is undergoing advanced testing for potential release in 2006. ICB-10-5 is a black bean with a shiny seed coat which is atypical as most cultivars in this market class have a dull black seed coat. This line has exceptional canning quality and has a nice polished appearance desirable for direct marketing in bulk bins or in clear packages on supermarket shelves. Although shiny black beans are consumed in Latin America, the commercial marketability of this seed type in the U.S. has yet to be determined. For instance Shiny Crow, a new black bean with shiny seed coat released in 2002 from Colorado State University, has not yet established itself in the marketplace. The seed size of Shiny Crow, 28-30 g per 100 beans, may limit its acceptance because it is much larger than the traditional size of 20 to 24 g/100 beans for U.S. black bean market class. Note that the seed size of ICB-10-5 is also large 28 g/100 seeds. At Moses Lake, the mean yield of all black bean varieties grown was 568 g (1.25 lb) per 10 row feet, and the mean yield of Black Onyx (farmer’s field) was 501 g (1.1 lb) per 10 row feet. The farmer’s field was adversely affected by *Sclerotinia* white mold, and he estimated this disease caused a 15–20% reduction in yield as compared to previous years with little or no white mold disease.

Pinto is the primary market class grown in the U.S., and Othello (USDA-ARS, Prosser, WA) has been the most widely grown pinto bean cultivar since its release in 1988. It is widely adapted and is early maturing (88-93 days). Burke (92-97 days) is a recent USDA-ARS/WSU release which possesses rust resistance, an advantage for production east of the continental divide where rust is prevalent, but it is a few days later than Othello. Montrose, a high yielding pinto released recently from Colorado State University, possesses rust resistance but is very susceptible to white mold disease. USPT-73 (USDA-ARS/WSU) has preliminary approval for advanced testing for cultivar release primarily for eastern WA production. This line has also performed extremely well in Colorado but lacks rust resistance which would limit its production there. USPT-73 has wide adaptability like Othello, but higher yield potential. USPT-CBB-1 (USDA-ARS, Prosser, WA) is a multiple disease resistant pinto with promise for national release.

Cranberry beans are synonymous with Roma beans that are eaten in Italy and neighboring countries. Cranberries are also grown for green shell bean production. Large immature seeds are harvested once red striping appears on the pods. Green shell beans are used in soups and salads. Cranberry beans are very susceptible to BCTV, a disease that plagues crop production (tomato, pumpkin, pepper, cilantro, and others) in the Columbia Basin on a periodic basis. Cardinal has wide adaptability and resistance to BCTV but suffers from an internal seed discoloration problem called black heart. The cranberry line 95:9186C (Univ. Idaho/USDA-ARS) is undergoing seed increase for advanced testing. This line has high yield potential and good seed quality. The breeding lines USCR-14 and -15 (USDA-ARS, Prosser, WA) show promise but are still in the preliminary stages of testing.

Great Northerns are primarily grown in Nebraska, with some produced in Idaho and a few in Washington. BelNeb-RR-1 (USDA-ARS in Beltsville, MS/NE) has resistance to halo blight, common bacterial blight, and Fusarium root rot, and is a parent of Montrose pinto but has never been officially released as a cultivar.

In most cases the new cultivars or breeding lines in advanced stages of testing yielded more than the standard check cultivars. This indicates that significant progress is being made in breeding dry beans with improved performance in Washington State.

Table 1. Plant height at 1st flowering and harvest (cm), plant stand at harvest, total bean weight (g) measured in 10 feet of row, and weight of 100 beans (g) at Vancouver Research and Extension Center and Moses Lake in 2003.

