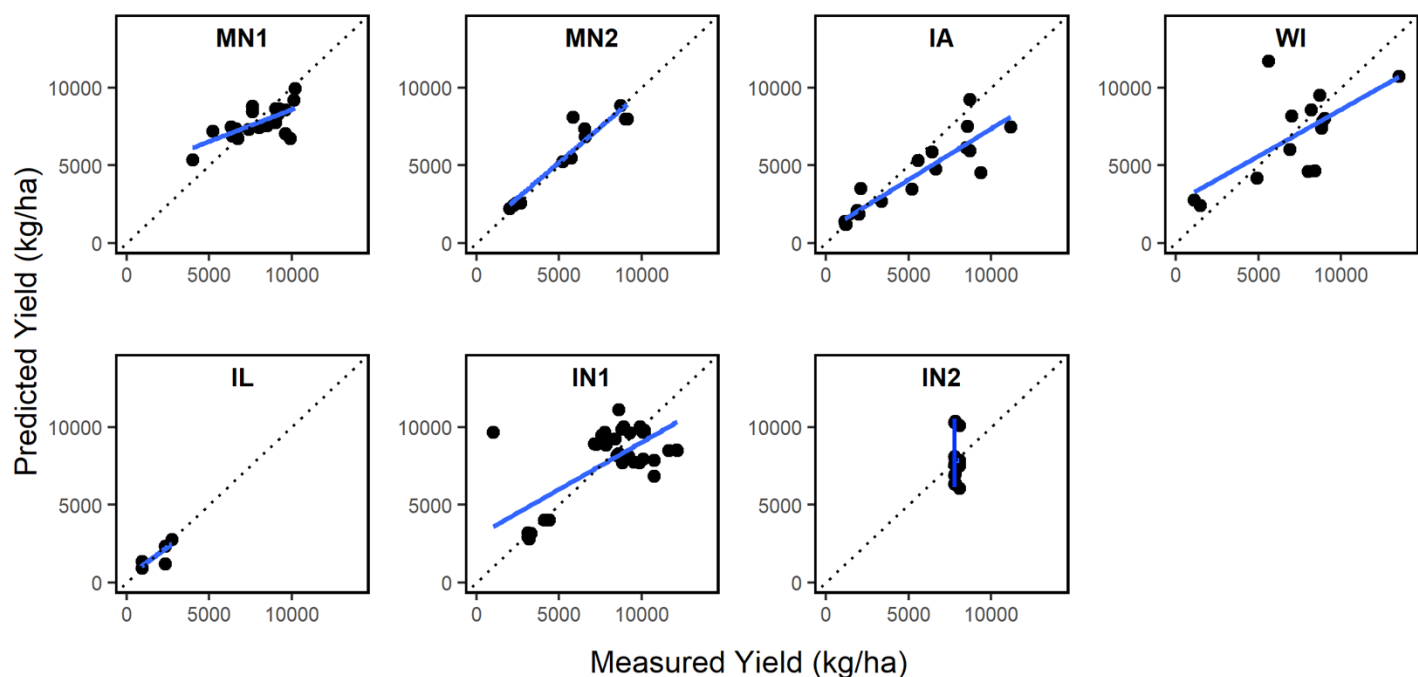
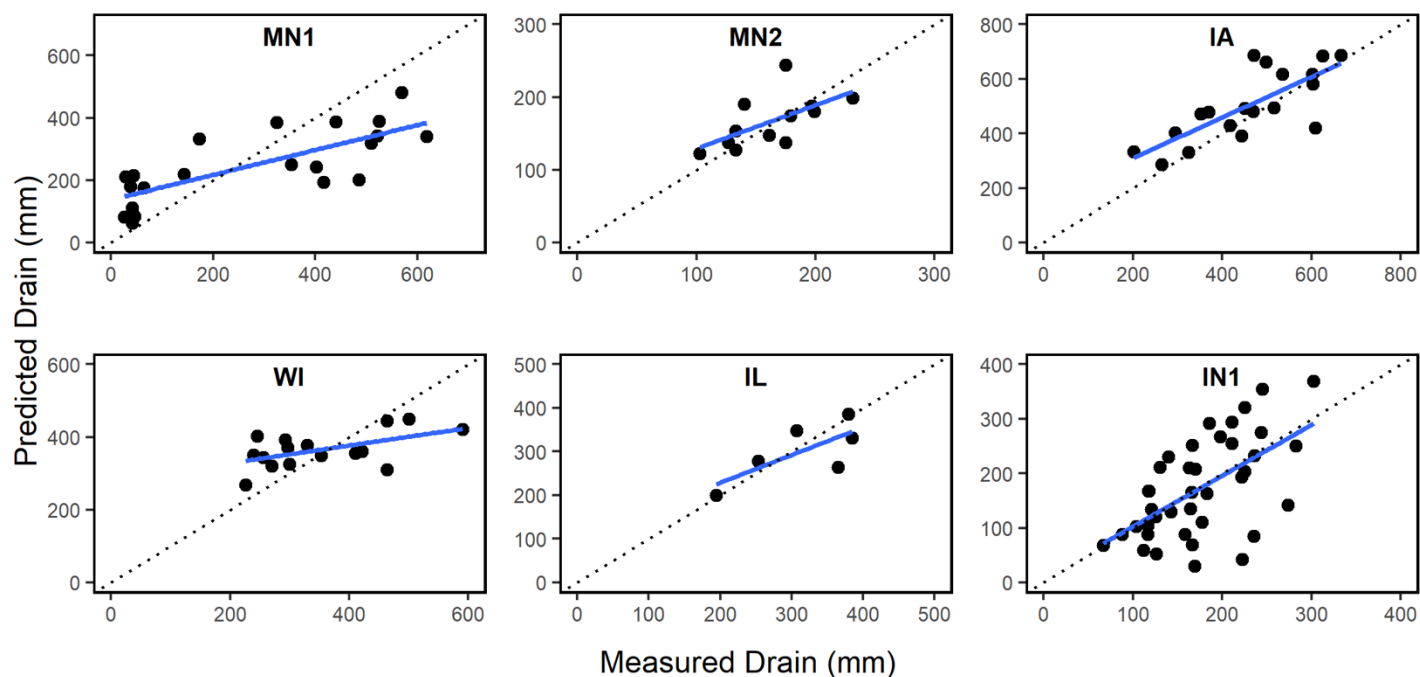


