MISSISSIPPI SOYBEAN PROMOTION BOARD
PROJECT NO. 06-2017 (YEAR 1)
2017 ANNUAL REPORT

Project Title: Stepwise Evaluation of High Technology Production Systems by Omission Research Techniques

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BACKGROUND AND OBJECTIVES

Soybean production in Mississippi was first reported in 1924 when 45,000 acres were planted; 21,000 acres were harvested for grain with an average yield of 8.0 bu/acre. Soybean was initially brought into this country as a protein hay crop and was used that way until well into the 1950's. The first one-million acre crop was harvested in 1961 and averaged 22.5 bu/acre. The peak acreage reached 4.1 million acres harvested in 1979 with an average state yield of 29.0 bu/acre, the largest state average in Mississippi history at that time.

State acreage declined after that, and by 1990 harvested acreage dropped to 1.9 million acres. After the turn of the century, harvested acres dropped to 1.12 million acres in 2001. In the last five years, soybean plantings have exceeded 2.0 million acres and in the same five years state average yields have been over 45 bu/acre. In 2014 and 2017, average soybean yields in the state were 52.0 and 53.0 bu/care, respectively. Grain crop rotations (corn and soybean) have become a standard on many farms across the Mid-south.

Much of the yield advantage has come with the adoption of the Early Soybean Production System (ESPS) that has successfully moved planting dates earlier into late March through April, moved to earlier maturity groups, and profited from irrigation even in an area that receives more than 50 inches of annual rainfall. While annual rainfall is plentiful, the distribution of timely rain often is not.

New technologies have seed-carried traits for insect, weed, and disease control that have increased seed cost but decreased other application and material costs. While much of the country has moved to narrower row spacings (30 inches or less), the Midsouth has not made the shift. Much of the irrigated production has continued to be grown on raised beds that facilitate getting water off the field (drainage) as well as getting water on the field (irrigation).

The decline in soybean acreage was generally on fields less suited to above-average soybean yields and better suited for trees and other mechanisms of conservation reserve. In order to take advantage of early planting and potential for narrower rows, many growers in the Midsouth adopted twin-row production (planting two rows on the same bed) systems in various forms. Having two rows that are 8-10 inches apart on 38-40-inch-wide raised beds have in effect created the 30-in-wide rows without every row being 30 inches apart.

As soybean yields increased, the amount of nutrients contained in the increased amount of harvested seed has also increased; these nutrients thus leave the field at harvest. For many years, much of the soybean acreage was not fertilized, with most fertilizer money going toward cotton being grown on the sandier soils. As yields increased and

nutrient uptake and removal also increased per acre, greater emphasis has been placed on soil sampling and following recommendations. Soil pH, phosphorus, and potassium adequacy are essential for optimum yields.

Many others are important for achieving optimum yields with many "automatic" inputs used without scouting or testing. The purpose of this research project is to evaluate some of the automatic inputs, including fungicide application, P and K, N and S, and dessication. Making applications when not needed add to the cost of production. Input costs are better utilized when needed and offer greater potential for return on investment. Planting equipment available to producers has been improved to insure more uniform planting and more equal spacing between plants. Maintaining optimum yields and reducing input costs lead to increased profitability. The whole plots for the main studies are based on seeding rates (8 or 12 seed/ft) planted in single-row or twin-row planting patterns.

Objective 1: Determine through stepwise (addition or removal) integration the value of specific inputs to both agronomic and economic productivity of soybean.

Objective 2: Evaluate the systems under rain-fed and irrigated conditions.

Objective 3: Determine the overall importance of input factors over time and from season to season and also evaluate the economic implications

OBJECTIVE 1 METHODS AND RESULTS

Multi-year field studies were initiated in the spring of 2017 on the Delta Research and Extension Center near Stoneville, MS to evaluate stepwise omission research techniques for determining the agronomic and economic impact of technology inputs. Current plot plans for the studies have been included (Appendix A). In the future, the goal is to add a nonirrigated location now that funding for the project has been secured.

The basis for the 2017 project involves single-row (SR) and twin-row (TR) planting at a low plant population (8 seed/ft of row) and at a high plant population (12 seed/ft of row). The actual seeding rate varies somewhat depending on the planter used. The SR-L, SR-H, TR-L, and TR-H constitute the whole plots with fungicide, desiccation, fertilizer P-K, and fertilizer N-S as the subplots. The priority of the used inputs was based on discussions with the state soybean specialist. These treatments were also based on practices deemed routine without scouting (see plot plans for complete treatment list).

Soybean cultivar "Credenz 4748 LL" was planted on 25 April on a stale seedbed that was rowed up in the fall of 2016. Singe-row planting was with a John Deere planter with seeding rate calibrated prior to planting (SR-L = 104,500 seed/acre and SR-H = 156,800 seed/acre). Twin-row planting was completed with a Monosem twin-row planter and seeding rates were based on the Monosem Application for smart phones. The row configuration by seeding rate systems were planted as strips across the field in order to maintain drainage and irrigation channels.

A summary of rainfall totals (daily) and rainfall events has been included in Table 1, with 57.7 inches of rain recorded between 1 January 2017 and 31 December 2017. The total rainfall events in each month and events with greater than one inch falling in a 24-hr period are also included. June, July and August rainfall were above normal while the 10.74 inches in August set an all-time record for August (8.25 inches above the 30-yr average). September through December rainfall was more than 2 inches below normal in each month (10.08 inches below normal). Below normal rainfall could impact soil moisture recharge but that can easily be overcome by spring rainfall in the Midsouth. January 2018 rainfall was 1.8 inches below normal, but total rainfall for February and March was 13.53 inches above normal.

Once the base whole plots were established, the area was divided into two studies, 17-SB34 (Addition) and 17-SB35 (Subtraction). The subplots were then set up within each study. Phosphorus (P) and potassium (K) were applied at rates of 100 lb P_2O_5/acre and 100 lb K_2O/acre, respectively on 31 May. Ammonium sulfate at 100 lb/acre was also applied to selected treatments per protocol, also on May 31. All fertilizer additions were made from pre-weighed bags applied as a simulated broadcast application (hand-applied) to the surface following the method preferred by producers.

Fungicide application to selected plots was made on 12 July utilizing Quadris Top® SBX applied at 7.5 oz/acre. This fungicide offers broad-spectrum preventive and curative disease control with two different modes of action. Application was broadcast-applied by ground applicator. The desiccation treatment was applied on 8 September using Gramoxone @ 16 oz/acre of product (15 day pre-harvest interval) with anticipated harvest two weeks later. Due to combine availability problems, plot harvest was delayed until 4 October for 17-SB34 and 5 October for 17-SB35, about two weeks later than planned.