| Market Class | Pl. Ht at | | Pl. Ht at | | Pl. | Pl. Stand | | T Bean | | T Bean Yld | | Wt 100 | |
|-------------------------------|--------------|--------|-----------|--------|--------------------|-----------|--------|--------------|--------|------------|--------|-----------|--------|
| | 1st Flw (cm) | | Hrv (cm) | | Vigor ^y | at Hrv | | Wt (g)/10 ft | | lbs/A | | beans (g) | |
| | VREU | ML | VREU | ML | ML | VREU | ML | VREU | ML | VREU | ML | VREU | ML |
| Light Red | | | | | | | | | | | | | |
| Kidney | 37.2 | 51.6 | 30.1 | 28.9 | 7.1 | 60.0 | 46.5 | 623.7 | 503.3 | 2988.3 | 2411.4 | 64.3 | 59.9 |
| CELRK | 36.9 | 52.9 | 28.1 | 27.1 | 7.8 | 55.0 | 43.5 | 495.0 | 545.3 | 2371.8 | 2612.6 | 60.8 | 60.0 |
| USWA-33 | 37.4 | 50.4 | 32.1 | 30.8 | 6.5 | 65.0 | 49.5 | 752.3 | 461.3 | 3604.7 | 2210.1 | 67.8 | 59.8 |
| Dark Red | | | | | | | | | | | | | |
| Kidney | 43.2 | 50.1 | 30.4 | 26.8 | 6.8 | 54.3 | 46.4 | 626.6 | 384.3 | 3002.4 | 1841.6 | 54.9 | 52.9 |
| H9659-37-2 | 45.0 | 53.7 | 32.2 | 21.6 | 7.3 | 55.0 | 37.5 | 671.8 | 396.0 | 3219.0 | 1897.5 | 54.0 | 50.3 |
| Montcalm | 41.9 | 46.7 | 28.7 | 25.0 | 6.8 | 58.0 | 56.8 | 511.5 | 359.8 | 2450.9 | 1723.8 | 54.3 | 53.3 |
| USWA-39 | 42.8 | 49.9 | 30.4 | 33.7 | 6.5 | 50.0 | 45.0 | 696.5 | 397.3 | 3337.3 | 1903.5 | 56.5 | 55.3 |
| Small Red | 34.1 | 43.5 | 24.3 | 17.5 | 6.3 | 56.7 | 49.4 | 789.7 | 391.9 | 3783.8 | 1877.9 | 41.7 | 35.7 |
| LeBaron | 32.8 | 42.2 | 26.3 | 17.8 | 6.3 | 55.0 | 51.8 | 647.5 | 331.0 | 3102.6 | 1586.0 | 41.3 | 34.3 |
| UI-239 | 41.0 | 41.0 | 27.7 | 16.4 | 6.3 | 67.0 | 47.8 | 974.5 | 323.0 | 4669.4 | 1547.7 | 37.8 | 32.0 |
| USRM-20 | 28.6 | 47.4 | 18.9 | 18.2 | 6.5 | 48.0 | 48.8 | 747.0 | 521.8 | 3579.3 | 2500.0 | 46.0 | 40.8 |
| Black | 39.8 | 43.7 | 32.4 | 28.3 | 6.9 | 63.3 | 52.3 | 807.4 | 568.3 | 3868.6 | 2723.2 | 25.8 | 23.2 |
| H9673-87 | 46.5 | 42.3 | 38.0 | 29.2 | 7.3 | 76.0 | 55.0 | 961.8 | 590.5 | 4608.6 | 2829.4 | 24.3 | 20.0 |
| ICB-10-5 | 40.2 | 42.8 | 32.6 | 24.0 | 7.3 | 73.0 | 50.8 | 804.3 | 521.8 | 3853.9 | 2500.0 | 27.8 | 28.5 |
