Table S1. Data sources. KSU performance test (https://www.agronomy.k-state.edu/outreach-and-services/crop-performance-tests/soybeans/, accessed 2022/03); Ciampitti et al., 2017 (https://doi.org/10.4148/2378-5977.7434); Ciampitti, et al., 2020 (figshare: 10.6084/m9.figshare.20018015).

Site	Lon	Lat	Year	Planting dates	Maturity group	Plant density (pl/m^2)	Harvest dates	Source
Assaria	-97.60	38.68	2014 - 2021	May 15 to June 14	IV and V	34 and 38	October 16 to November 1	K-State soybean performance trials
Belleville	-97.84	39.83	2014 - 2020	May 15 to June 17	III, IV and V	34 and 35	October 15 to October 27	K-State soybean performance trials
Columbus	-94.84	37.16	2016; 2017; 2019	June 27 to June 29	IV, V and VI	25 and 30	November 16 to November 21	K-State soybean performance trials
Erie	-95.24	37.56	2014; 2016 - 2021	May 19 to July 11	IV and V	25, 30 and 39	November 11 to December 10	K-State soybean performance trials
Kiro	-95.79	39.09	2017 - 2021	April 06 to June 10	III, IV and V	25 and 35	October 12 to October 22	K-State soybean performance trials
McCune	-95.01	37.35	2014 - 2016; 2018; 2019	June 06 to July 01	III, IV, V and VI	25, 35, 38	November 02 to November 29	K-State soybean performance trials
Onaga	-96.16	39.48	2014 - 2018	May 06 to June 22	IV	34 and 38	October 08 to November 19	K-State soybean performance trials
Ottawa	-95.24	38.53	2014 - 2021	May 16 to July 6	III, IV and V	34 and 35	October 14 to October 22	K-State soybean performance trials
			2014 - 2016	May 04 to July 15	IV and V	32	Not available	Ciampitti et al., (2017)
			2018 - 2019	May 10 to June 29	III and IV	32	October 18 to October 25	field research studies
Parsons	-95.17	37.22	2014; 2015; 2018; 2020	June 06 to July 07	IV, V and VI	25 and 30	November 5 to November 25	K-State soybean performance trials
			2014 - 2015	May 02 to July 01	IV and V	32	Not available	Ciampitti et al., (2017)

Pittsburg	-94.70	37.41	2014 - 2018; 2020 - 2021	June 10 to July 08	IV and V	30 and 38	November 03 to November 16	K-State soybean performance trials
Riley	-96.83	39.29	2019 - 2021	May 13 to June 04	IV	37 and 38	October 22 to October 24	K-State soybean performance trials
Rossville	-95.95	39.13	2016	May 30 to June 02	IV	25	October 19	K-State soybean performance trials
			2014 - 2017; 2021	May 07 to June 02	IV	34	October 14 to October 16	K-State soybean performance trials
Topeka	-95.67	39.04	2014-2016	April 30 to June 09	III, V and VI	32	Not available	Ciampitti et al., (2017)
			2018 - 2019	May 10 to June 29	III and IV	32	October 08 to October 17	Ciampitti, et al., (2020)

