

## 2011 DRY BEAN YIELD TRIALS

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The bean breeding program initiated its third season on the new 320 acre research farm, Saginaw Valley Research & Extension Center (SVREC) near Frankenmuth in 2011. A total of 5,600 yield trial plots planted in 32 tests were harvested in 2011 and over 2,360 single plant selections were made in the early generation nurseries. Yield trials at SVREC included 36-entry standard navy test; two 36-entry standard black tests; two 56-entry prelim navy tests; 84-entry prelim black test; 36-entry standard GN; 36-entry standard pinto test; 20-entry standard red/pink test; 84-entry prelim GN test; 36-entry prelim pinto test; 48-entry prelim red/pink test; 30-entry prelim FM test; 32-entry USDA red/pink test; 300-entry BeanCAP test; two canning quality trials for CONAGRA: 8-entry navy and 14-entry pinto; and 48-entry CDBN and regional test that includes pinto, GN, red and pinks. At Montcalm two bush cranberry tests with 128 and 72 entries; 112-entry prelim kidney test; 12-entry mayacoba test; two white mold tests: one with 64-entries and one 96-entry pinto trials; 96-entry BeanCAP drought trial; two 36-entry certified organic trials in Tuscola county and SVREC; on campus one potato leaf hopper (PLH) trial with 80-entries; and 130-entry nitrogen fixation (BNF) test. All trials at SVREC were direct harvested and the kidney, cranberry, drought, BNF and white mold trials in Montcalm and on campus were pulled mechanically and threshed in the same combine. In the drought and BNF trial plant biomass was determined on all plots prior to threshing. Root measurements were taken on the drought plots in Montcalm at flowering by digging plants and following protocol termed Shovelomics to measure root diameter, angle and vigor traits that may play a role in tolerating drought.

The season in Frankenmuth started with limited rainfall following planting through July 26-27 when more normal rainfall patterns prevailed throughout the remainder of the season. The drought reversed maturities with full-season black and navy beans maturing ahead of pinto and great northerns. As a result of the early drought, many of the early-season lines double-set, whereas the longer-season blacks and navies matured normally ahead of pinto, and great northern trials. Some entries in the 300-entry BeanCAP nursery remained green and never matured. Many of the pinto, great northern and small red lines lost 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. Rust was observed in Frankenmuth and is becoming an increasing threat to navy and black bean producers in Michigan. Resistance to race 22:2 in new navy and black bean lines has been identified. Plots at Montcalm had similar rainfall pattern but the stress was offset with supplemental irrigation and excellent yields over 35 cwt/acre were recorded in the kidney and cranberry trials. The BeanCAP drought trial showed good early moisture stress but following the late July rains, the entire trial re-grew, resulting in high yields and later maturity throughout. In addition to yield and agronomic data, roots were sampled and rated and biomass and harvest index were recorded. White mold infection was slow to develop in 2011 and never reached high levels of severity as in 2010. The exceptional yields in the BeanCAP drought trial were a surprise given that no irrigation was applied to the plot which received only 8" of rain over 4-month growing season compared to normal rain of 17.2" over the same time period.

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 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. 1101: Standard Navy Bean Yield Trial**

This 36-entry trial included standard commercial navy bean varieties, and advanced lines from the MSU breeding program, which carry the N-prefix. Yields ranged from 15.8 to 29.2 cwt/acre with a mean of 21.2 cwt/acre. The trial was fairly uniform and variability was well controlled (CV=9.9%) and the LSD needed for significance was 3 cwt/acre. Only five entries significantly out-yielded the test mean and included new varieties Merlin from Coop Elevator and Rexeter from Ontario and two older N08-sister lines from MSU program. The best yielding check varieties were Vista followed by Avalanche, whereas both T9905 and Medalist ranked below the test mean. MSU breeding line N09174 ranked second compared to first place in same trial in 2010 but canning tests and seed color characteristics will determine whether this breeding line will be considered for release.