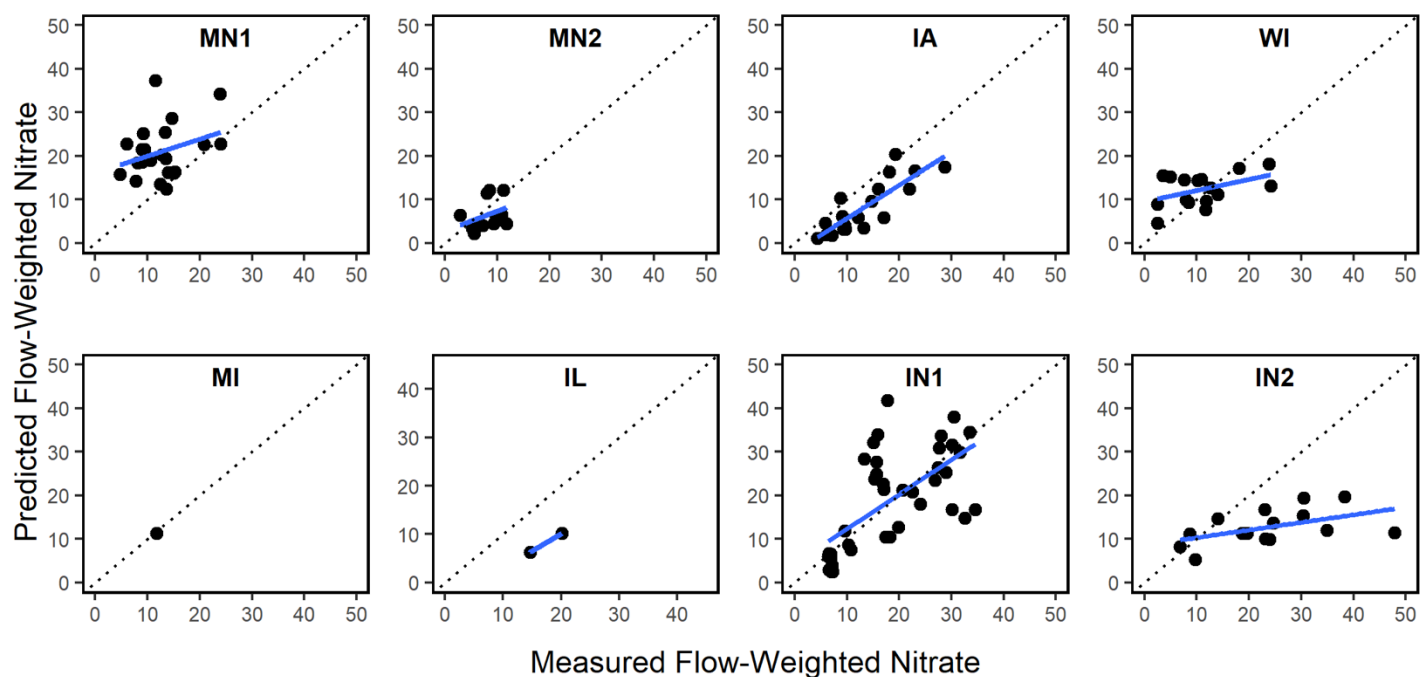
Supplementary Figure 1: Timeline of APSIM model simulations showing how leaching was summed up over one year of continuous maize and over both years of the maize-soybean 2-year rotation.



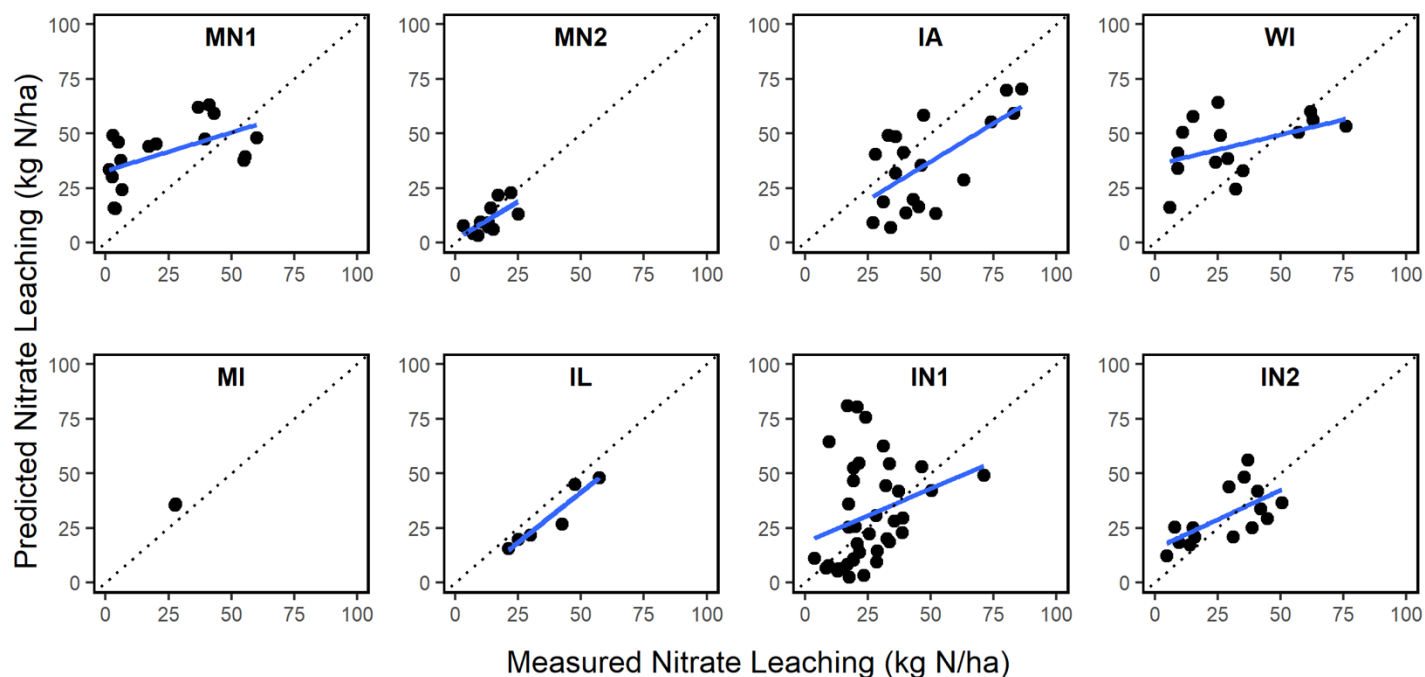
Supplementary Figure 2: Model calibration for yield data (solid blue line) relative to a 1:1 reference line (dotted black line). All yield data from experiments were reported annually with the exception of IN2 which only reported a 6-year average for each tile spacing treatment. The corresponding simulated yield data were output for each year of the experiments and so, captured the variability in yield from year to year discussed by the authors of IN2 [47].



