

## 2009 DRY BEAN YIELD TRIALS

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The bean breeding program was relocated to a new 250 acre research farm, Saginaw Valley Research & Extension Center near Frankenmuth in 2009. 3644 plots were harvested for yield in 2009 and over 3,800 single plant selections were made in the early generation nurseries. Yield trials were conducted at Frankenmuth, Montcalm, East Lansing, Kalamazoo and Tuscola counties in addition to 20 acres of early generation nurseries under development in 10 different market classes. At the Saginaw Valley Research & Extension Center, 12 yield trials were planted and all were direct harvested. These included the standard nurseries in small and medium-sized market classes, the Cooperative Dry Bean, and the Midwest Regional Performance Nurseries included 20-entry navy test; 25-entry standard black test; 72-entry preliminary navy test; two 64-entry prelim black tests: 56-entry standard GN and 72 entry standard pinto tests; 36-entry PYT GN test; two pinto PYT tests with 30 and 7 entries; red/pink test with 56 entries; 42-entry Coop and regional test that includes pinto, GN, red and pinks. At Montcalm, bush cranberry test with 36 entries; kidney test with 56 entries; two white mold tests one with 64-entries; one 96-entry pinto trial and 36-entry drought trial were planted and all were machine pulled. In addition two certified organic trials one 32-entry test at KBS and second 32-entry test were planted in Tuscola county; and one 80-entry trial to evaluate for resistance to potato leaf hopper (PLH) was conducted on campus. A wide range of reaction to PLH was observed among the 80-entries in the genetic population. All trials except for kidney, cranberry and white mold, organic, and PLH were direct harvested using new self-propelled plot combine.

Plots in Frankenmuth had a severe epidemic of common bacterial blight (CBB) due to high rainfall in June, while plots at Montcalm had a very severe infection of white mold. As a result the program was able to identify high levels of CBB resistance in black, navy, pinto, red and great northern market classes and modest levels of white mold tolerance in the cranberry bean trials. With few exceptions the highest-yielding entries in all tests at Frankenmuth had the highest levels of CBB resistance. Planting started June 2, in Frankenmuth under very cold conditions which persisted throughout the season. Cumulative growing degree days were over 300 units below the 30-year average for the region. Rainfall was 2.3 inches below the average for the season but June was a high rainfall month (4.81") which promoted white mold and CBB. Pinto beans produced the top yields (>42 cwt/acre) followed by blacks, navy, small reds and great northern in 2009. In Montcalm rainfall was more evenly distributed but high rainfall in August (4.74") promoted the spread of white mold and resulted in severe damage in cranberry and kidney trials. Overall yields at Montcalm were lower than in past years in all trials and lower yields were the result of high white mold levels. Two companion nurseries of 32-entries each were planted one in certified organic and one in conventional plots to compare genotypic response to the different management systems. Trials planted in certified organic grower's field in Tuscola county and at KBS had adequate rainfall. The conventional plot in Tuscola was lost to flooding. Weeds were controlled by cultivation and insects (PLH) were controlled with multiple sprays of pyganic in the organic plots. The conventional plots received normal recommended rates of fertilizer, herbicides and insecticides, otherwise all other practices were similar between plots.

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

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

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

### **Expt. 9101: Standard Navy Bean Yield Trial**

This 20-entry trial included standard commercial navy bean varieties, and advanced lines from the MSU breeding program, which carry the N-prefix. Yields ranged from 25 to 36 cwt/acre with a mean of 31 cwt/acre. The trial was fairly uniform and variability was moderate (CV=8.3%) and the LSD needed for significance was 3.7 cwt/acre. Only two entries significantly out-yielded the test mean and included Vista and N05324 which had ranked 1<sup>st</sup> and 2<sup>nd</sup> in 2006 and 2007. The best yielding check varieties Vista, T9905, Medalist, Lightning, ranked above the test mean, whereas Avalanche and OAC Dublin ranked below the mean. Breeding line N08007, ranked 1<sup>st</sup> in test 8103 in 2008 showed highest level of CBB resistance and yielded equivalent to Medalist. Canning tests and seed color characteristics will determine whether breeding lines N05324 or N08007 be considered for release.

