

2006 DRY BEAN YIELD TRIALS

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Twenty-four yield trials were conducted in 2006 in Saginaw, Montcalm, and Presque Isle counties in addition to 20 acres of early generation nurseries under development in 10 different market classes. At the Saginaw Valley Bean & Beet Research Farm, 16 yield trials were planted on nine acres. These included a 49-entry standard navy bean test; a 72-entry standard black test, a 30-entry preliminary navy & black bean test; four preliminary black bean tests (range 10-100 entries); a 56-entry standard pinto bean test; a 64-entry preliminary pinto test; a 36-entry standard great northern test; a 20-entry preliminary great northern bean test; a 30-entry standard red and pink bean test; a 36-entry preliminary red and pink test; a 16-entry standard vine cranberry test; 30-entry Tebo bean test; and a 20-entry Midwest Performance Trial with pintos and great northern from Michigan, Nebraska, North Dakota, and Colorado. At the Montcalm Research Farm, eight yield trials were planted on five acres. These included a 49-entry standard red and white kidney trial, 56-entry preliminary kidney bean test; a 42-entry standard bush cranberry test; a 25-entry preliminary cranberry bean test; a 64-entry variety trial to evaluate reaction to white mold was grown under sprinkler irrigation; a second 64-entry genetic study to evaluate for genetic resistance to white mold; a 64-entry study to evaluate for leaf hopper tolerance. A 16-entry regional trial was conducted cooperatively in Presque Isle County with new navy, black, pinto, great northern, small red, pink, tebo, and kidney bean varieties to give growers in this region an opportunity to see varieties in other market classes.

The 2006 field season started out favorably and growth was lush with above normal rainfall in July (>3" above normal). A 20-day dry period in August reduced yields and harvest proved challenging as the rains started the second week of September and were continuous through October. Many trials averaged 25 cwt/acre and top yields in black beans exceeded 40 cwt/acre compared to a statewide average of 17 cwt/acre for the commercial crop. Weather conditions favored the development of common bacterial blight (CBB) throughout the nurseries and the state. CBB pressure was high in all nurseries but particularly in the advanced black trial. Plots were rated for CBB as there was obvious resistance in both the black and navy tests. All small-seeded nurseries were direct harvested in 2006 and all medium-seeded tests were rod pulled similar to 2005. At the Montcalm Research Farm rainfall on the farm was slightly below average for June and August but was over 4" above normal for July (6.46"), so only one irrigation of 0.75" was applied to the nurseries. Despite access to irrigation, and adequate rainfall, plot yields were well below average due to heavy infection of common bacterial blight in the kidney and cranberry nurseries and the delay in harvest due to wet conditions in September and October. In the white mold trial that was irrigated 6 times for total of 3" to promote disease development, top yields exceeded 40 cwt/acre, whereas the top yields in kidney and cranberry beans was substantially lower (20-24 cwt/acre). There was a huge range in yield in the white mold trial due to heavy infections of both white mold and CBB and the delay in harvesting plots which resulted in higher losses in the white mold susceptible plots. In addition to the kidney, cranberry and white mold trials at Montcalm, research was conducted to identify genetic resistance to white mold and screening for tolerance to potato leaf hopper in a wide array of commercial bean classes.

The data for all tests are included in an attached section. Procedures and details on nursery establishment and harvest methods are outlined on the first page. Since the data collected on each test are basically the same, a brief discussion of each variable measured is presented below for clarification purposes.

1. Yield is clean seed weight reported in hundredweight per acre (cwt/acre) standardized to 18% moisture content. Dry beans are commercially marketed in units of 100 pounds (cwt).
2. Seed weight is a measure of seed size, determined by weighing in grams a pre-counted sample of 100 seeds, known as the 100-seed weight. To convert to seeds per 100g (10,000/100 seed wt); for example 100-seed weight of 50 converts to 200 seeds per 100 g (used in marketing).
3. Days to flower is the number of days from planting to when 50% of plants in a plot have one or more open flowers.
4. Days to maturity is the actual number of days from planting until date when all the plants in a plot have reached harvest maturity.
5. Lodging is scored from 1 to 5 where 1 is erect while 5 is prostrate or 100% lodged.
6. Height is determined at physiological maturity, from soil surface to the top of plant canopy, and is recorded in centimeters (cm).
7. Desirability score is a visual score given the plot at maturity that takes into consideration such plant traits as; moderate height, lodging resistance, good pod load, favorable pod to ground distance, uniformity of maturity, and absence of disease, if present in the nursery. The higher the score (from 1 to 9) the more desirable the variety, hence DS serves as a subjective selection index.

