

2002 DRY BEAN YIELD TRIALS

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Twenty-one yield trials were conducted in 2002 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 & Sugarbeet Research Farm, 16 yield trials were planted on nine acres. These included four navy bean tests, a 81-entry standard test, two 56-entry and a 30-entry preliminary tests; a 30-entry standard black test, two 56-entry and a 42-entry preliminary tests; two pinto bean trials included a 36-entry advanced trial, and a 42-entry preliminary test; two great northern bean trials included a 30-entry advanced test and a 36-entry preliminary test; a 30-entry standard red and pink bean test; a 25-entry preliminary red and pink test, a 15-entry standard vine cranberry test, and a 25-entry Midwest Performance Trial with pintos and great northerns from Michigan, Nebraska, North Dakota, and Colorado. At the Montcalm Research Farm, four yield trials were planted on five acres. These included a 36-entry standard red and white kidney trial, a 36-entry standard bush cranberry test, a 64-entry variety trial to evaluate reaction to white mold was grown under sprinkler irrigation and a 100-entry genetic study to evaluate for resistance to white mold. Despite abundant rainfall (13", June-August), white mold plots were irrigated to promote disease development due to dry September. A 16-entry regional trial was conducted cooperatively in Presque Isle County with new navy, black, great northern and kidney bean varieties to give growers an opportunity to see other market classes.

The 2002 field season proved to be quite favorable for bean production despite an extended dry period after planting. Favorable normal rainfall during June to August ensured good growth and the extremely dry (0.41") conditions in September hastened harvest. Both yield and quality were excellent in 2002, although dry conditions resulted in seed coat check problems in the commercial crop particularly in the Matterhorn variety, due to its rapid drydown. The annual precipitation (29.29") was four inches below 30-year average due to a lack of precipitation in September. Higher temperatures during the season resulted in a cumulative GDD 16% higher than the 30-year average. Yield data from Saginaw reflect the overall favorable growing conditions. Yields exceeding 40 cwt/acre and average yields exceeded 30 cwt/acre, compared to a statewide average of 18 cwt/acre for the commercial crop. A number of preliminary navy and black bean trials were direct harvested due to overall erect stature and uniform drydown. Despite some apparent harvest losses in the field the overall yields in these trials did not reflect significant reduction in yield due to harvest, despite the unknown yield potential of lines in preliminary trials. Seed splitting was more obvious in black bean trials that were direct harvest and will provide a basis to eliminate lines with this undesirable tendency. In Montcalm, with access to irrigation, plot yields were exceptional. In the white mold trial that was liberally irrigated to promote disease development five black lines yielded over 50 cwt/acre, and bush cranberry exceeded 45 cwt/acre. Productivity of kidney beans was lower (35 cwt/acre). Many genotypes with upright architecture avoided white mold, but the highly susceptible varieties did not escape the disease. In addition to the standard kidney, cranberry and white mold trials at Montcalm, research was conducted on root rot and genetic resistance to white mold. Finally yields in Northern Michigan were the highest recorded averaging 24 cwt/acre with high of 30 cwt/acre.

The data for all tests are included in an attached section. Procedures and details on nursery establishment and harvest methods is 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 cms.
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. 2101: Standard Navy Bean Yield Trial

This 81-entry trial included standard commercial navy bean varieties, breeding lines entered through the Cooperative Dry Bean Nursery and advanced lines from the MSU breeding program, which carry the N-prefix. Yields ranged from 28 to 37 cwt/acre with a mean of 31 cwt/acre. The trial was very uniform hence variability was well controlled ($CV=5.6\%$) and the LSD needed for significance was only 2.6 cwt/acre. Despite the overall excellent performance only eight entries significantly out-yielded the test mean and these included the varieties, Schooner, and the newly released, Seahawk variety from MSU, previously known as N97774. In this trial Seahawk significantly outyielded Mackinac, Mayflower and Cruiser varieties. Among the eight top-yielding lines were three sister lines N00710, N00711, and N00712 derived from the cross of

the white mold tolerant line from NDSU (ND-88-106-04) and a MSU breeding line. The NDSU line showed genetic potential as a parent since it was present in all six breeding lines in this elite high-yielding group. With the exception of the commercial varieties the top twenty entries were new lines that first entered testing in 2000 with N00 prefix.

