

Evaluation of Soybean Germplasm Under Pennsylvania Conditions

Final R2617-P07
NDB ✓

Project PSB R2017-07

Final Report

March 15, 2018

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In 2017, Penn State soybean evaluation trials were conducted at three locations: Blair, Centre, and Lancaster Counties.

On May 16th, at the Russell E. Larson Agricultural Research Center in Centre County, we planted 17 varieties in the RR Early Maturity Group (MG 3.0 and earlier) trial and 20 entries in the Non-RR trial. The 20 non-RR entries included 4 RR varieties, which were used as check plots. On May 19th, we planted 26 varieties the Centre County Late MG trial (MG 3.1 and later). All trials were planted in the same tilled field, but the late MG trial was planted on the opposite end of the field from the other trials, where soil conditions were not as favorable. On October 17th, the early MG trial was harvested and averaged 68.4 bushels per acre. On October 23rd, the late MG and Non-RR trials were harvested and averaged 63.2 and 60.0 bushels per acre respectively. The yields in the non-RR trial were approximately 15% lower when compared to 2016 and both RR trials were comparable to 2016 yields in the same trials.

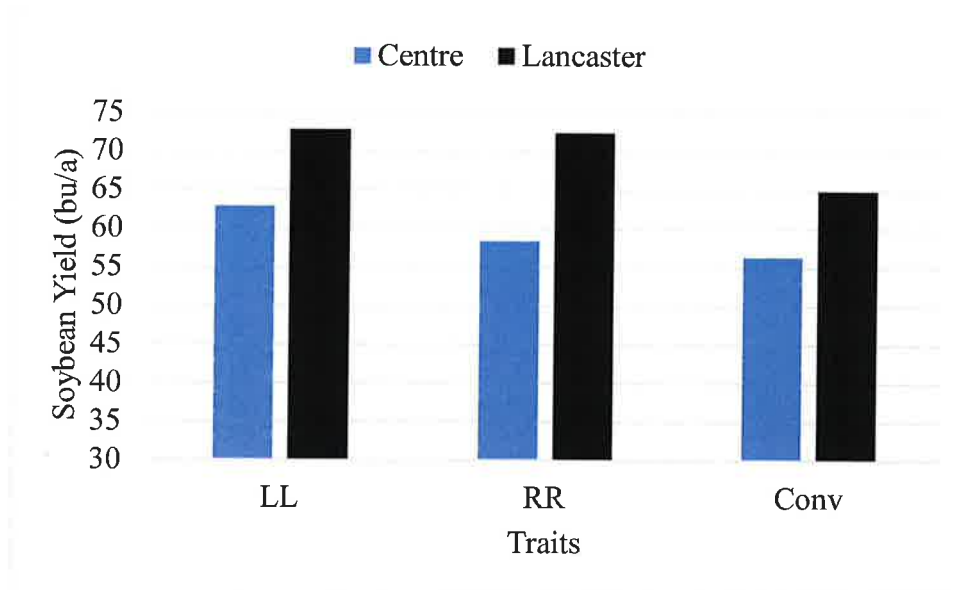
On May 17th, at the Southeast Agriculture and Research Center in Lancaster County, we planted 24 varieties in the non-RR trial, including 4 non-RR varieties to be used as check plots. On May 18th, we planted 18 varieties in the RR Early MG trial and 28 varieties in the RR Late MG trial at the same location. On July 17th, we planted 14 varieties in our Double-Crop trial in Lancaster County. All trials were planted into tilled ground. On October 19th, the early and late MG trials were harvested and averaged 64.3 and 70.1 bushels per acre respectively. On October 20th, the non-RR trial was harvested and averaged 71.1 bushels per acre. On November 15th, the Double-Crop trial was harvested and averaged 41.5 bushels per acre. The full-season RR trial yields were up considerably – approximately 30% - compared to the 2016 yields of the same trials. The yields of the non-RR trial and the Double-Crop trial were comparable to the 2016 yields of the same trials.