At the bottom of each table, the mean or average of all entries in a test is given to facilitate comparisons between varieties. In order to better interpret data, certain statistical factors are used. The LSD values refer to the Least Significant Difference between entries in a test at two levels of probability. The LSD value is the minimum difference by which two entries must differ before they can be considered significantly different. Two entries differing in yield by 1 cwt/acre cannot be considered as performing significantly different if the LSD value is greater than 1 cwt/ acre. Such a statement is actually a statement of "probable" difference. We could be wrong once in 20 times ($p=0.05$), on the average, or once in 100 times ($p=0.01$) depending on the level of probability. The other statistic, Coefficient of Variation (CV), indicates how good the test was in terms of controlling error variance due to soil or other differences within a location. Since it is impossible to control all variability, a CV value of 10% or less implies excellent error control and is reflected in lower LSD values. Under the pedigree column, all released or named varieties are **bolded** and always preceded by a comma (,); when preceded by a slash (/), the variety was used only as a parent to produce that particular breeding line.

Expt. 6101: Standard Navy Bean Yield Trial

This 49-entry trial included standard commercial navy bean varieties, and advanced lines from the MSU breeding program, which carry the N-prefix. Yields ranged from 19 to 32 cwt/acre with a mean of 26 cwt/acre. The trial was fairly uniform and variability was moderate (CV=9.4%) and the LSD needed for significance was 3.4 cwt/acre. Six entries significantly out-yielded the test mean and the check varieties Seahawk, Vista and Mayflower that equaled the test mean. The top group included new breeding lines with CBB resistance N05319, N05320 and N05357 from the four-way cross to combine CBB resistance sources. N05324 ranked 2nd and exhibited upright architecture, followed by N05310 and N04152. The top-yielding navy entry in test 6103 was a sib of N05324. N02237 that was the top yielding entry in 2003 and 2nd in 2004 and 2005 dropped below the test mean due to heavy CBB infection in 2006. Two potential breeding lines N04120 and N04158 with nice architecture only ranked 9th and 11th respectively, underscoring the difficulty of combining erect plant habit and yield.

Expt. 6102: Standard Black Bean Yield Trial

This 72-entry trial included the standard commercial black bean varieties and advanced breeding lines. Yields ranged from 20 to 30 cwt/acre with a test mean of 25 cwt/acre. Variability was very well controlled in this test, (CV=6.4%) and the LSD was 2.3 cwt/acre. Ten breeding lines significantly out-yielded the test mean. These new lines were derived from different parental combinations but only one line significantly out performed the check varieties. B03622 ranked 1st and this is the second year in four years that the line was in the top-yielding group. B01741 that previously topped tests 3102 and 2106 in 2003 and 2002, respectively, continues to show potential and ranked 2nd in this test. This line has been in the top-yielding group for five years but it does not meet the canning quality standards. B04554 that topped test 5102 in 2005 ranged 3rd and continues to show potential. This trial was very heavily infected with CBB and a number of erect lines (B05039, B05040, B05055) showed high levels of resistance. These same lines carried the SU91 marker linked to resistance. Among the top yielding varieties were Jaguar (27.4), Eclipse (26.4), Condor and Domino (23.6), whereas T-39 produced 22 cwt/acre. Since the trial was direct harvested, the data suggest that there exists significant yield potential in upright black beans adapted to the current conditions of mid-Michigan. Future advances will largely depend on canning quality of the entries.

Expt. 6103: Preliminary Navy and Black Bean Yield Trial

This 30-entry trial included new navy and black bean breeding lines from the MSU breeding program, which carry the N06- and B06-prefix and entries from Cooperative Dry Bean Nursery (CDBN). Yields ranged from 25 to 35 cwt/acre with a mean of 30 cwt/acre. Variability was well controlled (CV=6.1%) in the 3-replicate trial and the LSD needed for significance was 3 cwt/acre. Four entries significantly out-yielded the test mean and these included the new variety Jet Black from ISB, the 115M black bean line and line ND012103 from North Dakota. Plants of Jet Black exhibited consistent green stem defect at harvest. One black bean family B06310 from MSU was among the high-yielding group. Check varieties Vista, Condor, Jaguar and Seahawk were all lower yielding. The overall yields were higher than the standard navy trial (5101) and Vista yielded 2 cwt more in this test. None of the top-yielding lines had high DS scores (<5). Only those entries with

equivalent canning quality to Condor and Seahawk will be advanced in 2007.