Expt. 2102: Preliminary Navy Bean Yield Trial

This 56-entry trial of new navy bean breeding lines from the MSU program ranged in yield from 26 to over 36 cwt/acre with a mean yield of 31 cwt/acre. Variability was well controlled in this 3-rep test (CV=7.2%) despite being direct harvested, and the LSD was 3.7 cwt/acre. The breeding lines originated from combination of 2-way, 3-way or 4-way crosses with commercial varieties where both yield and quality traits were targeted. Only four entries significantly out-yielded the test mean and the two commercial check varieties, Vista and Mayflower and Seahawk. These included N00760 and N00729 with a high desirability score of 7.5. Comparative data from this trial is encouraging as entries were direct harvested yet the yield potential of experimental lines and checks would suggest that future preliminary trials can be harvested direct without comprising the data which would provide considerable saving of time and resources over conventional harvest. Only those entries with improved canning quality over Vista will be advanced in 2003.

Expt. 2103: Preliminary Navy Bean Yield Trial

This 56-entry trial of new navy bean breeding lines not previously tested from the MSU program ranged in yield from 21 to over 34 cwt/acre with a mean yield of 30 cwt/acre, similar in performance to entries in test 2102. Variability was well controlled in this 3-rep test, (CV=6.4%), and the LSD was 3.1 cwt/acre. The lines originated from combination of 2-way, 3-way or 4-way crosses with commercial varieties where both yield and quality traits were targeted and although planted in 2001, breeding lines (N01---) were lost to drought. Six entries significantly out-yielded the test mean. N00760 appeared among the elite lines in this test also. Entries were direct harvested as in test 2102 and the results suggest that method can continue to be used. N00756 was 7th in this test, 2nd in tests 2102 and 2104 and 3rd in test 2101 suggesting there was no penalty to direct harvest. Interestingly two of parents of the 4-way cross used to produce N00756 were the same parents of the three top-yielding entries in test 2101. Only those entries with improved canning quality over Vista will be advanced in 2003.

Expt. 2104: Preliminary Navy Bean Yield Trial

This 30-entry trial of new navy bean breeding lines not previously tested from the MSU program ranged in yield from 26 to over 41 cwt/acre with a mean yield of 33 cwt/acre, similar in performance to entries in test 2102. Variability was well controlled in this 3-rep test, (CV=6.9%), and the LSD was 3.8 cwt/acre. The lines originated from combination of 2-way, 3-way or 4-way crosses with commercial varieties where both yield and quality traits were targeted. Overall mean yield was higher than in previous three navy tests. The 3.6 cwt difference between Vista and Seahawk was not significant in this trial. Only four entries significantly out-yielded the test mean. Breeding lines N00756, and N00729 appeared among the elite lines in this test also whereas N00760 ranked 5th. None of the new breeding lines with the prefix N02 outperformed the check or the lines mentioned above. Progeny of Seahawk were evaluated in this trial. Only those entries with improved canning quality over Vista will be advanced in 2003.

Expt. 2105: Standard Black Bean Yield Trial

This 30-entry trial included the standard commercial black bean varieties including advanced breeding lines. Yields ranged from 25 to 36 cwt/acre with a mean for the test of 31 cwt/acre. Variability was well controlled in this test, (CV=6.7%) and the LSD was 2.9 cwt/acre. Four lines included the variety Jaguar were significantly higher yielding than the test mean. For the second year, 115 M (I01892) derived from a cross with a wild bean topped the trial. This cross appears to offer considerable yield potential as other sibs were among in the top entries in other trials. Among the top group was B00136, followed by the sister lines B00102 and B00103. The commercial varieties Onyx, Phantom, T-39, and Midnight were not significantly different, whereas Blackhawk and Black Jack were significantly lower yielding. B98306 derived from Crestwood navy bean, continues to show promise but was mid pack along with B00101 in this test. A new line from Ag-Canada L95F025 was also mid pack. The shiny black bean Shiny Crow was significantly below the test mean along with a line from USDA program in Prosser WA.

