

## **2017 DRY BEAN YIELD TRIALS**

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The dry bean breeding program initiated its ninth season on the 450 acre Saginaw Valley Research & Extension Center (SVREC) research farm near Frankenmuth MI in 2017. The MSU dry bean breeding and genetics program conducted 20 yield trials in 2017 in ten market classes and participated in the growing and evaluation of the Cooperative Dry Bean, Midwest Regional Performance, National Drought and the National Sclerotinia Nurseries in Michigan and winter nursery in Puerto Rico. The nurseries were planted in June 2017 into favorable soil moisture conditions, which continued through June. In July and August, trials received only 2.37” of rain during that 60-day period which hastened maturity and reduced overall yields. A major effort to expand evaluation of black beans with improved canning quality was made in 2017. A total of 3260 bean plots were trialed in 2017, 2590 plots at SVREC and 670 plots at the Montcalm Research Farm (MRF). In addition, selection for tolerance to drought stress during the extended dry period was possible in all nurseries based on performance under these conditions. Heavy rains (~5”) following planting at MRF resulted in plot loss and damage due to flooding but the surviving plots recovered and although maturity was delayed, overall yields were well above average. The same heavy rainfall patterns in the northern production area resulted in severe outbreak of anthracnose and resulting yield losses in growers’ fields. A new race of anthracnose was detected in Alcona County that overcame the resistance gene in Zenith. All current black, navy and small red bean varieties are susceptible to the new race, whereas most kidney bean varieties are resistant. The emergence of a new race of anthracnose has caused a refocus on the disease and breeding for resistance. However, the predominant race in Michigan is still race 73 and it is essential that all new varieties are resistant to this predominant race. The majority of black, navy and otebo breeding lines are resistant to race 73, but resistance in small red and pinto classes lags behind. One observation of the trials at SVREC was the shortening (dwarfing) of plant stature in the majority of trials. The heavy earlier rains following planting appears to have contributed to this dwarfing effect as it was also observed in production fields that received excessive rain following planting. Some varieties like Samurai otebo bean that normally stand 55 cm tall were rated at 48 cm in 2017. This dwarfing effect contributed to direct harvest losses in some lines.

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. 7101: Standard Navy Bean Yield Trial**

This 30-entry trial included standard commercial navy bean varieties, and advanced lines from the MSU breeding program, which carry the N-prefix. Yields ranged from 13.7 to 29.1 cwt/acre with a mean of 21.6 cwt/acre. Variability in this trial was moderate (CV=10.2%) and the LSD needed for significance was 2.6 cwt/acre. Four lines significantly out-yielded the test mean and included top yielding line N14229 from 2015 and 2016 trials. The top yielding entry had the highest agronomic rating (6.0) as it showed excellent dry down unlike many of the standard varieties that exhibited severe leaf retention. Yield potential in this cross was supported by sib N14230 which ranked 2<sup>nd</sup> in the trial. Merlin was the top variety in the trial and was among the top four entries. Two cultivars, Vigilant, and AAC Shock grouped above the test mean. Similar to past years, Medalist was among the lowest yielding varieties with Alpena and two lines from Puerto Rico. The low performance of Medalist results from severe leaf retention and failure to dry down. The inability of many varieties to mature uniformly was the result of the early drought stress resulting in the inability of the plants to set sufficient pod load (sink) to mature out normally. Canning tests will be conducted on all new MSU breeding lines before being considered for release.

### **Expt. 7102: Standard Black Bean Yield Trial**

This 48-entry trial included the standard commercial black bean varieties and advanced breeding lines. Yields ranged from 13.1 to 26.1 cwt/acre with a test mean of 21.6 cwt/acre. Variability was moderate in this test, (CV=10.1%) and the LSD was 2.6 cwt/acre. Six entries significantly outyielded the test mean and they included B16504, which ranked first in 2016. Black Bear was the top commercial variety at 22.2 cwt/acre and significantly outyielded Zenith, Zorro and Eclipse. The disappointing low yield of Zenith and Zorro was due to a seed emergence problem resulting from seed treatment that resulted in low stands. Zenith (26.2 cwt/acre) continues to outperform Zorro (23.0 cwt/acre) by 3.2 cwt/acre or 12% over 7 research trials in 2017. Entry PR1147-3 from Puerto Rico was the lowest yielding entry in the test. Canning tests will be conducted on new breeding lines to ensure only those with canning quality similar to Zenith are advanced.

