KANSAS SOYBEAN COMMISSION FINAL REPORT OF PROGRESS

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Title: "Integrating Germplasm Evaluation, Genetic Engineering, Breeding and High-Throughput Phenotyping to Improve Sustainability of Soybean Production"

Amount of Funding: $265,959

Department Heads: Gary Pierzynski, Marty Draper

Accomplishments for FY2018 (March 1, 2017 – February 28, 2018)

SCN Breeding and Management

SCN Screening Populations

Primary SCN screening populations included HG Types 7 and 1.2.3.5.6.7. Female indices on the HG Type 1.2.3.5.6.7 were >10% on all indicator lines except PI 437654 (line #4), and >20% on PI 88788 (line #2), the most common source of SCN resistance (Fig. 2). Female indices on the HG Type 7 population were <10% on all indicator lines except PI 548316 (line #7). A third screening population, HG Type 2.5.7, was added for FY 2017. This population produced female indices similar to those of HG Type 1.2.3.5.6.7 on PI 88788, but was more similar to the HG Type 7 population on indicator lines 1, 3, and 6 (Fig. 1).

Representative commercial cultivars are also included in all HG Type Tests. Commercial cultivars with resistance derived from standard resistance sources typically present lower levels of resistance than their source of resistance. KS4313N, for example, is only moderately resistant to our HG Type 7 population, while its resistance source PI 88788 is fully resistant (Fig. 2). This discrepancy increases as the level of resistance in PI 88788 decreases, with KS4313N exhibiting full susceptibility to HG Type 1.2.3.5.6.7, even though PI88788 displays moderate susceptibility to this population.

Figure 1. HG Type designations for primary SCN screening populations.

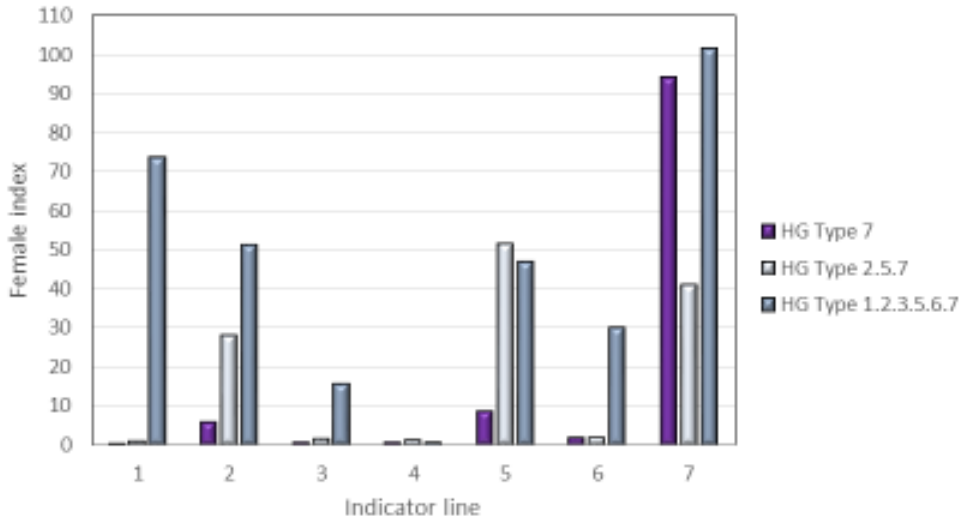
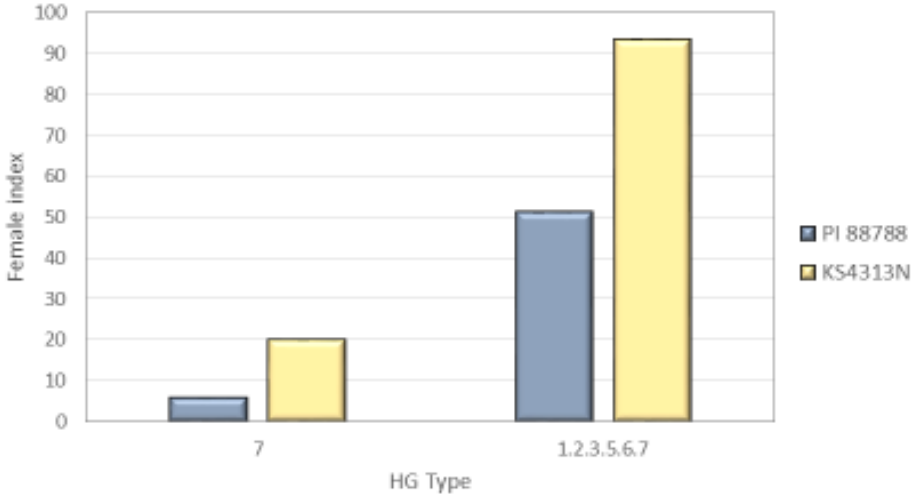


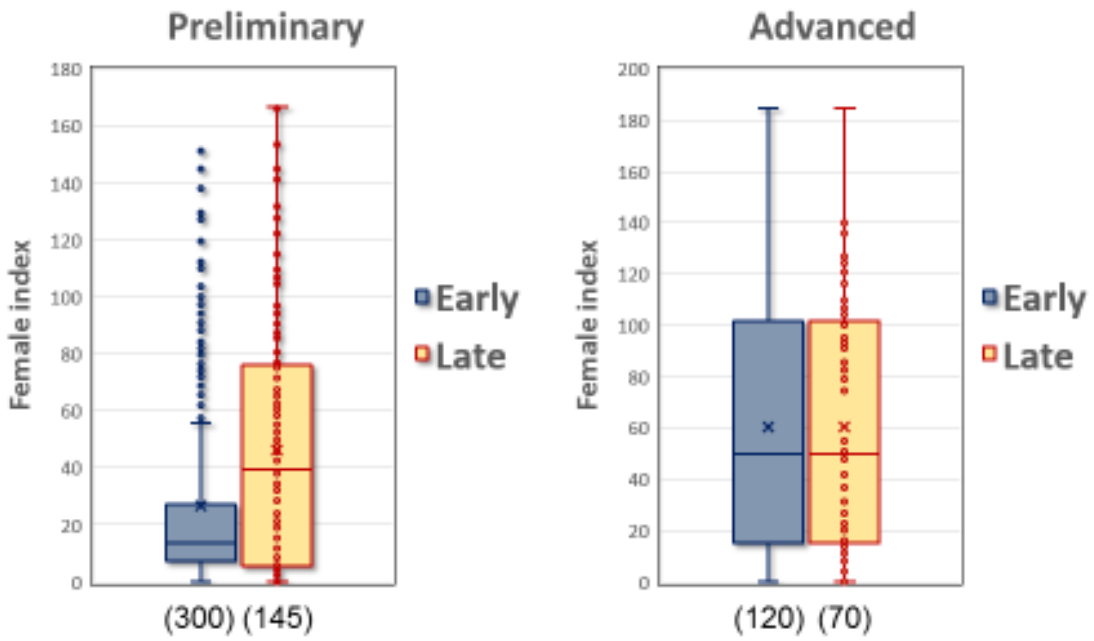
Figure 2. Female indices on KS4313N and its source of resistance PI 88788.



SCN Resistance Screening

Breeding lines: Soybean resistance to soybean cyst nematode (SCN) was evaluated in single pot screening trials for 445 preliminary breeding lines and in replicated screening trials for 190 advanced breeding lines (Fig. 3). Evaluations involved SCN populations HG Type 7, with a PI 88788 female index (FI) of 3.6 and HG Type 1.2.3.5.6.7, with a PI 88788 FI of 42.7. Approximately 36% of preliminary and 13% of advanced breeding lines exhibited a high level of resistance (FI < 10) to the HG Type 7 population, while 31% and 42%, respectively, were moderately resistant (10 ≤ FI < 30). Of those lines expressing resistance to HG Type 7, 20% of preliminary lines and 17% of advanced lines were resistant to moderately resistant to the HG Type 1.2.3.5.6.7 population.