Expt. 2106: Preliminary Black Bean Yield Trial

This 56-entry trial included new black bean breeding lines (prefix B01---) from the MSU program with new anthracnose resistance genes. Yields ranged from 22 to 36 cwt/acre with a mean for the test of 30 cwt/acre. Variability was well controlled in this 3-rep test (CV=8.9%) despite being direct harvested and the LSD was 4.4 cwt/acre. Six lines including 115M significantly out-yielded the test mean including the check variety, T-39. Three lines with equivalent top yield (36.1) all had excellent desirability scores of 5.5 or better particularly entry B01741 derived from cross of Tacana black bean from Mexico and Jaguar. The two sibs B00101 and B00102 were lower yielding but not significantly lower than the top yielding lines. The low yield of T-39 (27.7) may be a result of direct harvesting due to its prostrate growth habit. Another observation in the preliminary black bean trials that were harvested directly was the high level of seed coat splitting that occurred in certain lines. None of the checks or advanced lines exhibited this problem, but this information will be valuable in eliminating lines with a tendency toward splitting. Only those entries with improved canning quality over T-39 will be advanced in 2003.

Expt. 2107: Preliminary Black Bean Yield Trial

This 81-entry trial included new breeding lines from the MSU program with a range of parental material from South and Central America. Yields ranged from 16 to 38 cwt/acre with a mean for the test of 28 cwt/acre. Variability was moderately well controlled in this test, (CV=10.1%) and the LSD was 4.9 cwt/acre. Nine lines significantly out-yielded the test mean and only one line significantly outyielded the check variety, T-39. The top yielding entry B02559 derived from black lines with drought tolerance was clearly high yielded but showed a delayed maturity (104 days). The second entry from NDSU showed yield potential but split very badly after direct harvest. The advanced lines from MSU such as B00101 displayed no seed coat splitting problems. The third entry was the high yielding line 115M. Other high-yielding entries were derived from the drought line B98311 and lines from CIAT with the TLP code. One line B02590 selected for tolerance to white mold, ranked 6th in this test. There was considerable spread in yield in this test as some of the lines proved inferior due to poor recombination between parental lines. Only those entries with improved canning quality over T-39 will be advanced in 2003.

Expt. 2108: Preliminary Black Bean Yield Trial

This 42-entry trial included new black bean breeding lines (prefix B01) from the MSU program that have their origin in Mexico. Yields ranged from 24 to 42 cwt/acre with a mean for the test of 32 cwt/acre. Variability was well controlled in this 3-rep test (CV=7.7%) despite being direct harvested and the LSD was 4.1 cwt/acre. Only three lines significantly out-yielded the test mean including the check variety, T-39. These three lines originated from the same cross of two lines from Mexico and represent new sources of germplasm for future breeding efforts. The three lines have a larger seed size (>27g/100seeds), which could limit their use directly as new varieties. The next two highest yielding entries included the variety Jaguar and the line L88-63. This line was the top yielding line under drought conditions in Honduras and Mexico and represents a new source of germplasm for future breeding efforts. Other lines of note in this trial were B00102 and B00101 and 115M, which exceeded the mean but not significantly. The lowest yielding entry I00758 from CIAT split very severely which resulted in lower yield, whereas other CIAT lines I00759 and I01810 had the highest desirability score due to superior architecture and drydown. Only those entries with improved canning quality over T-39 will be advanced in 2003.

Expt. 2109: Standard Pinto Bean Yield Trial

This 36-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 23 to 32 cwt/acre with a mean of 27 cwt/acre. Variability was moderately well controlled (CV>10%) and the LSD needed for significance was 4 cwt/acre. Yields were lower than in the black and navy tests since many of the entries matured earlier and were effected by the drier conditions in July. Only three entries significantly out-yielded the test mean and these included the variety Kodiak. The top-yielding entry P00227 significantly out-yielded Othello and has shown promise with superior agronomic traits and favorable seed traits. One parental BelDakMi-RMR-11 has proven to be valuable as a good combiner that brings along earliness and rust resistance. Only those entries with equivalent canning quality to Othello will be advanced in 2003.

