

2005 DRY BEAN YIELD TRIALS

J.D. Kelly, B. Long, N. Blakely, K. Terpstra, and E. Wright
Crop and Soil Sciences

Twenty-five yield trials were conducted in 2005 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 64-entry standard navy bean test; a 90-entry standard black test, a 64-entry preliminary navy bean test; five preliminary black bean tests (range 64-100 entries); a 30-entry standard pinto bean test; a 64-entry preliminary pinto test; a 42-entry standard great northern test; a 56-entry preliminary great northern bean test; a 42-entry standard red and pink bean test; a 16-entry standard vine cranberry test; 36-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 56-entry standard red and white kidney trial, 56-entry preliminary kidney bean test; a 30-entry standard bush cranberry test; a 64-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; and two 30-entry genetic studies on drought tolerance in cranberry beans. A 16-entry regional trial was conducted cooperatively in Presque Isle County with new navy, black, pinto, great northern, small red, pink, and kidney bean varieties to give growers in this region an opportunity to see varieties in other market classes.

The 2005 field season proved to be quite challenging for bean production due to wet planting conditions in June followed by below normal precipitation (5.6" less) for the season. In June approximately 5" fell after planting which surprisingly did not reduce stands but put the trials in good shape for the sustained drought in August-September. Starting August 13, there were 46 days with only a trace of rain (0.06" on 8/19-20) and no measurable precipitation was recorded for 38 days from August 21st onwards. The season bore similarities to 2004 season but yields differed dramatically. Many trials averaged 30 cwt/acre and top yields in black beans reached 39 cwt/acre compared to a statewide average of 17 cwt/acre for the commercial crop. The extreme drought hastened maturity particularly in full-season varieties but unlike 2004 when yield were reduced, yields in 2005 were well above average. In 2004 when the earlier-maturing entries such as pintos and great northern outyielded the full season navy and black bean lines, the trend was reversed in 2005 with the highest yields in blacks followed by navies. All small-seeded nurseries were direct harvested in 2005 and all medium-seeded tests were rod pulled, but unlike 2004, when there was considerable seed loss due to small plant size and low pod location within the plant, the direct harvested plots generally outyielded the earlier season nurseries. At the Montcalm Research Farm rainfall on the farm was near average for June (4.03"), July (5.74"), August (2.21"), and September (4.86") and only 2" was applied in five sprinkler irrigations. Despite access to irrigation, and adequate rainfall, plot yields were below average due to heavy infection of common bacterial blight in the kidney and cranberry nurseries. In the white mold trial that was irrigated 12 times for total of 5.5" to promote disease development, top yields exceeded 34 cwt/acre, whereas the top yields in kidney and cranberry beans was substantially lower (20-27 cwt/acre). In addition to the kidney, cranberry and white mold trials at Montcalm, research was conducted to identify genetic resistance to white mold and search for drought tolerance in bush and vine cranberry beans.

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. 5101: Standard Navy Bean Yield Trial

This 64-entry trial included standard commercial navy bean varieties, breeding lines entered through the Cooperative Dry Bean Nursery (CDBN) and advanced lines from the MSU breeding program, which carry the N-prefix. Yields ranged from 25 to 32 cwt/acre with a mean of 29 cwt/acre. The trial was very uniform and matured early hence variability was low (CV=7.3%) and the LSD needed for significance was 3 cwt/acre. Only two entries significantly out-yielded the test mean and these included two breeding lines, N02251 and N02237 from the cross of Jaguar/Seahawk made to combine white mold tolerance of Seahawk with the upright architecture of Jaguar. The second entry in the test N02237 was the top yielding entry in test 3101 in 2003 and 2nd in 4101 in 2004. Vista ranked 3rd in the test and Seahawk and Mayflower were above the test mean. Another potential breeding line N04158 ranked 6th (31 cwt), matured early (92 days) and had very desirable upright architecture and uniform maturity (DS=7).

Expt. 5102: Standard Black Bean Yield Trial

This 90-entry trial included the standard commercial black bean varieties including advanced breeding lines. Yields ranged from 25 to 39 cwt/acre with a mean for the test of 33 cwt/acre. Variability was very well controlled in this test, (CV=6.5%) and the LSD was 3.1 cwt/acre. Five new breeding lines significantly out-yielded the test mean. These new lines were derived from different parental combinations and significantly out performed the check varieties. B01741 that topped tests 3102 and 2106 in 2003 and 2002, respectively, continues to show potential and ranked 8th in this test. Among the top yielding varieties were Eclipse (33.8), Jaguar (33.5) and Condor (33.2), whereas T-39 and Domino produced 31cwt/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.