Expt. 6104: Preliminary Black Bean Yield Trial

This small 10-entry trial included new black bean breeding lines (DPC-prefix) from the bean breeding program in the Dominican Republic. The DPC line had been developed from the cross of Arroyo Loro Negro (ALN) and Raven with the purpose of incorporating the *bc-3* gene from Raven to protect against necrotic strains of BCMV. We confirmed the presence of the gene in greenhouse tests at MSU. Yields ranged from 24 to 41 cwt/acre with a mean for the test of 29 cwt/acre. Variability was quite well controlled in this 3-rep test (CV=7.4%) despite being direct harvested and the LSD was 3.6 cwt/acre. Only one line B04554 significantly out-yielded the test mean exceeding the next entry (32 cwt/acre) by over 8 cwt/acre. It was significantly better than the check varieties Jaguar (28 cwt) and Condor (26 cwt) and continues to show high yield potential as in test 6102. The DPC lines significantly outyielded the ALN parent except DPC-5. All showed more upright architecture and low lodging scores compared to ALN. The best line DPC-1 was significantly better than the Raven parent and had the highest overall DS score compared to other sibs. We plan to continue testing this line and only those entries with canning quality equivalent to Condor will be advanced in 2007.

Expts. 6105-6107: Preliminary Black Bean Yield Trials

These three trials were established to study inheritance of high yield in black beans derived from an original cross with the Mexican black bean Tacana and a wild bean G24423 from Colombia. Four high yielding lines were identified in this cross: 48-21M (MSU accession I01891), 115-11M (I01892), 26-11M (I01893), and 39-11M (I01894). The most consistent high yielding line 115-11M has produced yields exceeding 50 cwt/acre in past seasons. The four lines were crossed with Jaguar and advanced using SSD to the F5 generation and the recombinant inbred lines (RILs) from these four crosses entered third year of yield testing in 2006. Test 6105 derived from cross 115-11M/Jaguar had 100 entries and ranged in yield from 26 to 38 cwt/acre with a mean of 31 cwt/acre. Variability was very well controlled in this 3-rep test (CV=5.3%) despite being direct harvested and the LSD was 2.7 cwt/acre resulting in 13 lines that significantly outyielded the test mean. Test 6106 derived from cross 48-21M/Jaguar had 64 entries and ranged in yield from 23 to 35 cwt/acre with a mean of 29 cwt/acre. Variability was well controlled in this 3-rep test (CV=7.4%) despite being direct harvested and the LSD was 3.5 cwt/acre resulting in 4 lines that significantly outyielded the test mean. Combined test 6107 derived from crosses 26-11M/Jaguar and 39-11M/Jaguar had 56 entries and ranged in yield from 23 to 34 cwt/acre with a mean of 29 cwt/acre. Variability was very well controlled in this 3-rep test (CV=5.3%) despite being direct harvested and the LSD was 2.6 cwt/acre resulting in 6 lines that significantly outyielded the test mean. In all tests the two parents were included along with some additional checks if space permitted. Jaguar ranged in yield from 26-30 cwt/acre and a number of entries significantly out-yielded the local adapted parent, T-39. Line 115-11M was planted in all tests and ranged in yield from 30-33 cwt/acre, whereas the original parent Tacana produced slightly lower yields of 29-31 cwt/acre in all tests. As in 2005, the top yielding entry (B04391 in test 6105) did not exceed top yield of 41 cwt/acre for B04554 in black bean test 6104.

Expt. 6108: Standard Great Northern Bean Yield Trial

This 36-entry trial included MSU great northern breeding lines and standard commercial check varieties. The test ranged in yield from 15 to 29 cwt/acre with a mean yield of 25 cwt/acre. Variability was well controlled (CV= 7.2%) resulting in a low LSD value (2.5 cwt/acre) for significance. Due to the wet weather, all the larger-seeded trials were rod pulled, not direct harvested like the small-seeded navy and black beans. Six breeding lines including Matterhorn significantly outperformed the test mean which underscores the difficulty of identifying lines that outperform Matterhorn. Two of the older entries (coded G97- and G98-) continue to perform well, whereas no G05- lines were in the this top group. Given the difficulty to improve on the performance of Matterhorn, other traits suitable for direct harvest and seed quality will receive attention. Overall seed size was small in 2006 and averaged 33.5g/100 seeds, whereas maturity was less than 85 days. In future years this trial will be direct harvested to determine which lines are best suited for this harvest method. Only those entries with larger seed size, improved dry seed quality and cracking resistance over Matterhorn will be advanced in 2007.