The center two rows of each 4-row plot were harvested, with sub-samples collected at the time of harvest. Harvest moisture, bushel test weight, and Seed Index (100-seed weight) were determined from the samples. Also, with the delay in harvest and the use of fungicide as a treatment, purple stain numbers were determined on the three 100-seed samples used to determine Seed Index. This was done by visual observation and counting of damaged seed based on the recommendations of Drs. Allen and Wilkerson (Plant Pathology).

Grain yields were adjusted to 13% moisture for all soybean samples. The data were then subjected to an Analysis of Variance. If the interactions were not significant, then the error terms were pooled (error estimates are the same) and LSD's were calculated for all treatments (Tables 2 and 4).

Soil samples were collected from each plot in both studies. The samples were collected, dried, and ground. The samples were submitted to the Southern Soils Laboratory in Yazoo City, MS with turn-around in less than a week. Since N, P, K, and S are components of the study, no additional fertilizer will be applied until the study has been completed. Since this area is irrigated from a well, no lime should be required but will be added if needed.

In the addition study (17-SB34), plot grain yields ranged from a low of 44.1 to a high of 64.0 bu/acre, with a field average of 56.4 bu/acre. Treatment averages are shown in Table 2 (averaged across 4 replications), with soybean grain yields ranging from 50.7 to 61.8 bu/acre. A summary of main effects (whole plots treatments and subplots treatments) are shown in Table 3.

The whole plot by subplots interaction was significant for yield but not for bushel test weight or Seed Index (Table 3). The highest grain yield when averaged across all subplot treatments was 58.4 bu/acre for TR-12 (twin-row planting @ 12 seed/ft of row). That yield was significantly higher than the TR-8 treatment. For single-row systems, their was no difference between the two seeding rates (Table 3). For subplot treatments averaged across whole plot treatments (SR vs. TR and 8 vs. 12 seed/ft. of row), there was no significant difference (Prob > F = 0.0905). In ranking the yields, the highest numerical yield came from the fungicide treatment alone (58.1 bu/acre) followed by fungicide+desiccant (57.8 bu/acre). The untreated system had lower yields, but the difference was not significant at the 5% level of probability, but would have been significant at the 10% level.

Bushel test weight ranged from 53.87 to 56.62 lb/bu, with a test average of 55.75 lb/bu (across all plots). Seed Index ranged from 12.93 to 16.77 g/100 seed, with a test average of 14.58. Both bushel test weight and Seed Index were adjusted to 13% moisture similar to grain yields. When averaged across replications, bushel test weight ranged from 54.85 to 56.20 lb/bu (Table 2), and Seed Index ranged from 13.29 to 15.69 g/100 seed (Table 2). Main effects are

summarized in Table 3 for both bushel test weight and Seed Index. Averaged across subplot treatments, twin-row planting had no impact on bushel test weight, but Seed Index was significantly lower for TR vs. SR. The lowest Seed Index was found with the untreated systems. Each additional input improved seed weights.

Purple seed stain is the result of Cercospora leaf blight (*Cercospora kikuchii*) presence and may reduce quality and marketability of soybean. The range in affected seed (average of three 100-seed lots) was from a low of 0.7% to a high of 8.0%, with a test average of 2.9%. Statistical analysis will determine the significance of the infection and will be included in future reports. This may only be a phenomena for 2017. No data have been included for this component of the research. Timely harvest should lead to decreasing the incidence of this disease.

In the second study (17-SB35), the omission study, the harvest and sampling were the same as previously described. Soybean grain yields ranged from 48.8 to 64.2 bu/acre with a test average of 56.4 bu/acre. Both 17-SB34 and 17-SB35 had the exact same average yield when corrected to 13% moisture. The bushel test weight ranged from 52.32 to 56.31 lb/bu with a test average of 54.79 lb/bu. Seed Index ranged from 12.68 to 16.10 g/100 seed with a test average of 14.75 g/100 seed.

The purple seed stain levels were just slightly lower than observed in the other test. When evaluating all treatment combinations (Table 4), the whole plot error term and the subplot error were pooled as the difference was not significant, indicating that the error terms are estimating the same natural variation (indicating a uniform field) and were pooled for the treatment analysis. With respect to all treatments (Table 4), there was no significant difference in either grain yield or bushel test weight. Similar to the first study, the additional treatment inputs improved Seed Index.

Main effects have been summarized in Table 5, with no significant interaction between whole plots and subplots. Grain yield was not significantly impacted by planting system (Planting Pattern [PP] and Seeding Rates [SR]), with only a slight trend favoring the higher seeding rates. All subplot treatments improved yield compared to the untreated, with the biggest advantage to fungicide alone (4.6 bu/acre increase). Bushel test weight and Seed Index were both impacted by the PP x SR whole plots and subplot treatments (Table 5). With some variability, the highest test weight was found with TR-12 compared to the lowest with SR-8. Single-row planting at either seeding rate was significantly higher with respect to Seed Index.

Planting Pattern X Seeding Rate X Planting Date Study

The whole plot component of the previously discussed research involves single-row and twin-row planting systems with two seeding rates, 8 and 12 seed/ft of row (104,500 and 156,800 seed/acre). In order to further evaluate this component of the initial studies, a third study was designed and implemented in 2017. This study was a factorial arrangement of row configuration (single-row [SR] vs. twin-row [TR]) with three seeding rates of 8 seed/ft of row (104,500 seed/acre), 10 seed/ft of row (130,700 seed/acre), and 12 seed/ft of row (156,800 seed/acre). The SR areas were planted with a John Deer planter while the TR area was planted with a Monosem Twin-row planter. The area was planted 8 May 2017 and harvested 6 October 2017. The cultivar was held constant with the other studies.

As part of the PhD project, canopy closure (R1 to R4) was monitored as well as plant stands and plant samples. At harvest, plant height was determined. From plant samples, nodes and pods were counted and summarized. At harvest, sub-samples were again collected for lab determination of harvest moisture, bushel test weight, and Seed Index. The study included the six treatments and eight replications. Soybean grain yields in this study ranged from 46.5 to 56.2 bu/acre, with an overall field average of 50.7 bu/acre. A complete summation of the data collected from the study is included in Tables 6-9 with both interaction and main effects included in each table.

Table 6 includes the grain yields corrected for moisture, bushel test weight, and Seed Index (100-seed weight) averaged across eight replications. There were no significant treatment differences for grain yield, bushel test weight, or Seed Index. Main effects were calculated once the interaction was determined to be non-significant. There was no difference in grain yield when averaged across seeding rates or across the planting pattern. This indicates that reducing the seeding rates from 12 to 8 seed/ft of row did not significantly impact grain yield. The only significant difference occurred with Seed Index when averaged across the seeding rates. The Seed Index for TR planting was lower than SR planting (Table 6).