On May 23rd, on a private farm in Blair County, we planted 19 entries in the RR Early MG trial and 22 entries in the RR Late MG trial. Unfortunately, all plots at the Blair County trials experienced severe slug damage early in the growing season. The end result was stand losses estimated to be between 50 and 75 percent and therefore we had no choice but to abandon these trials.

Growing conditions in Centre County during May were wetter than normal, with almost 8 inches of rain. This was followed by near normal rain in June and over 8 inches of rainfall in July. By the second half of August as well as much of September, conditions were dryer than normal and most likely reduced pod-fill to some degree. Growing conditions at the Lancaster County trials could be summarized as having adequate rainfall throughout the season, with relatively few dry spells. Each month during the growing season had at least 4 inches of rain and July received approximately 5 inches. The adequate rainfall and near normal temperatures in Lancaster contributed to the respectable yields in these trials.

We have seen a gradual increase in the number of non-RR varieties being entered into our tests in recent years and the biggest increase has been the number of Liberty Link (LL) entries. Many of the LL varieties have achieved respectable yields and have yielded as well or better than commonly grown RR check varieties in the same trials (Figure 1). In the Rock Springs non-RR trial in 2017, the average yields of the different traits were as follows: 10 LL varieties averaged 62.9 bu/ac; 4 RR2 varieties averaged 58.4 bu/ac; 6 non-traited varieties averaged 56.4 bu/ac. In the 2017 Lancaster non-RR trials, the different traits averaged as follows: 15 LL varieties averaged 72.8 bu/ac; 4 RR2 varieties averaged 72.4 bu/ac; 4 non-traited varieties averaged 64.9 bu/ac.

Figure 1. Yields of Liberty Link (LL) soybean lines in the non Roundup Ready trials in Centre and Lancaster Counties compared to roundup Ready check varieties and conventional non traited lines.



Results of the complete variety trials were posted on the Penn State Extension website at: <https://extension.psu.edu/2017-soybean-variety-trials>

A second phase of our 2017 project was to conduct seeding rate trials in both full-season (Centre County) and double crop soybeans.

Centre County

A full season soybean seeding rate trial was planted in Rock Springs on May 24, 2017. Six varieties were planted at four different seeding rates in a split plot design with variety as the main plot and seeding rate as the sub-plot. The six varieties chosen were Channel 3318R2X, Hubner 3437R2X, Growmark HS33A44, Chemgro 3346R2, Bayer 3548 LL, and Southern Harvest 3516LL. The seeding rates that were evaluated were 80,000 seeds/acre, 110,000 seeds/acre, 140,000 seeds/acre, and 170,000 seeds/acre. The trial was harvested on October 22nd and 23rd.

Within a week of planting there was approximately four inches of rain and cool temperatures, causing emergence to be much slower. By the time the soybeans were trying to emerge, the soil surface was crusted over which led to stand issues. A rotary hoe was used to break up the crust and help more beans get out of the ground but ultimately the stands were still less than ideal.

Plant populations were determined for each variety at each seeding rate based on stand counts that were done on June 21st. The Southern Harvest variety 3516LL had the highest plant population at each of the seeding rates that were planted. The best emergence percentage for any combination of variety and seeding rate was 53 percent for the Southern Harvest 3516LL planted at 170,000 seeds/acre.

Table 1. Final stands for each of the six varieties in the full season seeding rate trial in 2017.

	Population				Average across SR
	80K	110K	140K	170K	
Growmark HS33A44	31034	37612	40518	47764	39232
Chemgro 3346R2	28118	42057	45783	57855	43453
Channel 3318R2X	31270	37382	45999	55757	42602
Hubner 3437R2X	35007	36635	47554	47568	41691
Bayer 3548 LL	31697	44431	50326	61158	46903
Southern Harvest 3516LL	36765	51924	60636	90256	59895
	32315	41673	48469	60060	45629

Yields were determined not only for each variety and seeding rate but also for each variety across seeding rates and for each seeding rate across all varieties (Table 2). As expected, the yield across all varieties increased each with increasing the seeding rate. Overall, the Bayer 3548 LL had the highest average yield across all seeding rates at 45.3 bu/ac and the Hubner 3437R2X had the lowest average yield across all seeding rates at 31.5 bu/ac. Both the varieties and the seeding rates showed significant differences in the yields but there was no significance in the interaction. This means that none of the varieties responded differently to seeding rates or “bushed out” more than others. As in our variety trials, the LL varieties in this trial appeared to yield as well or better than RR varieties.