Expt. 6109: Standard Pinto Bean Yield Trial

This 56-entry trial included standard commercial pinto bean varieties, breeding lines entered through the Cooperative Dry Bean Nursery (CDBN) and advanced lines from the MSU breeding program that carry the P-prefix. The trial ranged in yield from 15 to 27 cwt/acre with a mean of 22 cwt/acre. Variability was well controlled (CV=8.2%) and the LSD needed for significance was 2.5 cwt/acre. Twelve entries significantly out-yielded the test mean and these included Buster variety, whereas Othello (22.4) was outside this group in 2006. The family (P04202-P04206) continues to dominate the yield trials both in yield and large seed size (~38g). These lines are candidates for release if they continue to perform well in white mold trials. The older lines P02630, P02624, and P02647 were in the top group despite inconsistent performance in 2005. Continued testing of the P05- lines is required before any decision will be made. Entries in CDBN were very viny, prostrate and did not perform well in 2006 and a few of these lines were extremely late maturing (>90d) compared to test mean of 86 days. Only those entries with equivalent canning quality, yield and maturity to Othello will be advanced in 2007.

Expt. 6110: Standard Pink and Small Red Bean Yield Trial

This 30-entry trial included small red and pink breeding lines from the USDA program at Prosser, Washington (USWA) and new pink lines from MSU (S-prefix), standard commercial check varieties. The test ranged in yield from 17 to 27 cwt/acre with a mean yield of 21 cwt/acre. Variability was well controlled (CV=8.2%) resulting in a LSD value (2.4 cwt/acre) for significance. Four lines significantly outperformed the test mean and these included three lines from USWA and S02753 from MSU that ranked 5th in 2005. Check varieties such as Merlot, Sedona and Brooks were lower yielding in 2006. The red and pink trial was very disappointing in 2006. The excessive rainfall during the season resulted in more vegetative growth in these lines and many were significantly delayed in maturity. There is a need to introduce more partitioning efficiency (high HI) into these classes when compared to the great northern class. Only those small red entries equivalent to Merlot and pink lines equivalent to Sedona in canning quality will be advanced in 2007.

Expt. 6111: Preliminary Great Northern Bean Yield Trial

This 20-entry trial included MSU great northern breeding lines and standard commercial check variety, Matterhorn and lines from the Cooperative Dry Bean Nursery (CDBN). The test ranged in yield from 7 to 27 cwt/acre with a mean yield of 21 cwt/acre. Variability was well controlled (CV<6.1%) resulting in LSD value (2.1 cwt/acre) for significance. Nine breeding lines significantly outperformed the test mean including the check variety Matterhorn. The top yielding line G06207 was erect and other new breeding lines that possessed a navy parent (N00760) were small-seeded. The best architectural line among these was G06211, but small seed size may be a problem. The UI-entries were not well adapted, all too viney, prostrate and the lowest yielding entry was very late. Given that Matterhorn ranked second in this test continues to underscore the difficulty of finding GN lines with improved yield potential over Matterhorn. Only those entries with improved dry seed quality and cracking resistance over Matterhorn will be advanced in 2007.

Expt. 6112: Preliminary Pinto Bean Yield Trial

This 64-entry trial included new pinto lines entering included yield testing and the check variety Buster and a large number of lines from USWA program. The test ranged in yield from 13 to 27 cwt/acre with a high mean yield of 21 cwt/acre. Variability was well controlled (CV=6.4%) resulting in a LSD value (2.2 cwt/acre) for significance. Nineteen lines including Buster significantly outperformed the test mean. The group included lines from USWA many of which had low DS values due to prostrate viney growth habit. Top entry P06131 derived from cross of two very erect MSU lines (P02646/P02630) had above average desirability based on plant height, lodging resistance and uniform maturity and larger seed. This cross produced a number of attractive, high-yielding, upright lines. A second family (P02627/P02647) was lower yielding but one line P06136 was in the top-yielding group. Two entries with blight resistance (USPT-CBB-series) ranked lower than 25th and the anthracnose resistant line (USPT-ANT) was very late and viney and yielded under 19 cwt/acre. Only those entries superior to Buster in canning quality will be advanced in 2007.