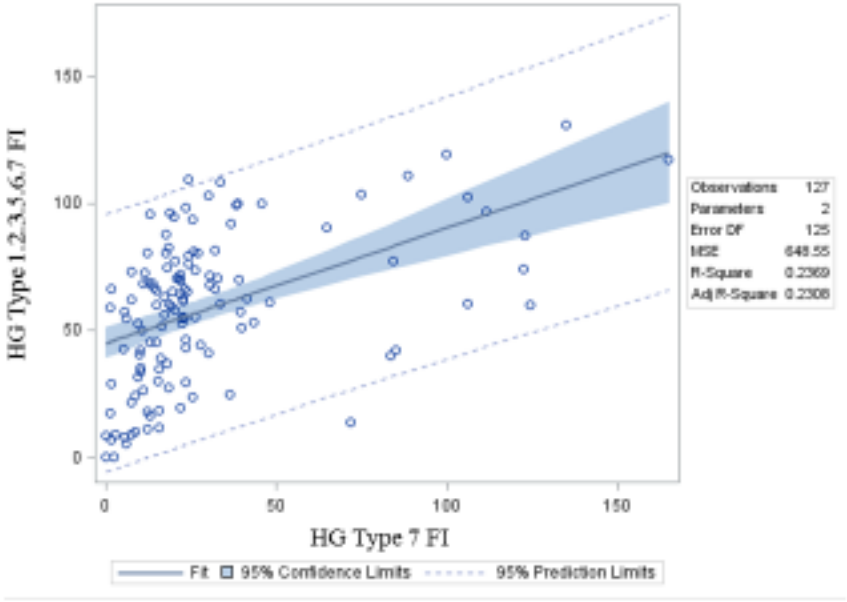
Figure 3. Summary of 2017 SCN screening results for K-State soybean breeding lines



Kansas Soybean Performance Test: Soybean resistance to soybean cyst nematode (SCN) was evaluated in replicated screening trials for 128 entries in the Kansas Soybean Variety Performance Test (KSVPT). Evaluations involved SCN populations that varied in their virulence to the common resistance source PI 88788: HG Type 7, with a PI 88788 female index (FI) of 3.6 and HG Type 1.2.3.5.6.7, with a PI 88788 FI of 42.7. Approximately 18% and 54% of KSVPT entries were resistant and moderately resistant, respectively, to the HG Type 7 population, while only 6% and 14% of entries were resistant and moderately resistant, respectively, to the HG Type 1.2.3.5.6.7

population. Mean FI across all entries was 28 points greater for the HG Type 1.2.3.5.6.7 populations compared to the HG Type 7 population. (Fig. 4).

Figure 4. Relationship between female indices (FI) for two SCN screening populations on 128 2017 KSVPT entries.



Variety Development/Genetics

Development of new populations

- A total of about 70 new populations were created in 2017 using over 20 different parents (Appendices II and III).
- Fourteen, single cross populations involved **drought resistant** parents.
- Over half of the single cross populations involved parents tolerant to **STS** herbicides.
- About 25% of the single cross populations involved at least one parent resistant to **SCN**.
- About eleven single cross populations involved at least one parent that possessed genes from a plant introduction that has not contributed to the genetic improvement of US soybean varieties. The goal of using these parents is to increase the **genetic diversity** of US germplasm to increase, or at least, maintain genetic gain.
- Eleven populations involved **high oleic** parents.
- Several populations involved converting a conventional line to a line possessing the **glyphosate resistance**.
- Thirteen populations involved parents with higher **protein**.
- Several populations were developed to incorporate the **NON-NODULATING** trait into adapted germplasm.

Yield trials

- We completed evaluations of nearly **5000 genotypes** in over 16,000 plots in Kansas (APPENDIX IV).
- Over 400 K-lines were evaluated in our preliminary trials.
- Over 150 K-lines were evaluated in our KS advanced yield trials.
- Over 300 (including 29 K-lines) breeding lines from programs across the country were evaluated in our KS Uniform Tests and Uniform Preliminary yield trials.
- Over 900 genotypes, (experimental breeding lines and **plant introductions**) were evaluated in our drought, remote sensing, and diversity yield trials.

Seed Increases

- All K-lines entered into the 2017 Uniform Preliminary, Uniform Tests or final testing in KS were place in seed increase blocks (APPENDIX V). Of the 42 experimental varieties under increase, 11 will be advanced for more testing and increase, three will be advanced to a large-scale increase, with the intent to release in 2019, and two entries have been released.

Outcomes of Research on Drought, Remote Sensing and Variety Development

- **Canopy reflectance represents high-throughput opportunity for phenotyping in stress environments.** We continue to develop models utilizing canopy reflectance and canopy thermal properties to estimate relative soybean maturity, seed yield, drought stress,

and disease resistance. The focus on 2017 was obtaining remote sensing data on SDS screening trials, on our progeny rows and on germplasm and varieties evaluated for drought stress. All spectral data collected in 2017 was accomplished through the use of UAVs. Selections based on data collected using the UAVs have been made, and will be evaluated in replicated yield trials in 2018 to characterize the benefits of using this technology.

- **Slow wilting QTL analysis.** Our assessment of slow wilting in genotypes under drought stress may help improve drought tolerance in soybean. In work with the Univ. of Arkansas, we characterized canopy wilting of 373 maturity group (MG) IV soybean genotypes to identify new and previously reported QTLs for canopy wilting. Over 60, environment-specific significant SNP – canopy wilting associations were identified. Some of the associations were located near previously reported chromosomal regions associated with canopy wilting, and other associations were new. This information may be important for pyramiding beneficial genes into the same genotype, and identifying parents to use in developing populations with improved drought tolerance.
- **Release of KS3618Ngr and KS5518.** The Kansas Agricultural Experiment Station approved the release of K4313Ngr and K12-1355. The release announcements and descriptions of the lines are in Appendix V.

Opportunities for Training and Professional Development

- Two graduate students worked on projects related to the objectives of this project. One graduate student completed his degree in the fall of 2017 and transferred to the University of Georgia to work on a Ph.D. degree. One graduate student will complete her degree in the spring of 2018. One new M.S. student joined the breeding project in January 2018 to work on using remote sensing to select in progeny rows.

Dissemination of Results

- Extension publications, news releases, and experiment station reports, field days, extension meetings and tours are used to share the results of this project. Web pages have been developed to disseminate information on new releases and germplasm and pests. Distribution of results of genotype characterization for resistance published online. Distribution of SCN survey results to cliental will provide much-needed information for making informed decisions by producers regarding variety selections for SCN management and by soybean breeders for the development of varieties with improved levels of resistance. Effects of high temperature stress on soybean, and evaluations of host plant resistance were published at scientific conferences and published in peer reviewed publications.

Publications for 2017

Journal articles

- Xavier A., D. Jarquin, R. Howard, V. Ramasubramanian, J.E. Specht, G.L. Graef, W.D. Beavis, B.W. Diers, Q. Song, P. Cregan, R. Nelson, R. Mian, J.G. Shannon, L. McHale, D. Wang, **W. Schapaugh**, A.J. Lorenz, S. Xu, W.M. Muir, K.M. Rainey. 2017. Genome-wide analysis of grain yield stability and environmental interactions in a multi-parental soybean population. Genes|Genomes|Genetics DOI:10.1534/g3.117.300300.
- Kaler, S., J.D. Ray, **W.T. Schapaugh**, C.A. King, and L.C. Purcell. 2017. Genome‐wide association mapping of canopy wilting in diverse soybean genotypes. Theor. Appl. Genet. 130:2203–2217. DOI 10.1007/s00122-017-2951-z.