### **Expt. 7103: Black Bean RIL Population 5 Yield Trial**

This 156-entry trial included recombinant inbred lines (RILs) developed by crossing Zenith with an advanced black bean breeding line, B12724, and inbreeding the progeny over several generations. This experiment was designed to determine the combining ability of two black beans that are known to possess excellent color retention when canned. Yields ranged from 16.6 to 31.7 cwt/acre, and the test mean of 26.3 cwt/acre was the same as Zenith, the top commercial variety in this test. Variability was low (CV=8.3%), resulting in a LSD of 3 cwt/acre. The B12724 parent yielded 24.1 cwt/acre, while the commercial checks Zorro and Eclipse yielded 23.4 and 22.9 cwt/acre, respectively. The entire RIL population was canned last year, and most lines maintained a dark black color after canning, some being darker than Zenith. Lines will be selected for this year's canning tests based on yield, agronomic, and previous canning data.

### **Expt. 7104: Black Bean RIL Population 76 Yield Trial**

This 156-entry trial included RILs developed by crossing an advanced black bean breeding line, B14311, with Zenith and inbreeding the progeny over several generations. The breeding line B14311 produces high yields, but turns an undesirable light brown color when canned. This experiment was designed to create a mapping population to identify which regions of the genome affect color retention of canned black beans. Yields ranged from 11.8 to 33.7 cwt/acre, with a test mean of 27.3 cwt/acre. Variability was low (CV=7.2%), resulting in a LSD of 3.2 cwt/acre. The parents of the population yielded 29.7 and 26.6 cwt/acre for B14311 and Zenith, respectively. Commercial checks Zorro and Eclipse yielded 25.2 and 24.5 cwt/acre, respectively. The entire RIL population was canned last year, and individual lines segregated dramatically for post-processing color retention. The entire RIL population will be canned again in 2018. The data will be used to find quantitative trait loci (QTL) and genetic markers that have the potential for use in marker-assisted selection for canning quality traits.

### **Expt. 7105: Black Bean RIL Population 86 Yield Trial**

This 156-entry trial included RILs developed by crossing two black bean advanced breeding lines, B14311 and B12724, and inbreeding the progeny over several generations. Line B14311 is high-yielding, but turns an undesirable light brown color when canned, while line B12724 is high-yielding and has canning quality comparable to Zenith. This experiment is designed to create a different mapping population than the one described above to identify which regions of the genome affect color retention of canned black beans in a different genetic background. Yields ranged from 20.4 to 36.0 cwt/acre with a test mean of 29.6 cwt/acre. Variability was very low (CV=6.2%), and resulted in a LSD of 3 cwt/acre. The parents of the population yielded 29.9 and 32.9 cwt/acre for B14311 and B12724, respectively. Commercial checks Zenith, Zorro, and Eclipse yielded 31.4, 27.8, and 26.5 cwt/acre, respectively, while the black bean breeding line B16504 topped the trial at 36.0 cwt/acre (over 10 cwt/acre more than in Expt. 7102). The entire RIL population was canned last year, and individual lines segregated dramatically for post-processing color retention and the entire RIL population will be canned again in 2018. The data will be used to find quantitative trait loci (QTL) and genetic markers that have the potential for use in marker-assisted selection for canning quality traits. Both line B12724 and Zenith both have excellent color retention, so using them as parents in separate populations may determine if they possess different QTL affecting this trait.