### **Expt. 1102: Standard Black Bean Yield Trial**

This 36-entry trial included the standard commercial black bean varieties and advanced breeding lines. Yields ranged from 18.4 to 29.9 cwt/acre with a test mean of 25.2 cwt/acre, generally exceeding the yield potential of the advanced navy trial. Variability was low in this test, (CV=9.1%) and the LSD was 3.2 cwt/acre. Only Loreto and one breeding line B09175 significantly out-yielded the test mean and the latter was black seeded sib derived from the top navy line in test 1101. Top yielding checks included Shania, Black Velvet, Jaguar and Zorro exceeded the test mean, whereas Condor, T-39, Eclipse and Aifi Wuriti were below the mean. Future advance of breeding lines will largely depend on disease reactions and canning quality of the entries.

### **Expt. 1103: Standard Black Bean Yield Trial**

This 36-entry trial included newer B10-black bean lines and check varieties compared to older entries in test 1102. Yields ranged from 17.4 to 30.1 cwt/acre with a mean of 23.2 cwt/acre. Variability was moderate in this test (CV=10.4%) and the LSD was 3.4 cwt/acre resulting in three lines that significantly outyielded the test mean. These lines have favorable DS scores and carry additional disease resistance for CBB, rust and anthracnose but future advances of many of these lines will largely depend on canning quality of the entries.

### **Expt. 1104: Preliminary Navy Bean Yield Trial**

This 56-entry trial included new navy bean lines along with check varieties. Yields ranged from 14.2 to 30.1 cwt/acre with a mean of 20.9 cwt/acre. Variability was moderate in this 3-rep test (CV=11.8%) and the LSD was 4 cwt/acre. Eight lines including Vista significantly outyielded the test mean. The top yielding entries were very erect, higher DS scores and many carry resistance to anthracnose, CBB and rust. Medalist produced lower yields similar to those in test 1101. Future advances of many of the new breeding lines will largely depend on disease reactions and canning quality of the entries.

### **Expt. 1105: Preliminary Navy Bean Yield Trial**

This 56-entry trial included new navy bean lines different in pedigree from those in 1104 along with check varieties. Yields ranged from 13.1 to 29.5 cwt/acre with a mean of 21.6 cwt/acre. Variability

was moderate in this 3-rep test (CV=12.4%) and the LSD was 4.4 cwt/acre resulting in only 4 lines that significantly outyielded the test mean. The top yielding entries were very erect, excellent dry down and had high DS scores. The top entry was 3 cwt higher than next entry and significantly outyielded Vista. A number of these lines carry Medalist as a parent. Future advances of many of the new breeding lines will largely depend on disease reactions and canning quality of the entries.

#### **Expt. 1106: Preliminary Black Bean Yield Trial**

This 84-entry trial included new black bean lines along with check varieties. Yields ranged from 12.2 to 30.1 cwt/acre with a mean of 22.9 cwt/acre. Variability was moderate in this 3-rep test (CV=10.4%) and the LSD was 3.8 cwt/acre. Nine lines significantly outyielded the test mean and showed nice upright architecture, good dry down and high DS scores. The top yielding entry significantly outyielded Zorro. The line with highest DS score yielded lower with Eclipse (21 cwt) as a result of small seed size which fell through a no 10- screen during cleaning. Future advances of many of the new breeding lines will largely depend on disease reactions and canning quality of the entries.

#### **Expt. 1107: Standard Great Northern Bean Yield Trial**

This 36-entry trial included MSU great northern and otebo breeding lines and standard commercial check varieties. The test ranged in yield from 13.3 to 27 cwt/acre with a mean yield of 20.8 cwt/acre. Variability was high (CV= 14%) resulting in a high LSD value (4.1 cwt/acre) needed for significance. Only two breeding lines significantly outperformed the test mean. Breeding line G09303 that topped the trial in 2010 and in 2011 showed no quality problems and carries the *Co-4<sup>2</sup>* gene which conditions resistance to anthracnose. The second line G08254 has been a top performer over past years and also significantly out-yielded the check variety Matterhorn. The lowest yielding entry was the Fuji tebo variety and a number of lines in tebo class (26-31g) significantly out-yielded the check. In prior years a large number of lines exhibited severe 'fish-mouth' seed damage making them commercially unacceptable. This seed condition was not as obvious in 2011, but only those entries with larger seed size, improved dry seed quality and cracking resistance better than Matterhorn will be advanced in 2012.

