

2013 DRY BEAN YIELD TRIALS

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The dry bean breeding program initiated its fifth season on the new 320 acre Saginaw Valley Research & Extension Center (SVREC) research farm near Frankenmuth in 2013. A total of 3,960 yield trial plots (24 tests) and approximately 2300 single plant selections were made in the early generation nurseries. Yield trials at SVREC included 42-entry standard navy test; 56-entry standard black test; 56-entry prelim navy test; 36-entry prelim black test; 24-entry standard GN; 25-entry standard pinto test; 36-entry standard red/pink test; 84-entry prelim GN test; 36-entry prelim red/pink test; 40, 80 and 56 entry prelim red tests; and 49-entry Co-op and regional test that includes pinto, GN, red and pinks. At Montcalm Research Farm (MRF) yield trials included 56-entry kidney test; 16-entry preliminary kidney test; 25-entry standard bush cranberry test; 20-entry prelim bush cranberry; 16-entry mayacoba test; 3-entry Fabada large white kidney test; 64-entry white mold test; two 96-entry drought trials, grown with and without irrigation. On campus a 130-entry nitrogen fixation (BNF) test was grown; and two 36-entry certified organic trials in Tuscola county. All trials were direct harvested except for the drought, and BNF trials that were rod pulled in order to measure plant biomass. This is the first season that we direct harvested large seeded and white mold trials at Montcalm.

The season in Frankenmuth proved to be dry once again. Annual rainfall was 1.8” below the 30 year average but rainfall totals for the months June-September was only 6.2” or 6” below the 30-year average. The major savior was the temperature as the demand for moisture was moderate. Growing degree days were near normal at just over 2400. Temperatures only exceeded 90F on five days in mid July otherwise the moderate temperatures reduced the need for more rainfall. Over the last decade, annual rainfall has fallen below the 30-year average of 29.1” in nine of the last ten years. The drought resulted in overall lower yields but allowed for selection of those bean lines that yield under these drought stressed conditions. As a result of the drought many of the pinto, great northern and small red lines lost their upright plant structure as a result of the regrowth making them difficult to harvest and reducing yields. The pink lines matured normally under these conditions and out-yielded the small red lines. Navy and black bean lines maintained their upright architecture but the drought dwarfed the black lines more dramatically than the navy lines. Overall maturities of most materials were delayed in the 5-7 day range. All trials were direct harvested at SVREC.

The plots at Montcalm received a total of 9.9” of rainfall and an additional 4” was provided through irrigation over the same 4-month growing season, 4.5” fell in August alone. The irrigated plots had excellent yields over 35 cwt/acre were recorded in the kidney and white mold trials. White mold infection developed well in 2013 and exceeded the low levels observed in 2011. In the drought study the non stress irrigated trial in contrast to the drought trial (that received only rainfall) developed very high levels of white mold infection due in large part to decumbent growth habit of many of the entries. As a result the non irrigated trial outperformed the irrigated trial, suggesting that beans have moderate levels of drought tolerance and do not require excessive levels of precipitation to produce optimum yields. Data on white mold allowed for a genetic analysis to locate regions in the genome that may condition resistance to the disease.

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 are the number of days from planting to when 50% of plants in a plot have one or more open flowers.
4. Days to maturity are 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 7) 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 value refers to the Least Significant Difference between entries in a test. 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, 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. 3101: Standard Navy Bean Yield Trial

This 42-entry trial included standard commercial navy bean varieties, and advanced lines from the MSU breeding program, which carry the N-prefix. Yields ranged from 14.7 to 28.0 cwt/acre with a mean of 23.3 cwt/acre. The trial was fairly uniform and variability was well controlled (CV=10.9%) and the LSD needed for significance was 3.0 cwt/acre. Only three entries significantly out-yielded the test mean and included two new half-sib lines and Vista variety. The surprise was the overall lower performance of N11283 that showed high potential in 2011 and 2012. The line continues to dry down well and was rated high on DS score. Varieties Rexeter, Medalist, Hyland and Indi were all mid pack in terms of performance. Overall performance of this test was disappointing compared to the preliminary test 3103 and only Merlin showed consistent performance at 25 cwt/acre in both tests. Canning tests will be conducted on all new MSU breeding lines before being considered for release.