Table 2. Soybean yields for each of the six varieties in the full season seeding rate trial in 2017.

	Yield (bu/ac)				Average across SR
	80K	110K	140K	170K	
Growmark HS33A44	32.8	39.6	38.2	41.7	38.1
Chemgro 3346R2	33.3	37.7	41.2	45.5	39.4
Channel 3318R2X	29.1	38.7	37.0	38.3	35.7
Hubner 3437R2X	29.7	26.0	35.2	34.9	31.5
Bayer 3548 LL	38.3	45.9	48.8	48.1	45.3
Southern Harvest 3516LL	37.8	44.4	44.1	48.3	43.6
Mean	33.5	38.7	40.7	42.8	

Seeding Rate LSD (.05) = 2.8

Seeding Rate LSD (.20) = 1.8

Variety LSD (.05) = 4.1

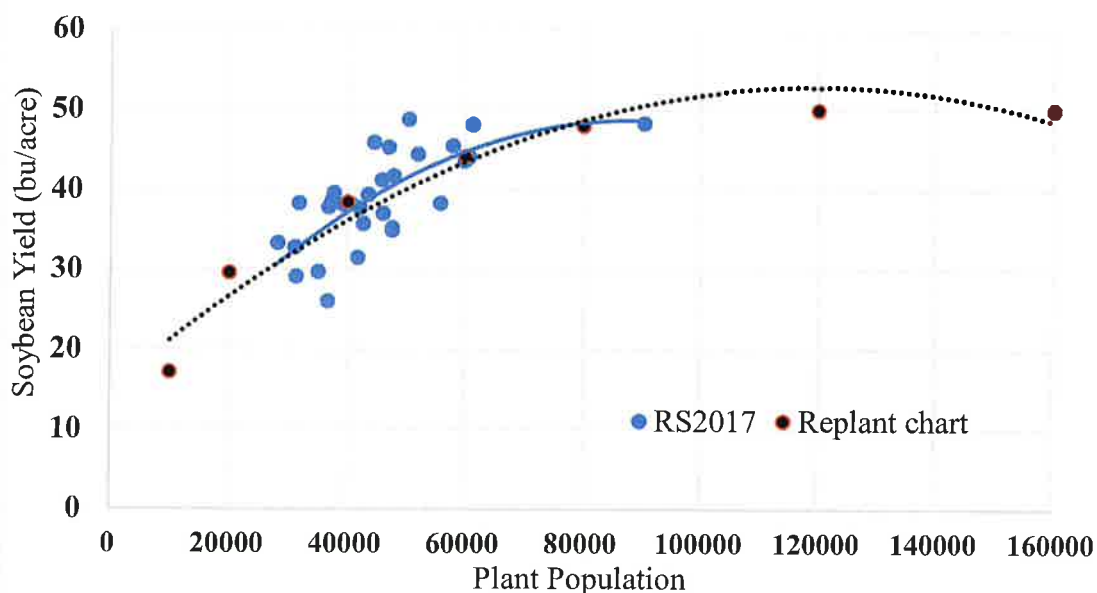
Variety LSD (.20) = 2.6

Variety x SR = NS

CV % = 15.9

We plotted the yields and plant populations (Figure 2) to determine the average response curve for increasing plant populations. Then we plotted the predicted response based on a Purdue University replant chart (one with very low plant populations) for drilled soybeans, assuming a maximum yield of 50 bu/acre. We found that the curves matched very closely. This helps to verify the replant chart data, which suggests that a 40000 stand of soybeans will still yield about 38 bu/acre in a 50 bu/acre yield environment. So despite the poor emergence in the trial we were able to find some useful information from this effort.