Expt. 6113: Preliminary Pink and Small Red Bean Yield Trial

This 36-entry trial included new small red and pink lines from MSU (R-prefix, S-prefix) along with check varieties and small red and pink breeding lines from the USDA program at Prosser, Washington (USWA). The test ranged in yield from 10 to 25 cwt/acre with a mean yield of 20 cwt/acre. Variability was well controlled (CV=5.1%) resulting in a low LSD value (1.7 cwt/acre) for significance. Eleven lines significantly outperformed the test mean and these included one line from USWA and the Brooks variety. Check varieties such as Merlot, and Sedona were lower yielding in 2006 for reasons stated in test 6110. Many of the new lines were more erect than either Merlot or Sedona and only those small red entries equivalent to Merlot and pink lines equivalent to Sedona in canning quality will be advanced in 2007.

Expt. 6114: Standard Tebo Bean Yield Trial

This 30-entry trial is the part of the program to develop a Tebo (Otebo) medium white bean with resistance to Bean Common Mosaic Virus (BCMV). Tebo is a specialty class that is exported to Japan for preparation of 'An' paste. Included in the test are both third backcross (BC3; G04-Prefix),

and fourth backcross (BC4; G05-Prefix) lines similar to Tebo with resistance to BCMV. Virus resistance came from Matterhorn parent and was backcrossed either 3 or 4-times to the Hime Tebo parent to recover Tebo plant and seed type. The test ranged in yield from 15 to 22 cwt/acre with a mean yield of 19 cwt/acre. Variability was fairly well controlled (CV=9.2%) resulting in a LSD value (2.5 cwt/acre) for significance. Only one line G04909 significantly outperformed the test mean, but it was not significantly higher than the Tebo check. Ten lines outyielded the Tebo parent and included G04914, which ranked 4th in test 5114, was also the top yielding line in test 4117 in 2004. Among the G05-lines, G05915 appeared the best with lower levels of CBB, early maturity and anthracnose resistance. Most lines were similar in seed size (24g) and maturity (82 days) to the Tebo parent. Otherwise the lines resembled the Tebo parent in plant type, height and lodging resistance. A select group of the highest-yielding lines will be evaluated for their suitability in making An paste and decisions on lines to advance will depend on those results.

Expt. 6115: Midwest Regional Performance Nursery (MRPN) Yield Trial

This 20-entry trial is conducted annually in cooperation with North Dakota (ND-prefix), Nebraska (NE-prefix) and Colorado (CO-prefix) in order to test new pinto and great northern lines from all four programs and assess their potential in the different regions. Yield ranged from 19 to 27 cwt/acre with a mean of 23 cwt/acre. Variability was low (CV=6.6%) resulting in a LSD value (2.5 cwt/acre) for significance. As a result only three lines were significantly higher in yield than the test mean. The top yielding entries P05459 and P05463 ranked 1st and 2nd in test 5113, along with a new line ND0203051 from North Dakota. In 2005, ND010307 ranked 2nd but dropped to 12th in this trial with the check varieties, Matterhorn, Buster and Montrose. This cooperative trial continues to be valuable as it allows an evaluation of potential new lines prior to release in other states.

Expt. 6116: Standard Vine Cranberry Bean Yield Trial

This 16-entry trial was grown in Saginaw to identify those lines with improved performance over the check, Michigan Improved Vine Cranberry (MICRAN). The test included new lines from MSU developed from backcrossing bush cranberry line C97407 with NSL, a high-yielding root rot resistance vine black bean from Mexico. Included in the test were new bush cranberry variety Capri and the check was a new vine cranberry variety Chianti, previously tested as Asgrow-0759. Yields ranged from 9 to 22 cwt/acre with a mean of 15 cwt/acre. Variability was moderate in this test (CV=7.8%) and LSD value of 1.7 cwt/acre was needed for significance. Five lines significantly outyielded the test mean and the same five lines outyielded the Chianti and Micran checks. The top entry Capri continues to be the best bush cranberry bean in this non-irrigated trial exceeding yield of other entries by over 3 cwt/acre. Capri (2nd in 2005) was the largest seeded entry and has exhibited canning quality equivalent to Micran in contrast to the traditional bush cranberry varieties that do not can satisfactorily. C03151 vine (type 3) that ranked 6th, previously ranked 1st in test 5116 and 3rd in 4112, 4224 and 3224 in 2005, 2004 and 2003, respectively. Seed size of the Chianti vine was small (37g) and its mediocre performance raises concerns over its future potential. One new line C05605 with an upright habit showed potential in 2006 along with bush line C03157. Only those entries with equivalent canning quality to Micran will be advanced in 2007.