Table 7 includes results for harvest moisture, initial stand counts, final stand counts, and plant height. Harvest moisture was not affected by the treatments in the study as everything had reached full maturity and dried down by harvest. The harvest moisture ranged from 11.8 to 12.3% with both SR and TR plots harvested at the same time. Samples were collected during the harvest process and used to determine harvest moisture and correct grain yields to a uniform moisture content.

As one should expect, stands were different based on seeding rates. Most soybean planting seed is not sold with extremely high germination and some could be as low as 80% according to the tags on the bags. The results do indicate some difference between SR and TR. For this particular study, TR planting had slightly higher final stands when averaged across the three seeding rates. Final stands were 19.2, 22.9, and 26.4 plants/3ft of row when averaged across the two planting systems (SR and TR) (Table 7). Plant height was not affected by the planting pattern or the seeding rate.

In order the assess plant characteristics, plants were collected from border rows at harvest to determine total main stem nodes (MSN), total main stem pods (MSP), total branch nodes (BN), and total branch pods (BP). The data from this component are summarized in Table 8. Total main stem nodes were not affected by treatments or treatment combinations. Total MSP showed a decline as seeding rates increased. Total BN also decreased as seeding rate increased as would be expected, while total BP was not significantly lowered but the trend was evident. Main effects showed no difference in MSN, MSP, BN, or BP for SR vs. TR and averaged across seeding rates. Total MSP, BN, and BP decreased with increasing seeding rates averaged across planting patterns (Table 8).

The final plant characteristic data collected were actually collected during the growing season. Canopy closure is of key interest to producers and can greatly impact weed control. One of the major positives for TR production is the ability of soybeans to shade the ground more quickly when planted in narrow rows. With the need for beds across much of the Midsouth, twin-row planting offers opportunities for narrow rows and maintenance of beds. As one should expect, canopy closure was more rapid with the TR system. Seeding rates did impact canopy closure at the early reproductive growth stages (R1-R2.5), but were not significantly different at the last two observations. Mr. Turner noted inconsistencies in the canopy data and felt that a uniform method of holding the camera was important for accurate canopy closure determinations.
The study just discussed was included in order to try to refine some of the whole plot information from the initial omission study. It was felt that based on this one year of data that as the team suspected, decreasing seeding rates, as long as seeding was uniform, could save producers money. With this in mind, two things are planned for addition in 2018 as part of Mr. Turner's PhD program. First, lowering the seeding rate another level to 6 seed/ft of row, and evaluating early vs. late planting to determine whether planting timing could also result in altered planting rates.

After the initial proposal was accepted and funded, Mr. Turner expressed interest in this project and has taken over its management and day-to-day management operations. Richard has completed his MS degree in Agronomy and has been accepted into the PhD program. He is interested in soybean management and production with a goal of becoming a crop consultant. Dr. Trent Irby, Extension Soybean Specialist, and I will serve as co-advisors. He officially began his PhD program in January, 2018, but has already been involved in taking data and measurements.

OBJECTIVE 2 METHODS AND RESULTS

In 2017 research was limited to an irrigated location on the Delta Research and Extension Center. In 2018, the study will be expanded to include a nonirrigated location at the North Mississippi Research and Extension Center at Verona, Mississippi. This area has been a traditional dryland (rainfed) area.

The two main studies will be duplicated utilizing the same variety and will be a component of Richard' dissertation. The other factor to be expanded will be a detailed evaluation of the whole plot factors in the main studies. The standard seeding rate for many producers has been 10-12 seed/ft. of wide row. The whole plot component is 8 and 12 seed/ft in both single-row and twin-row planting. Data collected in 2017 showed no significant yield reduction when the seeding rate was dropped from 12 to 8 seed/ft. The key of course is obtaining a uniform stand. To further expand this component, an additional lower seeding rate, 6 seed/ft of row, will be introduced in 2018.

The other important aspect is to look at the effect of planting date on the potential impact of seeding rate on yield. This will all become a part of the PhD project. The other factor that will be included is the treatment effect on seed quality. Samples have been collected to be processed through USDA-ARS (Dr. Nacer Bellaloui) to look at the effect of treatments on protein and oil content. These data will be reported as they become available.

OBJECTIVE 3 METHODS AND RESULTS

The agronomic and economic evaluation will follow harvest and yield determinations through the project. Richard is collecting all of the necessary data to evaluate the economic component. With no treatment impact on grain yield, adding multiple inputs only cost the producer money. Often the producer is looking to increase yield without analyzing the cost for getting that extra yield.

Soil samples were taken from each plot to monitor changes and levels of nutrients over time and offer a sound way for producers to know the nutrient status of particular fields. Adding fertilizer when none is needed or not adding fertilizer when fertilizer is needed are both costly errors that could be avoided with a little additional knowledge. Knowing the philosophy of soil testing is important. Some groups always recommend replacement no matter the current soil test level. This sells fertilizer but may not help the producer. If there is little probability of response then additions are not met with yield gains.

IMPACTS AND BENEFITS TO MISSISSIPPI SOYBEAN PRODUCERS

With over two million acres of soybean grown in Mississippi, maximum production may not be the optimum economic yield for the state. Great strides have been made in the last 60 years to bring soybean from a hay crop to an economically important grain crop and an economically important rotation crop.

Many factors have been evaluated over the last few decades and soybean production has moved from last on the list of operations to the forefront of operation planning. While some practices have greatly impacted the economics, the use of others has actually stretched the production dollar. Adding a two dollar input here and a five dollar input there or a twenty dollar "fix" may actually cost the producer all of his profit from a crop.

The overall objective of this project is to evaluate a whole series of inputs that could affect the bottom line. The techniques being used in this study have been used in other regions of the country where fewer inputs are used. The overall project will prove to be a great training opportunity for future agronomists and consultants.

Table 1: Rainfall summary for 2017 at the Delta Research and Extension Center, Stoneville, Mississippi. Includes daily and monthly totals and norms.

Delta Research and Extension Center
Stoneville, Mississippi
RAINFALL (INCHES) JANUARY to DECEMBER - 2017