Figure S1. Distribution of planting dates in the 13 sites of the dataset from 2014 to 2021.
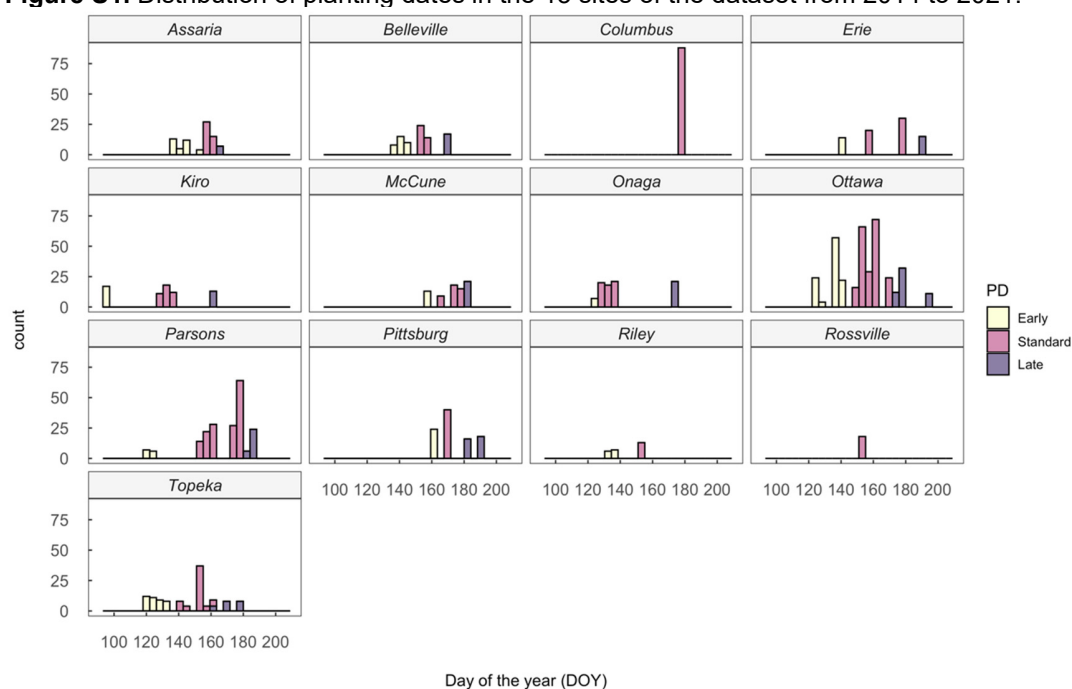
Table S2. Standard planting date, soil characteristics, and weather variables used to create the clusters

| Site | Standard planting date (DOY) | Weather characteristics | | | | Soil characteristics | | |
| | | Cumulative rainfall (mm) | Temp. max (°C) | | | Sand (%) | Silt (%) | Clay (%) |
			Jul	Aug	Sep			
Assaria	155 – 163	595	34	33	30	11	67	22
Belleville	150 – 160	601	33	31	29	10	59	31
Riley	150 – 160	691	32	31	29	4	61	35
Kiro	120 – 150	734	32	31	29	6	70	24
Onaga	127 – 140	713	32	31	29	10	65	25
Rossville	150 – 153	735	32	31	29	15	66	19
Topeka	120 – 160	717	32	31	29	7	60	33
Columbus	178 – 180	809	32	32	30	42	37	21
Erie	150 – 180	836	33	32	30	13	67	20
McCune	165 – 180	836	33	32	30	4	54	42
Ottawa	145 – 170	768	32	32	29	7	70	23
Parsons	150 – 180	819	32	32	30	13	67	20
Pittsburg	165 – 175	868	33	32	30	13	67	20