Expt. 6217: Standard Bush Cranberry Bean Yield Trial

This 42-entry trial was conducted on the Montcalm Research Farm to compare new and standard bush cranberry bean varieties under supplemental irrigation. Yields were low due to wet fall conditions that negatively impacted harvest. Yields ranged from 10 to 20 cwt/acre with a mean of 13 cwt/acre. Variability was high (CV=16%) in this test and the LSD needed for significance was high (2.9 cwt/acre). Seven lines significantly outyielded the test mean and these included the new variety, Capri and Hooter. Capri showed less damage from potato leaf hoppers in the unsprayed plots. Unfavorable harvest conditions also contributed to the low yield for Taylor Hort (10 cwt/acre). The top-yielding entry C05625 was significantly higher yielding than the next entry (difference >3cwt/acre) but it exhibited undesirable plant architecture (lodge=4) due to vine growth habit. This line will be tested in the vine cranberry test in Saginaw in 2007. Seed size of many entries was small in 2006 and varied from 32 g to 47g in C05625. A number of the new lines may not have acceptable seed size. Only those entries equivalent to Capri in seed size and canning quality will be advanced in 2007.

Expt. 6218: Preliminary Bush Cranberry Bean Trial

This 25-entry trial was grown in Montcalm to identify bush cranberry lines with improved performance over the check, Taylor Horticulture - THort. Yields ranged from 13 to 26 cwt/acre with a mean of 18 cwt/acre. Variability was moderate in this test (CV=12.2%) and LSD value of 3.5 cwt/acre was needed for significance. Only three lines significantly outyielded the test mean and these included two CBB resistant lines that significantly outyielded the THort check. Both lines showed good tolerance to CBB which reduced yield of other entries in the trial. However, CBB-19 showed best overall yield (>25 cwt/acre), seed size and early maturity, but it did have white mold in all reps. One new MSU entry C06814 showed both yield potential and larger seed size. Additional quality attributes need to be tested. Only those entries with equivalent canning quality similar to Capri and seed quality free of internal black spot will be advanced in 2007.

Expt. 6219: Standard Kidney Bean Yield Trial

This 49-entry trial was conducted on the Montcalm Research Farm to compare the performance of standard and new light red kidney (LRK), dark red kidney (DRK) and white kidney (WK) bean varieties from MSU and CDBN under supplemental irrigation (1 time total 0.75"). Yields ranged from 4 to 18 cwt/acre with a mean of 12 cwt/acre. Variability was high (CV=13.1%) resulting in a large LSD value (2.2 cwt/acre) needed for significance. Eleven entries significantly outyielded the test mean and these included new LRK lines (coded K056--) and DRK lines CBB-15, K05004, and K03240 and two WK (coded K059--) and the check, Chinook 2000. Two lines were noted to possess nice seed K05607-LRK and N05004-DRK. Other checks were lower yielding and CELRK only yielded 6 cwt/acre. The new CBB resistant line (CBB-15) continued to show potential and was top-yielding DRK in 2006 when compared to DRK breeding line K03240 that had showed superior performance in out-state trials in previous years. Unlike previous years LRK class showed the best potential over WK which had performed well in previous years. LRK breeding line K03601, Chinook Select did not outperformed Chinook 2000 in 2006. Other check varieties yielded poorly: CELRK, Beluga and Redcoat Soldier bean yielded 16 cwt/acre. Since canning quality is vital in kidney beans, only those DRK lines equivalent in canning quality to Red Hawk, LRK lines equal or better than CELRK and WK lines equivalent to Beluga will be advanced in 2007.