Expt. 2110: Preliminary Pinto Bean Yield Trial

This trial included 42-entries of new pinto bean breeding lines derived from pinto/GN crosses from the MSU program. The test ranged in yield from 20 to 32 cwt/acre with a mean yield of 28 cwt/acre. Variability was moderately well controlled (CV>10%) resulting in a LSD value (4.9 cwt/acre) for significance. Due to the large variability no lines significantly outperformed the test mean or the check variety Kodiak, suggesting that there is little yield potential in these new lines. Only those entries with improved canning quality to Othello will be advanced in 2003

Expt. 2111: Standard Great Northern Bean Yield Trial

This 30-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 24 to 34 cwt/acre with a mean yield of 29 cwt/acre. Variability was moderately well controlled (CV>10%) resulting in a modest LSD value (4.2 cwt/acre) for significance. Only one breeding line G99728 significantly outperformed the test mean but not the check variety Matterhorn. G99728 also has a favorable larger seed. Many of the lines, however, are derived from Matterhorn and do not appear to offer significantly improved potential for yield over the Matterhorn parent. G99750, which has been a consistent performer under white mold, had the largest seed size (50g/100seeds) in this test and yielded equivalent to Matterhorn, which

produced only 31 cwt/acre due in part to its early maturity. Only those entries with improved canning quality over Matterhorn will be advanced in 2003

Expt. 2112: Preliminary Great Northern Bean Yield Trial

This test included 36 new great northern breeding lines with the G-prefix. Yield ranged from 15 to 31 cwt/acre with a mean of 26 cwt/acre. Variability was moderately well controlled (CV<10%) resulting in a LSD value (4.2 cwt/acre) for significance. Only one breeding line G99728 significantly outperformed the test mean but not the check variety Matterhorn. Many of the lines, however, are derived from Matterhorn and do not appear to offer significantly improved potential for yield over the Matterhorn parent. Only those entries with improved canning quality over Matterhorn will be advanced in 2003.

Expt. 2113: Midwest Regional Performance Nursery (MRPN) Yield Trial

This 25-entry trial is conducted annually in cooperation with North Dakota (ND prefix), Nebraska (GN prefix) and Colorado (CO) 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 25 to 33 cwt/acre with a mean of 29 cwt/acre. Variability was well controlled (CV=5.8%) resulting in a LSD value (2.7 cwt/acre) for significance. Four lines including Montrose were significantly higher in yield than the test mean, followed by the varieties Buster, and Matterhorn. The top four lines included two GN lines from Nebraska and the MSU pinto line P00227 that topped the standard pinto test 2109. P99120, which has exhibited tolerance to white mold, produced a disappointing low yield. This cooperative trial continues to be valuable as it allows an evaluation of potential new lines prior to release in other states.

Expt. 2114: Standard Pink and Small Red Bean Yield Trial

This 30-entry trial included small red and pink breeding lines from the USDA program at MSU (USDA-MI), new pink lines from MSU, standard commercial check varieties and breeding lines entered as part of the Cooperative Dry Bean Nursery and small reds known as Honduran small reds (HSR-VIDAC) from Central America. The test ranged in yield from 16 to 32 cwt/acre with a mean yield of 26 cwt/acre. Variability was moderate (CV=12%) resulting in a high LSD value (4.4 cwt/acre) for significance. Only three lines significantly outperformed the test mean including the new small red variety, Merlot. The new pink line S00809 continued to show potential and ranked 5th ahead of the small red variety Brooks. The VIDAC lines from Central America along with the HSR variety Rojo Chiquito and Tio Canela were all lower yielding and grouped near the bottom of the trial suggesting they lack yield potential for production in temperate regions. Seed size in the HSR group ranged from 22 to 28 g/100seeds illustrating the difference in seed characteristics from the small red market class grown in the U.S.