Expt. 5103: Preliminary Navy Bean Yield Trial

This 64-entry trial included new navy bean breeding lines from the MSU breeding program, which carry the N05-prefix. Yields ranged from 20 to 37 cwt/acre with a mean of 30 cwt/acre. The 3-replicate trial was somewhat variable due to common bacterial blight (CBB) infection thus variability was moderate (CV=9.1%) and the LSD needed for significance was 4.4 cwt/acre. Four entries significantly out-yielded the test mean but did not include the varieties Vista and Seahawk. The overall yields were higher than the standard navy trial (5101) and Vista yielded 2 cwt more in this test. The top two lines had low DS scores due to problems with CBB and lodging but the third entry N05311 had a highly desirable combination of yield, seed size, maturity, height and lodging resistance (DS=6). Only those entries with equivalent canning quality to Seahawk will be advanced in 2006.

Expt. 5104: Preliminary Black Bean Yield Trial

This 72-entry trial included new black bean breeding lines (B05-prefix) from the MSU program with potential resistance to anthracnose and CBB. Yields ranged from 20 to 34 cwt/acre with a mean for the test of 28 cwt/acre. Variability was quite well controlled in this 3-rep test (CV=8.7%) despite being direct harvested and the LSD was 4 cwt/acre. Eight new lines significantly out-yielded the test

mean exceeding 32 cwt/acre, significantly better than the check varieties T-39 (28 cwt) and Condor (25 cwt). These lines could carry broad based resistance genes for anthracnose (*Co-4*² from SEL1308 and *Co-1*² from Kaboon) and two different QTL (partial resistance genes) for CBB resistance (BC420 from HR45 and SU91 in MSU breeding lines). Extensive screening will be conducted to verify both the anthracnose and CBB resistance in all entries. Only those entries with canning quality equivalent to Condor will be advanced in 2006.

Expts. 5105-5108: Preliminary Black Bean Yield Trials

These four 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 in excess of 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 second year of yield testing in 2005. Test 5105 derived from cross 26-11M/Jaguar had 64 entries and ranged in yield from 26 to 36 cwt/acre with a mean of 30 cwt/acre. Variability was very well controlled in this 3-rep test (CV=5.5%) despite being direct harvested and the LSD was 2.7 cwt/acre resulting in 6 lines that significantly outyielded the test mean. Test 5106 derived from cross 48-21M/Jaguar had 64 entries and ranged in yield from 21 to 37 cwt/acre with a mean of 30 cwt/acre. Variability was very well controlled in this 3-rep test (CV=6.1%) despite being direct harvested and the LSD was 2.9 cwt/acre resulting in 14 lines that significantly outyielded the test mean. Test 5107 derived from cross 115-11M/Jaguar had 100 entries and ranged in yield from 22 to 37 cwt/acre with a mean of 31 cwt/acre. Variability was very well controlled in this 3-rep test (CV=5.5%) despite being direct harvested and the LSD was 2.8 cwt/acre resulting in 21 lines that significantly outyielded the test mean. Test 5108 derived from cross 39-11M/Jaguar had 100 entries and ranged in yield from 21 to 35 cwt/acre with a mean of 30 cwt/acre. Variability was higher in this 3-rep test (CV=8.1%) resulting in a larger LSD value (3.9 cwt/acre) and eight lines 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 30-33 cwt/acre and a number of entries significantly out-yielded the local adapted parent. Line 115-11M was planted in all tests and ranged in yield from 29-34 cwt/acre, whereas the original parent Tacana produced slightly lower yields of 28-32 cwt/acre in all tests. All four trials will be repeated in 2006 to continue to investigate yield potential in black beans. The top yielding entry (B04366 in test 5107) equaled top yield (37 cwt/acre) in navy test 4103 but did not exceed top yield of 39 cwt/acre for B04554 in standard black bean test 5102.