Expt. 3102: Standard Black Bean Yield Trial

This 56-entry trial included the standard commercial black bean varieties and advanced breeding lines. Yields ranged from 7.5 to 27.4 cwt/acre with a test mean of 22.2 cwt/acre. Variability was moderate in this test, (CV=11.2%) and the LSD was 2.9 cwt/acre. Seven entries significantly outyielded the test mean and these included a new shiny seeded line ND081157 from NDSU. Zorro fell outside this group and below Loreto, Shania, Jaguar, and Black Velvet in performance. Eclipse performed below the test mean. The top yielding entry B10244 was the top yielder in 2011 and 2012 and exhibits an excellent combination of high yield potential, erectness, dry down and superior canning quality. A few lines from Colorado with CO-code did not perform well under local stress conditions.

Expt. 3103: Preliminary Navy Bean Yield Trial

This 56-entry trial included new navy bean lines and check varieties. Yields ranged from 16.3 to 29.3 cwt/acre with a mean of 22.3 cwt/acre. Variability was moderate in this 3-rep test (CV=10.4%) and the LSD was 3.1 cwt/acre and overall yields were better than advanced navy trial 2101. Five lines significantly outyielded the test mean and included N11283. Merlin was the highest yielding variety ahead of Medalist in the trial. The top yielding entry N11283 was almost 3 cwt better than the second entry, underscoring its yield potential (these results were similar to test 2104 in 2012). It was 6 cwt better than its parent, Medalist. Future advances of many of the new breeding lines will largely depend on disease reactions and canning quality of the entries.

Expt. 3104: Preliminary Black Bean Yield Trial

This 36-entry trial included new black bean lines and check varieties. Yields ranged from 8.0 to 23.9 cwt/acre with a mean of 17.0 cwt/acre. Variability was moderate in this 3-rep test (CV=11.1%) and the LSD was 2.6 cwt/acre. Twelve lines significantly outyielded the test mean and the top yielding entry B10244 was the same line as in test 3102. No varieties fell in this group. Two lines from Puerto Rico (PR-prefix) with high levels of disease resistance underperformed despite their Zorro parentage. The two checks, Shania and Zorro were similar in the mid group. Many of these lines carry anthracnose resistance but future advances of any new breeding lines will largely depend on confirmation of disease reactions and canning quality of the entries.

Expt. 3105: Standard Great Northern Bean Yield Trial

This 24-entry trial included MSU great northern breeding lines (G-prefix) and standard commercial check varieties and a small group of new otebo bean lines. The test ranged in yield from 10.8 to 25.0 cwt/acre with a mean yield of 16.9 cwt/acre. Variability was moderate (CV= 11.0%) resulting in a high LSD value (2.2 cwt/acre) needed for significance. Five breeding lines significantly outperformed the test mean and included three otebo breeding lines G12901-903 and two GN lines with G11-prefix. The new Powderhorn variety yielded equivalent to the test mean and ahead of Matterhorn. Two lines from USDA-WA, GN9-4 and PS02- performed below the test mean. In the otebo class, G12901 showed superior performance, 5 cwt ahead of the next entry and 14 cwt ahead of the Fuji check. G12901 is the first upright type-II otebo bean as previous varieties like Fuji are bush types. It shows outstanding performance and would be suitable for direct harvest. The line will continue to be tested for yield and quality traits, and its suitability in 'An' paste prior to any decision on release.

Expt. 3106: Standard Pinto Bean Yield Trial

This 25-entry trial included standard commercial pinto bean varieties and advanced breeding lines from the MSU breeding program with the P-prefix. The trial ranged in yield from 13.9 to 22.8 cwt/acre with a mean of 17.8 cwt/acre. Variability was low (CV=8.6%) in this trial and the LSD needed for significance was 1.8 cwt/acre. Five entries significantly out-yielded the test mean and these included the varieties Eldorado, and La Paz. Eldorado formerly tested as P07863 was the highest yielding pinto in the white mold trials in Montcalm in 2007, 2008 and 2009 was 2nd in this test in 2010 and 1st in 2011, 2012. Other varieties Medicine Hat fell below the test mean and only those high-yielding entries with more upright architecture and canning quality equivalent to Othello will be advanced in 2014.