Conference papers and presentations

- **William T. Schapaugh Jr**. and Brent Christenson. 2017. Utilizing multi-spectral readings to differentiate genotypes in two Soybean NAM populations. World Soybean Research Conf. Abstr.

Acknowledgment

The researchers cooperating in this project greatly appreciate the opportunity to interact with the Kansas Soybean Commission. We also appreciate the financial support of the Kansas Soybean farmer to develop new varieties, germplasm and information that supports the improvement of soybean production.

Appendix I. Kansas Soybean Variety Performance Test FY 2017 SCN and SDS ratings.								
			2017 SCN Female Index*			2016 SCN Female Index		2017 SDS** Ratings
SOURCE	ENTRY		Race 3 (HG Type 7)	Race 4 (HG Type 1.2.3.5.6.7)		Race 3 (HG Type 7)	Race 4 (HG Type 1.2.3.5.6.7)	
EMERGE GENETICS	e4194		0	0		18	61	-
EMERGE GENETICS	N4356s		0	0		-	-	-
FRONTIER SEED	49GT02		0	0		-	-	0
KANSAS AES	KS5502N		0	8		27.2	5	0.6
KANSAS AES	KS5507NRR		0	0		0.3	11	0.2
LG SEEDS	C4458RX		0	0		-	-	0.4
WILLCROSS	WXE3517NS		0	20		-	-	0.8
KANSAS AES	KS5004N		1	59		1	51	0.2
PUBLIC	LS09-1920		1	29		3.2	38	1.3
LG SEEDS	C3489RX		2	9		-	-	5.6
MORSOY	4997 RXT		3	65		-	-	10.4
CREDENZ	CZ 4748 LL		4	7		-	-	3.9
FRONTIER SEED	3SR92		4	17		14	36	7.6
ASGROW	AG5335		5	57		8.2	43.3	2.2
LG SEEDS	C3026RX		5	8		-	-	0
LG SEEDS	C3333RX		5	42		23.3	62	0.7
LG SEEDS	C3550RX		5	54		13.4	50	0.2
CREDENZ	CZ 3738 LL		6	5		-	-	0.2
CREDENZ	CZ 4105 LL		7	62		-	-	1.5
FRONTIER SEED	41GT37		7	22		-	-	13.3
FRONTIER SEED	4SR62		7	9		-	-	40.2
KANSAS AES	K12-1348		7	73		13	28	30.9
LG SEEDS	C3775RX		9	10		-	-	0.2
PUBLIC	LD06-7862		9	24		8.2	21	4.6
CREDENZ	CZ 4548 LL		10	32		-	-	6.3
EMERGE GENETICS	e3796		10	52		-	-	3
KANSAS AES	K4313NRRT		10	34		5.2	16	40
LG SEEDS	C4615RX		10	40		11.2	42	-
PUBLIC	SPENCER***		10	35		26.5	34	50
SYNGENTA	GH3982X		10	33		-	-	14.6
PHILLIPS	408NR2XS		11	50		-	-	0.6
CREDENZ	CZ 4918 LL		12	11		-	-	1.5
MIDLAND	3537NX		12	69		8.9	57	9.5
PHILLIPS	348NR2X		12	18		-	-	10
SYNGENTA	GH2981X		12	80		-	-	0.9

CREDENZ	CZ 4222 LL		13	16		-	-		0.2
MIDLAND	3926NRS2		13	45		12.7	51		27.6
MIDLAND	4956NXS		13	96		-	-		2.1
CHECK	MG3.5		14	68		13.4	33		10.95
KANSAS AES	KS4313N		14	60		6.8	13		36.2
PHILLIPS	506NR2XS		14	68		6.8	51		3.5
SYNGENTA	GH4142X		14	67		-	-		0.6
MORSOY	4667 RXT		15	60		-	-		3.7
SYNGENTA	GH3195X		15	66		-	-		31.1
WILLCROSS	WXE3367N		15	45		-	-		2.6
CREDENZ	CZ 4308 LL		16	35		-	-		0.2
LG SEEDS	C3985RX		16	19		-	-		0.2
PHILLIPS	363NR2YE		16	39		-	-		3
SYNGENTA	GH3985X		16	30		-	-		0.4
SYNGENTA	GH4542X		16	12		-	-		30
KANSAS AES	K13-1615		17	57		11.4	38		1.1
CHECK	MG4.9		18	27		14.6	42		16.1
CREDENZ	CZ 3548 LL		18	37		-	-		0
MORSOY	4706 RXT		18	88		11.2	43		24.6
PHILLIPS	411NR2Y		18	61		24.9	47		0.2
SYNGENTA	GH3324X		18	80		-	-		2.3
SYNGENTA	GH4307X		18	75		-	-		21.9
WILLCROSS	WX1441NLL		18	83		-	-		3.4
EMERGE GENETICS	e4394		19	96		8.9	55		0.4
PHILLIPS	387NR2X		19	59		14.3	30		0.2
MIDLAND	4963NRS2		20	66		16.3	40		4.5
MORSOY	4117 RXT		20	77		-	-		7.8
WILLCROSS	WX1745NLL		20	58		-	-		3.3
WILLCROSS	WXE3466NS		20	95		19	74		20.9
WILLCROSS	WXE3386N		21	70		9.8	50		0.6
ARKANSAS	R09-430		22	72		24.4	46.6		0.8
CREDENZ	CZ 4938 LL		22	19		-	-		19.1
SYNGENTA	GH3761X		22	65		-	-		1.1
SYNGENTA	NK S39-T3		22	53		-	-		12
WILLCROSS	WXE3446NS		22	55		-	-		15
CREDENZ	CZ 3601 LL		23	29		-	-		1.5
MIDLAND	3983NR2		23	61		11.6	67		16.5
MIDLAND	4328NX		23	63		-	-		1.7
MIDLAND	4373NR2		23	66		18.2	45		0.4
MISSOURI	S13-2743C		23	55		-	-		13.1
MORSOY	4327 RXT		23	43		-	-		26.6
WILLCROSS	WXE3377N		23	54		-	-		5.8
WILLCROSS	WXE3497NS		23	98		-	-		0.6

CHECK	MG4.2		24	80		24.6	43		20.2
WILLCROSS	WXE3437N		24	46		-	-		20.7
EMERGE GENETICS	e4996s		25	94		25	67		8.5
KANSAS AES	KS4117Ns		25	69		19.7	49		46.6
LG SEEDS	C4227RX		25	24		-	-		0.4
PHILLIPS	478NR2XSE		25	109		-	-		0.4
WILLCROSS	WXE3487NS		25	76		-	-		28.3
ASGROW	AG4232		26	56		19	45		36.3
CHECK	MG4.5		26	70		8	28		12
MORSOY	4426 RXT		26	81		15.6	38		10.2
MORSOY	4737 RXT		26	74		-	-		8
ASGROW	AG3432		27	80		53.9	53.5		5.8
SYNGENTA	GH3546X		28	44		-	-		1.5
CREDENZ	CZ 3841 LL		30	41		-	-		0.2
MORSOY	4535 RXT		30	104		20.5	44		55.6
MORSOY	3907RXT		31	68		-	-		0.6
EMERGE GENETICS	e4892s		32	81		14	37		0.6
MIDLAND	3938NX		32	67		-	-		0.2
CHECK	MG3.9		34	60		21.1	68		30.8
MIDLAND	3657NR2		34	108		13.6	35		7.8
CREDENZ	HBK LL4953		36	25		-	-		35.6
MIDLAND	4677NXS		37	92		12.4	57		7.8
EMERGE GENETICS	e4993		38	100		15	80		16.5
MORSOY	4857 RXT		38	100		-	-		35.2
EMERGE GENETICS	N4746s		39	70		-	-		15.9
KANSAS AES	K13-1830		39	58		31.4	61		8
WILLCROSS	WX1445NLL		40	51		-	-		10
MIDLAND	4797NRS2		41	62		16.3	45		46.7
ARKANSAS	OSAGE		44	53		88.5	92.9		14.1
MIDLAND	3633NR2		46	99		22	54		11.9
PHILLIPS	456NR2XS		48	61		24.6	57		29.4
MISSOURI	S13-10590C		65	90		-	-		0.4
MISSOURI	S13-1955C		72	14		-	-		0.2
EMERGE GENETICS	T4846s		75	104		-	-		5.4
FRONTIER SEED	4SR82		83	40		-	-		12.6
ARKANSAS	UA 5014C		84	78		125	84.3		1.1
MISSOURI	S14-9051R		85	42		-	-		7.2
PUBLIC	MORGAN***		89	111		67.2	52		72.2
ARKANSAS	R13-1019		100	119		-	-		12.6
KANSAS AES	KS3406RR		106	102		77.8	89		76.4