Day of Month	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	TOTAL
1	0.54	0.00	0.01	0.00	0.18	0.01	0.14	0.00	0.73	0.00	0.18	0.00	
2	0.69	0.24	0.10	0.00	0.00	1.77	1.29	0.04	0.00	0.00	0.11	0.00	
3	0.65	0.14	0.00	2.70	0.00	0.02	0.03	0.00	0.00	0.22	0.00	0.00	
4	0.01	0.00	0.00	0.01	0.87	0.03	0.00	0.18	0.00	0.00	0.96	0.00	
5	0.00	0.68	0.06	0.00	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.71	
6	0.00	1.51	0.06	0.00	0.00	0.00	0.00	0.13	0.02	0.00	0.00	0.36	
7	0.00	0.02	0.09	0.00	0.00	0.00	0.12	4.22	0.00	0.00	0.00	0.02	
8	0.00	0.00	0.83	0.00	0.00	0.00	0.73	1.54	0.00	0.02	0.05	0.00	
9	0.00	0.00	0.01	0.00	0.00	0.00	0.08	0.05	0.00	0.00	0.77	0.00	
10	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.32	0.00	0.05	0.00	0.00	
11	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	
12	0.00	0.00	0.32	0.01	1.65	0.01	0.00	0.00	0.15	0.00	0.00	0.00	
13	0.01	0.00	0.00	0.00	0.05	0.00	0.00	1.55	0.76	0.00	0.03	0.00	
14	0.01	0.00	0.23	0.00	0.00	0.02	0.00	0.30	0.00	0.00	0.00	0.00	
15	0.01	0.55	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	
16	0.00	0.00	0.00	0.00	0.00	0.35	0.01	0.00	0.00	0.22	0.00	0.00	
17	0.23	0.00	0.00	0.00	0.00	1.68	0.00	0.00	0.02	0.00	0.00	1.02	
18	0.69	0.00	0.00	0.61	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.03	
19	1.47	0.00	0.00	0.25	0.00	0.03	0.00	0.00	0.01	0.00	0.03	0.01	
20	1.28	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
21	0.01	0.46	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
22	0.93	0.05	0.00	0.64	0.05	0.24	0.00	0.00	0.00	0.21	0.00	0.01	
23	0.33	0.00	0.00	0.06	0.20	1.40	1.57	0.00	0.00	0.60	0.00	0.75	
24	0.01	0.00	0.00	0.00	1.35	1.95	0.10	0.00	0.00	0.00	0.00	0.01	
25	0.01	0.11	0.78	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	
26	0.00	0.00	0.02	0.00	0.00	0.01	0.20	0.02	0.00	0.00	0.00	0.00	
27	0.00	1.15	0.01	1.32	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.06	
28	0.00	0.12	0.01	0.01	0.18	0.00	0.00	0.44	0.00	0.56	0.00	0.00	
29	0.00		0.00	0.00	0.14	0.00	0.01	0.14	0.00	0.00	0.00	0.00	
30	0.00		0.43	1.00	0.03	0.00	0.00	1.70	0.00	0.00	0.00	0.00	
31	0.00		0.01		0.01		0.00			0.00		0.00	
TOTAL	6.88	5.03	2.98	6.63	4.88	7.58	4.31	10.74	1.69	1.88	2.14	2.98	57.73
*Normal	4.92	4.81	4.54	4.81	4.80	3.69	3.65	2.49	3.72	4.16	5.01	5.88	52.48
Difference	1.96	0.22	-1.56	1.82	0.08	3.89	0.66	8.25	-2.03	-2.28	-2.87	-2.90	5.25
Events	16	11	16	11	14	17	13	16	6	7	8	10	
> 1"	2	2	0	3	2	4	2	4	0	0	0	1	

WWW.MSSOY.ORG ⇒ MSPB WEBSITE WITH UP-TO-DATE SOYBEAN PRODUCTION INFORMATION

EXPERIMENT NO.:	17-SB34	**CROP:**	Soybean	**VARIETY:**	Credenz 4748 LL	**YEAR:** 2017
EXPERIMENT TITLE:	Evaluation of Soybean Production Systems - Stepwise Additions and Deletions					
SOIL TYPE:	Bosket vfsl/Dundee sicl			**CLASS:**	Mollic Hapludalfs/Typic Endoaqualfs	
LOCATION:	Delta Research & Extension Center			**FIELD:**	Field 2 A (South Side - West End)	

	2	**13**	**17**	**9**	**5**	**10**	**11**	**18**	**6**	**3**	**20**	**15**	**19**	**4**	**8**	**12**	**7**	**16**	**1**	**14**	
B	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	B
	5	**15**	**19**	**6**	**4**	**9**	**13**	**16**	**10**	**1**	**17**	**11**	**18**	**3**	**7**	**14**	**8**	**20**	**2**	**12**	
B	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	B
	3	**11**	**18**	**9**	**5**	**8**	**12**	**20**	**7**	**2**	**19**	**14**	**16**	**1**	**10**	**13**	**6**	**17**	**4**	**15**	
B	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	B
	1	**12**	**16**	**8**	**3**	**7**	**14**	**19**	**9**	**4**	**17**	**13**	**20**	**2**	**6**	**15**	**10**	**18**	**5**	**11**	
B	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	B

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Trt No	Rows X Seed Rate	Fungicide	Desiccant	Fert P-K	Fert N-S
1	SR-L				
2	SR-L	Y			
3	SR-L	Y	Y		
4	SR-L	Y	Y	Y	
5	SR-L	Y	Y	Y	Y
6	SR-H				
7	SR-H	Y			
8	SR-H	Y	Y		
9	SR-H	Y	Y	Y	
10	SR-H	Y	Y	Y	Y
11	TR-L				
12	TR-L	Y			
13	TR-L	Y	Y		
14	TR-L	Y	Y	Y	
15	TR-L	Y	Y	Y	Y
16	TR-H				
17	TR-H	Y			
18	TR-H	Y	Y		
19	TR-H	Y	Y	Y	
20	TR-H	Y	Y	Y	Y

SR-L = Single-row @104,544 SR-H = Single-row @ 156,816

TR-L = Twin-row @ 104,544 TR-H + Twin-row @ 156,816

Fertilizer P and K: 100 lb P_2O_5/acre and 100 lb K_2O/acre

Fertilizer N and S: Ammonium sulfate @ 100 lb/acre (21-0-0-23)

Nitrogen Application Information:

1 Fertilizer N: _____
2 Fertilizer P: _____
3 Fertilizer K: _____
3 Fertilizer S: _____

Seeding Date and Rate:

1 Seeding Date: _____
2 Seeding Rate: _____
3 Emergence Date: _____
4 Population: _____

Irrigation Information:

1 Date: _____ Amount _____
2 Date: _____ Amount _____
3 Date: _____ Amount _____
4 Date: _____ Amount _____
5 Date: _____ Amount _____

Harvest Information:

1 Area: _____
2 Date: _____

Protocol Treatments:

1 Fungicide (R3): _____
2 Desiccant (Pre-H): _____
3 Fertilizer P and K: _____
4 Fertilizer N and S: _____

100-ft.-long plots with 15-ft..-wide alleys

Four (4) replications

Fungicide: Quadris Top SBX @ 7.5 oz/acre

Desiccant: Gramoxone @ 16 oz/acre

EXPERIMENT NO.:	17-SB35	**CROP:**	Soybean	**VARIETY:**	Credenz 4748 LL	**YEAR:** 2017
EXPERIMENT TITLE:	Evaluation of Soybean Production Systems - Stepwise Additions and Deletions (SR vs TR,					
SOIL TYPE:	Bosket vfsl/Dundee sicl			**CLASS:**	Mollic Hapludalfs/Typic Endoaqualfs	
LOCATION:	Delta Research & Extension Center			**FIELD:**	Field 2 A (South Side - East End)	