### **Expt. 7106: Black Bean RIL Population 11 Yield Trial**

This 108-entry trial included RILs developed by crossing an advanced black bean breeding line, B14302, with Zenith and inbreeding the progeny over several generations. Like the previously mentioned line B14311, B14302 is a high-yielder but a poor-canner. Additionally, B14302 may carry a gene that confers resistance to the new race of anthracnose discovered in Alcona County. Due to time and space limitations, this population cannot be used for a genetic mapping study, but can be used to identify recombinants with good yield, canning quality, and potentially anthracnose resistance. Yields ranged from 21.8 to 38.5 cwt/acre, with a test mean of 30.2 cwt/acre. Variability was very low (CV=6.2%), and resulted in a LSD of 3.1 cwt/acre. The parents of the population had nearly identical yields, at 27.5 and 27.8 cwt/acre for B14302 and Zenith, respectively.

Commercial checks Zorro and Eclipse yielded 25.7 and 22.2 cwt/acre, respectively. Selections have been made in this population for good agronomic characteristics without knowledge of canning performance. However, these RILs have undergone hyperspectral and Vis/NIR imaging data on dry seed in an attempt to create a model that predicts canning quality based on dry seed alone. This imaging data can be used along with yield and anthracnose resistance to guide selection of which lines to include in canning tests.

#### **Expt. 7107: Black Bean RIL Populations 31 and 45 Yield Trial**

This 72-entry trial included two RIL populations derived by crossing black beans with poor color retention after canning (B14302 & B14303) with black beans with good color retention (B12724 & Zenith). Due to time and space limitations, these populations cannot be used for genetic mapping, but can be used to identify recombinants with good yield, canning quality, and potentially anthracnose resistance from B14302-derived lines. Yields ranged from 16.8 to 33.0 cwt/acre, with a test mean of 24.5 cwt/acre. Variability was moderate (CV=10.3%), and resulted in a LSD of 4.2 cwt/acre. Zenith performed well, yielding 30.4 cwt/acre. These populations have been selected for agronomic traits more rigorously than Population 11 in Expt. 7106. The highest-yielding lines will be selected for canning quality prior to advancing to 2018 trials.

#### **Expt. 7108: Standard Great Northern Yield Trial**

This 42-entry trial included MSU great northern breeding lines (G-prefix) and standard commercial check varieties. The test ranged in yield from 12.0 to 26.0 cwt/acre with a mean yield of 20.7 cwt/acre. Variability was moderate (CV= 11.6%) resulting in a LSD value of 2.3 cwt/acre needed for significance. Eight entries significantly outperformed the test mean and included the new Samurai otebo variety. Samurai is an upright type suitable for direct harvest and is comparable in yield to current upright black and navy bean varieties. The test tended to group by maturity where early season lines (<90d maturity) were generally lower yielding. Powderhorn check variety was among the lowest yielding entries, matured earlier (88d) due to drought. Many of the new G17-lines will need to be retested to determine the adaptation under more normal growing conditions.

#### **Expt. 7109: Standard Pinto Bean Yield Trial**

This 36-entry trial included MSU pinto lines (P-prefix) and standard commercial check varieties. The test ranged in yield from 9.6 to 21.6 cwt/acre with a mean yield of 15.4 cwt/acre. Variability was high (CV= 15.5%) resulting in a LSD value of 2.8 cwt/acre needed for significance. Nine entries significantly outperformed the test mean and included La Paz and Eldorado. Included in the top group was PT9-5-6 from USDA-WA program and a new slow dark pinto (SDP) from MSU. Included in the test was a number of SDP lines due to the renewed emphasis on slow dark trait. Many of these lines/bulks underperformed including three new slow-dark varieties, Radiant, Palomino and Vibrant. The emphasis on incorporating this trait into pinto beans appears to be bringing along negative traits that are negatively impacting yield due to genetic linkage drag. Overall, the yield potential in this trial was very low.

### **Expt. 7110: Standard Small Red and Pink 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 13.5 to 27.9 cwt/acre with a mean yield of 20.8 cwt/acre. Variability was moderate (CV=11.3%) resulting in a LSD value of 2.8 cwt/acre for significance. The top nine lines included three sib-lines (R17603, R17604, R17605) plus three small red varieties Viper, Cayenne and Gypsy Rose that significantly outperformed the test mean, while Merlot, Desert Song, and Rosetta pink ranked below the mean yield. Seed size of Viper (35g) is significantly smaller than that of Merlot (43g) and Cayenne (39g). Two small red line OAC Rosito from Canada and SR10-2-1 from USDA-WA significantly under performed. Overall more progress was observed among the small red R- lines than the pink S-lines. 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. All lines will be evaluated for canning quality and BCMV reaction prior to advancing to 2018 trials.