MISSOURI	S13-3851C		106	61		-	-		5.5
ARKANSAS	UA 5414RR		112	88		71	77.8		34.5
PUBLIC	RIPLEY****		122	74		57.8	95		27.8
KANSAS AES	K12-1355		123	87		32.3	36		0.4
MISSOURI	S13-1805C		124	60		-	-		0.4
KANSAS AES	K12-2333		135	131		53.2	82		34.4
PHILLIPS	454R2YSE		165	118		100.5	60		42.6
CV			70.7	48.2		56.53	45.35		88.13
GRAND MEAN			29.6	57.9		25.22	51.4		14
LSD			28.3	37.6		19.21	31.41		16.63
No. of Reps			3	3		3	3		3

* SCN Female Index = Soybean Cyst Nematode female index, where the female index (FI) = (mean # of cysts on tested variety/mean # of cysts on susceptible checks) x 100. A low FI (<10) means that the SCN population was not able to reproduce well on the differential line, and a high FI means that the SCN population was able to reproduce well. Reproduction rates were measured on plants grown in the greenhouse.

**SDS Score = Soybean Sudden Death Rating. SDSX is a score based on the severity and incidence of the disease at the R6 growth stage (full pod). The larger the score, the more severe and widespread the disease. A score of 100 indicates total plant death. SDSX scores were taken on plots near Manhattan and Rossville that were grown specifically to evaluate for SDS resistance.

***SDS susceptible check									
****SDS resistant check									

APPENDIX II. Parents used in 2017 crossing block.			
NAME	MG	TRAITS	PEDIGREE
HM11-W192	3	PRO	OHS305/OHS303
KS4117Ns	4	SCN, STS, Y	435.TCS / LD05-30578a
K12-1355	5	Y	R04-357/JTN-5503
K13-1830	5	Y	DS-880/R04-357
K13-1845	4S	STS	NCC05-1261/435.TCS
N05-7432 (N8002)	7	Drought, DIV	N7002 x N98-7265 (12.5% PI)
N10-7404	7	Drought	N01-11136 x N98-7265 (25% PI471938)
S13-16716	4S	HO, RR1	
S14-17636	5	HO	
KS4103sp	4	PRO	Flyer/BARC 6
KS5202sp	5	PRO	Hutcheson/BARC 9
46X714	4.6	YLD, STS, SDS	
49X715	4.9	YLD, STS	
e4993	5.2	YLD	
PI 661090	4	YLD, DR, DIV	
PI 597387	3	YLD, DIV	
K16-16 F2 RR1	5	F2 RR HO	S13-16716/K13-1830 F2
K16-10 BC1 F2 RR1	5	BC1 F2 RR	K13-1830 / K16-5 F2 RR1
K17-2 BC3 F1 RR1	4	BC3 F1 RR	K11-2363B/K16-9 BC2 F2 RR1
K17-3 BC1 F1	4	BC1 F1 HO	K11-2363B/K16-18 F2
K17-4 BC1 F1	5	BC1 F1 HO	K12-1355/K17-1 F1
K17-5 BC3 F1 RR1	5	BC3 F1 RR	K12-1355/K16-7 BC2 F2 RR1
DESCRIPTIVE CODE:			
PRO = PROTEIN, SCN = SOYBEAN CYST NEMATODE RESISTANCE			
STS = SULFUNREYL HERBICIDE RESISTANCE, Y = YIELD			
DIV = DIVERSITY, HO = HIGH OLEIC, RR = ROUNDUP READY 1			
SDS = SUDDEN DEATH SYNDROME, DR = DROUGHT, MG = MATURITY GROUP			

APPENDIX III. Populations created in 2017.		
POPULATION	PEDIGREE	PRIMARY FOCUS
K17-1 F1 HO	K12-1355/K16-20	HO
K17-2 F1 RR	K11-2363B / K16-9 BC2 F1 RR1	RR, SCN, STS
K17-3 F1 HO	K11-2363B / K18-18 F2	HO, SCN, STS
K17-4 F1 HO	K12-1355/ K17-1 F1	HO, Y
K17-5 F1 RR, HO	K12-1355 / K16-7 BC2 F2 RR1	RR, HO
K17-6 F1	HM11-W192 / KS4117Ns	PRO, SCN, STS, Y
K17-7 F1	HM11-W192 / KS4103sp	PRO, PRO
K17-8 F1	HM11-W192 / 46X714	PRO, Y, STS, SDS
K17-9 F1	46X714 / KS4117Ns	Y, STS, SDS, SCN,
K17-10 F1	46X714 / KS4103sp	Y, STS, SDS, PRO
K17-11 F1	46X714 / PI 661090	Y, STS, SDS, DR, DIV
K17-12 F1	46X714 / PI 597387	Y, STS, SDS, DIV
K17-13 F1	KS4117Ns / PI 661090	SCN, STS, Y, DR, DIV
K17-14 F1	KS4117Ns / PI 597387	SCN, STS, Y, DIV
K17-15 F1	e4993 / HM11-W192	Y, PRO
K17-16 F1	e4993 / KS4117Ns	Y, SCN, STS
K17-17 F1	e4993 / K12-1355	Y
K17-18 F1	e4993 / K13-1830	Y
K17-19 F1	e4993 / K13-1845	Y, STS
K17-20 F1	e4993 / N05-7432 (N8002)	Y, DR, DIV
K17-21 F1	e4993 / N10-7404	Y, DR
K17-22 F1	e4993 / KS4103sp	Y, PRO
K17-23 F1	e4993 / KS5202sp	Y, PRO
K17-24 F1	K13-1845 / PI 661090	STS, Y, DR, DIV
K17-25 F1	K13-1845 / PI 597387	STS, Y, DIV
K17-26 F1	49X715 / KS4117Ns	Y, STS, SCN, Y
K17-27 F1	49X715 / KS4103sp	Y, STS, PRO
K17-28 F1	49X715 / PI 661090	Y, STS, Y, DR, DIV
K17-29 F1	49X715 / PI 597387	Y, STS, Y, DIV
K17-30 F1	46X714 / HM11-W192	Y, STS, SDS, PRO
K17-31 F1	49X715 / HM11-W192	Y, STS, PRO
K17-32 F1	46X714 / K12-1355	Y, STS, SDS
K17-33 F1	49X715 / K12-1355	Y, STS
K17-34 F1	46X714 / K13-1830	Y, STS, SDS
K17-35 F1	49X715 / K13-1830	Y, STS
K17-36 F1	46X714 / K13-1845	Y, STS, SDS
K17-37 F1	49X715 / K13-1845	Y, STS, STS
K17-38 F1	46X714 / N05-7432 (N8002)	Y, STS, SDS, DR, DIV
K17-39 F1	49X715 / N05-7432 (N8002)	Y, STS, DR, DIV
K17-40 F1	46X714 / N10-7404	Y, STS, SDS, DR
K17-41 F1	49X715 / N10-7404	Y, STS , DR
K17-44 F1	K12-1355 / K13-1830	Y
K17-45 F1	K12-1355 / K13-1845	Y, STS
K17-46 F1	K12-1355 / N05-7432 (N8002)	Y, DR, DIV
K17-47 F1	K12-1355 / N10-7404	Y, DR
K17-48 F1	K13-1830 / K13-1845	Y, STS
K17-49 F1	K13-1830 / N05-7432 (N8002)	Y, DR, DIV
K17-50 F1	K13-1830 / N10-7404	Y, DR