Figure 2. Yield response to plant populations for the full season seeding rate trial at Rock Springs in 2017 (RS2017) compared to a predicted response from a Purdue extension replant chart.



Lancaster County

On July 13th, a double crop soybean seeding rate trial was planted in Landisville after wheat. Again six varieties were chosen and the four seeding rates were increased to 110,000 seeds/acre, 140,000 seeds/acre, 170,000 seeds/acre, and 200,000 seeds/acre. The varieties planted in this trial were Hubner 3437R2X, Growmark HS33A44, NK Brand S35C3, Hubner 3813R2, Bayer 3233 LL, and Bayer 3841 LL. This trial was also a split plot design in which variety was the main plot and seeding rate was the sub-plot. The trial was harvested on November 15th.

After the soybeans were planted on July 13th, the average high temperature for the rest of the month was 84.9 °F and it rained 3.15 inches. The seed benefitted from the warm temperatures and available moisture and did not take long to emerge. August and September were both warm with average high temperatures of 80.2 °F and 76.9 °F, respectively. It rained 3-4 inches in Landisville during both months with 4.14 inches in August and 3.37 inches in September. October was not quite as warm with an average high temperature of 69.8 °F but there was still moisture available as it rained 3.88 inches throughout the course of the month. The warm temperatures and rain that came after planting caused the percent emergence to be much higher than it had been in Centre County in the spring.

Stand counts for every variety and seeding rate were done on August 2nd to determine the plant populations and percent emergence. Emergence averaged 72.5% across the trial and declined slightly as planting rates increased. Among varieties, the NK Brand S35C3 variety had the highest plant population at three out of the four seeding rates (110K, 170K, and 200K) while the Hubner 3437R2X had the highest plant population at 140,000 seeds/acre. Overall, the best emergence percentage was 87 percent for the NK Brand S35C3 planted at 110,000 seeds/acre.

Table 3. Final stands for each of the six varieties in the double crop seeding rate trial in 2017.

	Population				Average across SR
	110K	140K	170K	200K	
Growmark HS33A44	81759	98289	109459	120925	102608
Bayer 3233 LL	82205	99481	116309	139541	109384
Hubner 3437R2X	86822	110650	121670	139243	114596
NK Brand S35C3	96055	107076	125989	145498	118654
Hubner 3813R2	81312	96055	123011	136563	109235
Bayer 3841 LL	85333	109310	119734	133286	111916
Mean	85581	103477	119362	135843	111066
Emergence (%)	77.8	73.9	70.2	67.9	72.5

The yields that were determined for every variety and seeding rate combination are shown along with the averages across all varieties and seeding rates (Table 4). As was the case at Rock Springs, the yields at Landisville increased as the seeding rate was increased. The Bayer 3841 LL had the highest average yield across all seeding rates at 39.6 bu/ac. On average across all seeding rates the lowest yielding variety was Growmark HS33A44 at 34.1 bu/ac. There was a tendency for the longer maturity soybean lines to yield more in this double crop trial and this is a pattern we have seen in the past. Also, as in our other variety tests the LL varieties appeared to yield as well as comparable maturity RR lines.

Unlike the trial at Rock Springs, the interaction between variety and seeding rate at Landisville was significant. This occurred because varieties had different response curves to seeding rates as show in Figure 3. Four of the varieties appeared to be reaching a maximum yield at the 200K seeding rate while two others seemed to be increasing. Thus for the majority of the varieties, we were reaching yield plateau near 135,000 plants per acre which is substantially less than our recommended level of 200,000 plants per acre and suggests there may be some potential to reduce soybean population recommendations.

Table 4. Soybean yields for each of the six varieties in the double crop seeding rate trial in 2017.