### **Expt. 9102: Standard Black Bean Yield Trial**

This 36-entry trial included the standard commercial black bean varieties and advanced breeding lines. Yields ranged from 25 to 42 cwt/acre with a test mean of 33 cwt/acre, exceeding the yield potential of the advanced navy trial. Variability was well controlled in this test, (CV=5.9%) and the LSD was 2.7 cwt/acre. Five breeding lines significantly out-yielded the test mean and included the variety Eclipse and breeding lines with CBB resistance. Zorro, Condor, Black Velvet and Shania exceeded the test mean, whereas T-39, Jaguar and Jet Black were below the mean. Since the trial was direct harvested, the data suggest that there exists significant yield potential in upright black beans adapted to the current conditions of mid-Michigan. Future advances will largely depend on disease reactions and canning quality of the entries.

### **Expt. 9103: Preliminary Navy Bean Yield Trial**

This 72-trial included new navy bean lines along with check varieties. Yields ranged from 21 to 39 cwt/acre with a mean of 32 cwt/acre. Variability was moderate in this 3-rep test (CV=9.6%) and the LSD was 4.9 cwt/acre resulting in 12 lines that significantly outyielded the test mean. The top yielding entries included Vista (as in test 9101) and a number of very erect breeding lines. Clearly resistance to CBB was a major factor in this test and a number of new lines showed good levels of resistance along with acceptable yield potential. Future advances of many of these lines will largely depend on disease reactions and canning quality of the entries.

### **Expt. 9104: Preliminary Black Bean Yield Trial**

This 64-trial included new black bean lines along with check varieties. Yields ranged from 27 to 40 cwt/acre with a mean of 33 cwt/acre. Variability was moderate in this 3-rep test (CV=9.6%) and the LSD was 5.1 cwt/acre resulting in only 4 lines that significantly outyielded the test mean. The top yielding entries were very erect and free of CBB based on high DS scores >5.0. There was a high level of CBB infection in this trial in contrast to test 9105 which showed higher levels of resistance among entries. The two check varieties Jaguar and Zorro yielded below the test mean. Future advances of many of these lines will largely depend on disease reactions and canning quality of the entries.

### **Expt. 9105: Preliminary Black Bean Yield Trial**

This 64-trial included new black bean lines along with check varieties. Yields ranged from 22 to 38 cwt/acre with a mean of 30 cwt/acre. Variability was moderate in this 3-rep test (CV=9.2%) and the LSD was 4.4 cwt/acre resulting in 14 lines that significantly outyielded the test mean including the Zorro check. Clearly resistance to CBB was a major factor in this test and a number of new lines showed good levels of resistance along with acceptable yield potential and upright plant architecture. Future advances of many of these lines will largely depend on disease reactions and canning quality of the entries.

### **Expt. 9106: Standard Great Northern Bean Yield Trial**

This 56-entry trial included MSU great northern breeding lines and standard commercial check varieties. The test ranged in yield from 17 to 35 cwt/acre with a mean yield of 28 cwt/acre. Variability was high (CV= 11.1%) resulting in a high LSD value (4.4 cwt/acre) needed for significance. Only four breeding lines significantly outperformed the test mean. Line G08217 which ranked 2<sup>nd</sup> in 2008 was in the top-10 entries but was not among the top 4-lines. The check varieties Matterhorn and Coyne performed below the test mean. The two bush Tebo beans Hime and Fuji were at the bottom on the test as they suffered major seed loss due to short plant stature as the trial is direct harvested. Included in the test were a few more upright Tebo lines (seed size 27-29 g/100 seed) that yielded above the test mean and are candidates for release as future Tebo varieties that are better suited for direct harvest. We encountered a major seed quality problem in many GN lines in 2009. A large number of lines exhibited severe 'fish-mouth' seed damage making them commercially unacceptable. This seed condition was not previously expressed at such a high incidence as was observed in 2009. Only those entries with larger seed size, improved dry seed quality and cracking resistance over Matterhorn will be advanced in 2010.