#### **Expt. 1108: Standard Pinto Bean Yield Trial**

This 36-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 16.7 to 27.6 cwt/acre with a mean of 22.3 cwt/acre. Variability was moderate (CV=10.4%) in this trial and the LSD needed for significance was 3.2 cwt/acre. Only three entries significantly out-yielded the test mean and these included the varieties La Paz, ND-307 and breeding line P07863 under consideration for release. P07863 was the highest yielding pinto in the white mold trials in Montcalm in 2007 2008 and 2009 was 2<sup>nd</sup> in this test in 2010. Other varieties Croissant and Lariat exceeded the test mean whereas Stampede and Santa Fe yielded below the test mean, and many MSU breeding lines will be discarded due to poor performance in this test. The new pinto 37-2 with tolerance to white mold was mid-pack in performance. Only those high-yielding entries with more upright architecture and canning quality equivalent to Othello will be advanced in 2012.

### **Expt. 1109: Standard Pink and Small Red Bean Yield Trial**

This 20-entry trial included small red and pink breeding lines from MSU (R-S-prefix), in addition to standard commercial check varieties. The test ranged in yield from 15.2 to 31 cwt/acre with a mean yield of 23.9 cwt/acre. Variability was moderate (CV=12.7%) due to direct harvesting resulting in a LSD value (4.4 cwt/acre) for significance. Only two pink breeding lines significantly outperformed the test mean followed by pink breeding line S08418 under consideration for release and Sedona variety. Small red check variety Merlot yielded above the test mean, but Merlot had an overall poor performance year combined with delayed maturity in many locations. Included in the test were two new small red lines from NDSU (ND prefix) and both performed above the test mean. NDZ06249 was recently released as the variety Rio Rojo and ND080547 is a breeding line with high levels of resistance to white mold as is PS02-050-2. The majority of small red lines were lower yielding and lack the canning quality of Merlot. Progress in small red breeding program has been limited by lack of useful variability.

### **Expt. 1110: Preliminary Great Northern Bean Yield Trial**

This 84-entry trial included new great northern bean lines along with check varieties. Yields ranged from 10.9 to 25.3 cwt/acre with a mean of 19.5 cwt/acre. Variability was moderate in this 3-rep test (CV=12.2%) and the LSD was 3.8 cwt/acre. Eight lines significantly out-yielded the test mean and the Matterhorn check variety. The top yielding entries exhibited quality seed and many carry resistance to anthracnose. G09303 was slightly lower yielding than top 15-entries. NE line from Nebraska yielded below test mean and many of the Matterhorn/EMP507 lines exhibited higher yield potential with tolerance to Empoasca leafhopper resistance. Future advances of many of the new breeding lines will largely depend on disease reactions and canning quality of the entries.

### **Expt. 1111: Preliminary Pinto Bean Yield Trial**

This 36-entry trial included new pinto bean lines along with check varieties. Yields ranged from 13.5 to 27.7 cwt/acre with a mean of 21.3 cwt/acre. Variability was moderate in this 3-rep test (CV=13%) and the LSD was 4.6 cwt/acre resulting in only 5 lines that significantly out-yielded the test mean and Santa Fe variety. Among the top entries is La Paz variety and the trial was topped by P07863 breeding line similar to test 1108. P08161 is a new erect line with leafhopper resistance and excellent dry down and high DS scores. Future advances of many of the new breeding lines will largely depend on disease reactions and canning quality of the entries.

### **Expt. 1112: Preliminary Red and Pink Bean Yield Trial -1**

This 48-entry trial included new small red and pink bean lines along with check varieties. Yields ranged from 15.9 to 28.6 cwt/acre with a mean of 21.6 cwt/acre. Variability was moderate in this 3-rep test (CV=11.3%) and the LSD was 4 cwt/acre. Five lines significantly out-yielded the test mean including Sedona variety. A few of top lines exhibited nice upright architecture, good dry down and high DS scores and future advances of many of the new breeding lines will largely depend on disease reactions and canning quality of the entries.