Expt. 6220: Preliminary Kidney Bean Yield Trial

This 56-entry trial was conducted to compare the performance of new DRK, LRK and WK-kidney bean lines (K06-prefix), entries in CDBN and lines from USWA to Montcalm check and a single-plant-selection of Montcalm DRK under supplemental irrigation at the Montcalm Research Farm. Yields ranged from 1 to 25 cwt/acre with a mean of 12 cwt/acre. Variability was very high (CV>25%) resulting in a large LSD value (5.2 cwt/acre) needed for significance. Overall yields in this test were low compared to previous years and were the direct result of wet fall conditions and a very severe infection with CBB. Seven entries significantly outyielded the test mean and these included two new WK-lines USWK-CBB-17, CBB-16 and the DRK line CBB-15 which topped the trial and exhibited good levels of resistance to CBB. Four new LRK lines from MSU were in the top group and appear to be competitive when compared to CELRK (10 cwt/acre). Other entries of note were two LRK lines from ND that yielded competitively (17cwt/acre) and possessed large seed size. The check variety, Montcalm outperformed the Montcalm selection, and three introduced lines A195, PS99-300B and the vine LRK- line USLK-CBB-9 underperformed as they were not adapted due to late maturity. A major breeding effort is underway to incorporate the resistance in the CBB-lines into MSU kidney bean lines. Caution will be exercised in the advance of any of the lines in this test due to their susceptibility to CBB and the high variability in the test. All entries will be canned prior to advance in 2007.

Expt. 6721: Regional Dry Bean Yield Trial, Presque Isle County

This 16-entry trial was conducted annually in grower's fields near Hawks by David Glenn (MSUE) with the primary focus of identifying different bean seed types with adaptation and potential for that northern region. Growing conditions were generally favorable in this region in 2005 with good harvest conditions in the fall. Yields ranged from 7 to 16 cwt/acre with a mean yield of 12 cwt/acre. Variability was well controlled (CV=7.6%) resulting in a LSD value (1.3 cwt/acre) needed for significance. Seven lines significantly out-yielded the test mean and these included Matterhorn, Seahawk, Merlot, Condor and new pinto line P04205, black line N04554 and new tebo bean G04914. The second group of lines included Condor, Sedona pink and N02237 navy. The last group included the kidney beans as in past years. Montcalm, Chinook Select and Red Hawk were among the lowest yielding entries and the new DRK lines K03240 and CBB-15 showed the worst potential along the kidneys. These two lines have shown good potential in trials down state. Despite the long and successful production of dark red kidney beans in this region, other seed types such as reds, pinks, blacks, navy, pintos and GN are potential alternatives to the current kidney bean varieties grown in this region.

Expt. 6222: White Mold Variety Yield Trial

This 64-entry trial was conducted at Montcalm to evaluate a range of diverse dry bean varieties and breeding lines for reaction to white mold under natural field conditions. Genotypes included commercial navy and black bean cultivars, elite MSU lines, and new sources of white mold resistance entered as part of the National *Sclerotinia* Bean Trial including the AN (Aztec/ND) pinto population. Lines in the National trial were developed at MSU, OSU, CSU, Cornell, NDSU and USDA-WA. Entries were planted in two row plots with two rows of susceptible spreader variety Beryl between plots. Supplemental overhead irrigation was applied 6 times for a total of 3" to

maintain adequate levels of moisture for favorable disease development at the critical flowering period. Natural white mold infection occurred across the entire trial and was extremely severe in certain plots. White mold was rated on a per plot basis on a scale of 1 to 9 based on disease incidence and severity where 9 had 90+% incidence and high severity index. White mold ranged from 20 to 90%. The test ranged in yield from 6 to 41 cwt/acre with a mean yield of 18 cwt/acre. Variability was high due to white mold pressure (CV=15.3%), thus a high LSD value (4.5 cwt/acre) was needed for significance. Despite the high disease pressure, ten lines significantly outyielded the test mean and the results are most unusual. Two black lines B04316 and B05055 exceed 40 cwt/acre and were 13 cwt higher than the third entry P04204 pinto that topped the same trial in 2005. Both black lines exhibited CBB resistance and continued to grow when other entries had succumbed to disease. In the top group was the first kidney line CBB-15 that also exhibited high levels of resistance to CBB. Two pink lines including Sedona and two upright navy bean lines were in the top group. The mold-tolerant pinto AN-37 dropped to 15 cwt/acre in contrast to the pinto line P05405 (22 cwt). Black line B05001 from the genetic study (test 6223) yielded 20 cwt and 115M was similar to Condor. Among the best MSU varieties were Sedona and Merlot, whereas Jaguar, Seahawk and Condor produced disappointing yields (16-19 cwt/acre) and Capri only yielded 14 cwt compared to 17-18 cwt/acre in adjacent trials. Yields for Matterhorn (21 cwt/acre) in adjacent plots in contrast to Beryl GN that was used as a spreader and had the highest mold rating (90%) combined with the lowest yield (6 cwt/acre). The major surprise was Bunsi with 77% mold infection and yield of only 8 cwt in 2006. The four Cornell lines with lower white mold ratings ranged in yield from 7-17 cwt/acre, but past experience using low yielding resistant germplasm as parents has not proved useful in breeding for white mold resistance. Overall the trial confirmed results from previous years and this trial will continue to be a vital part of the breeding effort to improve tolerance to white mold in dry beans.