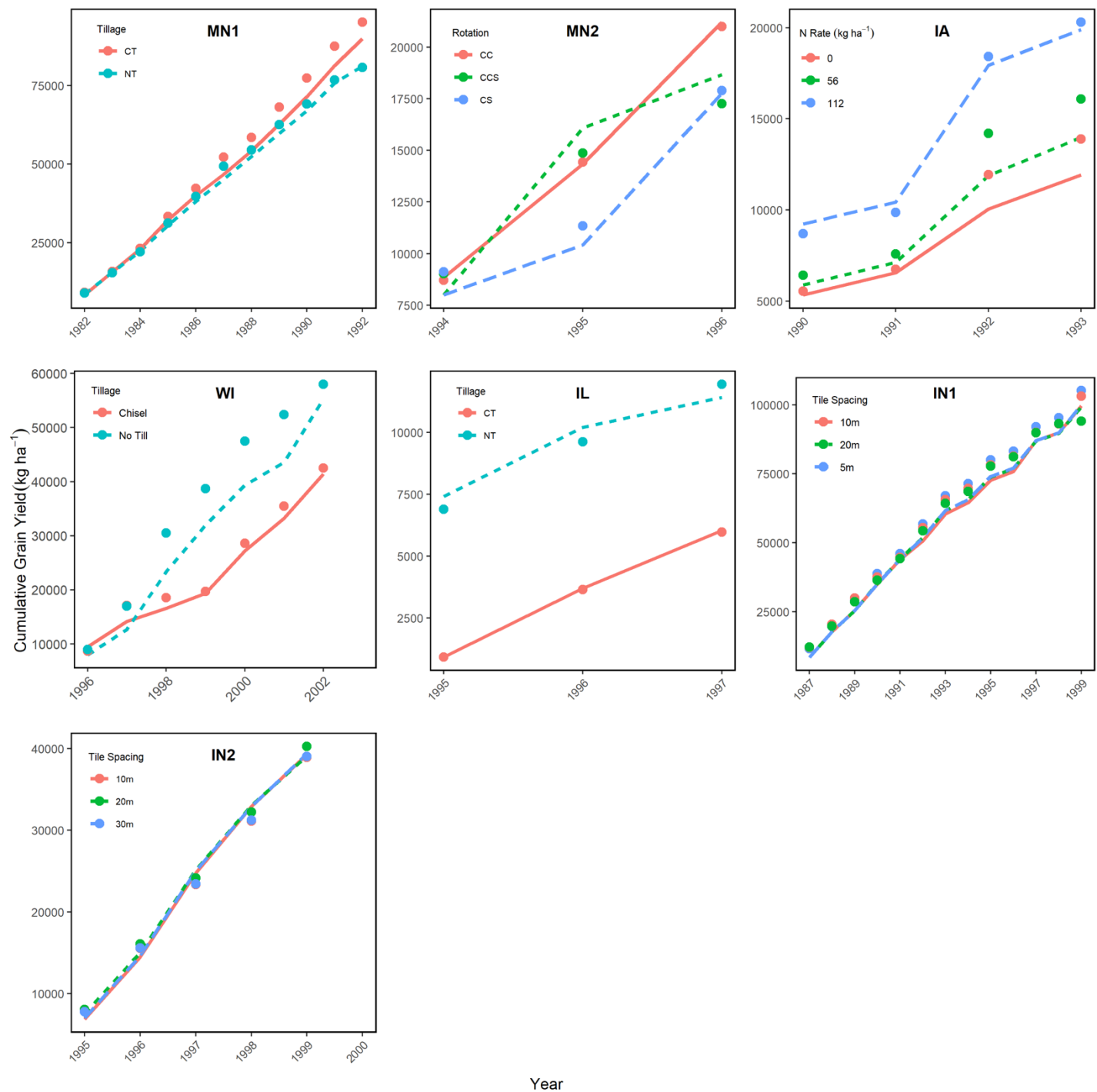
Supplementary Figure 3: Model calibration for drainage data (solid blue line) relative to a 1:1 reference line (dotted black line). All drainage data were both reported and simulated for each experimental year.



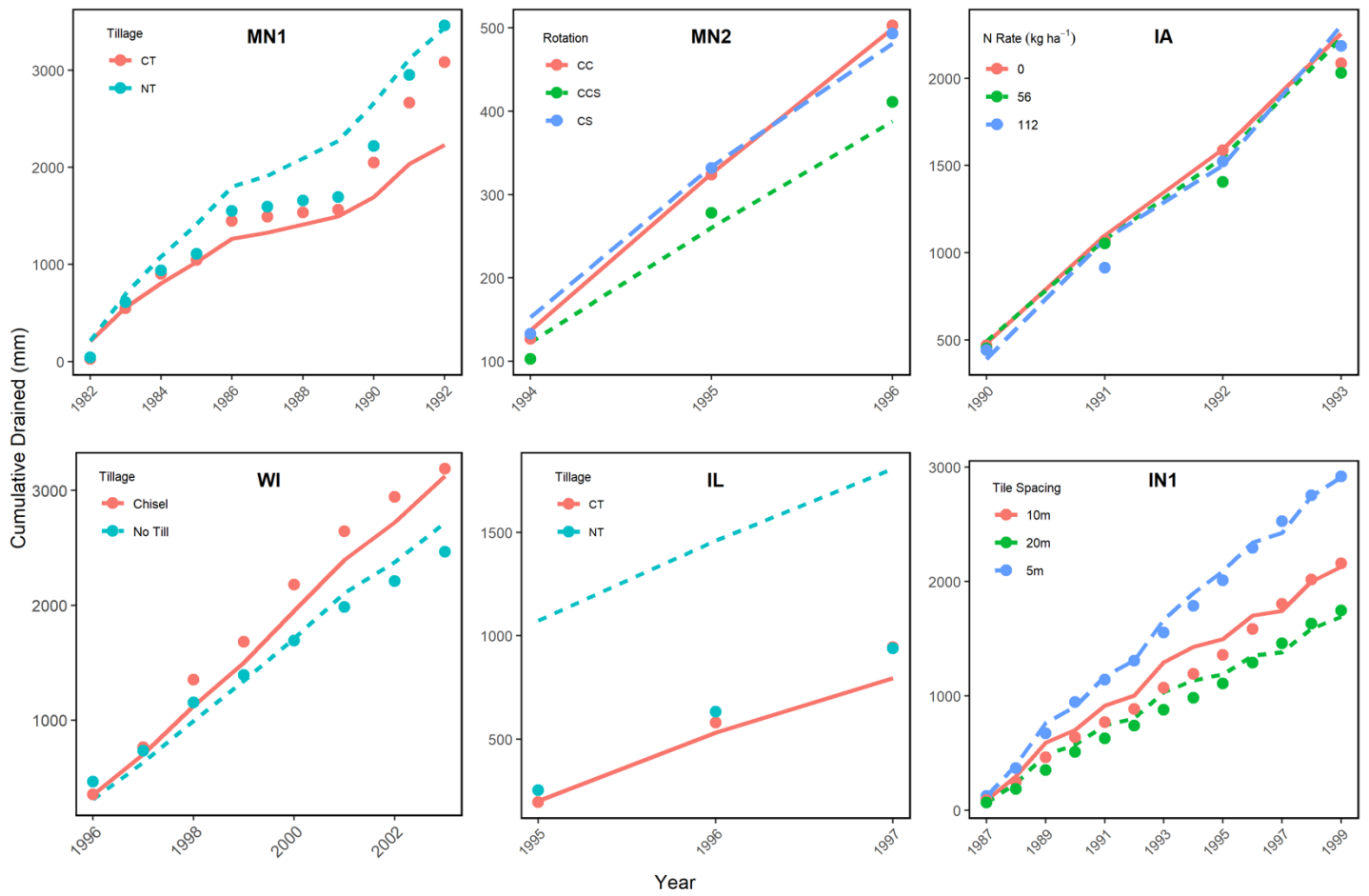
Supplementary Figure 4: Model calibration for flow-weighted $\text{NO}_3\text{-N}$ data (solid blue line) relative to a 1:1 reference line (dotted black line). All flow-weighted nitrate data were both reported and simulated for each experimental year with the exception of MI which reported a 3-year average [43].