### **Expt. 9107: Standard Pinto Bean Yield Trial**

This 72-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 19 to 38 cwt/acre with a mean of 28 cwt/acre. There was greater variability (CV=13.5%) in this trial than in past years and the LSD needed for significance was 5.3 cwt/acre. The trial was direct harvested which would explain the higher variability and lower yield of the more prostrate check varieties, Buster and Othello. Only five entries significantly out-yielded the test mean and these included the new varieties Lariat and La Paz. Both Lariat and La Paz were among the latest maturing entries. Two sister lines with CBB resistance that were the top entries in 2008 were among the top 5 in 2009. Breeding line P07863 was the highest yielding pinto in the white mold trials in Montcalm in 2007 2008 and 2009 was in top 10. Other lines from the same cross exceeded the test mean, whereas a few were among the lowest yielding. The new varieties Stampede and Santa Fe yielded above the test mean, whereas the prostrate varieties Buster and Othello were among the lowest yielding. A few lines exhibited the fish-mouth defect but not with the same frequency as the GNs. Only those entries with more upright architecture and equivalent canning quality to Othello will be advanced in 2010.

### **Expt. 9108: Standard Pink and Small Red Bean Yield Trial**

This 56-entry trial included small red and pink breeding lines from MSU (R-S-prefix), standard commercial check varieties. The test ranged in yield from 17 to 33 cwt/acre with a mean yield of 27 cwt/acre. Variability was high (CV=10.8%) due to direct harvesting resulting in a LSD value (4.1 cwt/acre) for significance. Six lines significantly outperformed the test mean including three red and three pink lines. Despite the high yield some of these lines have been determined to be susceptible to BCMV and will be discarded. Some lines in the trial showed high levels of resistance to CBB but lacked the seed quality of Merlot, whereas others were highly susceptible, similar to Merlot. Check varieties Merlot and Sedona yielded above the test mean, whereas Brooks was lower than the test mean. The test was slightly lower yielding as this portion of the field had standing water early in the season. Reselections were made in Merlot in 2007 to remove the late maturing plants and the reselected line was similar to Merlot in yield and phenotype. Only those small red entries equivalent to Merlot and pink lines equivalent to Sedona in canning quality with BCMV resistance will be advanced in 2010.

#### **Expt. 9109: Preliminary Great Northern Bean Yield Trial**

This 36-entry trial includes new MSU great northern breeding lines (G09-prefix) and standard commercial check varieties. The test ranged in yield from 16 to 31 cwt/acre with a mean yield of 25 cwt/acre. Variability was high (CV= 11.1%) resulting in a high LSD value (4.5 cwt/acre) needed for significance. Only three breeding lines significantly outperformed the test mean and one family dominated this test. The trial was planted in a section of field that flooded during the heavy June rains, so plants were generally shorter which presented difficulties for direct harvest and probable lower yields. As in test 9106, seed quality problems were observed among these lines and only those entries with larger seed size, improved dry seed quality and cracking resistance compared to Matterhorn will be canned and advanced in 2010.

#### **Expt. 9110: Preliminary Pinto Bean Yield Trial**

This 30-entry trial includes new MSU pinto bean breeding lines (P09-prefix) and standard commercial check varieties. The trial ranged in yield from 20 to 31 cwt/acre with a mean of 24 cwt/acre. Variability (CV=11.7%) was high in this trial and the LSD needed for significance was 4.6 cwt/acre. Only the variety La Paz significantly outperformed the test mean, and yielded 3.2 cwt/acre above the next entry. Santa Fe yielded below the test mean. The trial was planted in a section of field next to test 9109 that flooded during the heavy June rains, so plants were generally shorter which presented difficulties for direct harvest and probable lower yields. Only those entries with more upright architecture, suitable for direct harvest and equivalent canning quality to Othello will be advanced in 2010.