K17-52 F1 HO	S14-17636 / K12-1355	HO, Y
K17-54 F1 HO	S14-17636 / K13-1845	HO, STS
K17-55 F1 RR	Harosoy NN / K17-2 BC3 F1 RR1	RR, NN
K17-56 F1 RR	Williams NN / K17-2 BC3 F1 RR1	RR, NN
K17-57 F1 RR	Lee NN / K17-2 BC3 F1 RR1	RR, NN
K17-58 F1 RR	Harosoy NN / K4313NGR	RR, NN
K17-59 F1 RR	Williams NN / K4313NGR	RR, NN
K17-60 F1 RR	Lee NN / K4313NGR	RR, NN
K17-42 F1	46X714 / KS5202sp	Y, STS, SDS, PRO
K17-43 F1	49X715 / KS5202sp	Y, STS, PRO
K17-64 BC1 F1 HO	KS4117Ns / K17-3 BC1 F1	SCN, STS, Y, HO
K17-65 BC2 F1 HO	K12-1355 / K17-4 BC1 F1	Y, HO
K17-51 F1 RR HO	S13-16716 / KS4117Ns	HO, RR1, SCN, STS, Y
K17-53 F1 RR HO	S13-16716 / K13-1830	HO, RR1, Y
K17-61 BC1 F1 RR HO	K13-1830 / K16-16 F2 RR1	Y, HO
K17-62 BC2 F1 RR	K13-1830 / K16-10 BC1 F2 RR1	Y, RR
K17-63 BC4 F1 RR	KS4117Ns / K17-2 BC3 F1 RR1	SCN, STS, Y, RR
K17-66 BC4 F1 RR	K12-1355 / K17-5 BC3 F1 RR1	Y, RR
K17-67 GH F1	KS4117Ns / KS4103sp	SCN, STS, Y, PRO
K17-68RR GH F1 RR NN	Harosoy NN / K17-63	NN, SCN, STS RR
K17-69RR GH F1 RR NN	Williams NN / K17-63	NN, SCN, STS RR
K17-70RR GH F1 RR NN	Harosoy NN / K4313NGR	NN, SCN, STS RR
K17-71RR GH F1 RR NN	Williams NN/ K4313NGR	NN, SCN, STS RR
K17-72RR GH BC1F1 RR NN	K17-63/K17-56	RR, STS, SCN
DESCRIPTIVE CODE:		
PRO = PROTEIN, SCN = SOYBEAN CYST NEMATODE RESISTANCE		
STS = SULFONYLUREA HERBICIDE RESISTANCE, Y = YIELD		
DIV = DIVERSITY, HO = HIGH OLEIC, RR = ROUNDUP READY 1		
SDS = SUDDEN DEATH SYNDROME, DR = DROUGHT		
NN = NON-NODULATING		

APPENDIX IV. 2017 Field trials.

			Entries	Plots/	Locations/Number of plots								
EXPT			Total	Test	MAN(1)	Onaga	MAN(2)	OTT	MCC	PIT	PIDC	SAL	TOP
Kansas Advanced Tests													
17 KAE			120	240	240	240	240	240				240	
17 KAL			70	140	140			140	140	140		140	
Kansas Preliminary Tests													
17 KPE			300	378	378		378						
17 KPL			150	189	189		189						
Progeny Rows			6111	6111	6111								
Northern Uniform Tests													
17 U3			23	69	69								
17 P3A			25	50	50								
17 P3B			25	50	50								
17 U4			20	60	60	60		60					
17 P4			30	60	60	60		60					
Southern Uniform Tests													
17 U4S			30	90					90	90			
17 P4S			35	70					70	70			
17 U5			30	90					90	90			
17 P5E			40	80					80	80			
17 P5L			20	40					40	40			
Soybean Performance, MISC Tests													
17	SP1	ONAGA	45	180		180							
17	SP6E	MCCUNE 4'S	32	128					128				
17	SP6L	MCCUNE 5'S	36	144					144				
17	SP10	ASSARIA	34	136								136	
17	SP13E	PIDC	28	112							112		
17	SP13L	PIDC	28	112							112		
17	SP15	TOPEKA SDS	131	393									393
17	NAM10 SDS	TOPEKA	160	640									640
Drought/Diversity Tests	DROUGHT												
17 WGS3	MO Drought	MG3 WGS Set 7' long	200	400								400	
17 WGS4	MO Drought	MG4 WGS Set 7' long	254	508								508	
17 WGS5	MO Drought	MG5 WGS Set 7'long	90	180								180	
17 D	MO Drought	Study D 2-row	74	222				222				222	
17 DT-01	Georgia Drought	2-row	160	480								480	
17 CJ3	CJ3	protein diversity	20	40	40								
17 CJ4	CJ4	protein diversity	20	40	40								
17 T MAP	Tomentella	diversity	246		492								
					MAN(1)	Onaga	MAN(2)	OTT	MCC	PIT	PIDC	SAL	TOP
	Total # yield plots at each location, 2017				7919	540	807	722	782	510	224	1826	1033
		Grand total no. plots: 14,363											