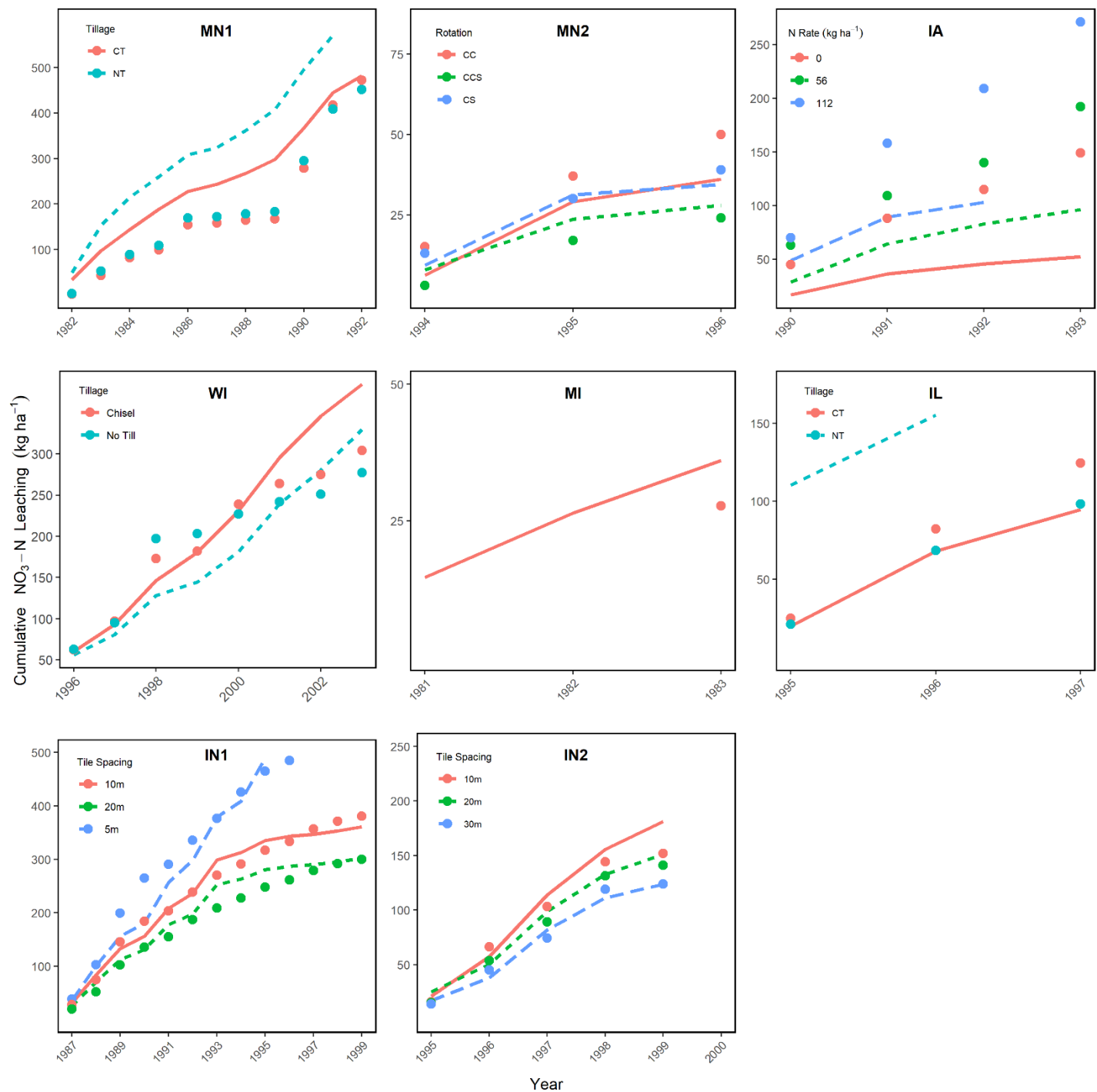
Supplementary Figure 5: Model calibration for $\text{NO}_3\text{-N}$ leaching load data (solid blue line) relative to a 1:1 reference line (dotted black line). All nitrate leaching data were both reported and simulated for each experimental year with the exception of MI which reported a 3-year average [43].