Expt. 3107: Standard Pink and Small Red Bean Yield Trial

This 36-entry trial included small red and pink breeding lines from MSU (R-small red; S-pink prefix), in addition to standard commercial check varieties. The test ranged in yield from 10.6 to 29.7 cwt/acre with a mean yield of 21.4 cwt/acre. Variability was moderate (CV=9.2%) resulting in a LSD value (2.3 cwt/acre) for significance. Eight breeding lines including Sedona variety significantly outperformed the test mean. The two top lines SR9304 and SR9303 were private lines that performed very well. SR9304 lodged badly and would not be suitable for direct harvest, whereas SR 9303 was more erect but had a small seed (25g compared to 33 g for Merlot). Other lines in this group were sister lines R12844 and R12845 that need to be evaluated for canning quality. Rosetta pink yielded above the test mean whereas, small red variety Merlot and Rio Rojo yielded significantly below the test mean. Merlot had an overall poor performance year combined with delayed maturity in many locations similar to 2011 and 2012. The lowest yielding entry was a small red line from Puerto Rico that has good levels of root rot resistance. Progress in small red breeding program has been limited by a lack of useful variability and inability to combine performance with upright architecture and suitable canning quality in new lines.

Expt. 3108: Preliminary Great Northern Bean Yield Trial

This large 84-entry trial included new great northern bean lines and otebo lines along with check varieties. Yields ranged from 13.1 to 31.2 cwt/acre with a mean of 20.3 cwt/acre. Variability was controlled in this 3-rep test (CV=8.9%) and the LSD was 2.5 cwt/acre. Fifteen lines significantly out-yielded the test mean and Eldorado pinto was a parent in 14/15 top entries, illustrating its potential to enhance yields in the GN class. Test 3108 was the top yielding trial in 2013. Matterhorn and Powderhorn yielded above the test mean, whereas all new otebo lines fell below the test mean but better than Fuji at the bottom of the trial. These lines significantly outyielded the Fuji check variety. Future advances of many of the new breeding lines will largely depend on disease reactions and canning quality of the entries.

Expt. 3109: Preliminary Small Red Bean Yield Trial

This 42-entry trial included new small red and pink bean lines along with check varieties bred to ensure they had adequate levels of resistance to BCMV. Yields ranged from 13.3 to 28.9 cwt/acre with a mean of 20.2 cwt/acre. Variability was low in this 3-rep test (CV=7.9%) and the LSD was 2.2 cwt/acre. Fifteen lines significantly out-yielded the test mean including the Merlot variety, and SR9303 from test 3107. Many of the new lines originate from diverse crossing to introduce more genetic variability into this class that includes resistance to anthracnose and BCMV. The overall appearance of the new lines was disappointing based on low DS scores (>5). Only two lines had an improved DS score. This underscores the challenge in developing high yielding upright small red beans with good canning quality. Future advances of many of the new breeding lines will largely depend on their reaction to BCMV, seed quality, color and canning quality of the entries.

Expts. 3110, 3111, 3112: Small Red Bean Yield Genetic Trials

The three genetic studies were conducted as yield trials to evaluate three recombinant inbred line (RIL) populations consisting of 40 (3110); 80 (3111) and 56 (3112) individuals. The populations were derived from crosses between Merlot and SER95 (3110); SER48 (3111); and SER94 (3112). The SER lines were developed at CIAT Colombia as sources of drought tolerance in the small red seed type. Yields ranged from 7.4 to 25.6 cwt/acre with a mean of 16.3 cwt/acre in test 3110. Variability was moderate in this 3-rep test (CV=11.3%) and the LSD was 2.5 cwt/acre. Seventeen lines significantly out-yielded the test mean including the Merlot variety. The SER lines yielded below the test mean. Yields ranged from 7.8 to 26.4 cwt/acre with a mean of 16.2 cwt/acre in test 3111. Variability was moderate in this 3-rep test (CV=12.2%) and the LSD was 2.7 cwt/acre. Twenty-three lines significantly out-yielded the test mean but did not include the Merlot variety. The SER lines yielded below the test mean. Yields ranged from 6.1 to 25.3 cwt/acre with a mean of 16.0 cwt/acre in test 3112. Variability was moderate in this 3-rep test (CV=12.8%) and the LSD was 2.8 cwt/acre. Sixteen lines significantly out-yielded the test mean including the Merlot, Rosetta varieties and a single plant selection out of Merlot. The SER lines and the small red PR line 10IS-2423 yielded below the test mean. All these lines mature very early and do not yield up to the Merlot check, despite possessing drought tolerance. The entries in all three tests behaved very similarly and data will be analyzed to identify QTL associated with yield under stress in all three populations. Some lines with acceptable seed quality will be entered in the preliminary small red yield trials in 2014.