### **Expt. 1113: Preliminary Flor de Mayo Bean Yield Trial**

This 30-entry trial included new upright flor de mayo (FM) bean lines along with check varieties. This is the first trial with FM lines bred for adaptation, upright architecture, yield and suitability for local production. Yields ranged from 15.1 to 31.5 cwt/acre with a mean of 23.5 cwt/acre. Variability was moderate in this 3-rep test (CV=13.5%) and the LSD was 5.2 cwt/acre. Four lines significantly out-yielded the test mean and all the FM varieties, Desert Rose, FM Dolores, M38, Eugenia and Anita from Mexico. Included in the test was small red line R08516 and pink line release candidate S08418. A few of top FM lines exhibited nice upright architecture, good dry down and high DS scores and future advances of many of the new breeding lines will largely depend on disease reactions and canning quality of the entries.

### **Expt. 1114: Preliminary Red and Pink Bean Yield Trial - 2**

This 32-entry trial included new small red and pink bean lines from the USDA-WA program along with check varieties from MI and WA. Yields ranged from 16.1 to 29.6 cwt/acre with a mean of 23 cwt/acre. Variability was high in this 3-rep test (CV=15.4%) as there was a wide range of maturities and growth habits in this test. The LSD was 5.8 cwt/acre, so only two lines significantly out-yielded the test mean including Sedona variety. Interestingly most of the top lines were pink beans (PK-prefix), whereas the small red (SR) lines yielded below the test mean. The main purpose of the test was to identify more genetic variability in both seed types to help expand the MSU program. A few lines exhibited nice upright architecture with good dry down but many lines has low DS scores indicating an overall lack of adaptation to local conditions. All entries carry different genes for resistance to BCMV which will be valuable in the MSU breeding program.

### **Expt. 1115: Commercial Pinto Bean Quality Trial**

This trial was conducted to test current commercial pinto bean varieties and evaluate their potential and canning quality in Michigan – second year for this trial. The trial was conducted at a second location in Michigan and at two other locations in ND and NE. The 14-entry trial ranged in yield from 16.9 to 27.8 cwt/acre with a mean of 22.8 cwt/acre. Variability was high (CV=16.4%) resulting in a high LSD value (5.3 cwt/acre) for significance. Due to the small number of entries no line was significantly higher in yield than the test mean. There was a wide range in variation in growth habit and maturity between entries which contributed to the range in yield and high variability in the test. This trial mirrored pinto test 1108, with La Paz and ND-307 in the top group but the surprise was the separation of the top 4 entries from the rest of the trial. All entries will be canned and evaluated by Conagra brand team for suitability in their canned products.

### **Expt. 1116: Commercial Navy Bean Quality Trial**

This trial was conducted to test current commercial navy bean varieties and evaluate their production potential and canning quality in Michigan – second year for this trial. The trial was conducted at a second location in Michigan and at two other locations in ND and NE. The 8-entry trial ranged in yield from 21.2 to 26.2 cwt/acre with a mean of 23.8 cwt/acre. Variability was moderate (CV=11.2%) resulting in a high LSD value (3.9 cwt/acre) for significance. Due to the small number

of entries no line significantly out-yielded the test mean. The top yielding entry was Medalist followed by Schooner. Unlike other navy trials where Medalist did not perform well, it showed its yield potential in this trial in 2011. Among the other varieties, Norstar was the lowest yielding similar to 2010. All entries will be canned and evaluated by Conagra brand team for suitability in their canned products.

#### **Expt. 1117: 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 48-entry trial ranged in yield from 5.8 to 24.4 cwt/acre with a mean of 18.5 cwt/acre. Variability was moderate (CV=13.3%) resulting in a LSD value (4 cwt/acre) for significance. As a result only six lines were significantly higher in yield than the test mean including ND-307 and Longs Peak varieties. The top yielding entries were all pintos included Sequoia, Othello, Lariat, Buster, Montrose, Apache, La Paz, Croissant varieties and breeding line P07863, whereas Odyssey, Matterhorn, Stampede, Coyne, Santa Fe and Max yielded below the test mean. The longer-season vine cranberry varieties Chianti and Bellagio were the lowest yielding entries and do not perform at the level of pintos or great northern. This cooperative trial continues to be valuable as it allows an evaluation of potential new lines prior to release in other states and a number of full-season, high-yielding pinto bean lines were identified in 2011.