#### **Expt. 9111: 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 42-entry trial

ranged in yield from 17 to 41 cwt/acre with a mean of 30 cwt/acre. Variability was high (CV=11.1%) resulting in a LSD value (5.4 cwt/acre) for significance. As a result only nine lines were significantly higher in yield than the test mean. The top yielding entries were all pintos included Lariat and ND307 varieties from ND and the 5<sup>th</sup> entry P07863 was the top yielding entry in the white mold trials in 2007-2009. The group included four lines from Colorado, and I08913 also topped the trial in 2008. Among the check varieties, Stampede, Croissant, Buster and Coyne yielding above the test mean, whereas Santa Fe, Sequoia, Othello, Max, Montrose, Jackpot, Hime and Fuji tebo yielded below the test mean. Many of the lower yielding checks have a decumbent type-III or short type-1 bush habit that is not suited for direct harvest. 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 2009.

#### **Expt. 9126: Commercial Pinto Bean Yield Trial**

This trial was conducted to test new commercial pinto bean varieties from Seminis and Ameriseed programs and access their potential in the Michigan. The 7-entry trial ranged in yield from 30-43 cwt/acre with a mean of 35 cwt/acre. Variability was well controlled (CV=4.4%) resulting in a very low LSD value (2.2 cwt/acre) for significance. Due to the small number of entries only one line was significantly higher in yield than the test mean. The top yielding entry P07863 was over 6 cwt/a higher than the next entry. Among the other varieties, Baja, Medicine Hat and Durango yielding above the test mean, whereas Santa Fe, Sonora, and Mariah yielded below the test mean. This was the highest yielding trial in 2009 and helped to confirm the yield potential under direct harvest of a number of full-season, high-yielding pinto bean varieties.

#### **Expt. 9212: Standard Bush Cranberry Bean Yield Trial**

This 36-entry trial was conducted on the Montcalm Research Farm to compare new and standard bush cranberry bean varieties under supplemental irrigation. Yields ranged from 15 to 31 cwt/acre with a mean of 24 cwt/acre. Variability was very high (CV=22%) in this test due to severe white mold pressure and the LSD needed for significance was high (7.4 cwt/acre). As a result no lines significantly outyielded the test mean. White mold was rated on 1-5 scale and ranged from low of 0.9 to high of 4.6. Despite the very high levels of white mold pressure, a family of full-sibs originating from cross X03516/C99804 all showed relatively high yield combined with lower disease ratings (<2). All check varieties, Hooter, T. Hort, Capri, Crimson and Hooter yielded below the test mean and exhibited high levels of white mold (>2). Two vine cranberry lines C06808 and Chianti were also severely infected with white mold and should not be grown under this irrigated management system. Only those entries equivalent to Capri in seed size with improved canning quality will be advanced in 2010.

#### **Expt. 9213: Standard Kidney Bean Yield Trial**

This 56-entry trial was conducted on the Montcalm Research Farm to compare the performance of standard and new light red kidney (LRK), dark red kidney (DRK) and white kidney (WK) bean varieties from MSU and CDBN under supplemental irrigation (5x total 2.9"). Yields ranged from 16 to 32 cwt/acre with a mean of 23 cwt/acre. Variability was high (CV=17.3%) resulting in a large LSD value (5.7 cwt/acre) needed for significance. Only one entry WK K08961 significantly

outyielded the test mean, yielding 4 cwt/a more than the next entry in 2009, while the same line ranked 4<sup>th</sup> in 2008. White mold was very severe in this test and check varieties CELRK and Redcoat yielded above the test mean, whereas Red Hawk, Chinook, Beluga and Montcalm yielded below the test mean. Two breeding lines from Puerto Rico, T-27 and T-28 showed potential and will be used as parents. 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 2010.