Figure S2. Interval where setting pods occurs in the state of Kansas according to NASS-USDA (https://quickstats.nass.usda.gov/results/20E59F49-96CD-3192-AEF5-6B5B63E28C43, visited April 2022)
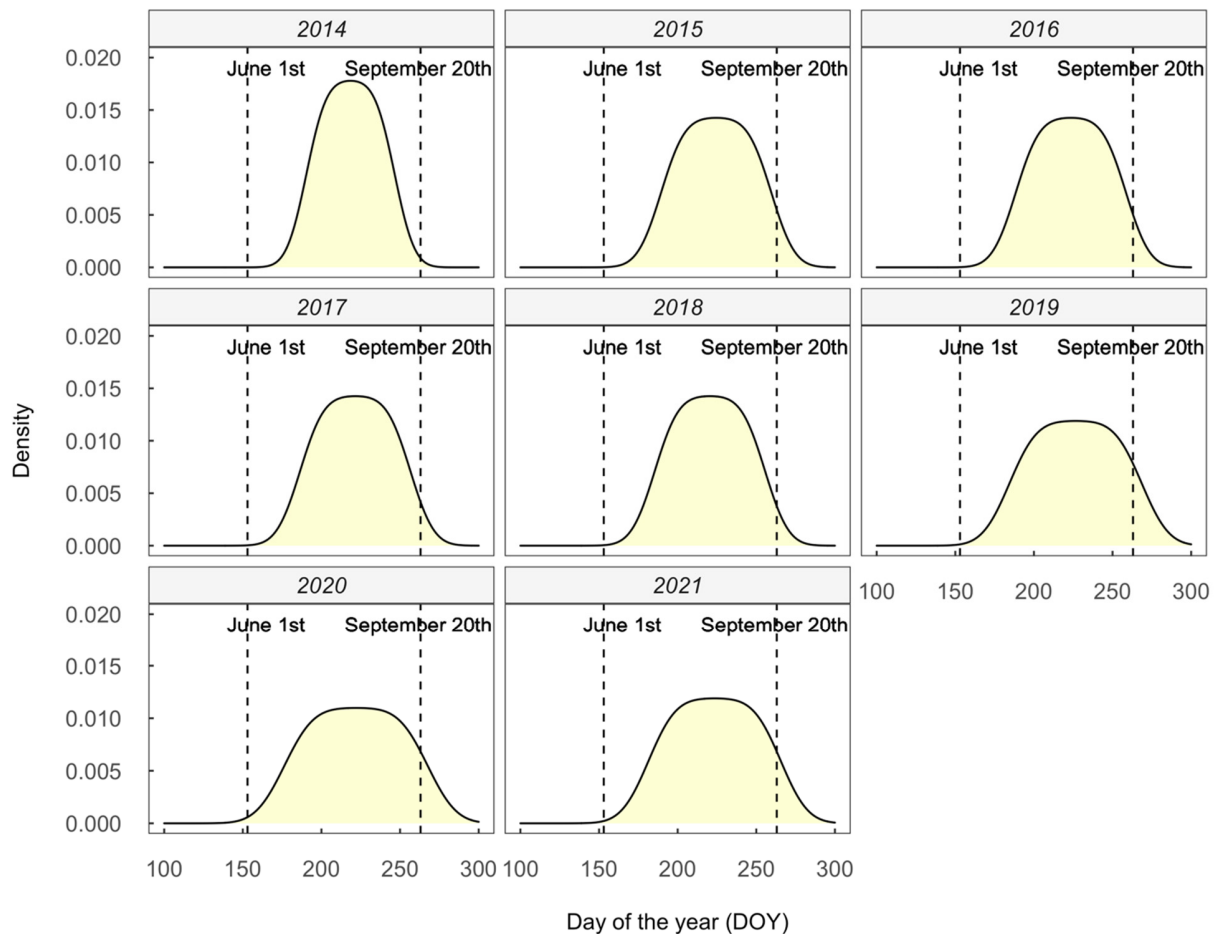
TABLE S3: Parameters included in the generic genotypes used from APSIM Next generation.

Parameter	Generic_MG			
	MG3	MG4	MG5	MG6
Vegetative.Target.FixedValue (°Cd)	380	388	396	404
EarlyFlowering.Target.FixedValue (°Cd)	120	140	160	180
EarlyGrainFilling.Target.FractionofGrainfillPeriod.FixedValue	0.361	0.324	0.072	0.056
LateGrainFilling.Target.EntireGrainfillPeriod.FixedValue (°Cd)	664	664	696	712
VegetativePhotoperiodModifier.XYPairs.X	13.4, 16.91	13.1, 16.49	12.83, 16.13	12.58, 15.8
ReproductivePhotoperiodModifier.XYPairs.X	13.4, 16.91	13.1, 16.49	12.83, 16.13	12.58, 15.8