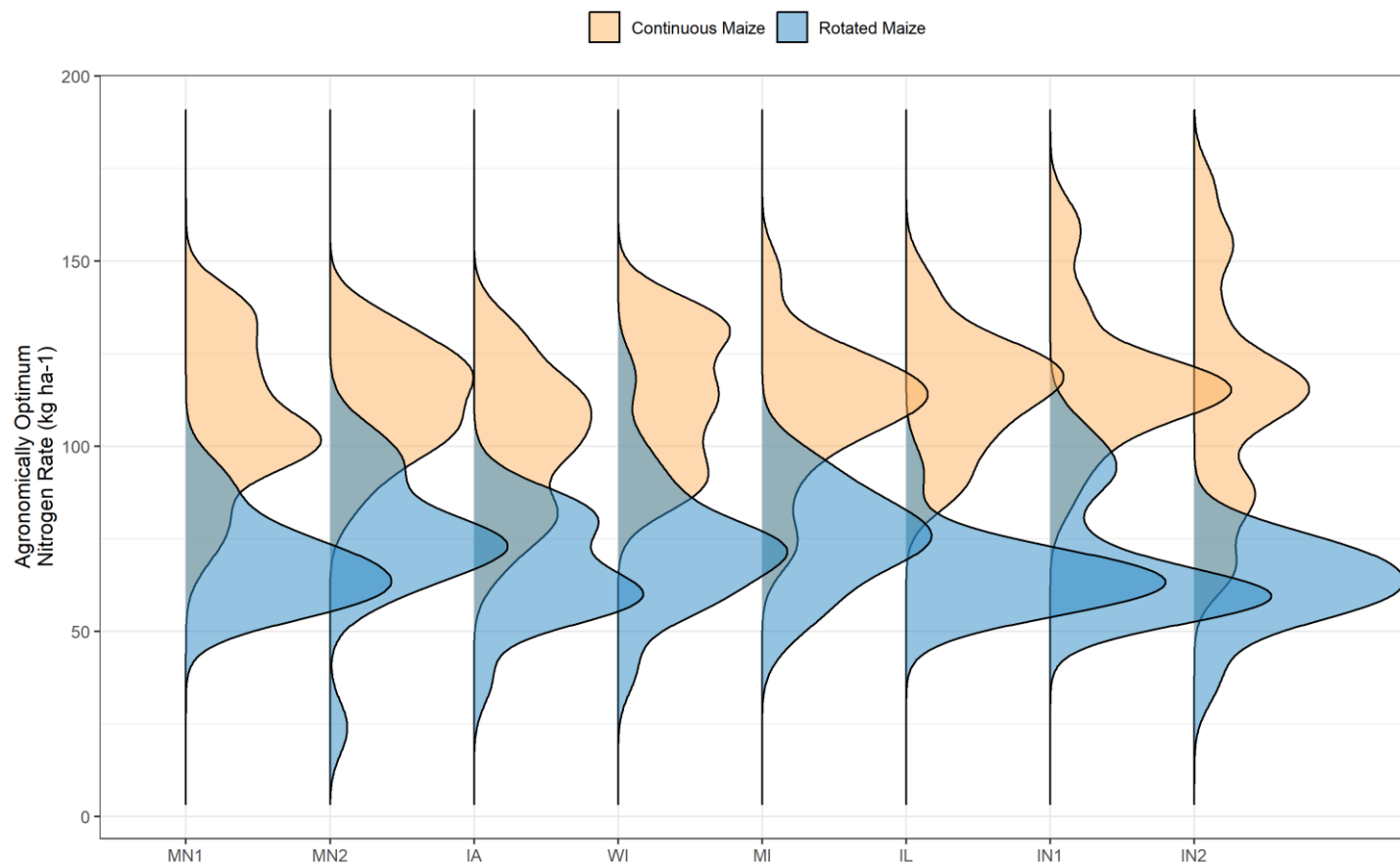
Supplementary Figure 6: Cumulative grain yield of modelled experiments in which measured yield data was available. Points are real data and lines are simulated data.



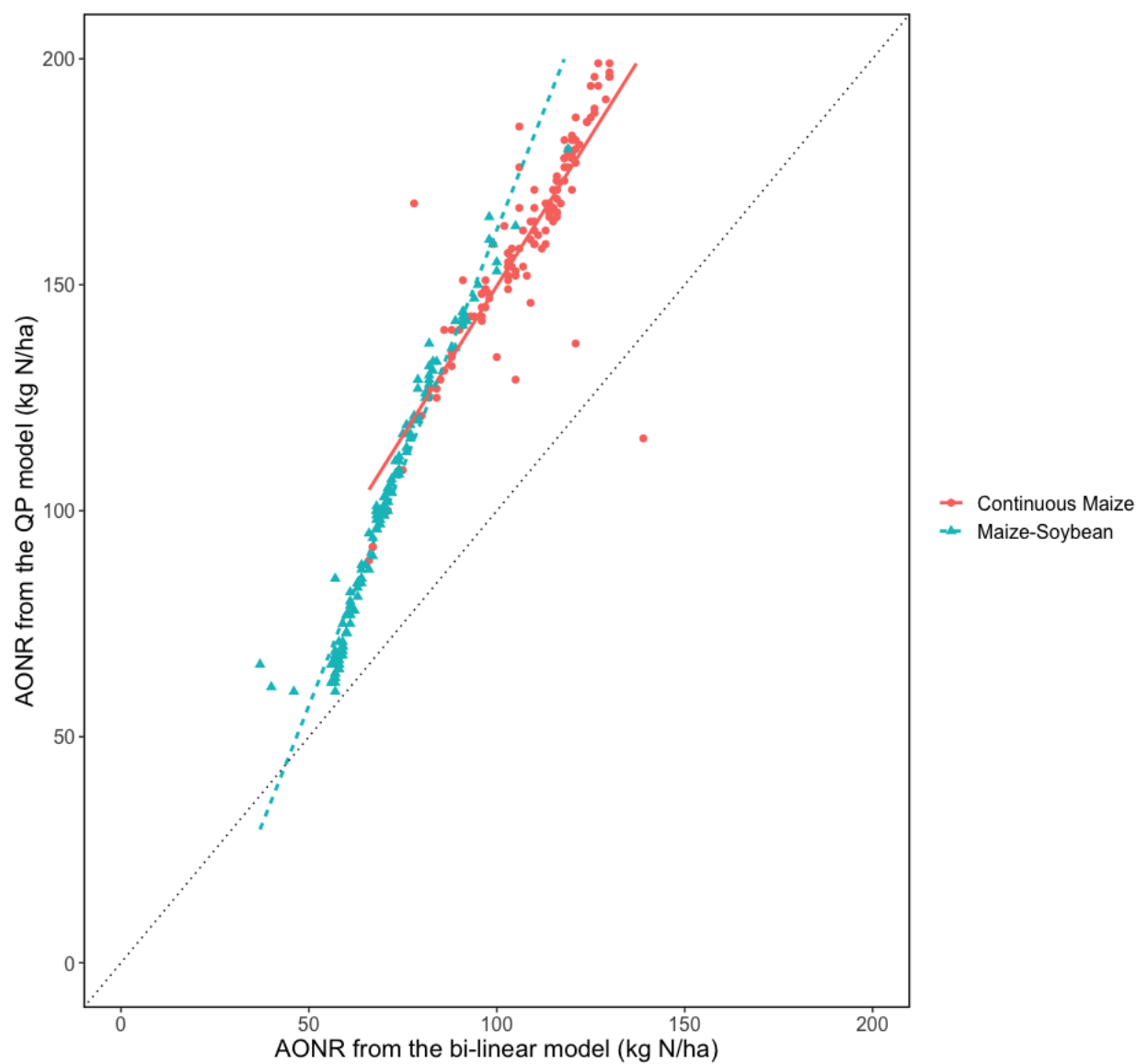
Supplementary Figure 7: Cumulative drainage of modelled experiments in which measured drainage data was available. Points are real data and lines are simulated data.



Supplementary Figure 8: Cumulative $\text{NO}_3\text{-N}$ leaching of modelled experiments in which measured leaching data was available. Points are real data and lines are simulated data.