Expt. 3113: Combined Midwest Regional Performance Nursery (MRPN) & Cooperative Dry Bean Nursery (CDBN) Yield Trial

The MRPN 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. The CDBN is a national trial and includes all classes but only medium-sized entries were included in this trial. The 49-entry trial ranged in yield from 13.0 to 24.8 cwt/acre with a mean of 19.8 cwt/acre. Variability was moderate (CV=9.4%) resulting in a LSD value (2.5 cwt/acre) for significance. As a result eleven lines were significantly higher in yield than the test mean including the new MSU varieties, Eldorado, Rosetta and Powderhorn. In the top group were pinto, small red, pink, and great northern lines from Idaho, USDA-WA, NDSU and UC Davis. Two new slow darkening pintos PT11-61 and PT1030 yielded below the test mean. As in tests in previous years, Buster was the lowest yielding entry suggesting that it does not tolerate drought stress. This cooperative trial continues to be valuable as it allows an evaluation of potential new lines prior to release in other states and confirmed performance of new MSU varieties released in 2014.

Expts. 3914 & 3915: Organic Dry Bean Yield Trials

Two 36-entry navy and black trials were conducted on certified organic grower farms (Findlay -3914; Sattleburg – 3915) under organic production systems, with no fertilizer, no chemical seed treatments or weed or insect control, no harvest aid chemicals using seed inoculated with native Rhizobium to evaluate new breeding lines, and current varieties for potential production under this management system. Test 3915 was not harvested as the plants were under moisture stress most of the season and they developed strange abnormal growth due to factors of disease (virus) or pollution that resulted in small plants and low yields. In test 3914, yields ranged in yield from 10.8 to 24.4 cwt/acre with a mean of 17.5 cwt/acre. Variability was moderate (CV=15.2%) resulting in a LSD value (3.1 cwt/acre) for significance. Only five lines were significantly higher in yield than the test mean and this included the advanced black bean B10244 being considered for release as a new variety. Zorro was the top yielding variety followed by Merlin, Vista, Medalist and Shania. The non-nodulating check R99 that cannot fix nitrogen was the lowest yielding entry suggesting that nitrogen may be a limitation in these organic systems and require bean varieties that are high N-fixers. A group of high nitrogen fixating lines derived from Puebla 152 was included, but one of these lines fell in the top 5-group. Since organic growers may choose to save seed as organic seed is not widely available, resistance to seed-borne CBB would be an important criterion in their selection of bean varieties to grow. A number of the entries in this trial have high levels of resistance to CBB. The trial will be repeated in 2014 with a different mix of breeding lines. The trial was bordered with new pinto bean variety Eldorado which yielded 19.3 cwt/acre.

Expt. 3216: Standard Kidney Bean Yield Trial

This 56-entry trial was conducted on the Montcalm Research Farm (MRF) 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 (7x total 4"). Yields ranged from 13.1 to 37.8 cwt/acre with a mean of 26.9 cwt/acre. Variability was moderate

(CV=11.6%) resulting in a large LSD value (4.2 cwt/acre) needed for significance. Fourteen breeding lines significantly out-yielded the test mean, including 10 WK lines and the four varieties, Snowdon, CELRK, Clouseau and Majesty. White kidney lines continue to out-yield red kidney lines in this trial with yields in excess of 32cwt/a, whereas the highest yielding LRK lines ranked just outside the top group. Varieties that yielded above the test mean included Red Hawk and Red Rover whereas Chinook, Beluga, Yeti, Montcalm and Inferno were below the mean. Unlike 2012 season when there was a high incidence of CBB in the trial, little disease pressure was observed in 2013. New DRK line ND061210 and LRK line ND061106 from NDSU were late maturing and yielded below the test mean similar to Montcalm. 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 2014.

Expt. 3217: Preliminary Kidney Bean Yield Trial

This small 16-entry trial was conducted on the MRF to compare new and standard white kidney bean varieties under supplemental irrigation (7x total 4"). Yields ranged from 20.1 to 34.0 cwt/acre with a mean of 28.3 cwt/acre. Variability was low (CV=7.0%) in this 3-rep test and the LSD needed for significance was 2.8 cwt/acre. Four lines significantly out-yielded the test mean and included Snowdon and Clouseau, similar to test 3216. The top entry K13902 WK showed excellent growth and vigor, dry down and plant structure in a white kidney seed smaller than Snowdon (69 vs 81 g/100 seeds). Two sister lines of K13902 were in the top 5 entries, suggesting the yield potential of the cross. Only those entries with improved yield and equivalent to Beluga in seed size, earlier maturity and canning quality will be advanced in 2014.