Expt. 2115: Preliminary Pink and Small Red Bean Yield Trial

This 25-entry trial included new pink breeding lines from the MSU program. The test ranged in yield from 20 to 33 cwt/acre with a mean yield of 23 cwt/acre. Variability was moderate (CV=13.7%) resulting in a high LSD value (5.2 cwt/acre) for significance. Only one line S02754 significantly outperformed the test mean due to the high variability in this test. Few of the lines showed yield potential and only those entries with satisfactory canning quality will be advanced in 2003.

Expt. 2116: Standard Vine Cranberry Bean Yield Trial

This 15-entry trial was grown in Saginaw to identify those lines with improved performance over the check, Michigan Improved Vine Cranberry (MIC). Test included lines from MSU, including some bush cranberry lines, lines from USDA-WA and NDSU (coded ND). Yields ranged from 13 to 24 cwt/acre with a mean of 18 cwt/acre. Variability was high in this test ($CV > 17\%$) and LSD value of 4.4 cwt/acre was needed for significance. As in past years, only one line I01815 significantly outyielded the test mean, but the line had an undesirable decumbent growth habit. Seed size of I01815 from the USDA program in Washington may be too small (48g/100seeds) for the trade. The lines from NDSU yielded equivalent to MIC and all had the advantage of larger seed size ($> 60g$). The biggest surprise in this test was the performance of the bush cranberry line C99833. C99833 ranked 3rd in yield in test 2219 in Montcalm and if the line continues to perform in diverse soil types and cans equivalent to MIC, it may meet the international market needs of vine cranberry trade. Interest in this seed type is high since large seed size combined with excellent canning quality would serve a dual purpose for both the canning and dry pack markets. Other bush lines C99804 and C00301 performed better than the more recent vine cranberry entries with the C01-prefix that did not meet the yield expectations for this class.

Expt. 2217: Standard Kidney Bean Yield Trial

This 36-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 under supplemental irrigation. Yields ranged from 16 to 35 cwt/acre with a mean of 28 cwt/acre. Variability was very high at this location due to soil and disease factors ($CV > 20\%$) resulting in a large LSD value (8.1 cwt/acre) needed for significance. Overall yield in this test were lower than other tests at Montcalm suggesting the lower yield potential of the kidney bean class in general. No lines significantly out-yielded the test mean due to the high variability in the test. The highest-yielding checks in this test were Chinook 2000 followed by Red Hawk and Beluga. Interestingly the highest yielding materials were the white kidney lines, which occupied the top seven positions with the exception of the check Chinook 2000 and the viney red kidney I01751 from USDA-WA. Despite the long history of breeding of red kidney the clear yield potential exists in the white kidney class. Use will be made of the WK lines as parents to improve performance of the red kidney classes. The new DRK variety, Nichols is not adapted to our region with a maturity of 109 days and a corresponding low yield of 18 cwt/acre.

Expt. 2219: Standard Bush Cranberry Bean Yield Trial

This 36-entry trial was conducted to compare new and standard bush cranberry bean varieties. Yields ranged from 11 to 46 cwt/acre with a mean of 30 cwt/acre. Variability was very high ($CV > 22\%$) in this test and the LSD needed for significance was high (9.5 cwt/acre). Only three lines significantly outyielded the test mean. The two top yielding entries were siblings but C00302 has a small seed size (55g/100seeds) whereas C00305 had an acceptable larger seed size (61g/100seeds). The third highest-yielding line was C99833 that has shown consistent performance over years and was one of the top yielding entries in test 2116 grown without irrigation in Saginaw. Seed size of C99833 of 64g is also highly acceptable compared to 57g seed size of the check Taylor Hort. Two lines C99804 that showed tolerance to common blight and C00301 continue to show yield potential combined with favorable large seed size ($> 65g$). Both lines exceeded the check variety Hooter by over 10 cwt/acre. The lowest yielding entries in this trial were two yellow bean varieties from California that demonstrated lack of adaptation due to their late maturity.