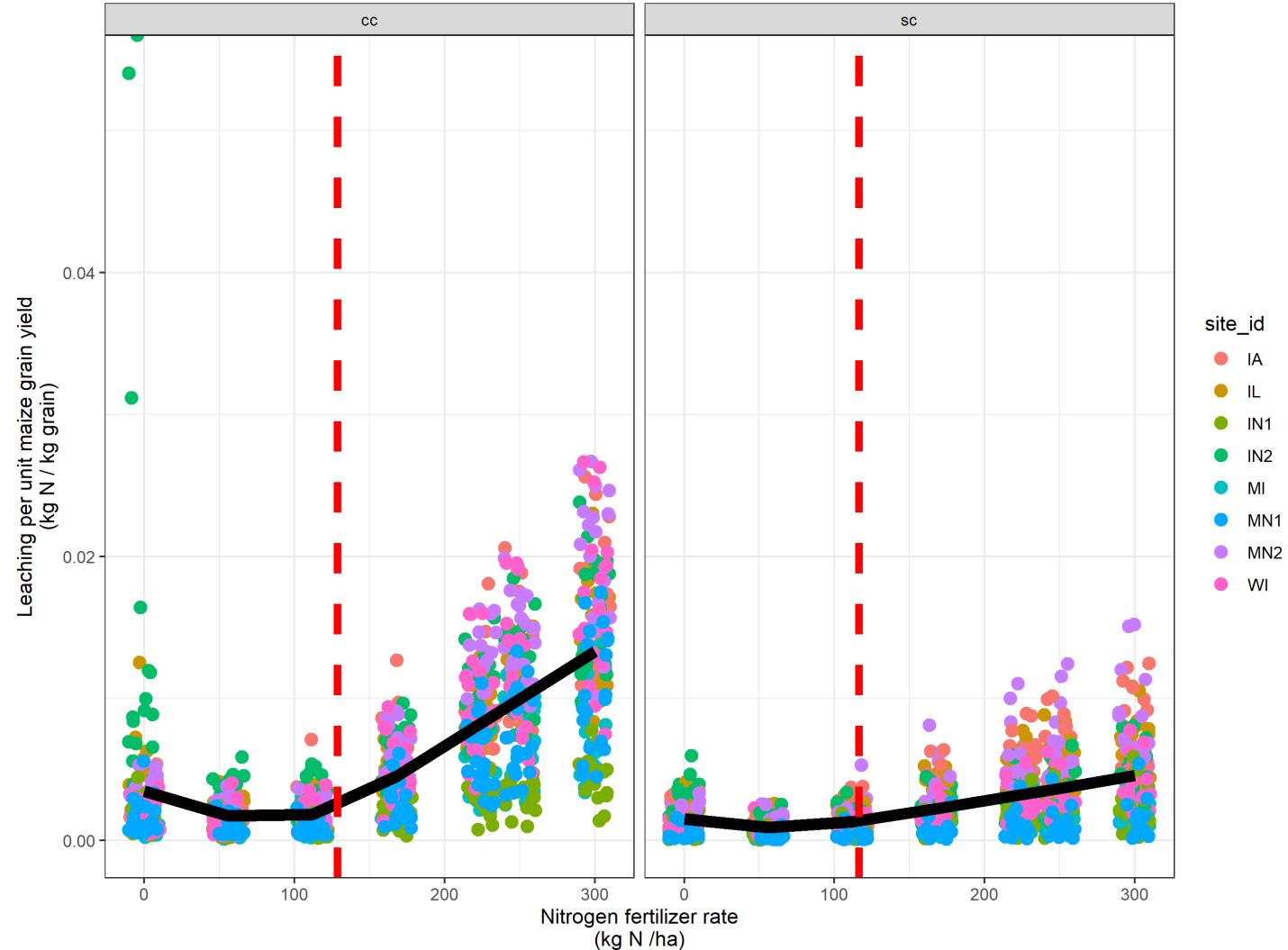


Supplementary Figure 9: Distribution plots of AONR values in study sites.



Supplementary Figure 9: AONR (kg N/ha) calculated using the bi-linear model plotted against AONR (kg N/ha) calculated using the quadratic plateau model for each system (Continuous Maize (solid red line; $y = 1.5x - 0.2$) and Maize-Soybean Rotation (dashed blue line; $y = 2.2x - 56.3$) relative to a 1:1 reference line (dotted black line).

Leaching per unit maize grain yield is minimized at fertilizer rates lower than leaching breakpoint



Supplementary Figure 10: Yield-scaled leaching response to increases in Nitrogen fertilizer rate in continuous maize (left) and the two-year maize-soybean rotation (right). Colors correspond to the different sites. The black line is the average modeled response. The red dashed vertical line is the leaching breakpoint.

Supplementary Table 1: Overview of the published studies used in this modeling study

Site ID	Reference	First/Co Author(s)	Publication Date	State	Lat	Long	Treatment	Experimental Years	Soil Texture
MN1	[38]	Randall & Iragavarapu	1995	Minnesota	44.07639	-93.5242	Tillage	1982-1992	Clay Loam
MN2	[39]	Huggins	2001	Minnesota	44.239	-95.3189	Rotation	1994-1996	Clay Loam
IA	[10]	Lawlor	2008	Iowa	42.4024	-94.8019	N Rate	1990-1993	Clay Loam
WI	[40]	Masarik & Norman	2014	Wisconsin	43.283	-89.367	Tillage	1996-2003	Silt Loam
MI	[41]	Gold & Loudon	1989	Michigan	43.39845	-83.6976	Tillage	1981-1983	Loam
IL	[42]	Gentry	2000	Illinois	40.05627	-88.2175	Tillage	1995-1997	Clay Loam
IN1	[43,44]	Kladivko	2004; 2005	Indiana	39.02583	-85.54	Tile Spacing	1987-1999	Silt Loam
IN2	[45]	Hofmann	2004	Indiana	40.47137	-86.9931	Tile Spacing	1995-2000	Silty Clay Loam

Supplementary Table 2: Weather data summary (max and min monthly temperatures, monthly precipitation, monthly radiation during the growing season) for modeled sites.