Figure S3. Comparison of days of the year where anthesis occurs between the simulated data and data obtained from the National Agricultural Statistics Service (https://quickstats.nass.usda.gov/results/21B7C2DA-A180-3470-A7F4-383E92588748, visited April 2022).
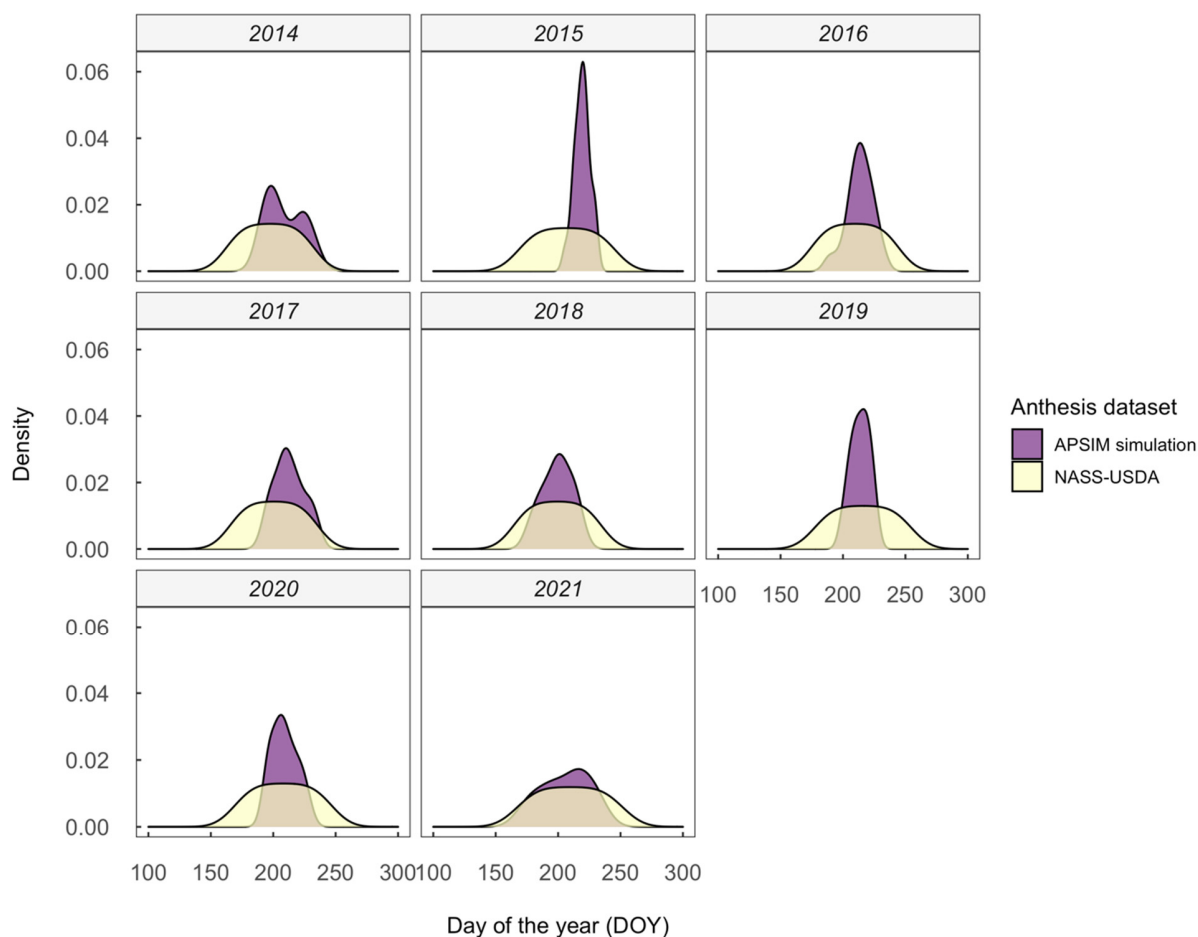
TABLE S4: Soybean seed yield (kg ha^{-1}) for the different planting dates x maturity groups combination in the South-east cluster. Values within different letters are significantly different at P<0.05.