Expt. 2721: Regional Dry Bean Yield Trial, Presque Isle County

This 16-entry trial was conducted annually in growers' fields near Hawks by David Glenn (MCES) with the primary focus of identifying different bean seed types with adaptation and potential for that region. Growing conditions were very favorable in this region in 2002, and as a result yields were highest recorded for this region, ranging from 13 to 30 cwt/acre with a mean yield of 24 cwt/acre. Variability was moderately well controlled (CV=13%) resulting in a high LSD value (4.4 cwt/acre) needed for significance. Four black lines significantly out-yielded the test mean, including the new navy variety Seahawk that topped this trial in 2001. The new black bean breeding lines B00102, B98304, B00103, B00136 and B00101 all showed real potential in this region over the two checks T-39 and Jaguar. Red Hawk was the highest yielding kidney bean in the trial but kidney bean lines were among the lowest yielding entries. Despite the long and successful production of dark red kidney beans in this region, other seed types are potential alternatives to the current kidney bean varieties.

Expt. 2222: 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 field conditions. The test ranged in yield from 21 to 54 cwt/acre (a record yield) with a mean yield of 38 cwt/acre. Variability was well controlled despite white mold pressure (CV>13%), yet a high LSD value (8.2 cwt/acre) was needed for significance due to high yield potential of the trial. Genotypes included commercial navy and black bean cultivars, parents and lines from a recombinant inbred line population where marker assisted selection was being practiced, elite MSU lines, and new sources of white mold resistance entered as part of the National Sclerotinia Bean Trial. Those lines were developed at the Universities of Guelph, Nebraska, MSU, OSU, CSU, Cornell, NDSU and USDA-WA. Entries were planted in two row plots with two rows of Midland (susceptible spreader) between plots. Supplemental overhead irrigation was used 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. A sample of 30 plants from the two center rows in each plot and replication was rated for disease incidence (% infected among 30 plants sampled) and percent disease severity at harvest maturity using the same 30-plant sample. Disease incidence ranged from 4 to 86% (CV=36%) whereas disease severity ranged from 1.5 to 46% (CV=43%). Similar to last year, plant architecture played a significant role in white mold avoidance in 2002. Despite the high disease pressure, eight lines significantly out-yielded the test mean, including five sister lines and the top entry 115M that topped the same trial in 2001. This is the second year that 115M has significantly outperformed all other entries suggesting that this material has genes that could be exploited for yield potential. Among this group was the great northern G99750 which for the last three years has outperformed other GN checks with a DSI=10% (Matterhorn =15%). A new pinto line AN37 from NDSU showed the lowest DSI score and shows potential to introduce improved levels of tolerance to white mold into this market class. B00101 black line continues to show potential over the check T-39 (45 versus 37 cwt/acre) under white mold pressure for the second year. 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. 2223: White Mold Genetic Yield Trial

This 100-entry trial was conducted at Montcalm for a second season to evaluate the genetic resistance to white mold in 98 recombinant inbred lines (RILs) developed from the cross of Bunsii/Raven. The test consisted of 4-reps and included the 98 RILs and the two parents. The test ranged in yield from 28 to 50

cwt/acre with a mean yield of 40 cwt/acre. Variability was moderately well controlled despite white mold pressure ($CV > 11\%$), yet a high LSD value (6.6 cwt/acre) was needed for significance due to high yield potential of the trial. Only data from the parents and the 10 best and 10 worst entries are shown in the table for Expt. 2223. Only five lines significantly outyielded the test mean, but yields were very high in this trial despite the white mold. These yields compared favorably with those in the white mold trial, tests 2222 and 1223 in 2001. Disease ratings ranged from 10-29% in the top yielding entries and as expected were significantly higher in the low yielding entries ($DSI = 12-51\%$). Bunsu had a low DSI of 15% compared to the susceptible parent, Raven with a $DSI = 44\%$. These data will be used to conduct a genetic mapping experiment to find markers associated with white mold resistance in navy and black beans.