	2	**13**	**17**	**9**	**5**	**10**	**11**	**18**	**6**	**3**	**20**	**15**	**19**	**4**	**8**	**12**	**7**	**16**	**1**	**14**	
B	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	B
	5	**15**	**19**	**6**	**4**	**9**	**13**	**16**	**10**	**1**	**17**	**11**	**18**	**3**	**7**	**14**	**8**	**20**	**2**	**12**	
B	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	B
	3	**11**	**18**	**9**	**5**	**8**	**12**	**20**	**7**	**2**	**19**	**14**	**16**	**1**	**10**	**13**	**6**	**17**	**4**	**15**	
B	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	B
	1	**12**	**16**	**8**	**3**	**7**	**14**	**19**	**9**	**4**	**17**	**13**	**20**	**2**	**6**	**15**	**10**	**18**	**5**	**11**	
B	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	B

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Trt No	Rows X Seed Rate	Fungicide	Desiccant	Fert P-K	Fert N-S
1	SR-L	Y	Y	Y	Y
2	SR-L	Y	Y	Y	
3	SR-L	Y	Y		
4	SR-L	Y			
5	SR-L				
6	SR-H	Y	Y	Y	Y
7	SR-H	Y	Y	Y	
8	SR-H	Y	Y		
9	SR-H	Y			
10	SR-H				
11	TR-L	Y	Y	Y	Y
12	TR-L	Y	Y	Y	
13	TR-L	Y	Y		
14	TR-L	Y			
15	TR-L				
16	TR-H	Y	Y	Y	Y
17	TR-H	Y	Y	Y	
18	TR-H	Y	Y		
19	TR-H	Y			
20	TR-H				

SR-L = Single-row @104,544 SR-H = Single-row @ 156,816

TR-L = Twin-row @ 104,544 TR-H + Twin-row @ 156,816

Fertilizer P and K: 100 lb P_2O_5/acre and 100 lb K_2O/acre

Fertilizer N and S: Ammonium sulfate @ 100 lb/acre (21-0-0-23)

Nitrogen Application Information:

1 Fertilizer N: _____
2 Fertilizer P: _____
3 Fertilizer K: _____
3 Fertilizer S: _____

Seeding Date and Rate:

1 Seeding Date: _____
2 Seeding Rate: _____
3 Emergence Date: _____
4 Population: _____

Irrigation Information:

1 Date: _____ Amount _____
2 Date: _____ Amount _____
3 Date: _____ Amount _____
4 Date: _____ Amount _____
5 Date: _____ Amount _____

Harvest Information:

1 Area: _____
2 Date: _____

Protocol Treatments:

1 Fungicide (R3): _____
2 Desiccant (Pre-H): _____
3 Fertilizer P and K: _____
4 Fertilizer N and S: _____

100-ft.-long plots with 15-ft.-wide alleys

Four [4] Replications

Fungicide: Quadris Top SBX @ 7.5 oz/acre

Desiccant: Gramoxone @ 16 oz/acre

Table 2. Summary of soybean yield, bushel test weight and Seed Index for single-row and twin-row production at different seeding rates. Multiple input - Additions (17-SB34)

Trt.	Treatments Fungi-Desic-P/K-NS	Grain Yield (bu/acre)	Bushel Test Wt. (lb/bu)	Seed Index (g/100 seed)
Single-Row - 8 seed/ft				
1	Untreated	55.2 cd	54.85 f	13.8842 ef
2	Fungicide	57.4 a-d	55.70 a-e	15.0212 a-d
3	Fungicide + Desiccant	56.2 bcd	55.88 a-d	15.4620 a
4	Fungi + Desicc + P-K	57.1 bcd	56.06 ab	15.6563 a
5	Fungi + Desicc + P-K + N-S	54.8 de	55.40 c-f	15.4690 a
Single-Row - 12 seed/ft				
6	Untreated	54.3 de	55.21 ef	14.1625 e
7	Fungicide	59.3 abc	55.80 a-e	15.3423 a
8	Fungicide + Desiccant	55.6 cd	55.52 b-e	15.2613 ab
9	Fungi + Desicc + P-K	54.8 de	55.94 abc	15.6856 a
10	Fungi + Desicc + P-K + N-S	57.2 bcd	55.71 a-e	15.1239 abc
Twin-row - 8 seed/ft				
11	Untreated	56.1 cd	55.82 a-e	13.3310 f
12	Fungicide	55.1 cde	55.68 a-e	14.1583 e
13	Fungicide + Desiccant	57.8 a-d	56.20 a	14.1380 e
14	Fungi + Desicc + P-K	50.7 e	55.90 a-d	14.4167 cde
15	Fungi + Desicc + P-K + N-S	54.0 de	55.28 def	13.9052 ef
Twin-Row - 12 seed/ft				
16	Untreated	55.0 cde	55.92 abc	13.2949 f
17	Fungicide	60.6 ab	56.10 ab	14.4522 cde
18	Fungicide + Desiccant	57.8 a-d	55.92 abc	14.2627 de
19	Fungi + Desicc + P-K	61.8 a	56.04 ab	14.5032 b-e
20	Fungi + Desicc + P-K + N-S	56.7 bcd	56.09 ab	14.0560 ef
	LSD (0.05)	4.4	0.63	0.7621
	Prob. > F	0.0048	0.0063	<0.0001

Means across four (4) replications (n=20). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

Table 3. Summary of Main Effects for soybean yield, bushel test weight and Seed Index for single-row and twin-row production at different seeding rates. Multiple input - Additions (17-SB34).

Trt.	Treatments Fungi-Desic-P/K-NS	Grain Yield (bu/acre)	Bushel Test Wt. (lb/bu)	Seed Index (g/100 seed)
Whole Plot - Plant Pattern X Seeding				
	SR-8	56.1 ab [1/]	55.58 [1/]	15.0985 a [1/]
	SR-12	56.2 ab	55.64	15.1151 a
	TR-8	54.7 b	55.77	13.9898 b
	TR-12	58.4 a	56.01	14.1138 b
	LSD (0.05)	2.2	0.39	0.2844
	Prob. > F	0.0326	0.1212 ns	<0.0001
	C. V. (%)	5.55	0.77	3.85
Subplot Treatments				
	Untreated	55.2 [2/]	55.45 c [2/]	13.6681 c [2/]
	Fungicide	58.1	55.82 ab	14.7435 ab
	Fungicide + Desiccant	56.8	55.88 ab	14.7810 ab
	Fungi + Desicc + P-K	56.1	55.98 a	15.0654 a
	Fungi + Desicc + P-K + N-S	55.7	55.62 bc	14.6385 b
	LSD (0.05)	2.2	0.30	0.3986
	Prob. > F	0.0950 ns	0.0069	<0.0001
	C. C (%)	5.55	0.77	3.85
	Whole Plot X Subplot Interaction	0.0412	0.0836 ns	0.9169 ns