#### **Expt. 1118: BeanCAP Small-Seeded Yield Trial**

This 108-entry trial is part of a national trial being conducted at four locations in the US to compare performance of small-seeded (Mesoamerican race) bean varieties released in North America over the last century. In addition to the field performance seed from all locations is being analyzed for over 15 minerals and nutrients to determine genetic variability in order to conduct genetic mapping of these traits for future improvement. Most of the small seeded varieties belong to navy and black bean classes. Yields ranged from 4.9 to 34.8 cwt/acre with a mean of 21.9 cwt/acre. The trial was fairly uniform and variability was well controlled in this 2-rep test (CV=10.4%) and the LSD needed for significance was 4.5 cwt/acre. Seventeen entries significantly out-yielded the test mean and included many varieties from the MSU program. The lower yielding entries tended to be entries from Canada that were very early maturing and a few unadapted types from overseas such as Puebla 152. Clear progress in breeding for upright plant architecture was very obvious between the recent and older varieties. In addition to the normal agronomic traits the growth habits of all entries was recorded.

#### **Expt. 1119: BeanCAP Medium-Seeded Yield Trial**

This 200-entry trial is part of a national trial being conducted at four locations in the US to compare performance of medium-seeded (Durango & Jalisco races) bean varieties released in North America over the last century. In addition to the field performance seed from all locations is being analyzed for over 15 minerals and nutrients to determine genetic variability in order to conduct genetic mapping of

these traits for future improvement. Most of the medium seeded varieties belong to pinto, great northern, small red and pink bean classes. Yields ranged from 5.9 to 32.4 cwt/acre with a mean of 19.4 cwt/acre. The trial was highly variable due to range of maturities and growth habit so variability was not well controlled in this 2-rep test (CV=23.3%) and the LSD needed for significance was 8.9 cwt/acre. Thirteen entries significantly out-yielded the test mean and included two breeding line S08418 and P07863 under consideration for release from MSU program. The lower yielding entries tended to be very early maturing entries from Canada, and viney prostrate types that presented harvest problems and a few unadapted types from overseas. Clear progress in breeding for upright plant architecture was very obvious among the recent and older varieties. In addition to the normal agronomic traits the growth habits of all entries was recorded.

### **Expt. 1120: Organic Dry Bean Yield Trial**

A 36-entry navy and black trial was conducted on SVREC under organic production systems, with no fertilizer, no chemical weed or insect control, no harvest aid chemicals using bare seed to evaluate new breeding lines, current and old varieties for potential production under this management system. The same exact trial was repeated on organic grower farm in Tuscola county to compare results. Weeds or insects were not a problem in this trial. Yields ranged in yield from 5.3 to 18.9 cwt/acre with a mean of 15.3 cwt/acre. Variability was moderate (CV=12.8%) resulting in a LSD value (2.8 cwt/acre) for significance. Only four lines were significantly higher in yield than the test mean and this included the Zorro variety. Earlier studies suggested that black beans may perform better under organic system since they fix more nitrogen, and in this test the top four entries were black. The fifth entry was the high yielding navy breeding line N09174 which suggests that lines which perform well under conventional systems are the same ones that perform best under organic production systems. Medalist was the best navy variety, whereas Vista and Black Velvet were mid-pack in performance. The lowest yielding entry was the non-nodulating check R99. This would indicate that nitrogen was a limiting factor in this test as R99 cannot fix nitrogen resulting in low yield. Overall yields in this test were from 5-10 cwt lower than same entries grown under conventional conditions, suggesting the cost to this management system. 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 2012 with a different mix of breeding lines.