| UI-911 | 32.7 | 46.1 | 26.5 | 31.5 | 6.3 | 41.0 | 51.0 | 656.0 | 592.8 | 3143.3 | 2840.2 | 25.3 | 21.0 |
| Pinto | 42.5 | 46.9 | 28.5 | 18.2 | 6.2 | 60.0 | 44.5 | 647.4 | 377.0 | 3102.1 | 1806.2 | 45.3 | 38.5 |
| Burke | 44.6 | 45.7 | 28.8 | 17.3 | 6.0 | 54.0 | 42.8 | 670.3 | 294.8 | 3211.8 | 1412.3 | 44.3 | 37.3 |
| Montrose | | 45.3 | | 17.7 | 5.7 | | 43.7 | | 315.0 | | 1509.4 | | 35.7 |
| Othello | 32.9 | 47.5 | 29.4 | 17.0 | 6.5 | 58.0 | 40.3 | 626.3 | 379.0 | 3001.0 | 1816.0 | 43.8 | 38.0 |
| USPT-73 | 51.4 | 50.9 | 28.5 | 19.4 | 6.0 | 63.0 | 49.8 | 794.0 | 474.8 | 3804.5 | 2274.8 | 48.5 | 42.0 |
| USPT-CBB-1 | 41.2 | 45.0 | 27.3 | 19.5 | 7.0 | 65.0 | 46.0 | 499.0 | 421.3 | 2391.0 | 2018.5 | 44.5 | 39.5 |
| Cranberry | 40.2 | 50.0 | 94.5 | 23.5 | 7.3 | 53.0 | 45.4 | 655.1 | 436.6 | 3139.0 | 2091.8 | 60.3 | 55.2 |
| 95:8186C | 44.6 | 48.3 | 26.6 | 24.2 | 7.0 | 58.0 | 50.5 | 847.8 | 488.0 | 4062.3 | 2338.3 | 61.0 | 54.8 |
| Cardinal | 37.6 | 52.0 | 24.5 | 19.0 | 7.3 | 69.0 | 53.0 | 519.8 | 365.0 | 2490.7 | 1748.9 | 58.8 | 56.3 |
| USCR-14 | 41.4 | 51.1 | 297.0 | 19.7 | 7.5 | 50.0 | 37.8 | 529.8 | 490.5 | 2538.6 | 2350.3 | 56.5 | 53.0 |
| USCR-15 | 37.3 | 48.7 | 29.9 | 31.2 | 7.3 | 35.0 | 40.3 | 723.0 | 402.8 | 3464.3 | 1929.8 | 65.0 | 56.8 |
| Great Northern | 25.5 | 42.9 | 29.3 | 22.3 | 6.8 | 55.0 | 46.8 | 869.0 | 267.0 | 4163.9 | 1279.4 | 40.0 | 32.0 |
| BelNeb-RR-1 | 25.5 | 42.9 | 29.3 | 22.3 | 6.8 | 55.0 | 46.8 | 869.0 | 267.0 | 4163.9 | 1279.4 | 40.0 | 32.0 |
| Other | 31.3 | 33.9 | 29.2 | 32.1 | 8.0 | 11.0 | 49.0 | 403.3 | 417.0 | 1932.5 | 1998.1 | 33.0 | 30.0 |
| Orca-2 | 31.3 | 33.9 | 29.2 | 32.1 | 8.0 | 11.0 | 49.0 | 403.3 | 417.0 | 1932.5 | 1998.1 | 33.0 | 30.0 |
| Average | 38.7 | 46.7 | 41.5 | 23.4 | 6.8 | 55.3 | 47.1 | 685.7 | 425.2 | 3285.8 | 2037.6 | 47.2 | 42.3 |
| P value | 0.0001 | 0.0003 | 0.0392 | 0.0000 | 0.1352 | 0.0000 | 0.1868 | 0.0000 | 0.0002 | | | 0.0000 | 0.0000 |
| Black Onyx^y | | | | | | | 42.5 | | 501.0 | | | | 21.0 |