Year	Maximum Temperature (°C)					Minimum Temperature (°C)					Precipitation (mm)					Radiation Sum (MJ/m²)				
	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep
	MN1																			
1982	29	30	35.5	34	28.5	2.5	5	12	6.5	0	180	38	68	136	106	617.8	598.8	708.9	528.4	380.8
1983	24.5	33	35.5	35	32.5	0	3.5	12	12	-1	128	96	126	126	109	623.7	669	647.9	607.4	365.7
1984	27.5	31	32.5	35	32.5	-1.5	9	8	8.5	-4	75	158	124	46	60	638.6	616.9	671.9	598.5	428
1985	31.5	37	34.5	30.5	32.5	4.5	4	8.5	6	-1	55	60	52	161	139	624.1	608.4	704.9	513.3	380.2
1986	31	33.5	33	30.5	30	1.5	6.5	12.5	4.5	3.5	85	191	156	71	169	627.5	650.5	670.7	601.2	359.7
1987	33.5	37	35.5	33	30.5	2.5	5	10.5	6	5.5	65	67	180	130	57	658.8	727.1	697.6	528	462.9
1988	33	37.5	39	37	33	1	7	10.5	6	4.5	46	28	29	94	107	696.4	754.2	742.3	530.2	408.5
1989	29	33	36	33.5	28.5	-4.5	4	13	8.5	-1.5	50	65	91	120	33	614.2	645.1	744.3	619.6	487
1990	31.5	32	38	31	32.5	1	3.5	10	10	1.5	138	174	202	106	35	619.6	671.6	683.4	615.9	464.1
1991	30.5	35.5	34.5	32	28.5	1.5	12	10.5	10	-1	201	115	195	117	107	447	655.7	694.7	572.5	389
1992	29.5	32	28	31.5	29.5	0	3	8	6	-1.5	61	136	99	112	61	702.2	645.7	558.3	604.7	436.5
	MN2																			
1994	31.5	32.5	30.5	32	30.5	0.5	9.5	11	7	2.5	39	115	55	124	89	718.1	597.3	623.8	510	392.1
1995	25.5	36	38.5	33	29	3	3.5	9.5	11	-2.5	125	71	184	84	90	558.3	617.9	710.2	551.5	458.2
1996	33	34.5	32	32	29.5	0	5	8.5	10.5	1.5	116	136	87	124	58	503	677.2	670.5	663.7	432.7
	IA																			
1990	29	34	36	33	33.5	-1.5	5	11	10	2	185	274	178	93	52	563.1	675.1	660.1	633.7	521.7
1991	31.5	34.5	35	32	31	1	11.5	10	10.5	-1	179	131	43	100	64	492.9	676.4	683	594.9	446.7
1992	32	31	31	31	28.5	1.5	6.5	9.5	7.5	-0.5	53	66	222	70	80	690.3	700.8	529.5	664.1	466.9
1993	28	30.5	31	31.5	29.5	3	5.5	12.5	10	0.5	124	181	207	187	63	516.4	549.3	568.1	550.3	453.6
2000	30.5	34.5	32.5	33.5	36.5	3.5	8	10.5	12.5	1	72	81	90	72	24	595.2	660.5	660.7	567	464
2001	32.5	34	35	34.5	29	5.5	6.5	12	12	1	203	92	80	131	76	507.1	671.8	616.4	609	445.8
2002	33	35.5	36	33.5	33.5	-0.5	9.5	13	8	1	107	65	90	246	36	681.1	735.3	726.9	594.3	478.3
2003	29	32.5	35	36.5	31.5	4	9.5	12	12.5	0.5	118	127	155	24	52	587.9	648.8	710.3	684.3	488.8
2004	29.5	32.5	32	31	32	-1	6.5	10	6.5	2.5	180	131	77	64	70	585.5	646.6	689.3	606.7	506.2
	WI																			
1996	30	32.5	29.5	31	30	-0.5	6.5	9	9.5	3.5	119	208	86	62	28	485.6	562.8	675.4	639.2	461.3
1997	25.5	31.5	31.5	28	27.5	-1	9	8.5	6.5	3	42	186	166	78	55	596.1	708.6	633.4	505.6	443.9
1998	30.5	32	31	30.5	31	6	4.5	10.5	10	2	73	168	75	112	74	663	587	722.4	560.7	515.8
1999	29	31.5	35.5	31.5	31.5	3.5	6	12	9	-0.5	142	128	148	76	55	589.6	627	710.4	574.5	483.7
2000	28	30.5	30	33	28.5	2	6.5	10	11.5	2.5	348	172	70	69	103	546.2	606.8	629.9	588.3	452.5

Maximum Temperature (°C)						Minimum Temperature (°C)					Precipitation (mm)					Radiation Sum (MJ/m²)				
Year	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep
2001	29.5	31.5	34.5	34	28	4.5	7.5	10	8	1.5	123	137	229	102	149	530.2	595.4	690.6	569.5	448.7
2002	29.5	33.5	33.5	32	32.5	0	8	11	10.5	2	145	43	64	86	85	603.3	629.4	700.8	620.5	483.5
2003	24.5	32.5	30	34	31.5	3	5.5	12	9	-4	122	98	118	27	112	643.2	654.2	643.7	636.3	476.2
	MI																			
1981	23.2	23.8	25	20.8	18.6	6	21.5	20.5	21.5	13.5	77	89	54	116	214	589.3	641.8	668.2	559.1	436
1982	29.5	27.5	32	29.5	31	2.5	5	8.5	2	2	51	118	60	86	69	589.3	665.2	668.2	559.1	448.4
1983	24	33	34.5	33.5	33.5	-1	3	6	9.5	1	144	75	48	81	112	589.3	641.8	668.2	559.1	436
	IL																			
1995	26.5	35.5	38	34.5	32	3.5	10	13	12	-1	192	53	46	143	39	489	645.4	745.7	606	498.2
1996	32	34.5	34	34	29.5	3	9	11	13.5	5.5	294	104	83	71	56	498.7	607.9	703.7	636.1	486.9
1997	29.5	34	36	32	31.5	1.5	10.5	11.5	9.5	6	113	105	35	144	65	596.8	627.3	724.5	534.8	500.8
	IN1																			
1987	30.7	32.8	33.5	34	32	19.1	7.4	11	4	4	36.8	46.7	179.8	41.6	48.7	713.7	704.3	673.4	673.7	514.9
1988	31.7	37.9	38.1	36.6	29.6	0.2	4.7	8.6	9.5	3.9	5.1	11.2	105.4	99.8	94.9	757	763.9	727	634.7	494.2
1989	30.2	32.2	32.9	32	30.9	0.4	8	13.2	8	6	118.8	125.9	77.2	114.3	73.1	700.8	700.6	653.4	608.3	475.7
1990	26.1	31.9	35	33	33	1	4.3	12	11	1	255.7	111.2	86.1	80.5	34.5	636.2	687.6	763.1	732.7	542.6
1991	31	33	35	36	33	2	11	12	13	0	110	10.4	89.2	161.3	67.1	740.5	859	812.7	729.8	575.6
1992	28	32	32	32	30	1	5	13	8	2	67.3	120.2	319.8	123.7	68.3	750.5	811.5	694.7	715.7	538
1993	29	31	35	33	29	5	5	12	12	-1	92.5	89.2	74.2	177.8	83.8	770.2	748.9	754.9	693.4	535.1
1994	30	34	32	31	31	-1	9	10	8	5	87.9	81.5	94.7	113.3	72.1	818.6	802	798.6	709.4	548.6
1995	28	33	35	33	33	2	7	10	13	0	251	68.3	65.2	336.3	30.7	732.8	772.3	792.7	684.7	565.4
1996	31	32	32	32	30	1	10	10	12	3	130.6	160.5	124.7	42.7	136.7	750.8	739.5	759	755.5	553.6
1997	29	32	36	32	32	0	9	10	7	3	158	135.6	64.8	133.6	24.9	740.2	679	831.5	677.8	594.5
1998	32	34	34	34	34	6	5	12	11	6	96.5	190	143	67.1	37.6	738.7	680	802.1	753.7	591.9
1999	31	35	38	36	36	3	8	12	10	1	62.5	71.1	41.1	57.4	13	816.2	784.3	815.1	747.2	633.1
	IN2																			
1995	26	35	36.5	34.5	32	1.5	7	11.5	9.5	-2.5	169	67	56	54	33	532	640.4	711.6	602.6	495.6
1996	31.5	33.5	32	32.5	29	2	8.5	9.5	12.5	4.5	166	129	147	24	72	495.1	622.2	691.8	624.5	467.6
1997	28	33	35	31	30	1	10	11	8.5	3	112	138	63	63	40	543.4	599.8	716.8	560.8	490.4
1998	32.5	34.5	33	32	33.5	9	4.5	12.5	12	3	104	231	137	46	25	618.7	606.4	723.4	598.1	499.2
1999	29.5	33.5	36	33	34.5	6.5	6.5	11.5	10	1	113	58	64	74	58	629.7	638.7	739.6	613.1	571.7
2000	30	31.5	30	34	30.5	4	6.5	10	10.5	2	141	192	125	28	89	522.3	601.2	676.2	601.3	477.9