### **Expt. 1221: Preliminary Kidney Bean Yield Trial**

This 112-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 (6x total 3.2"). Yields ranged from 22.8 to 39.1 cwt/acre with a mean of 30.5 cwt/acre. Variability was moderate (CV=13.1%) resulting in a large LSD value (6.5 cwt/acre) needed for significance. Only four WK breeding lines significantly out-yielded the test mean, included K08961 under consideration for release. K08961 was also the top-yielding entry in 2010, 2009, yielding 4 cwt/a more than the next entry, while the same line ranked 4<sup>th</sup> in 2008. White kidney lines continue to out-yield red kidney lines in this trial and yields in excess of 35cwt in kidney beans is excellent. The highest yielding LRK line ranked 10<sup>th</sup> while DRK line ranked 12<sup>th</sup> and the highest yielding variety Clouseau LRK ranked 11<sup>th</sup> in the trial. All entries



were ranked for presence of CBB, those lines with values 2 or lower exhibited genetic resistance. Other varieties that yielded above the test mean include Inferno, vine DRK Majesty, Pink Panther, Red Hawk and the new earlier-season K10902 selected out of Beluga. Varieties that yielded below the test mean included CELRK, Redcoat, Redstar, Montcalm, Beluga and Chinook. 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 2012.

#### **Expt. 1222: Preliminary Bush Cranberry Bean Yield Trial -1**

This 128-entry trial was conducted on the Montcalm Research Farm to compare new and standard bush cranberry bean varieties under supplemental irrigation (6x total 3.2”). Yields ranged from 17.5 to 35 cwt/acre with a mean of 27.2 cwt/acre. Variability was moderate (CV=14.6%) in this 3-rep test and the LSD needed for significance was high (6.4 cwt/acre). As a result four lines significantly out-yielded the test mean. CBB was rated on 1-5 scale and ranged from low of 1.0 to high of 4.9 indicating that many lines with values less than 2.0 had high levels of resistance. Check variety Etna yielded above the test mean while Capri yielded below the test mean. 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 Capri in seed size with improved yield, earlier maturity and canning quality will be advanced in 2012.

#### **Expt. 1223: Preliminary Bush Cranberry Bean Yield Trial -2**

This 72-entry trial was conducted on the Montcalm Research Farm to compare new and standard bush cranberry bean varieties under supplemental irrigation (6x total 3.2”). Yields ranged from 18.2 to 32.2 cwt/acre with a mean of 25.4 cwt/acre. Variability was moderate (CV=12.6%) in this 3-rep test and the LSD needed for significance was high (5.2 cwt/acre). As a result only one line significantly out-yielded the test mean. CBB was rated on 1-5 scale and ranged from low of 1.0 to high of 4.9 indicating that many lines with values less than 2.0 had high levels of resistance. Check variety Etna and Red Rider yielded above the test mean while Capri and UCD901 yielded below the test mean. The trial represented genotypes with different genetic background than those in test 1222 but this trial lacked a wide range in maturity, and many of the lines had smaller seed (<50g) than check varieties. Only those entries equivalent to Capri in seed size with improved yield, earlier maturity and canning quality will be advanced in 2012.

#### **Expt. 1224: Preliminary Mayacoba Bean Yield Trial**

This small 12-entry trial was conducted on the Montcalm Research Farm to compare new bush mayacoba (yellow) bean varieties with checks under supplemental irrigation (6x total 3.2”). Yields ranged from 17.7 to 33.1 cwt/acre with a mean of 23.5 cwt/acre. Variability was moderate (CV=13.7%) in this 3-rep test and the LSD needed for significance was high (5.5 cwt/acre). As a result only one line K08961 significantly out-yielded the test mean. The white kidney line was included as a local check and it out-yielded the best mayacoba line by 7.5 cwt/acre. This underscores the difficulty of identifying a high yielding mayacoba seed for production in Michigan. Check variety UC707, Myasi and Higuera from Mexico yielded below the test mean and were over 5 cwt less than the best mayacoba line. The trial was heavily infected with CBB. Only those entries with improved yield and local adaptation will be advanced in 2012.