Expt. 5109: Standard Great Northern Bean Yield Trial

This 42-entry trial included MSU great northern breeding lines and standard commercial check varieties and breeding lines entered as part of the Cooperative Dry Bean Nursery. The test ranged in yield from 22 to 30 cwt/acre with a mean yield of 26.5 cwt/acre. Variability was well controlled (CV= 8.1%) resulting in a low LSD value (3 cwt/acre) for significance. All the larger-seeded trials were also rod pulled, not direct harvested like the small-seeded navy and black beans. Only two breeding lines significantly outperformed the test mean and neither was significantly outyielded the check variety Matterhorn. The top entry from the University of Idaho (UI) was a traditional late

maturing prostrate vine that is not suitable for production in Michigan (DS=1.5). A similar late-maturing entry ranked from the UI ranked fifth. These vine types are high yielding but will present problems in wetter years with white mold, and harvest quality particularly since they are white seeded. The best MSU entry G97941 dates back to 1997 and none of the more recent G02 or G04 lines showed improved yield potential over Matterhorn. One promising line G02453 that ranked 2nd in test 4110 in 2004, 5th in test 3104 in 2003 fell to 7th in this trial, although the yield was equivalent to Matterhorn (27.7cwt/acre). Only those entries with improved dry seed quality and cracking resistance over Matterhorn will be advanced in 2006.

Expt. 5110: Standard Pinto Bean Yield Trial

This 30-entry trial included standard commercial pinto bean varieties, breeding lines entered through the Cooperative Dry Bean Nursery and advanced lines from the MSU breeding program that carry the P-prefix. The trial ranged in yield from 18 to 32 cwt/acre with a mean of 28 cwt/acre. Variability was well controlled (CV=7%) and the LSD needed for significance was 2.8 cwt/acre. Only three entries significantly out-yielded the test mean and these included Buster and new line ISB-1131 from Idaho Seed Bean Company. The line has a viney type habit and ranked low in desirability (2.0) similar to the traditional vine variety Othello (DS=2.0). Buster topped the trial but was not significantly better than Othello. Early season (85 days) lines such as Othello and ISB lines were favored in 2005 due to lack of precipitation in August and September. Long-season (100 days) lines were among the lowest yielding. Breeding line P00218 continues to show potential with 92 d maturity and large seed (47g). Breeding line P02633 that ranked 6th in test 4111 in 2004, showed equivalent yield potential with high desirability score (DS=6) in 2005. P04203 that did well in test 4111 (>29cwt) was a disappointing 19th in this test. Sibs P04205 and P04207 showed more potential in 2005. The two full-sib lines P02646, P02647 and P02630 that showed potential in 2003 as possessing high yield, early maturity and architecture similar to Matterhorn produced disappointing lower yields (27-29 cwt/acre) in this trial. Only those entries with equivalent canning quality, yield and maturity to Othello will be advanced in 2006.

Expt. 5111: Standard Pink and Small Red Bean Yield Trial

This 42-entry trial included small red and pink breeding lines from the USDA program at MSU (USDA-MI) and USDA-WA (PS-prefix), new pink lines from MSU (S-prefix), standard commercial check varieties. The test ranged in yield from 15 to 34 cwt/acre with a mean yield of 27 cwt/acre. Variability was well controlled (CV=8.3%) resulting in a LSD value (3.2 cwt/acre) for significance. Ten lines significantly outperformed the test mean and these included Merlot (1st), Desert Rose, the flor-de-mayo line K124467 from ADM, which topped the trial in 2004 and 2003 and the new pink bean variety, Sedona. Three new pink lines (S05-prefix) were in this group but none of small red lines (R-prefix) from the USDA-MI program fell in this group. Only those small red entries equivalent to Merlot and pink lines equivalent to Sedona in canning quality will be advanced in 2006.

Expt. 5112: Preliminary Great Northern Bean Yield Trial

This 56-entry trial included MSU great northern breeding lines and standard commercial check

variety, Matterhorn. The test ranged in yield from 15 to 35 cwt/acre with a mean yield of 27 cwt/acre. Variability was moderate ($CV < 10\%$) resulting in LSD value (4.2 cwt/acre) for significance. Only four breeding lines significantly outperformed the test mean including the check variety Matterhorn. The top yielding line G02453 is a sib of a pinto line derived from cross between an erect pinto and the white mold tolerant line G99750 (architectural avoidance). A number of GN lines with sister pinto lines from the same cross were evaluated in this test. 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 2006.