Genetic Studies conducted in Michigan in 2002

One genetic study to determine the inheritance of resistance to *Fusarium* root rot in large seeded dark red kidney and cranberry populations was conducted at Montcalm in 2002. The study involved two RIL populations developed by the inbred backcross method. Two inbred backcross populations consisting of 90 and 78 $BC_2F_{4.5}$ individuals each were developed between Red Hawk*2/Negro San Luis (NSL) and C97407*2/NSL and grown in the field for agronomic evaluation, seed increase and generation advance. NSL was originally selected for root rot tolerance in Mexico and was initially crossed into Red Hawk DRK and cranberry breeding line to transfer resistance to these highly susceptible market classes. The RILs harvested from the field will be evaluated for resistance to *Fusarium* in a greenhouse screen. Based on greenhouse and field data, studies to detect markers linked to resistance will be initiated. The inbred BC method was used to develop populations where the plant and seed type was close to commercial kidney and cranberry standards expected by the industry. Prior work on root rot resistance using single crosses had not resulted in the identification of resistance in large seeded types with satisfactory commercial seed or plant types. Variability between the lines in the populations for root rot resistance was observed, although most lines still lack the desired seed size and other agronomic traits. Both populations were re-selected during harvesting due to severe infection with common bacterial blight, leaf deformity, lodging, and late maturity. After re-selecting for these traits, 88 and 33 individuals were chosen for the kidney and cranberry populations, respectively. As part of the genetic study the relationship of root architecture or root traits with root rot resistance is being studied using several different cultivars. To date we have identified a few traits that may have some possible correlation with root rot. These traits will be re-evaluated during the summer 2003.

A second study was conducted to evaluate lines for local adaptation that were derived from crosses of local bean cultivars with Plant Introduction (PI) lines that had previously been reported to carry resistance to white mold in greenhouse tests. The PIs were a wild source (PI 318,695), landrace (PI 325,685) and an Andean cultivated source (PI 313,850). Seed size of the wild and landrace was under 4g/100seeds and the Andean PI weighed 64g/100seeds. The inbred BC method was used to introgress exotic sources in three cultivated varieties, Bunsu, Tacana and Huron. A total of 638 individuals in seven BC_2F_4 populations were planted, but only three populations were harvested based on appearance, pod load, maturity, adaptation, maturity, plant height, structure and seed size traits. The crosses with Bunsu produced poorly adapted late maturing individuals that were discarded. Two populations of Huron and Tacana with PI 318,695 and the third population between Tacana and PI 313,850 were selected for further study and selection for white mold resistance in greenhouse testing. The populations with Tacana had 90 individuals each, whereas the cross with Huron has only 35 individuals.

A third study was a marker-assisted selection (MAS) study for resistance to common bacterial blight (CBB). During the summer of 2002, 454 F5 lines comprised of black and navy beans were planted for selection and advance. These lines represented five different populations into which resistance to CBB has been introgressed. The presence of the molecular marker SU91 within these populations had previously been ascertained. Based on agronomic traits, 38 of the 484 lines were selected for harvest. Only 16 lines showed presence of the marker, we will use the selected lines to evaluate the efficiency of MAS in breeding for CBB resistance. In addition to these populations, 40 lines with a combination of different resistance sources to CBB and anthracnose were developed using as parents some of these lines originated from the five populations grown this summer.

Early Generation Breeding Materials grown in Michigan in 2002.

F₃ through F₅ lines.

Navy and Black - 601 lines
609 lines white mold, 454 lines bacterial blight
Pinto - 124 lines
GN - 76 lines
Pinks and Reds – 43 lines
Kidney (DR, LR, White) - 150 lines
Cranberry (bush, vine) - 153 lines

F₂ populations

Navy and Black - 264 populations
Pinto - 20 populations
GN - 11 populations
Pinks and Reds – 3 populations
Kidney (DR, LR, White) - 31 populations
Cranberry (bush, vine) - 76 populations

F₁ populations: 191 different crosses among six contrasting seed types.