### **Expt. 9214: 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 7 times for a total of 3.9" to maintain adequate levels of moisture for favorable disease development at the critical flowering period. Natural white mold infection occurred across the entire trial and was extremely severe in certain plots. White mold was rated on a per plot basis on a scale of 1 to 9 based on disease incidence and severity where 9 had 90+% incidence and high severity index. White mold ranged from 20 to 67% and pressure was lower than in past years. The test ranged in yield from 10 to 34 cwt/acre with a mean yield of 23 cwt/acre. Variability was high (CV=16.1%), thus a high LSD value (6.0 cwt/acre) was needed for significance. Despite the variability, 13 lines significantly outyielded the test mean but overall yields were much lower in 2009 compared to data collected in 2007 and 2008. La Paz, Merlot, Lariat and Condor fell in the top group along with pinto line P07863 that was the top yielder in 2007 and 2008 and was entered in NSI trial. This line continues to demonstrate superior yield performance under white mold pressure. Among the entries in this top group were the two pinto lines P07757 and P07751 that ranked 1<sup>st</sup> and 2<sup>nd</sup> in 2007 and P07740 also showed excellent potential. Two pink lines S08410 and S08418 were the first pink lines to yield in the top group. K08961 white kidney that topped test 9213 fell in the top group also. The high yielding black lines entries (B07104, B05055) from past years and navy lines all yielded below the test mean in 2009. Sedona and Santa Fe yielded above test mean despite white mold pressure. Two cranberry lines yielded well above the test mean and showed white mold avoidance. One line C08714 was among highest yielding in test 9212. White mold resistance in G122 cranberry broke down (36%) in 2009 and G122 only yielded 18 cwt or 9 cwt/a less than two new bush cranberry lines. Large seeded white fabada bean K08920 with seed weight of 98g/100seeds yielded equivalent to G122. Among the varieties that produced disappointing yields below the test mean were Zorro, Jaguar, Coyne, Medalist, Stampede and Bunsii. Stampede pinto yielded only 15 cwt/a, less than half yield of Lariat and appears to be very susceptible to white mold (43%). WM31, CN605 had the lowest yields despite lower mold ratings. Almost all entries from NSI trial were among the lowest yielding lines in the test including the susceptible check, Beryl (99%). 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 and this trial will continue to be a vital part of the breeding effort to improve tolerance to white mold in dry beans.

### **Expt. 9215: White Mold Genetic Yield Trial**

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 AP630 developed from the cross of AN 37/P02630. The cross was made to introduce white mold resistance from AN 37 into the upright pinto line P02630 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 16 to 75% so disease pressure was high due to the cool wet season and additional 7 irrigations for a total of 3.9 inches to promote disease development. The test was planted in the same arrangement as test 9214. Yield ranged from 18 to 33 cwt/acre with a mean yield of 27 cwt/acre and yielded 13 cwt/a less than 2008. Variability was high (CV=15.2%), and a LSD value (5.9 cwt/acre) was needed for significance. Due to the high variability, only one line significantly outyielded the test mean and the results are similar to data collected in 2007 and 2008. Top entry was pinto line P07863 that was the top yielder in 2007 and 2008 so this line continues to demonstrate superior yield performance under white mold pressure. The two parents yielded below the test mean and many of the lowest yielding entries were similar in both years. A genetic mapping experiment to find markers associated with white mold resistance and high yield under white mold pressure in this population will be initiated. Elite lines will be included in standard pinto bean yield tests in 2010.

### **Expts. 9227: Drought Trial**

Two 36-entry trials were conducted in Montcalm to compare performance of new breeding lines from different programs in the U.S. and Puerto Rico under normal and drought stress conditions. Both trials were planted as 2-rep experiments and one trial was to receive no additional irrigation following flowering in order to induce drought stress. Excessive rainfall (4.74"-August) caused local flooding in the field resulting in partial loss of the expt. As a result a single 2-rep experiment was harvested as rainfall was abundant in 2009 and resulted in severe white mold infection in some plots and no drought stress. Yield ranged from 9 to 35 cwt/acre with a mean of 20 cwt/acre. Variability was high (CV=20.8%), and a LSD value of 8.2 cwt/a was needed for significance. As a result only three lines that significantly exceeded test mean. This group included Croissant pinto from CSU and two pinto breeding lines from Nebraska, but the test was dominated by pinto bean genotypes. Many of the other entries were new breeding lines from TARS program in Puerto Rico. The lowest yielding entries Onion and Marquis GN was the result of severe white mold infection.