### **Expt. 1225: 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 Beryl between plots. Supplemental overhead irrigation was applied 8 times for a total of 4.2" 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 11 to 99% and pressure was moderate compared to 2010. The test ranged in yield from 8.9 to 41.4 cwt/acre with a mean yield of 31.5 cwt/acre. Variability was moderate (CV=11.3%), thus a high LSD value (5.8 cwt/acre) was needed for significance. As a result ten lines significantly out-yielded the test mean and included Zorro and La Paz pinto varieties. The top group included new pinto 37-2 from USDA-WA for the second year along with pinto line P07863 that was the top yielder in 2007, 2008 and 2009 and small red line ND080547. The P07863 line continues to demonstrate superior yield performance under white mold pressure. Included in top group were four MSU black breeding lines and pinto 50-2 from USDA-WA. Overall navy lines were among the lowest yielding in the test compared to black bean lines. The top navy line in the test ranked 38<sup>th</sup> and new varieties like Medalist and Rexeter yielded below test mean. Santa Fe, Jaguar, Merlot, Eclipse, Lariat, Condor Sedona, Clouseau and Matterhorn performed above the test mean, whereas all high-yielding pintos, Stampede, performed below the mean due to white mold pressure. K08961 white kidney that was in top group in 2009 dropped below test mean in 2010 and 2011 due to high white mold pressure and ranked next to Beluga. This was the second year that five of entries in NSI trial yielded above the test mean as many of the standard entries from NSI trial were among the lowest yielding lines in the past. 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 a vital part of the breeding effort to improve tolerance to white mold in dry beans.

### **Expt. 1226: White Mold Genetic Yield Trial- AP647**

A 4-replicate 96-entry trial was conducted at Montcalm to evaluate the genetic resistance to white mold in the recombinant inbred line (RIL) pinto population AP647 developed from the cross of AN 37/P02647. The cross was made to introduce white mold resistance from AN 37 into the upright pinto line P02647 from the MSU program and this is the third year to evaluate this population. Natural white mold infection occurred across the entire trial and ranged from 17 to 83% so disease pressure was moderate due to the wetter season and additional 8 irrigations for a total of 4.2 inches to promote disease development. The test was planted in the same arrangement as test 1225. Yield ranged from 23.4 to 45.6 cwt/acre with a mean yield of 32.2 cwt/acre. Variability was moderate (CV=13.3%), and a LSD value (6.9 cwt/acre) was needed for significance. Due to the high variability, six lines significantly outyielded the test mean. One parent yielded above while other yielded below the test mean. A genetic mapping experiment to find markers associated with white mold resistance and high yield under white mold pressure in this population is underway. Elite lines will be included in standard pinto bean yield tests in 2012.

### **Expt. 1227: BeanCAP Drought Yield Trial**

This 96-entry trial is part of a national trial being conducted at eight locations in the US to compare performance of small and medium-seeded (Middle American gene pool) bean varieties under conditions of drought. The site was selected to produce drought conditions in coarse textured sandy loam. In addition to the field performance of each entry seed from all locations is being analyzed for over 15 minerals and nutrients to determine genetic variability in order to conduct genetic mapping of these traits for future improvement. Yields ranged from 5.3 to 43.1 cwt/acre with a mean of 30.3 cwt/acre. The trial was variable due to range of maturities and growth habit so variability was not well controlled in this 2-rep test (CV=15.5%) and the LSD needed for significance was 9.4 cwt/acre. Six entries significantly out-yielded the test mean and included three MSU varieties, Matterhorn, Merlot and Santa Fe along with two pinto varieties Lariat and La Paz and Carioca bean A285. Yields were high despite the drought stress as no irrigation was applied and the plot which only received 8" out of normal rainfall 17.2" over the 4-month season. In addition to yield and agronomic data, data was collected on root structure of all entries sampled during flowering. At harvest plant biomass was also recorded to measure harvest index (HI). Harvest index ranged from low of 4% in lowest yielding unadapted entries to 47% in highest yielding entry. 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. Clear progress in breeding for drought tolerance and upright plant architecture was very obvious among the recent varieties. In addition to the normal agronomic traits the growth habits of all entries was recorded.