APPENDIX V. 2017 seed increases.				
ENTRY		PEDIGREE		
	2017 Test*/STATUS		2018 STATUS	Foundation Seed in 2018
Breeder's Seed plots				
NON-GMO CONVENTIONAL ENTRIES				
K14-1094	U4	K07-1633 / LD04-13265	D**	
K14-1153	U4	LD04-13265 / K07-1633	D	
K14-1269	Retest mg4	LG06-5920 / 435.TCS	D	
K14-1358	U4, sts	NCC05-1261 / 435.TCS	K14-1358-1, K14-1358-5, K14-1358-9 TO KA	
K15-1043	P3	AR10-305003 / 435.TCS	D	
K15-1008	P4, SCN	AR10-305003 / 435.TCS	U4	
K15-1039	P4, SCN	AR10-305003 / 435.TCS	D	
K15-1278	P4, STS SCN	LD06-7620 / 435.TCS	D	
K15-1279	P4, STS SCN	LD06-7620 / 435.TCS	D	
K15-1283	P4, STS SCN	LD06-7620 / 435.TCS	U4	
K15-1294	P4, STS SCN	LD06-7620 / 435.TCS	D	
K15-1303	P4, SCN	LD06-7620 / 435.TCS	SCN U4	
K15-1307	P4, STS SCN	LD06-7620 / 435.TCS	D	
K15-1310	P4, STS SCN	LD06-7620 / 435.TCS	SCN U4	
K07-1544	KA		COLDROOM	
K10-8556	KA		COLDROOM	
K15-1681	P4S, STS	KS5004N/435.TCS	U4S	
K15-1755	P4S	KS5004N / NCC06-339	D	
K15-1874	P4S, STS	KS5004N / 435.TCS	U4S	
K15-1891	P4S, STS	KS5004N / 435.TCS	D	
K15-1992	P4S	NCC05-1261 / LD00-3309	D	
K15-1788	P5	NCC05-1261 / 435.TCS	U5	
K15-1800	P5	NCC05-1261 / 435.TCS	U5	YES
K15-1809	P5	NCC05-1261 / 435.TCS	U5	
K15-1853	P5, STS	NCC05-1261 / 435.TCS	D	
K15-1854	P5, STS	NCC05-1261 / 435.TCS	D	
K15-1855	P5, STS	NCC05-1261 / 435.TCS	KA	
K14-1717	U4S, sts	NCC05-1261 / 435.TCS	K14-1717-1 and K14-1717-5 TO KA	
K14-1719	U4S, sts	NCC05-1261 / 435.TCS	D	
KS5005sp	TEST, MG5		COLDROOM	
KS5007sp	TEST, MG5		COLDROOM	
K14-1686	U5	S05-11482 / DS-880	U5	YES
K14-1726	U5	NCC05-1261 / 435.TCS	D	
Amsoy 71	North Dakota Increase	Planted in CB	ND	
Coles	North Dakota Increase	Planted in CB	ND	
Corsoy	North Dakota Increase	Planted in CB	ND	
Hark	North Dakota Increase	Planted in CB	ND	
Hodgson	North Dakota Increase	Planted in CB	ND	
Weber	North Dakota Increase	Planted in CB	ND	
Wells	North Dakota Increase	Planted in CB	ND	
A11	North Dakota Increase	Planted in CB	ND	
K13-1156	CALYXT INCREASE		CALYXT, increase in WN	
K13-1777	CALYXT INCREASE		CALYXT, increase in WN	
K13-1786	CALYXT INCREASE		CALYXT, increase in WN	
K13-1809	CALYXT INCREASE		CALYXT, increase in WN	
KS4202	poor germ, increase MG4		COLDROOM	
KS4607	poor germ, increase late MG4		COLDROOM	
GMO ENTRIES				
K04-3083RR	poor germination, increasing seed g5		COLDROOM	
KS5507NRR	need to increase, MG5		COLDROOM	
Foundation Seed Production				
CONVENTIONAL				
K13-1615	Retest, Foundation production, MG4	LS07-3125 / 435.TCS	D	
K12-2333	RETEST, MED INCREASE, MG4	LG04-5993 x LG04-5187	D	
K11-2363B	RELEASE, MG4	435.TCS / LD05-30578a	RELEASED IN 17	
K12-1355	LARGE INCREASE, MG5	R04-357/JTN-5503	RELEASED IN 18	
K12-1348	RETEST, Foundation production, MG5	R04-357/JTN-5503	D	
K13-1830	U5, Foundation production	DS-880 / R04-357	INCREASE, RETEST, MG5	YES
GMO ENTRIES (RR1)				
K4313NRRT	INCREASE, MG4, SVPT	KS4313N_5/KS3406RR	RELEASE IN 18	
KS3406RR	INCREASE, MG3, SVPT		PRIOR RELEASE	
* U, P, SVPT, KA = Uniform Tests, Preliminary Tests, Soybean Variety Performance Tests, Kansas Advance Tests, respectively. ** D = discard.				

APPENDIX V. Release of KS3618Ngr and KS5518.

Kansas Agricultural Experiment Station
Kansas State University
Manhattan, KS 66506

Notice of Release of KS3618Ngr (Glyphosate Resistant) Soybean

The Kansas Agricultural Experiment Station announces the release of 'KS3618Ngr' soybean [*Glycine max* (L.) Merr. Scientists contributing to this release are William Schapaugh, Professor, Jacob Petersen, Assistant Scientist and Rene Hessel, Assistant Scientist, Department of Agronomy, and Timothy Todd, Instructor, and Thomas Oakley, Research Assistant, Department of Plant Pathology.

KS3618Ngr is backcross derived line using the recurrent parent KS4314N, which KAES released in 2013. The pedigree of KS3618Ngr is KS4313N (5) X KS3406RR. KS3618Ngr is a glyphosate resistant variety. KS3618Ngr has white flowers, light tawny pubescence, tan pods at maturity, indeterminate growth habit, and seeds with black hila.

KS3618Ngr is a late group 3 maturity variety that is best adapted to the northern part of KS. KS3618Ngr tends to be a couple of days later and slightly taller than KS3406RR with similar yield potential. KS3618Ngr has average resistance to soybean cyst nematode (SCN) and possesses moderate resistance to Soybean Sudden Death Syndrome (SDS) compared with other commercial varieties. Compared to our previous release, KS3406RR, KS3618Ngr has better resistance to SCN and SDS.

The Foundation Seed Program, Department of Agronomy, Kansas State University will maintain breeder's seed of this cultivar. Information on licensing for commercialization can be obtained from Christopher D. Brandt, President/CEO, Kansas State University Research Foundation, 2005 Research Park Circle, Suite 105, Manhattan, KS 66502-5020 (phone: 785-532-5720; email: tech.transfer@k-state.edu).

Small quantities of seed for research purposes can be obtained by request from William Schapaugh, Department of Agronomy, Kansas State University, Manhattan, KS (phone: 785-770-7906; email: wts@ksu.edu) .

John D. Floros — 2-5-2018

John D. Floros — Date

Director, Kansas Agricultural Experiment Station

Experimental designation for KS3618Ngr was K4313Ngr.

K4313Ngr is backcross derived line using the recurrent parent KS4314N, which KAES released in 2013. K4313Ngr is a glyphosate resistant variety. The pedigree of K4313Ngr is KS4313N (5) X KS3406RR. This line has been tested in KS for three years. KS4313Ngr tends to be a couple of days later and slightly taller than KS3406RR with similar yield potential (Tables 1-4). K4313Ngr is resistant to soybean cyst nematodes and possesses moderate resistance to Soybean Sudden Death Syndrome where as KS3406RR is susceptible to both diseases (Table 5). K4313Ngr has white flowers, light tawny pubescence, tan pods at maturity, indeterminate growth habit, and seeds with black hila. K4313Ngr is a late group 3 maturity variety that is best adapted to the northern part of KS.

Table 1. Yield (bu/ac) of K4313Ngr in Kansas Soybean Variety Performance Tests (2015-2017).					
	Experiments (n)	K4313Ngr	KS3406RR	% of KS3406RR	Significance
All Data	31	51	50	101%	NS
Year					
2015	8	51	45	113%	+
2016	17	51	53	97%	NS
2017	6	50	49	101%	NS
Experiment	Location				
15 SP1	Onaga	23	24	99%	NS
15 SP11	Hutchinson	38	32	119%	+
15 SP12	Colby	73	64	115%	+
15 SP19	Rossville	44	32	135%	+
15 SP2	Rossville	86	71	121%	+
15 SP4	Ottawa	49	50	97%	NS
15 SP8	Belleville	36	37	98%	NS
15 SP9	Scandia	62	52	118%	+
16 SP1	Onaga	66	62	107%	NS
16 SP10	Assaria	46	48	95%	NS
16 SP11	Hutchinson	58	63	92%	-
16 SP12	Colby	70	72	97%	NS
16 SP15E	Parsons	25	32	78%	-
16 SP16E	Ottawa	65	61	106%	+
16 SP17	Scandia	48	54	89%	-
16 SP19 SHSD	Rossville	30	25	121%	NS
16 SP19 TO	Topeka	36	30	120%	NS
16 SP2	Rossville	66	71	92%	NS
16 SP3	Rossville	47	56	84%	-
16 SP4	Ottawa	78	75	103%	NS
16 SP5E	Parsons	40	49	81%	-
16 SP6E	McCune	45	45	101%	NS
16 SP7E	Erie	43	39	108%	NS
16 SP8	Belleville	56	65	86%	-
16 SP9	Scandia	57	58	99%	NS
17 SP1	Onaga	64	63	102%	NS
17 SP10	Assaria	28	31	90%	-
17 SP13E	Pittsburg	17	23	75%	-
17 SP2	Rossville	83	76	108%	+
17 SP4E	Ottawa	71	64	110%	+
17 SP5E	Parsons	36	37	97%	NS

Table 2. Maturity (days after Aug 31) of K4313Ngr in Kansas Soybean Variety Performance Tests (2015-2017).