Cluster	Planting date	Maturity group	Mean yield (kg ha^{-1})
	15-Apr	VI	4958 a
	15-Apr	V	4931 ab
	1-May	VI	4821 abc
	1-May	V	4818 abc
	15-Apr	IV	4808 abc
	1-May	IV	4750 abcd
	15-May	V	4742 abcd
	15-May	IV	4701 abcd
	15-May	VI	4624 bcde
	1-Jun	V	4530 cdef
	1-Jun	V	4519 cdef
	15-Apr	III	4429 defg
	15-Jun	IV	4319 efgh
South-east	1-Jun	VI	4318 efgh
	1-May	III	4311 efgh
	15-May	III	4256 fghi
	15-Jun	V	4173 ghij
	1-Jun	III	4078 hijk
	15-Jun	VI	3949 ijk
	1-Jul	IV	3891 jkl
	15-Jun	III	3832 klm
	1-Jul	V	3618 lmn
	1-Jul	III	3527 mn
	1-Jul	VI	3520 mn
	15-Jul	IV	3357 no
	15-Jul	III	3145 op
	15-Jul	VI	3025 pq
	15-Jul	VI	2803 q

Table S5: ANOVA (Type III Wald chi square tests) of the current weather (2012 – 2021) for the three clusters within Kansas.

Cluster	Component	P-value
North-central	Planting date	<2.2e-16 ***
	Maturity group	6.54e-10 ***
	Planting date : Maturity group	0.9991
North-east	Planting date	<2.2e-16 ***
	Maturity group	2.15e-09 ***
	Planting date : Maturity group	0.9989
South-east	Planting date	<2.2e-16 ***
	Maturity group	3.39e-10 ***
	Planting date : Maturity group	0.0284 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Figure S4: Simulated seed yield (kg ha^{-1}) across the 30 years of study within the three clusters in Kansas (North-central, North-east, and South-east).
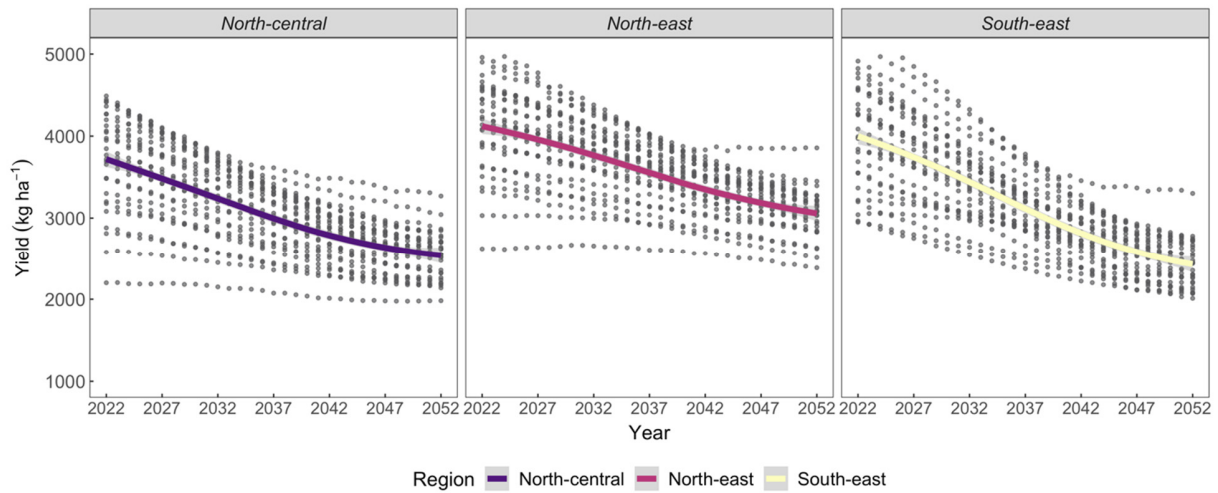
Table S6: Climate change in the future (2043 – 2052) compared to the current weather (2012 – 2021) in the three clusters in Kansas.