### **Expt. 7111: Preliminary Otebo Yield Trial**

This 48-entry trial included MSU otebo breeding lines (G-prefix) and standard commercial check varieties. The test ranged in yield from 9.7 to 28.3 cwt/acre with a mean yield of 18.9 cwt/acre. Variability was high (CV= 14.1%) resulting in a LSD value of 3.6 cwt/acre needed for significance. Nine entries significantly outperformed the test mean and included the new Samurai otebo variety. Samurai is an upright type suitable for direct harvest and is comparable in yield to current upright black and navy bean varieties. Most of the G17-entries are derived from crosses with Samurai to introduce anthracnose resistance. The majority of entries carry resistance to race 73 and resistance to the new race discovered in 2017. Since this bean type is processed as bean paste in Japan the top yielding entries including Samurai are being tested for pasting properties and levels of resistance starch to ensure that they meet the quality standards of that industry.

### **Expt. 7112: 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 36-entry trial ranged in yield from 7.6 to 26.4 cwt/acre with a mean of 18.0 cwt/acre. Variability was moderate (CV=11.5%) resulting in a LSD value (2.8 cwt/acre) for significance. As a result, 13 lines were significantly higher in yield than the test mean including varieties Cayenne, Staybright, and La Paz. In the top group were pinto and great northern lines from MSU, USDA-WA (PT-prefix), Colorado, and NDSU. Staybright is a slow dark pinto that showed good agronomic adaptation. Performance of other slow darkening pintos COSD-7 from CSU and Palomino from NDSU was below average. Twin Falls was the best overall pinto from Idaho as the other two varieties Nez Perce and Blackfoot significantly under performed. This cooperative trial continues to be valuable as it allows an evaluation of potential new lines prior to release in other states. Canning quality will also be evaluated for all entries.

### **Expt. 7113: National Dry Bean Drought Nursery**

This 40-entry trial was conducted at the SVREC to evaluate a series of breeding lines identified through shuttle breeding between University Nebraska and USDA-TARS station in Puerto Rico as possessing improved levels of drought stress. The trial was replicated by colleagues at various locations across the US. Yields ranged from 8.1 to 24.5 cwt/acre with a mean of 16.6 cwt/acre. Variability was moderate (CV=10.9%) and the LSD needed for significance was 2.5cwt/acre. Eleven lines significantly out-yielded the test mean, including varieties Cayenne, Zenith, Croissant, Longs Peak, and Merlot, while Blackfoot was the lower yielding entry as in test 7112. Since drought was a factor in 2017, it was gratifying to see that new MSU varieties were in the top group. This suggests that continued selection for high performance under local precipitation patterns has resulted in materials that exhibit improved performance under stressful conditions.

### **Expt. 7214: Standard Kidney Bean Yield Trial**

This 64-entry trial was conducted on new ground on the Montcalm Research Farm (MRF) to compare the performance of standard and new light red kidney (LRK), dark red kidney (DRK), white kidney (WK), varieties from MSU and CDBN under supplemental irrigation (10x total 5.4”). A prominent feature of this trial was lack of root rot disease pressure as noted in past years and lack of deer feeding due to erection of a deer fence. Yields ranged from 29.0 to 43.2 cwt/acre with a mean of 35.6 cwt/acre. Variability was low (CV=9.4%) resulting in a LSD value of 3.9 cwt/acre needed for significance. Eleven entries significantly out-yielded the test mean, including the varieties Chaparral, Beluga, and a new WK line ND122386 from NDSU. Varieties Clouseau, Dynasty, Talon, Red Rover and Rosie were above the test mean, while Red Hawk, Montcalm, Red Cedar, Snowdon and CELRK fell below the mean. Both Snowdon and Red Cedar has seed quality problems, which resulted in poor emergence and low stands, which contributed to the lower yields. These results provide a comparison of all current red and white kidney bean varieties.