Expt. 3218: Standard Bush Cranberry Bean Yield Trial

This 25-entry trial was conducted on the MRF to compare new and standard bush cranberry bean varieties under supplemental irrigation (7x total 4"). Yields ranged from 21.0 to 30.9 cwt/acre with a mean of 25 cwt/acre. Variability was low (CV=8.7%) and the LSD needed for significance was 2.6 cwt/acre. Four lines significantly out-yielded the test mean, including the Etna check which topped the trial. No CBB was observed in the trial so there was no negative effect on the yield of Etna, whereas Capri yielded below the test mean. Etna had the largest seed size at 74 g/100 seed. The trial represented a broad array of genotypes with different genetic background and a wide range in maturity, lodging resistance and yield potential among entries. Only those entries equivalent to Etna in seed size with improved yield, earlier maturity and canning quality will be advanced in 2014.

Expt. 3219: Preliminary Bush Cranberry Bean Yield Trial

This 20-entry trial was conducted on the MRF to compare new and standard bush cranberry bean varieties under supplemental irrigation (7x total 4"). Yields ranged from 12.4 to 32.2 cwt/acre with a mean of 21.4 cwt/acre. Variability was moderate (CV=13.2%) in this 3-rep test and the LSD needed for significance was 3.9 cwt/acre. Four lines significantly out-yielded the test mean, including the Etna check which topped the trial as in test 3218. C11266 was in the top group as in test 3218, but it had a smaller seed size (56g) than Etna at 74 g/100 seed. The small seed size of many of the entries is a concern and few lines showed any potential over Etna in seed size or performance.

Expt. 3220: Yellow Mayacoba Bean Yield Trial

This 16-entry trial was planted at the MRF to identify potential new bush mayacoba (yellow) bean varieties that might be suited for production in Michigan. Materials included one yellow line Y11405, and a yelloweye line from MSU, 12 canario lines from Puerto Rico and two checks Snowdon and Red Hawk. The 12 lines from PR flowered very late and did not mature, so only the checks and Y11405 were harvested. Y11405 yielded 23.4 cwt/a; Red Hawk yielded 23.1 cwt/a; and Snowdon yielded 33.4 cwt/a. In the absence of CBB, Y11405 yielded equivalent to Red Hawk and produced an attractive yellow (mayacoba) seed in an upright bush habit. The line is under consideration for release.

Expt. 3221: Large White Fabada Bean Yield Trial

A small trial of large white seeded lines was planted separately at the MRF as the seed is too large to plant with machine. The trial included three large seeded white lines that range in size and shape from 85 to 105 g/100seeds. Yields ranged from 18.5 to 19.1 cwt/acre with a mean of 18.9 cwt/acre. Variability was moderate (CV=11.8%) in this 3-rep test and the LSD needed for significance was 3.9 cwt/acre. The large fabada line K11925 yield 18.5 cwt/a with a seed size of 105 g/100seeds. In an adjacent plot Snowdon yielded 33.4 cwt/a with a seed size of 80 g/100 seeds. The data underscore the difficulty of combining high yield with large seed size. Other lines tested included K11802, round marrowfat line (88g/100seeds) and K12824 (85g) which will be discarded due to seed quality problems. The fabada line K11925 is under consideration for release.

Expt. 3222: National 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* Initiative (NSI) Nursery. 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 Matterhorn between plots and were direct harvested. Supplemental overhead irrigation was applied 9 times for a total of 5.75" 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 18.5 to 99% and pressure was high with a mean value of 46.3% in 2013. The test ranged in yield from 6.6 to 38.9 cwt/acre with a mean yield of 25.1 cwt/acre. Variability was moderate (CV=13.6%), thus a high LSD value (4.6 cwt/acre) was needed for significance. As a result 18 lines significantly out-yielded the test mean and included the Rosetta, Eldorado, Zorro and Merlin varieties and the new pinto line 37-2 from USDA-WA for the fourth year. The new GN variety Powderhorn just fell outside the top group and Snowdon was the highest yielding kidney bean. As in past years pintos and reds dominated the entries at the top of trial, followed by blacks, navy and pink lines and large seeded kidney were among the lowest yielding in the test. Many of the standard entries from NSI trial were among the lowest yielding lines and yielded below the susceptible check Beryl. Past experience using low-yielding white mold resistant germplasm as parents has not proved useful in breeding for white mold resistance. Overall the trial confirmed results from previous years (susceptible check-Beryl rated 99% WM) and this trial will continue to be part of the breeding effort to improve tolerance to white mold.