Expt. 5113: Preliminary Pinto Bean Yield Trial

This 64-entry trial included new pinto lines entering included yield testing and the check variety Buster. The test ranged in yield from 20 to 32 cwt/acre with a high mean yield of 27 cwt/acre. Variability was moderate ($CV = 7.8\%$) resulting in a LSD value (3.4 cwt/acre) for significance. Six lines including Buster significantly outperformed the test mean. The group included two lines (B05459, B05463) with above average desirability based on plant height, lodging resistance and uniform maturity. Only those entries superior to Buster in canning quality will be advanced in 2006.

Expt. 5114: Preliminary Tebo Bean Yield Trial

This 36-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 were 10 third backcross (BC3; G04-Prefix), previously tested in 2004 and 25 new 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 22 to 30 cwt/acre with a mean yield of 27 cwt/acre. Variability was very well controlled ($CV = 5.2\%$) resulting in a LSD value (2.2 cwt/acre) for significance. Only the Tebo check variety significantly outperformed the test mean. Twelve of the lines were not significantly lower yielding than Tebo parent and will be retested in 2006. Overall the G04 lines appeared to be higher yielding than the G05 lines and G04914, which ranked 4th in this test, was the top yielded line in test 4117 in 2004. Most lines were similar in seed size and maturity to the Tebo parent (32g) ranged from 30-33 g and some lines were a few days (94 days) earlier than the parent (96 days). Otherwise the lines resembled the Tebo parent in plant type, height and lodging resistance. Given that none of the lines outyielded the parent, only the best lines will be backcrossed to Tebo to recover the yield potential of the original parent.

Expt. 5115: 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 access their potential in the different regions. Yield ranged from 20 to 33 cwt/acre with a mean of 27 cwt/acre. Variability was acceptable ($CV = 10.3\%$) resulting in a higher LSD value (4.5 cwt/acre) for significance. As a result only two varieties Montrose and ND010307 were significantly higher in yield than the test mean. Despite its yield potential in 2005 and past years,

Montrose is not well suited to Michigan due to its excessively viney prostrate (Lodging=5) growth habit. The varieties, Weihing, Matterhorn and Buster yielded equivalent to or less than the test mean this year, suggesting that new lines are outperforming the check varieties. Among the top lines included pinto lines ND010307 from NDSU, P02630 from MSU and great northern lines NE2-04-02 from Nebraska and G02453 from MSU. This cooperative trial continues to be valuable as it allows an evaluation of potential new lines prior to release in other states.

Expt. 5116: 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 Chiante, previously tested as Asgrow-0759. Yields ranged from 19 to 30 cwt/acre with a mean of 24 cwt/acre. Variability was moderate in this test (CV>8%) and LSD value of 2.8 cwt/acre was needed for significance. Only three lines significantly outyielded the test mean and the same three lines and Chiante outyielded the Micran check. The top entry C03151 ranked 3rd in previous tests 4112, 4224 and 3224 in 2004 and 2003. The performance of the bush cranberry bean Capri was excellent, placed 2nd after C03151. Seed size of C03151 was satisfactory at 50g/100 seeds (=200 seeds/100g) as some of the lines had smaller seed size than Micran check. This material represents new germplasm in the vine cranberry seed class that exhibited good canning quality in 2004. The new variety Chiante showed favorable combination of large seed, early maturity and lodging resistance in a vine growth habit. Only those entries with equivalent canning quality to Micran will be advanced in 2006.

Expt. 5217: Standard Bush Cranberry Bean Yield Trial

This 30-entry trial was conducted on the Montcalm Research Farm to compare new and standard bush cranberry bean varieties under supplemental irrigation (5 times total 2"). Yields were low due to a residual corn herbicide (atrazine) effect that reduced stands and overall plant vigor. Some genotypes were more severely affected than others making any comparisons with previous year data difficult. Yields ranged from 5 to 20 cwt/acre with a mean of 14 cwt/acre. Variability was moderate (CV=10%) in this test and the LSD needed for significance was high (2 cwt/acre). Eight lines significantly outyielded the test mean and these included six lines derived from backcrossing program with black bean NSL from Mexico and the new variety, Capri. Cardinal and Hooter (16 cwt/acre) varieties yielded below the test mean and the low yield for Taylor Hort (9 cwt/acre) was due to the herbicide effect. The variety Talento Nano from Italy produced disappointing yield (11 cwt/acre) despite showing good adaptation, yields and curly top resistance in Idaho in 2003. Likewise the yellow bean CPC00153 did not show favorable adaptation. Seed size varied from 43 g in Taylor Hort to 51 g in Capri. 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 2006.