### **Expt. 1429: Potato Leafhopper – PLH Trial**

A single 80-entry trial was conducted in East Lansing to compare reaction of RIL population to natural infection with PLH. The population consisting of both GN and pinto seed types was developed from cross of Matterhorn with EMP507 line selected in Puerto Rico with resistance to PLH. The trial was rated for reaction to PLH based on PLH counts, leaf burn and leaf curl symptoms – typical damage caused by the pest. Yield ranged from 12.5 to 37.7 cwt/acre with a mean of 26.8 cwt/acre. Variability was high (CV=15.4%), and a LSD value of 6.7 cwt/acre was needed for significance. As a result ten lines significantly exceeded test mean including P08161 pinto line with excellent architecture and low scores. These lines significantly exceeded the performance of the Matterhorn parent and will be evaluated further. Leaf curl ratings ranged from low 1.0 to 5.0 but showed a high CV=16.9%. Likewise the PLH count showed an unsatisfactory high CV=36.8% which suggests that there is too much variability in this measurement to use this as a useful screening method. The trial was repeated in no choice field cages where the same numbers of insects/nymphs were placed on the bean plants being evaluated, to identify those lines that better tolerate insect pressure. Tolerance to PLH would be useful trait for organic bean producers who cannot apply conventional insecticides to control this insect pest.

### **Expt. 1431: Biological Nitrogen Fixation – BNF Yield Trial**

A single 130-entry trial was conducted 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. The trial was rated for leaf color during season as a measure of N deficiency. Yield ranged from 7.8 to 38.3 cwt/acre with a mean of 26.8 cwt/acre. Variability was high (CV=16.1%), and a LSD value of 6.9 cwt/acre was needed for significance. As a result eight lines significantly exceeded test mean and these lines exceeded the performance of the Zorro parent and will be evaluated further. At harvest plant biomass was also recorded to measure harvest index (HI). Harvest index ranged from low of 9% in lowest yielding unadapted entries to 46% in higher yielding entries. 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 the Beancap drought trial 1227. 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.

### **Expt. 1932: Organic Dry Bean Yield Trial, Tuscola County**

A 36-entry navy and black trial was conducted in a commercial organic grower Sattelberg Farms in Tuscola County near Unionville to evaluate new breeding lines, current and old varieties for potential production under this management system. This test is an exact replica of test 1120 grown on SVREC and weeds or insects were not a problem in this trial. Yields ranged in yield from 10.6 to 27.2 cwt/acre with a mean of 20.6 cwt/acre. Variability was moderate (CV=13.6%) resulting in a LSD value (3.9 cwt/acre) for significance. Seven lines were significantly higher in yield than the test mean and this included the Zorro variety which topped the trial. Earlier studies suggested that black beans may perform better under organic system since they fix more nitrogen, and in this test the top seven entries were black. The navy bean entries suffered from the disadvantage of poor stands as the seed planted came from 2010 plots that suffered severe drought stress and were extremely dry at harvest, resulting in intrinsic seed damage and poor germination. Medalist was the lowest yielding navy variety, whereas Vista and Black Velvet were above the test mean. The lowest yielding entry was the non-nodulating check R99. This would indicate that nitrogen was a limiting factor in this test as R99 cannot fix nitrogen resulting in low yield. Overall yields in this test were equivalent to those grown under conventional conditions, suggesting that farmer management is a critical component compared to test 1120 where management was at a minimum. The trial will be repeated in 2012 with a different mix of breeding lines.

### **Early Generation Breeding Material grown in Michigan in 2011**

#### **F3 through F5 lines**

Navy and Black - 334 lines  
 Pinto - 255 lines  
 GN - 143 lines  
 Pinks and Reds - 160 lines  
 Kidneys (DR, LR, White) - 189 lines  
 Cranberry (bush, vine) - 226 lines  
 Yellow Eye – 11 lines

#### **F2 populations**

Navy and Black -136 populations  
 Pinto - 52 populations  
 GN - 71 populations  
 Pinks and Reds - 104 populations  
 Kidneys (DR, LR, White) – 81 populations  
 Cranberry (bush, vine) – 42 populations

**F1 populations:** 484 different crosses among ten contrasting seed types.