Expts. 3223 & 3224: BeanCAP Drought Yield Trials

Two 96-entry trials were conducted in adjacent fields one was irrigated (test 3223) and the other (test 3224) received only rainfall reported earlier in this report. The purpose of the trial was to evaluate drought stress on performance and root traits of diverse group of genotypes. Agronomic, yield, harvest index and root data were collected on both trials. The study is part of student research project supported by Beancap and USDA-NIFA grant. The irrigated trial received supplemental water from seven irrigations totaling 4" and yields ranged from 4.7 to 38.4 cwt/acre with a mean of 23.4 cwt/acre. White mold developed in this trial due to additional irrigation resulting in greater variability in this 3-rep test was slightly higher (CV=17.5%) and the LSD needed for significance was 5.5 cwt/acre. Eighteen entries significantly out-yielded the test mean and included varieties Eldorado, and Santa Fe known to possess avoidance to white mold; Rosetta, Medicine Hat, Lariat, and Jaguar. In the non irrigated trial, yields ranged from 17.6 to 36.2 cwt/acre with a mean of 27.0 cwt/acre, higher than the irrigated trial. The trial was fairly uniform but variability was high due to the prolonged drought (CV=16.8%) and the LSD needed for significance was 6.1 cwt/acre. Only eight entries significantly out-yielded the test mean and included varieties such as Sedona, Roza and Merlot, and Sierra known to possess drought tolerance. Other lines SER48 and BAT477 known to possess drought tolerance performed below the test mean. As in 2012 the higher performance in the non irrigated trial again suggesting that the delayed rainfall (4.5" in August) was sufficient to produce a successful bean crop as the additional irrigation promoted white mold development among the decumbent genotypes in the non stress/irrigated trial.

Expt. 3425: Biological Nitrogen Fixation – BNF Yield Trial

This 130-entry trial was grown for third season in East Lansing to measure nitrogen fixation and yield of RIL population grown in a low N (0.03%; normal range 0.05-0.1%) site as only those lines that fix more N will produce more yield under these conditions. The black bean population was developed from cross of Zorro with Puebla 152 line selected as a high nitrogen fixer. Yield ranged from 14.7 to 39.4 cwt/acre with a mean of 28.6 cwt/acre. Variability was moderate (CV=10.6%), and a LSD value of 4.1 cwt/acre was needed for significance. As a result 23 lines significantly exceeded test mean and these lines exceeded the performance of the Zorro parent and check varieties. Only line B11567 that ranked third was second in 2011 as the data from the 2012 season was inconsistent and damaged by stress. The top yielding check was PR0443-151 selected for yield under low soil fertility levels in Puerto Rico. The non-nodulation check, R99 was among the lowest yielding entries, suggesting that N was limiting in this trial. The trial received favorable rainfall over the growing season as reflected in the high yields obtained. At harvest plant biomass was also recorded to measure harvest index (HI). Harvest index ranged from low of 15% in lowest yielding unadapted entries to 40% in higher yielding entries and these values were lower than in past years. The lower yielding entries tended to be late maturing entries combined with viney prostrate types that did not partition into the seed, hence lower HI. There is a strong correlation between HI and yield and results are similar to those observed in other trials. Selecting for high yield must be accompanied with partitioning into the seed. Bean lines with enhanced BNF would be useful trait for organic bean producers who cannot apply conventional fertilizers to increase yield and a few of these lines were evaluated in the organic trial, test 3914.

Early Generation Breeding Material grown in Michigan in 2013

F3 through F5 lines

Navy and Black - 224 lines
Pinto - 55 lines
GN - 70 lines
Pinks and Reds - 56 lines
Kidneys (DR, LR, White) - 54 lines
Cranberry (bush, vine) – 6 lines

F2 populations

Navy and Black -269 populations
Pinto - 58 populations
GN - 75 populations
Pinks and Reds - 47 populations
Kidneys (DR, LR, White) – 50 populations
Cranberry (bush, vine) – 49 populations

F1 populations: 589 different crosses among ten contrasting seed types.