[1/] Means across subplot treatments and replications (n=20). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

[2/] Means across whole plot treatments and replications (n=16). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

Table 4. Summary of soybean yield, bushel test weight and Seed Index for single-row and twin-row production at different seeding rates. Multiple input - Deletions (17-SB35)

Trt.	Treatments Fungi-Desic-P/K-NS	Grain Yield (bu/acre)	Bushel Test Wt. (lb/bu)	Seed Index (g/100 seed)
Single-Row - 8 seed/ft				
1	Fungi + Desicc + P-K + N-S	56.7	54.40	15.4109 a
2	Fungi + Desicc + P-K	55.6	54.66	15.3329 ab
3	Fungicide + Desiccant	56.9	54.45	15.5576 a
4	Fungicide	55.2	55.06	15.3076 ab
5	Untreated	52.7	54.30	14.7047 bcd
Single-Row - 12 seed/ft				
6	Fungi + Desicc + P-K + N-S	57.3	54.24	15.4713 a
7	Fungi + Desicc + P-K	56.4	54.65	15.6217 a
8	Fungicide + Desiccant	56.5	54.89	15.3132 ab
9	Fungicide	60.5	54.58	15.4348 a
10	Untreated	53.8	54.96	15.0045 abc
Twin-row - 8 seed/ft				
11	Fungi + Desicc + P-K + N-S	56.1	54.06	14.1878 de
12	Fungi + Desicc + P-K	55.4	54.77	14.2573 de
13	Fungicide + Desiccant	56.3	55.27	14.3903 cde
14	Fungicide	57.0	55.14	14.3911 cde
15	Untreated	53.4	55.18	13.7426 ef
Twin-Row - 12 seed/ft				
16	Fungi + Desicc + P-K + N-S	58.9	54.44	14.3575 cde
17	Fungi + Desicc + P-K	58.0	54.82	14.1517 de
18	Fungicide + Desiccant	57.2	54.97	14.2875 de
19	Fungicide	59.5	55.52	14.6009 cd
20	Untreated	53.8	55.38	13.4187 f
	LSD (0.05)	5.1	0.96	0.6851
	Prob. > F	0.2375 ns	0.1662 ns	<0.0001

Means across four (4) replications (n=20). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

Table 5: Summary of Main Effects for soybean yield, bushel test weight and Seed Index for single-row and twin-row production at different seeding rates. Multiple input - Deletions (17-SB35).

Trt.	Treatments Fungi-Desic-P/K-NS	Grain Yield (bu/acre)	Bushel Test Wt. (lb/bu)	Seed Index (g/100 seed)
Whole Plot - Plant Pattern X Seeding				
	SR-8	55.4 [1/]	54.58 c [1/]	15.2627 a [1/]
	SR-12	56.9	54.67 bc	15.3691 a
	TR-8	55.6	54.88 ab	14.1938 b
	TR-12	57.5	55.03 a	14.1632 b
	LSD (0.05)	2.0	0.25	0.2581
	Prob. > F	0.1156 ns	0.0107	<0.0001
	C. V. (%)	6.57	1.32	3.41
Subplot Treatments				
	Fungi + Desicc + P-K + N-S	57.2 a [2/]	54.29 b [2/]	14.8569 a [2/]
	Fungi + Desicc + P-K	56.3 a	54.73 ab	14.8409 a
	Fungicide + Desiccant	56.7 a	54.89 a	14.8871 a
	Fungicide	58.0 a	55.08 a	14.9336 a
	Untreated	53.4 b	54.96 b	14.2176 b
	LSD (0.05)	2.6	0.52	0.3580
	Prob. > F	0.0117	0.0323	0.0009
	C. C (%)	6.57	1.32	3.41
	Whole Plot X Subplot Interaction	0.9859 ns	0.8457 ns	0.9570 ns

[1/] Means across subplot treatments and replications (n=20). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

[2/] Means across whole plot treatments and replications (n=16). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

Table 6: Summary of soybean yield, bushel test weight and Seed Index for single-row and twin-row production at different seeding rates. Main Effects and Interaction Effects.

Trt.	Treatments		Grain Yield (bu/acre)	Bushel Test Wt. (lb/bu)	Seed Index (g/100 seed)
	Seed/ft	Seed/acre			
	SR-8	104,554	49.9 [1/]	56.26 [1/]	13.5475 [1/]
	SR-10	130,680	50.1	55.93	13.4160
	SR-12	156,816	51.1	56.42	13.8176
	TR-8	104,554	50.8	56.80	13.3482
	TR-10	130,680	50.5	56.27	13.3587
	TR-12	156,816	51.7	56.27	13.1543
		Overall Mean	50.7	56.36	13.4402
		LSD (0.05)	1.7	0.96	0.4175
		Prob. > F	0.2660 ns	0.5873 ns	0.0582 ns
		C. V. (%)	3.24	1.68	3.06
Planting Pattern (Main)					
	Single-row		50.3 [2/]	56.20 [2/]	13.5937 a [2/]
	Twin-row		51.0	56.53	13.2868 b
		LSD (0.05)	1.0	0.55	0.2410
		Prob > F	0.1744 ns	0.2430 ns	0.0141
Seeding Rate (Main)					
	8 seed/ft		50.3 [3/]	56.53 [3/]	13.4478 [3/]
	10 seed/ft		50.3	56.10	13.3874
	12/seed/ft		51.4	56.47	13.4855
		LSD (0.05)	1.2		
		Prob > F	0.1108 ns	0.3925 ns	0.7944 ns
		Planting Pattern X Seed rate	0.9287 ns	0.7998 ns	0.1071 ns

[1/]Means across replications (n=8). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.
[2/] Means across 3 seeding rates and 8 replications (n=24). Means followed by the same letter are not significantly different at 5% as determined by Fisher's Protected LSD. No letters are used where F is not significant.
[3/] Means across 2 planting patterns and 8 replications (n=16). Means followed by the same letter are not significantly different at 5% as determined by Fisher's Protected LSD. No letters are used where F is not significant.

Table 7: Summary of soybean yield, bushel test weight and Seed Index for single-row and twin-row production at different seeding rates. Main Effects and Interaction Effects.