### **Expt. 7215: Preliminary Kidney Bean Yield Trial**

This 48-entry trial was conducted to compare the performance of new kidney bean lines from MSU grown under supplemental irrigation (10x total 5.4”). A prominent feature of this trial was lack of root rot disease pressure as noted in past years and lack of deer feeding due to erection of a deer fence. Yields ranged from 28.8 to 49.9 cwt/acre with a mean of 38.9 cwt/acre. Variability was moderate (CV=10.9%) in this 3-rep experiment resulting in a LSD value of 5.8 cwt/acre needed for significance. Only four lines significantly outyielded the test mean and these are all new K17-lines. The group included two WK sibs and two half-sibs one WK and one DRK. Clouseau yielded above the test mean while Red Hawk, Red Cedar and Snowdon varieties dropped below the test mean. There was no difference in yield between Red Hawk and Red Cedar, other than Red Cedar showed good levels of CBB resistance. Since canning quality is vital in kidney beans, only those lines equivalent in canning quality to check varieties will be advanced in 2018.

### **Expt. 7216: Standard Yellow Bean Yield Trial**

This 28-entry trial was conducted on new ground at MRF to compare the performance of new yellow bean lines from MSU under supplemental irrigation (10x total 5.4”). This is the first yellow bean trial conducted with MSU lines (Y-prefix) and new varieties from programs in the US and Canada. Yields were exceptional despite the fact that portions of the trial were lost due to flooding following planting. Yields ranged from 29.2 to 54.2 cwt/acre with a mean of 38.2 cwt/acre. Variability was moderate (CV=9.2%) resulting in a LSD value of 4.1 cwt/acre needed for significance. Seven lines significantly outyielded the test mean and these included the new Patron variety, its sib (DBY-28-1), a private variety SVS-0863, three lines from the MSU program and AAC Y012 from Canada. This is the first yellow bean test with new MSU lines that all carry I-gene resistance to BCMV. The AAC lines are susceptible to BCMV. These results are initial efforts to breed adapted yellow beans and retain the strong yellow seed color of the Mexican Peruano, Azufrado, Mayacoba seed types. The virus resistance in all new lines will be verified and the lines will be canned before being advanced in 2018.

### **Expt. 7217: National White Mold Yield Trial**

This 35-entry trial was conducted 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, USDA-WA, and Guelph. 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 17times for a total of 7.8” to maintain adequate levels of moisture for favorable disease development at the critical flowering period. The trial was planted on old bean land previously infected with white mold. The trial was badly damaged by flooding following planting so harvest was restricted to surviving plots, which had variable levels of white mold infection due to differences in plant vigor. The test ranged in yield from 2.6 to 40.8 cwt/acre with a mean yield of 22.2 cwt/acre. Variability was high (CV=14.6%), thus a high LSD value (4.4 cwt/acre) was needed for significance. Twelve lines significantly out-yielded the test mean and included Zenith and a large number of new B16-black bean and P16-pinto lines. Kidney beans were among the lowest yielding entries similar to previous years, but root rots may have been a contributing factor. This trial will continue to be part of the breeding effort to improve tolerance to white mold in future varieties in 2018.

### **Expt. 7218: White Mold x Fertility Trial**

A small trial was conducted to see the interaction between N-fertility levels on the incidence of white mold in two contrasting bean cultivars, Zenith black and Viper small red. Both varieties have similar growth habits and maturities but differ in reaction to white mold. Zenith shows greater level of resistance to white mold. The trial was conducted adjacent to test 7217 and received the same irrigation amounts (17x, 7.8”). Three N-treatments, 20 lbs/a, 40 lb/a and 80 lbs/a were applied to each variety across 4 replicates. White mold developed and appeared to more severely infect the Viper variety, incidence of 40% versus 11% for Zenith (Table 1). However, Viper outperformed Zenith at all N treatments. This was due in part to a seed quality issue with Zenith.