^y = Plant vigor was measured on a scale of 1 to 9 where 1 was worst and 9 was best

^z = Variety planted in farmer's field; data is average of 2 samples

Table 2. Length and width of 25 beans (cm), average pod length and width (cm), and average number of beans/pod at Vancouver Research and Extension Center and Moses Lake in 2003.

| Market Class | Length 25 | | Width 25 | | Pod | | Pod | | Av. No. | |
|-------------------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|------------|------------|------------|
| | Beans (cm) | | Beans (cm) | | Length (cm) | | Width (cm) | | Beans/pod | |
| Entry | VREU | ML | VREU | ML | VREU | ML | VREU | ML | VREU | ML |
| Light Red Kidney | 42.1 | 42.9 | 20.7 | 20.6 | 11.8 | 12.7 | 1.0 | 1.1 | 3.9 | 3.7 |
| CELRK | 41.8 | 43.4 | 20.5 | 20.8 | 11.1 | 11.8 | 1.0 | 1.1 | 3.5 | 3.5 |
| USWA-33 | 42.3 | 42.4 | 20.8 | 20.4 | 12.5 | 13.7 | 1.0 | 1.2 | 4.2 | 3.9 |
| Dark Red Kidney | 39.5 | 40.7 | 19.6 | 20.3 | 11.5 | 11.7 | 1.1 | 1.2 | 4.5 | 3.5 |
| H9659-37-2 | 38.8 | 40.6 | 19.1 | 20.3 | 11.4 | 12.0 | 1.0 | 1.1 | 5.5 | 3.9 |
| Montcalm | 39.3 | 41.0 | 19.0 | 19.9 | 11.7 | 11.2 | 1.2 | 1.3 | 4.2 | 3.6 |
| USWA-39 | 40.5 | 40.5 | 20.6 | 20.8 | 11.4 | 11.9 | 1.2 | 1.3 | 3.8 | 3.1 |
| Small Red | 29.2 | 28.9 | 20.2 | 19.2 | 9.0 | 8.9 | 1.0 | 1.2 | 4.9 | 3.9 |
| LeBaron | 29.8 | 28.0 | 19.4 | 18.8 | 9.0 | 8.8 | 1.1 | 1.1 | 4.2 | 3.8 |
| UI-239 | 26.4 | 27.6 | 20.4 | 18.1 | 8.2 | 8.5 | 0.9 | 1.2 | 6.1 | 4.0 |
| USRM-20 | 31.3 | 31.1 | 20.9 | 20.8 | 9.9 | 9.4 | 1.1 | 1.2 | 4.5 | 3.8 |
| Black | 24.3 | 23.8 | 15.9 | 15.8 | 9.1 | 9.1 | 0.9 | 0.9 | 5.9 | 5.3 |
| H9673-87 | 23.3 | 22.3 | 15.6 | 15.3 | 9.5 | 9.3 | 0.9 | 0.8 | 6.1 | 5.8 |
| ICB-10-5 | 25.3 | 26.3 | 16.9 | 17.6 | 9.1 | 8.7 | 0.9 | 0.9 | 5.5 | 4.3 |
| UI-911 | 24.4 | 23.0 | 15.1 | 14.6 | 8.8 | 9.4 | 0.9 | 0.9 | 6.1 | 5.7 |
| Pinto | 32.5 | 32.3 | 20.3 | 20.4 | 9.8 | 9.9 | 1.1 | 1.2 | 4.2 | 4.3 |
| Burke | 31.5 | 30.5 | 20.9 | 20.4 | 9.0 | 9.5 | 1.2 | 1.3 | 4.0 | 4.1 |
| Montrose | | 32.3 | | 20.3 | | 10.3 | | 1.1 | | 4.9 |
| Othello | 31.6 | 30.9 | 20.4 | 20.5 | 9.8 | 10.0 | 1.1 | 1.2 | 4.2 | 3.8 |
| USPT-73 | 34.4 | 34.8 | 20.0 | 20.6 | 11.3 | 11.5 | 1.1 | 1.2 | 4.8 | 4.7 |
| USPT-CBB-1 | 32.5 | 32.9 | 20.0 | 20.1 | 9.2 | 8.3 | 1.1 | 1.1 | 3.6 | 3.9 |
| Cranberry | 35.6 | 36.3 | 21.6 | 21.9 | 11.2 | 11.6 | 1.2 | 1.2 | 4.3 | 4.1 |
| 95:8186C | 34.3 | 35.2 | 20.9 | 21.5 | 11.6 | 11.1 | 1.1 | 1.2 | 4.7 | 4.1 |
| Cardinal | 34.9 | 36.4 | 21.9 | 22.8 | 9.7 | 11.0 | 1.1 | 1.2 | 3.9 | 4.2 |
| USCR-14 | 35.8 | 36.4 | 21.1 | 21.5 | 11.2 | 11.5 | 1.2 | 1.2 | 4.1 | 4.0 |
| USCR-15 | 37.4 | 37.1 | 22.4 | 21.8 | 12.2 | 12.6 | 1.2 | 1.2 | 4.4 | 4.2 |
| Great Northern | 29.0 | 29.6 | 17.5 | 18.5 | 10.3 | 11.3 | 1.2 | 1.1 | 3.4 | 5.5 |
| BelNeb-RR-1 | 29.0 | 29.6 | 17.5 | 18.5 | 10.3 | 11.3 | 1.2 | 1.1 | 3.4 | 5.5 |
| Other | 28.3 | 28.5 | 17.1 | 17.5 | 9.4 | 10.1 | 1.1 | 1.1 | 4.9 | 5.3 |
| Orca-2 | 28.3 | 28.5 | 17.1 | 17.5 | 9.4 | 10.1 | 1.1 | 1.1 | 4.9 | 5.3 |
| Average | 33.0 | 33.2 | 19.5 | 19.7 | 10.9 | 10.5 | 1.1 | 1.1 | 4.6 | 4.3 |
| P value | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0033 | 0.0000 | 0.0021 | 0.0000 |
| Black Onyx ^y | | 23.3 | | 15.5 | | | | | | |

^z = Variety planted in farmer's field; data is average of 2 samples