Expt. 5218: Preliminary Bush Cranberry Bean Trial

This 64-entry trial was grown in Montcalm to identify bush cranberry lines with improved performance over the check, Taylor Horticulture - THort. Yields ranged from 7 to 20 cwt/acre with a mean of 12 cwt/acre. Variability was moderate in this test (CV=10%) and LSD value of 2 cwt/acre

was needed for significance. Eleven lines significantly outyielded the test mean and the top nine lines significantly outyielded the THort check. A number of higher-yielding entries had seed size (46g) and maturity (94 days) equivalent to the check. Only those entries with equivalent canning quality and seed quality to Capri will be advanced in 2006.

Expt. 5219: Standard Kidney Bean Yield Trial

This 56-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 (5 times total 2"). Yields ranged from 9 to 28 cwt/acre with a mean of 17 cwt/acre. Variability was high (CV=13%) resulting in a large LSD value (3.2 cwt/acre) needed for significance. Overall yields in this test were higher compared to bush cranberry test 5217 and kidney PYT test 5220. Eleven entries significantly outyielded the test mean and these included one new DRK line K03240 (1st in test 4219 in 2004), eight white kidney lines and check varieties Montcalm and Mogul white kidney. DRK breeding line K03240 also showed superior performance in outstate trials (test 5721) in Presque Isle, Bay and Montcalm counties. As previously noted in 2004, despite the long history of breeding red kidneys, the yield potential now appears to exist in the white kidney class. Most promising WK lines are K04604 and K04612 and K01974 which showed potential in past years performed very poorly in 2005 due to delayed maturity. Use will be made of the WK lines as parents to improve performance of the red kidney classes. LRK breeding line K03601, Chinook Select significantly outperformed Chinook 2000 by 4 cwt/acre, and that seed will be used to replace Chinook 2000 over the next few years. Other check varieties yielded poorly: CELRK (10), Beluga and Chinook 2000 (15), Red Hawk (17) and Redcoat Soldier bean yielded 16 cwt/acre. One of the lowest yielding entries for the second year was USWA-70 released as Silver Cloud white kidney. 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 2006.

Expt. 5220: Preliminary Kidney Bean Yield Trial

This 56-entry trial was conducted to compare the performance of new kidney bean lines (K05-prefix) compared to Chinook Select light red kidney lines from MSU under supplemental irrigation. Yields ranged from 4 to 22 cwt/acre with a mean of 11 cwt/acre. Variability was moderate (CV=10.6%) resulting in a LSD value (1.8 cwt/acre) needed for significance. Overall yields in this test were very low compared to previous years and were the direct result of a very severe infection with CBB. Seventeen entries significantly outyielded the test mean and these included the new DRK line USDK-CBB-15 which topped the trial and exhibited resistance to CBB, K04605 and K04612 with large seed (66g). The check variety, Chinook Select only yielded 10 cwt/acre compared to 19 cwt in test 5219 due to the CBB pressure. A major breeding effort is underway to incorporate the resistance in USDK-CBB-15 into MSU kidney bean lines. Caution will be exercised in the advance of any of the lines in this test due to their low performance and susceptibility to CBB and all entries will be canned prior to advance in 2006.