	Yield (bu/ac)				Average across SR
	110K	140K	170K	200K	
Growmark HS33A44	30.6	32.6	35.3	38.0	34.1
Bayer 3233 LL	33.0	38.8	35.7	40.2	36.9
Hubner 3437R2X	35.0	35.0	37.3	42.1	37.3
NK Brand S35C3	36.7	36.4	40.6	39.5	38.3
Hubner 3813R2	34.6	36.7	41.2	40.1	38.1
Bayer 3841 LL	36.1	37.5	43.2	41.7	39.6
Mean	34.3	36.2	38.9	40.3	

Seeding Rate LSD (.05) = 1.3

Seeding Rate LSD (.20) = 0.8

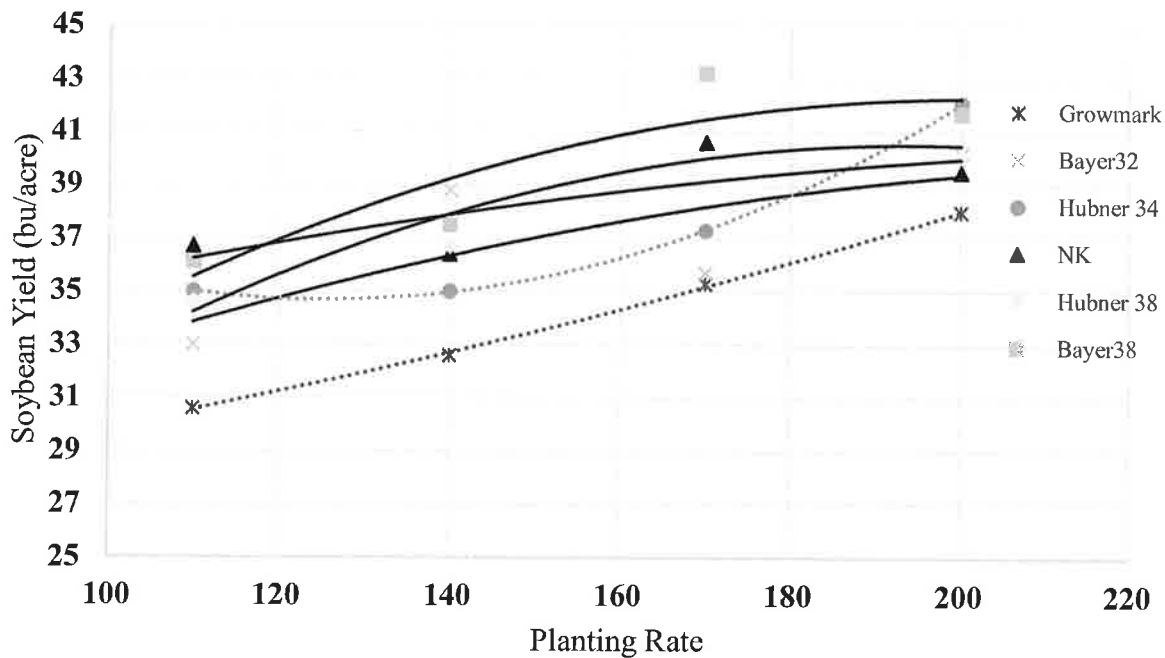
Variety LSD (.05) = 18.9

Variety LSD (.20) = 4.6

Variety x SR (p = 0.01)

CV % = 13.8

Figure 3. Yield response to plant populations for the double crop seeding rate for each of the varieties.



Overall, the population trials resulted in population responses that were similar to those expected based on previous work, but final plant stands were too low in general to reach the maximum yields in both studies. The evidence from these trials supports the ideas that optimum plant populations in full season soybeans are 100-120K and in double crop 150K. This confirms the need to assess final stands and adjust seeding rates accordingly. The studies also confirmed what we have seen in other studies: comparable yields of LL lines compared to RR lines and some yield advantage of fuller season soybeans in double crop environments.

For more information, please feel free to contact Mark Antle at (814) 360-7831 or Greg Roth at (814) 863-1018.