Viper germinated at 97%, while Zenith germinated at 64%. The trial was damaged earlier by flooding which contributed to the high CV. The yield increase due to an additional 40 lb N over the 20 lb N base was 9% similar across varieties, but significantly lower than the 27% observed in 2016. Interestingly there was no gain by applying 80 lb N compared with the 40 lb N recommended rate. In fact, a small but non-significant decrease was observed. Based on the data, the increased rate of N does not appear to contribute to higher white mold ratings; in fact, the highest white mold rating was observed at the recommended 40 lb rate. The work needs to be repeated in 2018.

### **Expt. 7219: Iowa State Yield Trial**

This small 4-entry trial was a collaboration with Iowa State University who were evaluating four contrasting bean types at a number of locations across the US to determine the effects of location on mineral element content of the seed. The four varieties were the yellow bean MY 06326, Taurus great northern, Eclipse black and Montcalm DRK. Yields were exceptional and MY 06326 now holds the record yield of 58.6 cwt/acre at the MRF. Yields ranged from 37.3 to 58.6 cwt/acre with a mean of 47.9 cwt/acre. Variability was well controlled (CV=4.2%) resulting in a LSD value of 3.3 cwt/acre needed for significance. Only the yellow bean significantly outyielded the test mean. MY 06326 is a private variety licensed by the Kelley Bean Company and bred by Provita, but it is susceptible to BCMV. The surprising high yield of the yellow bean would suggest that this market class could be grown successfully in the Montcalm area. This is also supported by the high yields recorded in the yellow bean test 7216.

### **Expt. 7220: Yellow Bean Root Rot Yield Trial**

This small 6-entry trial was conducted on land at MRF that had exhibited serious root rot problems in prior years. The purpose was to compare few elite yellow bean lines under root rot conditions as past observations showed them to be more resistant than kidney beans. Yields were reduced substantially compared to test 7216 on new land. Yields ranged from 22.5 to 36.2 cwt/acre with a mean of 28.4 cwt/acre. Variability was surprisingly low (CV=4.7%) resulting in a LSD value of 2.9 cwt/acre needed for significance. Two lines significantly outyielded the test mean and these were the same high yielding lines in test 7216. The new Patron variety dropped 30 cwt between tests and the overall test mean was 10 cwt less than test 7216. These results continue to underscore the importance of overall soil health for successful bean production and the yield losses that soil borne pathogens can cause.

### **Early Generation Breeding Material grown in Michigan in 2017**

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

Navy and Black - 153 lines  
Pinto - 30 lines  
GN - 27 lines  
Pinks and Reds – 22 lines  
Kidneys (DR, LR, White) - 59 lines

#### **F2 populations**

Navy and Black -149 populations  
Pinto - 83 populations  
GN & Tebo - 34 populations  
Pinks and Reds - 28 populations  
Kidneys (DR, LR, White) - 98 populations  
Yellow – 67 populations

**F1 populations:** 371 different crosses among ten contrasting seed types.

**Table 1. Expt. 7218: White Mold x Fertility Trial**

Variety	Yield & Seed Size							
	Yield cwt/acre				100 seed weight (g)			
N rate	20 lb	40 lb	80 lb	Mean	20 lb	40 lb	80 lb	Mean
Zenith	25.1	27.9	27.7	26.5	24.1	24.3	24.8	25.1
Viper	29.6	32.1	31.7	31.0	30.6	30.8	30.8	31.0
Mean	27.2	29.6	29.5	28.7	27.7	28.2	28.1	28.0
LSD .05			4.4	3.6			0.96	0.79
CV%				17.2				3.8

Variety	White Mold Ratings							
	Disease Incidence %				Disease Index DIX			
N rate	20 lb	40 lb	80 lb	Mean	20 lb	40 lb	80 lb	Mean
Zenith	9.0	19.0	5.8	11.3	7.1	14.1	1.4	7.5
Viper	35.0	45.7	40.0	40.2	24.7	39.1	26.4	30.1
Mean	22.0	32.4	22.9	25.7	15.9	26.6	14.9	18.8
LSD .05			22.2	12.9			17.9	10.4