Expt. 6223: White Mold Genetic Yield Trial

This 64-entry trial was conducted at Montcalm to evaluate the genetic resistance to white mold in two inbred backcross line (IBL) populations developed from the cross of Tacana*/PI 313850 and Tacana*2/PI 318695. The two PI accessions have shown resistance to white mold in the greenhouse but do not flower under temperate long day conditions hence they cannot be field tested. PI 313850 is a landrace cultivar from Peru whereas PI 318695 is a wild accession from Mexico. Twenty lines from each population with tolerance to white mold based on the straw test and 10 susceptible lines were planted for field evaluation. Natural white mold infection occurred across the entire trial and was extremely severe in certain plots, and ranged from 30% to 83%. There did not appear to be an association between % white mold and yield. The test ranged in yield from 5 to 19 cwt/acre with a mean yield of 13 cwt/acre. Variability was high due to white mold pressure and the adaptation of the lines (CV=19.5%), so high LSD value (4.1 cwt/acre) was needed for significance. Seven lines significantly outyielded the test mean, and included four lines with the landrace parent and two from the wild bean parent and 115M, and only four lines were significantly higher yielding than the Tacana parent. One line 8690 had previously ranked 4th in test 5223 in 2005, 5th in test 4223 in 2004, 3rd in test 3223 in 2003 and was among the higher yielding lines in test 6222. The same line yielded 3 cwt higher in test 6222 which suggests that the mold pressure in test 6223 was higher due to severity in the spreader rows. There has been a lack of consistent performance among lines between test years. Overall the yields were lower (mean yield =13 cwt/acre) as compared to those in the same test 4223 in 2004 (mean yield =31 cwt/acre). These data will be used along with 2003, 2004

and 2005 data to conduct a genetic mapping experiment to find markers associated with white mold resistance in the landrace and wild bean PI accessions.

Expts. 6224: Leafhopper Screening Trial

This 64-entry trial was conducted to determine the reaction of diverse group of genotypes to natural infections by potato leaf hopper (PLH). No insecticide was applied to this nursery and the numbers of PLH nymphs were counted on three separate occasions prior to flowering. Genotypes were similar to those in the white mold trial where insecticides were used to control PLH. Plans were made to compare results from both trials as they were managed similarly other than the insecticide treatment. The trial was direct harvested. The yield ranged from 3 to 30 cwt/acre with a mean of 11 cwt/acre. Variability was very high (CV=21.3%), the LSD was 3.8 resulting in six lines that significantly exceeded test mean. The two top-yielding entries B05055 and B04316 were the same two black lines that topped test 6222. The same pattern was observed as in test 6222 where these two lines significantly exceeded the yield of the other 62 entries. Both lines yielded 13cwt more than the third entry. This dramatic difference in yield appeared to be due to ability of both lines to resist both heavy white mold and CBB infections which reduced yields of the other entries. Both lines continued to grow under the wet fall conditions when other entries had matured prematurely. The four other entries that fell in the top group included two other black lines, a navy and a pinto line. DRK line, CBB-15 performed best among the kidneys by a wide margin. Early counts of PLH nymphs were low even though the test was planted near an alfalfa field. The numbers did not increase as expected when the alfalfa was cut and numbers actually crashed in the third count, so that aspect of the nursery was abandoned. Plans to continue this research in 2007 are underway.

Early Generation Breeding Material grown in Michigan in 2006

F3 through F5 lines

Navy and Black - 75 lines
Pinto - 301 lines
GN - 87 lines
Pinks and Reds - 136 lines
Kidneys (DR, LR, White) - 148 lines
Cranberry (bush, vine) - 22 lines

F2 populations

Navy and Black -182 populations
Pinto - 78 populations
GN - 37 populations
Pinks and Reds - 84 populations
Kidneys (DR, LR, White) - 75 populations
Cranberry (bush, vine) - 41 population

F1 populations: 370 different crosses among six contrasting seed types.
Early Generation Breeding Material grown in Michigan in 2006.