	Experiments (n)	K4313Ngr	KS3406RR	% of KS3406RR	Significance
All Data	25	29	27	109%	+++
Year					
2015	5	34	30	113%	+
2016	13	29	27	109%	++
2017	7	27	25	105%	NS
Experiment	Location				
15 SP1	Onaga	35	37	94%	
15 SP12	Colby	30	24	127%	
15 SP19	Rossville	26	21	122%	
15 SP2	Rossville	39	34	115%	
15 SP4	Ottawa	39	33	117%	
16 SP1	Onaga	25	23	111%	
16 SP10	Assaria	29	32	91%	
16 SP12	Colby	33	30	112%	
16 SP15E	Parsons	28	32	89%	
16 SP16E	Ottawa	37	30	125%	
16 SP19 SHSD	Rossville	25	19	128%	
16 SP19 TO	Topeka	25	19	132%	
16 SP2	Rossville	10	6	167%	
16 SP3	Rossville	23	22	105%	
16 SP4	Ottawa	36	30	120%	
16 SP5E	Parsons	35	36	99%	
16 SP6E	McCune	37	35	105%	
16 SP7E	Erie	35	35	100%	
17 SP1	Onaga	24	24	98%	
17 SP10	Assaria	15	15	97%	
17 SP13E	Pittsburg	39	38	102%	
17 SP15	Rossville	21	18	119%	
17 SP2	Ottawa	29	22	130%	
17 SP4E	Parsons	25	24	104%	
17 SP5E	Parsons	35	36	97%	

Table 3. Lodging (score: 1=good to 5=poor) of K4313Ngr in Kansas Soybean Variety Performance Tests (2015-2017).

	Experiments (n)	K4313Ngr	KS3406RR	% of KS3406RR	Significance
All Data	31	1.9	1.7	112%	NS
Year					
2015	7	2.2	1.8	125%	NS
2016	17	1.8	1.6	107%	NS
2017	7	1.8	1.6	109%	NS
Experiment	Location				
15 SP1	Onaga	1.0	1.0	100%	
15 SP11	Hutchinson	1.3	2.0	65%	
15 SP12	Colby	3.0	1.0	300%	
15 SP19	Rossville	4.3	3.3	130%	
15 SP2	Rossville	3.8	3.0	127%	
15 SP4	Ottawa	1.0	1.0	100%	
15 SP8	Belleville	1.0	1.0	100%	
16 SP1	Onaga	2.0	1.0	200%	
16 SP10	Assaria	1.0	1.0	100%	
16 SP11	Hutchinson	1.8	2.3	78%	
16 SP12	Colby	2.5	1.1	227%	
16 SP15E	Parsons	1.0	1.0	100%	
16 SP16E	Ottawa	2.0	1.8	111%	
16 SP17	Scandia	1.0	1.0	100%	
16 SP19 SHSD	Rossville	4.3	3.7	116%	
16 SP19 TO	Topeka	5.0	3.7	135%	
16 SP2	Rossville	1.5	2.3	65%	
16 SP3	Rossville	1.3	2.0	65%	
16 SP4	Ottawa	1.5	2.0	75%	
16 SP5E	Parsons	1.0	1.0	100%	
16 SP6E	McCune	1.0	1.0	100%	
16 SP7E	Erie	1.0	1.0	100%	
16 SP8	Belleville	1.0	1.0	100%	
16 SP9	Scandia	1.0	1.0	100%	
17 SP1	Onaga	2.5	1.5	167%	
17 SP10	Assaria	1.0	1.0	100%	
17 SP13E	Pittsburg	1.0	1.0	100%	
17 SP15	Rossville	1.7	1.0	170%	
17 SP2	Rossville	3.3	4.5	73%	
17 SP4E	Ottawa	2.0	1.5	133%	
17 SP5E	Parsons	1.0	1.0	100%	

Table 4. Height (inches) of K4313Ngr in Kansas Soybean Variety Performance Tests (2015-2017).

	Experiments (n)	K4313Ngr	KS3406RR	% of KS3406RR	Significance
All Data	28	35	34	104%	**
Year					
2015	7	30	29	104%	ns
2016	14	37	37	102%	ns
2017	7	34	32	108%	ns
Experiment	Location				
15 SP1	Onaga	25	26	96%	
15 SP11	Hutchinson	27	24	112%	
15 SP12	Colby	30	26	116%	
15 SP19	Rossville	41	36	112%	
15 SP2	Rossville	41	40	103%	
15 SP4	Ottawa	26	28	96%	
15 SP8	Belleville	24	25	96%	
16 SP1	Onaga	41	39	105%	
16 SP10	Assaria	34	34	99%	
16 SP11	Hutchinson	33	28	115%	
16 SP12	Colby	29	32	90%	
16 SP16E	Ottawa	41	38	109%	
16 SP17	Scandia	41	40	103%	
16 SP19 SHSD	Rossville	37	31	120%	
16 SP19 TO	Topeka	41	40	103%	
16 SP2	Rossville	39	42	93%	
16 SP3	Rossville	40	40	100%	
16 SP4	Ottawa	41	41	99%	
16 SP6E	McCune	34	33	102%	
16 SP8	Belleville	30	33	92%	
16 SP9	Scandia	43	41	105%	
17 SP1	Onaga	42	41	104%	
17 SP10	Assaria	24	27	90%	
17 SP13E	Pittsburg	28	24	117%	
17 SP15	Rossville	36	29	122%	
17 SP2	Rossville	48	40	120%	
17 SP4E	Ottawa	37	36	103%	
17 SP5E	Parsons	26	26	100%	

(ns)= no significant difference, (*)= significantly better or larger, (-)= significantly worse or smaller
(*** or ---)= prob. <=1%, (** or --)= prob. >1% and <=5%, (* or -)= prob. >5% and <=10%,
(ns)= probability >10%. Probability calculations are derived from paired t-tests.

Table 5. SOYBEAN CYST NEMATODE AND SUDDEN DEATH SYNDROME RATINGS FOR K4313Ngr.

	2017 SCN FI*		2016 SCN FI		2015 SCN FI		2017 SDS** Rossville	2016 SDS Rossville
NAME	HG 7	HG 1.2.6.7	HG 7	HG 1.2.6.7	HG 7	HG 1.2.6.7	Mean	Mean
KS3406rr	106	102	78	89	115	103	76	19
K4313Ngr	14	60	1	51	6	20	36	6
LSD (0.10) =	28	38	19	31	23	37	17	13
NO. of cysts on susceptible checks=	534	496	825	624	424	572		

* SCN Female Index = Soybean Cyst Nematode female index based on a greenhouse assay, where the female index (FI) = (mean # of cysts on tested variety/mean # of cysts on susceptible checks) x 100. A low FI (<10) means that the SCN population was not able to reproduce well on the differential line, and a high FI means that the SCN population was able to reproduce well.

**SDS Score = Soybean Sudden Death Rating. SDSX is a score based on the severity and incidence of the disease at the R6 growth stage (full pod). The larger the score, the more severe and widespread the disease. A score of 100 indicates total plant death.

Kansas Agricultural Experiment Station
Kansas State University
Manhattan, KS 66506

Notice of Release of KS5518 Conventional (non-GMO) Soybean

The Kansas Agricultural Experiment Station announces the release of 'KS5518' soybean [*Glycine max* (L.) Merr. Scientists contributing to this release are William Schapaugh, Professor, Jacob Petersen, Assistant Scientist and Rene Hessel, Assistant Scientist, Department of Agronomy.