Treatments		Harvest Moisture (%)	Initial Stand (Plants/3ft)	Final Stand (Plant/3 ft)	Plant Height (In)
Seed/ft	Seed/Ac				
SR-8	104,554	12.3	23.6 b [1/]	18.9 b [1/]	41.4 [1/]
SR-10	130,680	12.2	23.0 b	20.8 b	40.2
SR-12	156,816	12.0	30.6 a	25.8 a	42.0
TR-8	104,554	11.8	22.1 b	19.6 b	40.3
TR-10	130,680	12.1	28.9 a	25.0 a	39.6
TR-12	156,816	12.0	29.9 a	27.0 a	41.6
	Overall Mean	12.1	26.4	22.8	40.9
	LSD (0.05)	1.4	4.0	2.7	2.3
	Prob. > F	0.9505 ns	<0.0001	<0.0001 ns	0.2872 ns
	C. V. (%)	9.45	14.79	11.69	5.63
Planting Pattern (Main)					
Single-row		12.2	25.8 [2/]	21.8 b [2/]	41.2 [2/]
Twin-row		12.0	27.0	23.9 a	40.5
	LSD (0.05)	0.7	2.3	1.6	1.3
	Prob > F	0.4912 ns	0.2903 ns	0.0105	0.2931 ns
Seeding Rate (Main)					
8 seed/ft		12.0	22.9 c [3/]	19.2 c [3/]	40.8 [3/]
10 seed/ft		12.2	25.9 b	22.9 b	40.0
12/seed/ft		12.0	30.2 a	26.4 a	41.8
	LSD (0.05)	0.8	2.7	1.9	1.6
	Prob > F	0.9316 ns	<0.0001	<0.0001	0.0877 ns
	PP X SR Interaction	0.7859 ns	0.0208	0.1490 ns	0.9382 ns

[1/]Means across replications (n=8). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

[2/] Means across 3 seeding rates and 8 replications (n=24). Means followed by the same letter are not significantly different at 5% as determined by Fisher's Protected LSD. No letters are used where F is not significant.

[3/] Means across 2 planting patterns and 8 replications (n=16). Means followed by the same letter are not significantly different at 5% as determined by Fisher's Protected LSD. No letters are used where F is not significant.

Table 8: Summary of plant characteristics from a comparison of single-row and twin-row production at different seeding rates. Main Effects and Interaction Effects.

Treatments		Main Stem Nodes (Total Number)	Main Stem Pods (Total Number)	Branch Nodes (Total Number)	Branch Pods (Total Number)
Seed/ft	Seed/Ac				
SR-8	104,554	15.4	47.9 a [1/]	7.1 b [1/]	11.5 [1/]
SR-10	130,680	15.2	46.4 ab	8.4 b	13.9
SR-12	156,816	14.6	41.5 b	3.4 a	5.0
TR-8	104,554	15.3	47.6 a	8.4 b	14.4
TR-10	130,680	14.8	43.3 ab	5.2 a	8.3
TR-12	156,816	15.0	43.0 ab	3.6 a	5.0
	Overall Mean	15.0	44.9	6.0	9.7
	LSD (0.05)	0.8	4.9	4.6	8.6
	Prob. > F	0.4851 ns	0.0515	0.1086 ns	0.1047 ns
	C. V. (%)	5.73	10.66	75.81	87.77
Planting Pattern (Main)					
Single-row		15.1	45.2 [2/]	6.3 [2/]	10.1 [2/]
Twin-row		15.0	44.6	5.7	9.2
	LSD (0.05)	0.5	2.8	2.7	5.0
	Prob > F	0.8163 ns	0.6672 ns	0.6596 ns	0.7106 ns
Seeding Rate (Main)					
8 seed/ft		15.3	47.7 a [3/]	7.7 a [3/]	12.9 a [3/]
10 seed/ft		15.0	44.8 ab	6.8 ab	11.1 a
12/seed/ft		14.8	42.3 b	3.5 b	4.9 b
	LSD (0.05)	0.6	3.4	3.3	6.0
	Prob > F	0.2313 ns	0.0109	0.0333	0.0301
	PP X SR Interaction	0.4922 ns	0.4091 ns	0.3593 ns	0.3710 ns

[1/]Means across replications (n=8). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.
[2/] Means across 3 seeding rates and 8 replications (n=24). Means followed by the same letter are not significantly different at 5% as determined by Fisher's Protected LSD. No letters are used where F is not significant.
[3/] Means across 2 planting patterns and 8 replications (n=16). Means followed by the same letter are not significantly different at 5% as determined by Fisher's Protected LSD. No letters are used where F is not significant.

Table 9: Summary of percent canopy closure over time for single-row and twin-row production at different seeding rates. Main Effects and Interaction Effects.

Treatments		Canopy Closure 6/19 (1) R1	Canopy Closure 6/26 (2) R2.5	Canopy Closure 7/3 (3) R3	Canopy Closure 7/12 (4) R4
Seed/ft	Seed/Ac				
SR-8	104,554	48.7 e	48.7 c [1/]	69.0 b [1/]	78.8 c [1/]
SR-10	130,680	50.4 de	50.4 c	70.4 b	79.7 bc
SR-12	156,816	53.7 cd	53.7 c	74.3 b	84.0 b
TR-8	104,554	57.3 bc	57.3 b	92.8 a	92.2 a
TR-10	130,680	58.7 b	58.7 ab	87.5 a	91.5 a
TR-12	156,816	65.3 a	65.3 a	89.3 a	92.3 a
	Overall Mean	55.7	51.7	80.6	86.4
	LSD (0.05)	4.5	4.7	5.6	5.1
	Prob. > F	<0.0001	<0.0001	<0.0001	<0.0001
	C. V. (%)	8.01	8.93	6.80	5.81
Planting Pattern (Main)					
Single-row		50.1 b [2/]	42.4 b [2/]	71.3 b [2/]	80.8 b [2/]
Twin-row		60.5 a	61.1 a	89.9 a	92.0 a
	LSD (0.05)	2.6	2.7	3.2	1.3
	Prob > F	<0.0001	<0.0001	<0.0001	<0.0001 s
Seeding Rate (Main)					
8 seed/ft		53.0 b [3/]	50.0 b [3/]	80.9 [3/]	85.5 [3/]
10 seed/ft		54.6 b	50.7 b	79.0	85.6
12/seed/ft		59.5 a	54.5 a	81.8	88.2
	LSD (0.05)	3.2	3.3	3.9	3.6
	Prob > F	0.0006	0.0214	0.3362 ns	0.2458 ns
	PP X SR Interaction	0.5180 ns	0.8774 ns	0.0746 ns	0.3372 ns

[1/]Means across replications (n=8). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.
[2/] Means across 3 seeding rates and 8 replications (n=24). Means followed by the same letter are not significantly different at 5% as determined by Fisher's Protected LSD. No letters are used where F is not significant.
[3/] Means across 2 planting patterns and 8 replications (n=16). Means followed by the same letter are not significantly different at 5% as determined by Fisher's Protected LSD. No letters are used where F is not significant.