Cluster	Weather variable	Winter	Spring	Summer	Fall	Year
North-central	Maximum temperature (°C)	-0.33	-0.63	1.34	1.03	
	Minimum temperature (°C)	0.04	-0.17	1.72	1.63	
	Cumulative rainfall (mm)	34	65	-171	-77	-148
North-east	Maximum temperature (°C)	-0.22	-0.27	1.38	1.65	
	Minimum temperature (°C)	0.19	-0.22	1.39	1.81	
	Cumulative rainfall (mm)	30	121	-162	-61	-73
South-east	Maximum temperature (°C)	0.16	0.19	1.70	1.65	
	Minimum temperature (°C)	0.46	0.15	1.55	1.81	
	Cumulative rainfall (mm)	-21	24	-223	-87	-308

Table S7: Soybean seed yield (kg ha^{-1}) for the different planting dates x maturity groups combination within the three clusters in Kansas. Values within different letters are significantly different at $P<0.05$.

Cluster	Planting date	Maturity group	Mean yield (kg ha^{-1})
	15-Apr	III	3380 a
	1-May	III	3185 b
	15-Apr	IV	3008 c
	15-May	III	2954 cd
	1-May	IV	2947 cd
	15-Jun	IV	2919 cd
	1-Jun	IV	2838 de
	15-May	IV	2836 de
	1-Jun	III	2832 de
	1-May	V	2799 de
	1-Jul	IV	2795 de
	15-May	V	2721 ef
	15-Jun	V	2710 ef
North-central	15-Jun	III	2699 efg
p-value =	1-Jun	V	2697 efg
	15-Apr	V	2693 efg
	1-Jul	V	2575 fgh
	15-Jul	IV	2534 gh
	15-Apr	VI	2469 hi
	1-May	VI	2468 hi
	1-Jul	III	2436 hi
	15-May	VI	2336 ij
	15-Jul	III	2305 ij
	15-Jun	VI	2260 j
	15-Jul	V	2256 j
	1-Jun	VI	2250 j
	1-Jul	VI	2210 j
	15-Jul	VI	1986 k
	15-Apr	III	3851 a
	15-Apr	IV	3536 b
	15-Apr	VI	3504 bc
	15-Apr	V	3461 bcd
North-east	1-May	III	3448 bcd
	1-Jun	V	3430 cd
	15-Jun	V	3396 de
	1-May	VI	3379 de
	15-May	V	3373 de

	15-Jun	IV	3370 de
	1-Jun	IV	3332 ef
	1-May	V	3310 efg
	15-May	VI	3256 fgh
	1-Jul	IV	3217ghi
	1-May	IV	3194 hi
	15-May	IV	3188 hi
	1-Jul	V	3177 hi
	15-May	III	3172 hij
	1-Jun	VI	3140 ijk
	1-Jun	III	3080 jk
	15-Jun	VI	3068 kl
	15-Jul	IV	2981 lm
	15-Jun	III	2954 m
	1-Jul	VI	2932 m
	1-Jul	III	2754 n
	15-Jul	V	2737 n
	15-Jul	III	2641 o
	15-Jul	VI	2478 p
	15-Apr	III	3369 a
	15-Jun	VI	2947 b
	1-Jul	VI	2917 b
	1-Jun	VI	2909 bc
	1-Jul	V	2847 cd
	15-Jun	V	2834 d
	1-May	III	2809 de
	15-May	VI	2807 de
	1-May	VI	2762 ef
	15-Apr	IV	2748 efg
South-east	15-Jul	VI	2725 fg
	1-Jun	V	2691 gh
	15-Jul	V	2657 hi
	15-Apr	VI	2650 hi
	15-Jun	IV	2617 i
	15-Jul	IV	2552 j
	1-Jul	IV	2537 j
	1-Jun	IV	2459 k
	15-May	III	2399 kl
	15-May	V	2390 l
	1-May	IV	2375 lm

15-Jun	III	2313 mn
15-Apr	V	2304 n
1-May	V	2278 no
1-Jun	III	2255 no
15-Jul	III	2219 op
15-May	IV	2163 pq
1-Jul	III	2139 q