KS5518 is an F4 single plant selection from the cross R04-357/JTN-5503. KS5518 has white flowers, gray pubescence, tan pods at maturity, determinate growth habit, and seeds with buff hila. KS5518 is a mid-group V maturity variety. It is well adapted to a wide range of soil types and climates throughout Southeast KS, Southern MO, Northern AR and where other maturity group V varieties are grown.

KS5518 was tested as experimental line, K12-1355, in the Southern Uniform Soybean tests, the K-State Breeding program and the Kansas Soybean Variety Performance Tests from 2013 through 2017. In 2014, K12-1355 ranked number 1 in seed yield in the Uniform Preliminary 5 Test. In 2015, seed yield of K12-1355 was good, statistically equal to the highest yielding checks in the Uniform 5 Test. In Kansas breeding plots and the Soybean Variety Performance Test trials, K12-1355 has performed well, yielding about 6% higher than KS5005N. K12-1355 does not possess resistance to Soybean Cyst Nematode but does possess moderate resistance to Soybean Sudden Death Syndrome.

The Foundation Seed Program, Department of Agronomy, Kansas State University will maintain breeder's seed of this cultivar. Information on licensing for commercialization can be obtained from Christopher D. Brandt, President/CEO, Kansas State University Research Foundation, 2005 Research Park Circle, Suite 105, Manhattan, KS 66502-5020 (phone: 785-532-5720; email: tech.transfer@k-state.edu).

Small quantities of seed for research purposes can be obtained by request from William Schapaugh, Department of Agronomy, Kansas State University, Manhattan, KS (phone: 785-770-7906; email: wts@ksu.edu) .

John D. Floros — 2-5-2018

John D. Floros — Date

Director, Kansas Agricultural Experiment Station

Experimental designation for KS5518 was K12-1355.
K12-1355 is an F4 single plant selection from the cross R04-357/JTN-5503. K12-1355 has white flowers, gray pubescence, tan pods at maturity, determinate growth habit, and seeds with buff hila. K12-1355 is a mid-group V maturity variety. It is well adapted to a wide range of soil types and climates throughout Southeast KS, Southern MO, Northern AR and where other maturity group V varieties are grown.

It has been tested in Kansas and the Southern Uniform Soybean tests. In 2014, K12-1355 ranked number 1 in seed yield in the Uniform Preliminary 5 Test (Table 1). In 2015, seed yield of K12-1355 was good, statistically equal to the highest yielding checks in the Uniform 5 Test (Table 2). In Kansas breeding plots and the Soybean Variety Performance Test trials, K12-1355 has performed well, yielding about 6% higher than KS5005N (Tables 3-4). K12-1355 does not possess resistance to Soybean Cyst Nematode but does possess moderate resistance to Soybean Sudden Death Syndrome (Table 5).

TABLE 1. 2014 Prelim UP5 Summary, K-lines with checks (A total of 33 entries evaluated over 10 locations).

					Seed			
Entry	Yield bu/a	Maturity index	Lodging score	Height inches	quality score	weight g/100	protein @13%	oil @13%
OSAGE	58.2	0	1.3	27	1.7	12.7	32.8	18.1
Ellis	58.1	-2	1.3	26	1.8	12.7	35.2	18.6
JTN-5203	54.1	-2	1.2	26	2	13.4	35.3	19.1
AG 5332RR2Y	59.4	-3	1.9	32	2.5	14.9	36.0	18.9
95Y70	57.3	5	2.5	38	1.7	13.5	35.1	19.4
AG 5534RR2	57.5	3	1.4	32	1.8	15.8	34.8	19.7
K12-1028	56.2	-1	1.4	26	1.7	13.3	36.1	18.8
K12-1039	53.9	-5	1.4	28	1.9	13	36.0	18.6
K12-1099	50.7	-4	1.8	27	2.1	15.7	33.8	19.7
K12-1353	56.1	0	2.4	33	1.9	12.8	35.0	19.5
K12-1355	59.7	-1	1.9	29	1.8	14.5	34.4	19.7
Mean	55.7	0	1.7	29	1.9	14.1	35.5	19.0
LSD(0.05)	4.7	3		2	0.3	0.8	0.6	0.3
CV(%)	11.1			10	20.4	6.5	1.7	2

TABLE 2. 2015 UT5 Summary, K-lines with checks (A total of 27 entries evaluated over 15 locations).

					Seed			
Entry	Yield bu/a	Maturity index	Lodging score	Height inches	quality score	weight g/100	protein @13%	oil @13%
OSAGE	57.7	0	1.4	27	1.9	12.7	37.5	18.3
Ellis	59.8	-2	1.7	27	1.9	12.6	35.2	18.5
JTN-5203	54.2	-3	1.6	27	2.1	12.7	35.4	19
UA 5612	56.7	1	2.3	32	2.2	12.8	35.3	18.9
AG 5332RR2Y	58.4	-4	2.2	35	2.3	13.7	35.5	18.7
AG 5534RR2	54.6	1	1.9	33	2	14.8	35	19.6
AG 5335	55.2	-2	1.8	36	2.2	14.6	35.9	19.2
K12-1355	57	-1	2.3	29	1.9	14.1	34.2	19.4
Mean	57.2	-1	2	31	2.1	13.8	35.5	18.9
LSD(0.05)	4	2	0.3	2	0.3	0.8	0.5	0.4
CV(%)	12.1	435	29	9	24	8	1.7	2.2

Table 3. Performance of K12-1355 with K-lines across 20 KS breeding traits at McCune, Pittsburg, Manhattan, and Salina (2013-2017).

Strain	Yield bu/a	Maturity date	Lodging score	Height inches	Seed Weight g/100
Experiments	20	10	20	19	4
K12-1355	52.9a	45.5a	2.5a	34a	15.5a
KS5004N	49.7b	39.4b	1.9b	34a	13.3b
C.V. %	8.2	5.8	32.9	7.4	6.8

Table 4. Seed yield (bu/a) of K12-1355 with K-lines in KS breeding trials, by location (2013-2017).

Strain	McCune	Pittsburg	Manhattan	Salina
K12-1355	56.0a	55.5a	56.5a	35.6a
KS5004N	52.0b	51.4b	51.4b	32.9a
C.V. %	7.2	16.8	6.1	7.9

† Numbers within a column, or within a location, followed by the same letter, not significantly different at the 0.1 level of probability.

TABLE 5. SOYBEAN CYST NEMATODE AND SUDDEN DEATH SYNDROME RATINGS FOR K12-1355.

	2017 SCN FI*		2016 SCN FI		2015 SCN FI		2017 SDS** Rossville	2016 SDS Rossville
NAME	HG 7	HG 1.2.6.7	HG 7	HG 1.2.6.7	HG 7	HG 1.2.6.7	Mean	Mean
K12-1355	123	87	32	36	82	56	0	14
KS5004N	1	59	1	51	1	76	0	4
LSD (0.10) =	28	38	19	31	23	37	17	13
NO. of cysts on susceptible checks=	534	496	825	624	424	572		

* SCN Female Index = Soybean Cyst Nematode female index based on a greenhouse assay, where the female index (FI) = (mean # of cysts on tested variety/mean # of cysts on susceptible checks) x 100. A low FI (<10) means that the SCN population was not able to reproduce well on the differential line, and a high FI means that the SCN population was able to reproduce well.

**SDS Score = Soybean Sudden Death Rating. SDSX is a score based on the severity and incidence of the disease at the R6 growth stage (full pod). The larger the score, the more severe and widespread the disease. A score of 100 indicates total plant death.