Expt. 5721: 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 15 to 28 cwt/acre with a mean yield of 22 cwt/acre. Variability was not well controlled (CV=11.3%) resulting in a high LSD value (3.4 cwt/acre) needed for significance. Three lines significantly out-yielded the test mean and these included Merlot, Condor and new navy line N02237 which showed potential in test 5101. The second group of lines included the medium seeded pinto P04203, Matterhorn GN, Sedona pink and Seahawk navy. The last group included the kidney beans as in past years. Montcalm, Chinook 2000 and Red Hawk were among the lowest yielding entries and the new DRK line K03240 showed the best potential. This line has shown similar 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. 5222: 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 12 times for a total of 5.5" 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 88%. The test ranged in yield from 6 to 35 cwt/acre with a mean yield of 22 cwt/acre. Variability was high due to white mold pressure (CV=12.5%), thus a high LSD value (4.6 cwt/acre) was needed for significance. Despite the high disease pressure, seventeen lines significantly outyielded the test mean and these included seven advanced pinto lines, AN-37, B05001 from the genetic study (test 5223), three pink lines (S04-Prefix), and Vista. This is the first year out of five that 115M was not among the top entries. For the fourth year, the pinto line AN37 from NDSU exhibited low mold score and high yield. The major surprise was the number of pinto lines that performed well but had high white mold pressure based on % rating. Many were sister lines and all had as parent G99750, which showed similar disease avoidance in past years. Among the best MSU varieties were Merlot small red and Jaguar, as both Seahawk and Condor produced disappointing yields (16 cwt/acre). Similar yields were observed for Matterhorn in adjacent plots. Beryl GN was used as a spreader and had the highest mold rating (88%) combined with low yield (11 cwt/acre). The four Cornell lines selected for white mold resistance were the lowest yielding in the test, similar to G122 cranberry. 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. 5223: 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 whereas PI 318695 is a wild accession. 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 23% to 77%. There did not appear to be an association between % white mold and yield. The test ranged in yield from 7 to 23 cwt/acre with a mean yield of 16 cwt/acre. Variability was high due to white mold pressure and the adaptation of the lines (CV=15.4%), so high LSD value (4 cwt/acre) was needed for significance. Ten lines significantly outyielded the test mean, and included seven lines with the landrace parent and two from the wild bean parent and 115M, and three lines were significantly higher yielding than the Tacana parent. One line 8690 that ranked 4th had previously ranked 5th in test 4223 in 2004, 3rd in test 3223 in 2003 and was among the significant top yielders in test 5222. The same line yielded 7 cwt higher in test 5222 which suggests that the mold pressure in test 5223 was higher due to severity in the spreader rows. Overall the yields were lower (mean yield =16 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 and 2004 data to conduct a genetic mapping experiment to find markers associated with white mold resistance in the landrace and wild bean PI accessions.

Expts. 5224 & 5225: Cranberry Drought Trials

Two 30-entry trials were conducted to determine the effect of drought on performance of recombinant inbred lines from the cranberry population C97407*2/NSL grown under stress and non-stress in drought prone soils in Montcalm in 2005. The study involved 26 BC₂F_{4:7} IBLs developed by the inbred backcross method, plus checks and parents. The drought test (Expt. 5225) received no additional moisture other than natural rainfall, whereas the non-stress test (Expt. 5224) received 4 irrigations for an additional total of 2". The yield in the irrigated test 5224 ranged from 6 to 24 cwt/acre with a mean of 14 cwt/acre. Variability was very high (CV=21.9%), the LSD was 5.2 resulting in four lines that significantly exceeded test mean. The yield in the drought test 5225 ranged from 8 to 19 cwt/acre with a mean of 13.5 cwt/acre. Variability was very high (CV=27%), the LSD was 5.9 resulting in only one line that significantly exceeded test mean. There was no significant reduction in yield due to the drought treatment as rainfall was adequate in 2005. The geometric mean (GM) between treatments was calculated and yields ranged from 7 to 21 cwt/acre with a mean of 14 cwt/acre. The top yielding entry was line C03157 that exceeded yield of the drought tolerant black bean checks B04647 (L66-83) and B98311 in both experiments. The high LSD values prevented the identification of lines that were significantly higher yielding than the C97407 parent and making comparisons with data from previous years. A number of the cranberry lines showed considerable yield potential over both the parent and check variety and may be valuable germplasm for producers interested in growing cranberries with less irrigation to avoid problems with white mold.

Early Generation Breeding Material grown in Michigan in 2005

F3 through F5 lines

Navy and Black - 802 lines
Pinto - 229 lines
GN - 279 lines
Pinks and Reds - 440 lines
Kidneys (DR, LR, White)- 491 lines
Cranberry (bush, vine) - 499 lines

F2 populations

Navy and Black -5 populations
Pinto - 7 populations
GN - 6 populations
Pinks and Reds - 22 populations
Kidneys (DR, LR, White) - 28 populations
Yellow Eye - 1 population

F1 populations: 375 different crosses among six contrasting seed types.
Early Generation Breeding Material grown in Michigan in 2005