Table S1: Soil Test Results from Field 2A West End (Experiment: 17-SB34). Evaluation of soybean production - Planting Pattern and Seeding Rates with Stepwise Addition and Deletions of Subplot Inputs. (*Additions*)

Soil Test Information			Soil Test Range		
Soil Test	Obs	Units	Low	High	Average
pH (water)	80		6.44	7.87	6.96
Phosphorus	80	lb P/acre	50	174	91
Potassium	80	lb K/acre	593	998	797
Exchangeable H	80	meq/100g	0.00	1.50	0.59
Exchangeable K	80	meq/100g	0.76	1.28	1.02
Exchangeable Ca	80	meq/100g	12.76	19.86	16.67
Exchangeable Mg	80	meq/100g	4.39	7.20	5.87
Exchangeable Na	80	meq/100g	0.12	1.00	0.18
Cation Exchange Capacity	80	meq/100g	19.54	28.66	24.34
Organic Matter	80	%	1.65	2.97	2.06
Total Sulfur	80	lb S/acre	137	202	173
Zinc	80	lb Zn/acre	3.1	10.1	4.1
Manganese	80	lb Mn/acre	74	123	95

Analyses completed by Southern Soil Laboratory at Yazoo City Mississippi. Composited sample from 8-10 cores per plot (Lancaster Extraction)

Table S2. Summary of Main Effects for soil test pH, phosphorus and potassium for single-row and twin-row production at different seeding rates. Multiple input - Additions (17-SB34).

Trt.	Treatments Fungi-Desic-P/K-NS	Water pH	Phosphorus (lb P/acre)	Potassium (lb K/acre)
Whole Plot - Plant Pattern X Seeding				
	SR-8	6.99 ab [1/]	86 [1/]	776 b [1/]
	SR-12	6.94 ab	92	784 b
	TR-8	6.97 b	94	828 a
	TR-12	6.95 a	90	801 ab
	LSD (0.05)	0.13	12	38
	Prob. > F	0.7601 ns	0.5070 ns	0.0507
	C. V. (%)	3.66	0.77	3.85
Subplot Treatments				
	Untreated	6.91 bc [2/]	84 b [2/]	805 ab [2/]
	Fungicide	7.14 a	84 b	742 c
	Fungicide + Desiccant	6.94 bc	81 b	766 bc
	Fungi + Desicc + P-K	6.79 c	103 a	846 a
	Fungi + Desicc + P-K + N-S	7.04 ab	102 a	825 a
	LSD (0.05)	0.18	13	54
	Prob. > F	0.0044	0.0005	0.0018
	C. C (%)	5.55	19.54	9.50
Whole Plot X Subplot Interaction		0.8454 ns	0.7415 ns	0.6623 ns

[1/] Means across subplot treatments and replications (n=20). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

[2/] Means across whole plot treatments and replications (n=16). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

Table S3: Soil Test Results from Field 2A East End (Experiment: 17-SB35). Evaluation of soybean production - Planting Pattern and Seeding Rates with Stepwise Addition and Deletions of Subplot Inputs. (*Deletions*)

Soil Test Information			Soil Test Range		
Soil Test	Obs	Units	Low	High	Average
pH (water)	80		6.47	7.50	6.95
Phosphorus	80	lb P/acre	43	154	65
Potassium	80	lb K/acre	576	992	804
Exchangeable H	80	meq/100g	0.00	1.40	0.66
Exchangeable K	80	meq/100g	0.74	1.27	1.03
Exchangeable Ca	80	meq/100g	11.69	18.88	16.10
Exchangeable Mg	80	meq/100g	4.01	6.82	5.77
Exchangeable Na	80	meq/100g	0.10	0.20	0.14
Cation Exchange Capacity	80	meq/100g	16.96	27.45	23.70
Organic Matter	80	%	1.62	2.25	1.88
Total Sulfur	80	lb S/acre	120	193	165
Zinc	80	lb Zn/acre	2.7	6.8	3.5
Manganese	80	lb Mn/acre	61	108	85

Analyses completed by Southern Soil Laboratory at Yazoo City Mississippi. Composited sample from 8-10 cores per plot (Lancaster Extraction)

Table S4. Summary of Main Effects for soil test pH, phosphorus and potassium for single-row and twin-row production at different seeding rates. Multiple input - Deletions (17-SB35).

Trt.	Treatments Fungi-Desic-P/K-NS	Water pH	Phosphorus (lb P/acre)	Potassium (lb K/acre)
Whole Plot - Plant Pattern X Seeding				
	SR-8	6.93 ab [1/]	69 [1/]	791 b [1/]
	SR-12	6.93 ab	65	825 b
	TR-8	6.98 b	66	826 a
	TR-12	6.95 a	61	773 ab
	LSD (0.05)	0.16	7	48
	Prob. > F	0.8467 ns	0.1469 ns	0.0880 ns
	C. V. (%)	3.71	25.13	11.36
Subplot Treatments				
	Fungi + Desicc + P-K + N-S	6.96 [2/]	76 a [2/]	843 [2/]
	Fungicide +Desicc + P-K	6.89	83 a	817
	Fungicide + Desiccant	6.94	56 b	794
	Fungicide	7.09	56 b	785
	Untreated	6.87	55 b	778
	LSD (0.05)	0.18	12	65
	Prob. > F	0.1448 ns	<0.0001	0.2633 ns
	C. C (%)	3.71	25.13	11.36
	Whole Plot X Subplot Interaction	0.6327 ns	0.3264 ns	0.7093 ns

[1/] Means across subplot treatments and replications (n=20). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

[2/] Means across whole plot treatments and replications (n=16). Means followed by the same letter are not significantly different at the 5% as determined by Fisher's Protected Least Significant Difference. No letters are used where the Prob. > F is not significant.

Table S5: Soil Test Results from Field 12E (Experiment: 17-SB33). Evaluation of soybean production - Planting Pattern and Seeding Rates. Delta Research and Extension Center, Stoneville, MS. 2017.

Soil Test Information			Soil Test Range		
Soil Test	**Obs**	**Units**	**Low**	**High**	**Average**
pH (water)	80		5.77	7.12	6.24
Phosphorus	80	lb P/acre	35	80	55
Potassium	80	lb K/acre	238	469	322
Exchangeable H	80	meq/100g	0.20	3.10	1.77
Exchangeable K	80	meq/100g	0.30	0.60	0.41
Exchangeable Ca	80	meq/100g	4.34	8.25	6.34
Exchangeable Mg	80	meq/100g	1.40	2.46	1.97
Exchangeable Na	80	meq/100g	0.08	0.13	0.10
Cation Exchange Capacity	80	meq/100g	6.62	13.41	10.59
Organic Matter	80	%	0.94	1.39	1.14
Total Sulfur	80	lb S/acre	48	88	69
Zinc	80	lb Zn/acre	2.1	5.1	2.8
Manganese	80	lb Mn/acre	38	76	52

Analyses completed by Southern Soil Laboratory at Yazoo City Mississippi. Composited sample from 8-10 cores per plot (Lancaster Extraction)