### **Expts. 9817, 9818, 9819, 9820, 9921, 9922: Organic Dry Bean Yield Trials, KBS & Tuscola County**

Sixteen small-seeded and 16 large-seeded genotypes were evaluated for their performance in an organic production system. Side by side, organic and conventional, plots were planted in fields at Kellogg Biological Station (KBS), Kalamazoo County (Expts. 9817, 9818, 9819, 9820) and also in a commercial grower's fields in Tuscola County near Unionville (Expts. 9921, 9922, 9923, 9924). Organic plots were planted in certified organic fields whereas conventional plots planted on adjacent non certified land served as a control. Heavy rainfall in late June resulted in flooding of the conventional plots (Expts. 9923, 9924) in Tuscola, resulting in low stands and damaged plots so the trial was abandoned. Organic plots and conventional plots were identical in layout and genotypes included. Organic plots were managed using approved organic methods while traditional practices



were followed on conventional plots. Rainfall was adequate at Tuscola county (>4 inches in June) and created some localized flooding whereas July (<0.2inches) was extremely dry at KBS and plots required additional irrigation yet 7" fell in August, creating weed problems and regrowth. Despite these problems, yields at KBS were the highest over the 3-year test period. Yield for the small-seeded trials at KBS ranged from 17 to 35 cwt/acre for the organic experiment while the conventional trial had higher yields, with a range of 17 to 42 cwt/acre. The mean yield for organic was 27 cwt/acre with a mean yield of 31 cwt/acre for the conventional plot. There was considerable variability in both trials (18.8% organic; 23.9% conventional) resulting in high LSD values of 7.2 and 10.5, respectively, so only one genotype was significant in both trials. Variety Zorro was in the top 2- 4 entries in both tests. The large-seeded organic experiment at KBS yielded considerably less than the conventional. The average yield for the organic plots was 23.4 cwt/acre compared to 32.5 cwt/acre in conventional. There was considerable range in yield in each test, ranging from 12 to 33 cwt/acre for organic with the range from 20 to 43 cwt/acre for the conventional. Variability was higher in the conventional trial (19.2%) compared to the organic trial (13.7%). In the organic trial, three genotypes yielded significantly higher than the test mean, and these included Buster, Merlot, whereas CELRK had the lowest yield. In the conventional trial, only Buster yielded significantly greater than the test mean followed by Merlot and Sedona, whereas CELRK had the lowest yield. Yield was lower in the organic plots than conventional plots indicating that nutrients were a limiting factor and may be more of a more significant factor reducing yields in large-seeded beans.

In Tuscola County, small-seeded genotypes in the organic plots (test 9921) ranged in yield from 22 to 32 cwt/acre with a mean of 26 cwt/acre. Variability was high (CV=13.3%) and LSD need for significance was 5.0 cwt/a. As a result only one genotype Zorro significantly exceeded test mean. As expected the non-nodulating genotype, R99, was the lowest yielder in the test. The large-seeded genotypes in the organic plots (test 9922) ranged in yield from 12 to 30 cwt/acre with a mean of 21 cwt/acre. Variability was very high (CV=26.4%) and LSD need for significance was 7.7cwt/a. As a result only two genotypes significantly exceeded test mean and included Merlot small red and new upright pinto P06131. Other varieties that exceeded the test mean included Santa Fe, Sedona, Matterhorn, Capri, Red Hawk and Buster, whereas the lowest yielding entries were Beluga and CELRK. Overall yields were excellent in this trial despite some problems with white mold and ozone air pollution and those varieties with proven yield potential in conventional plots appear to be the best performers in the organic system. Lower yielding kidney beans are not recommended for organic production systems.

## **Early Generation Breeding Material grown in Michigan in 2009**

### **F3 through F5 lines**

Navy and Black - 904 lines  
Pinto - 392 lines  
GN - 316 lines  
Pinks and Reds - 110 lines  
Kidneys (DR, LR, White) - 337 lines  
Cranberry (bush, vine) - 309 lines  
Yellow Eye – 14 lines  
Flor De Mayo – 41 lines

### **F2 populations**

Navy and Black -193 populations  
Pinto - 101 populations  
GN - 63 populations  
Pinks and Reds - 148 populations  
Kidneys (DR, LR, White) – 84 populations  
Cranberry (bush, vine) – 90 populations

**F1 populations:** 576 different crosses among nine contrasting seed types.