Supplementary Table 3: Soil data summary for modeled sites. Abbreviations: BD is the bulk density, LL is the soil water lower limit (wilting point), DUL is the soil water upper limit (field capacity), SAT is the soil water holding capacity (saturated), KS is hydraulic conductivity, OM is organic matter, F-inert is the fraction of organic matter is stable/cannot be broken down, pH refers to the soil's acidity/alkalinity level.

Site = MN1 (Minnesota, lat = 44.08, long = -93.52)

depth_inc	texture	BD	LL	DUL	SAT	KS	OM	F-inert	pH
cm	-	g/cm3	mm/mm	mm/mm	mm/mm	mm/d	%	fraction	
0-30	Clay Loam	1.1	0.2	0.4	0.5	212	3	0.394	7.5
30-60	Clay Loam	1.3	0.2	0.35	0.5	146	2.6	0.72	7.9
60-100	Clay Loam	1.4	0.2	0.3	0.4	1334	1	0.754	8.3
100-150	Clay Loam	1.55	0.1	0.3	0.4	133	0.25	0.888	8.75
150-210	Clay Loam	1.6	0.1	0.3	0.35	16.5	0	0.999	9
210-300	Clay Loam	1.6	0.1	0.3	0.3	10	0	0.999	9
300-390	Clay Loam	1.6	0.1	0.3	0.3	5.7	0	0.999	9

Site = MN2 (Minnesota, lat = 44.24, long = -95.32)

depth_inc	texture	BD	LL	DUL	SAT	KS	OM	F-inert	pH
cm	-	g/cm3	mm/mm	mm/mm	mm/mm	mm/d	%	fraction	
0-30	Clay Loam	1.5	0.1	0.2	0.3	176	1.85	0.444	6.7
30-60	Clay Loam	1.5	0.1	0.2	0.3	140	1.1	0.709	6.5
60-100	Clay Loam	1.6	0.1	0.2	0.3	165	0.65	0.754	7
100-150	Clay Loam	1.6	0.1	0.2	0.3	130	0.25	0.809	7.95
150-210	Clay Loam	1.6	0.1	0.2	0.3	10	0	0.999	8
210-300	Clay Loam	1.6	0.1	0.2	0.3	5.7	0	0.999	8
300-390	Clay Loam	1.6	0.1	0.2	0.3	3.5	0	0.999	8

Site = IA (Iowa, lat = 42.4, long = -94.8)

depth_inc	texture	BD	LL	DUL	SAT	KS	OM	F-inert	pH
cm	-	g/cm3	mm/mm	mm/mm	mm/mm	mm/d	%	fraction	
0-30	Clay Loam	1.3	0.2	0.4	0.5	130	2.75	0.545	7.9
30-60	Clay Loam	1.6	0.2	0.4	0.5	87	1.65	0.831	8
60-100	Clay Loam	1.6	0.2	0.3	0.4	58	0.4	0.976	7.9
100-150	Clay Loam	1.6	0.2	0.3	0.4	52	0.1	0.999	8.1
150-210	Clay Loam	1.6	0.2	0.3	0.4	15.5	0	0.999	8.1
210-300	Clay Loam	1.6	0.2	0.3	0.4	10	0	0.999	8.1
300-390	Clay Loam	1.6	0.2	0.3	0.4	5	0	0.999	8.1

Site = WI (Wisconsin, lat = 43.28, long = -89.37)

depth_inc	texture	BD	LL	DUL	SAT	KS	OM	F-inert	pH
cm	-	g/cm3	mm/mm	mm/mm	mm/mm	mm/d	%	fraction	
0-30	Clay Loam	1.4	0.2	0.4	0.5	203	1.4	0.545	6.5
30-60	Clay Loam	1.4	0.2	0.4	0.5	104	0.55	0.831	6.2
60-100	Clay Loam	1.5	0.2	0.3	0.45	81	0.45	0.976	6.4
100-150	Clay Loam	1.5	0.1	0.3	0.4	58	0.35	0.999	6.55
150-210	Clay Loam	1.6	0.1	0.25	0.4	15	0.3	0.999	6.85
210-300	Clay Loam	1.6	0.1	0.2	0.3	9.7	0	0.999	7
300-390	Clay Loam	1.6	0.1	0.2	0.3	6	0	0.999	7

Site = MI (Michigan, lat = 43.4, long = -83.7)

depth_inc	texture	BD	LL	DUL	SAT	KS	OM	F-inert	pH
cm	-	g/cm3	mm/mm	mm/mm	mm/mm	mm/d	%	fraction	
0-30	Clay Loam	1.5	0.2	0.3	0.4	39	1.77	0.545	7.6
30-60	Clay Loam	1.5	0.2	0.4	0.4	40	1.1	0.831	7.8
60-100	Clay Loam	1.5	0.3	0.4	0.4	36	0.65	0.976	7.9
100-150	Clay Loam	1.5	0.2	0.4	0.4	33	0.25	0.999	7.9
150-210	Clay Loam	1.5	0.2	0.35	0.4	9	0	0.999	7.9
210-300	Clay Loam	1.5	0.2	0.3	0.4	6	0	0.999	7.9
300-390	Clay Loam	1.5	0.2	0.3	0.4	3.3	0	0.999	7.9

Site = IL (Illinois, lat = 40.06, long = -88.22)

depth_inc	texture	BD	LL	DUL	SAT	KS	OM	F-inert	pH
cm	-	g/cm3	mm/mm	mm/mm	mm/mm	mm/d	%	fraction	
0-30	Clay Loam	1.5	0.2	0.3	0.4	466	2.3	0.545	6.7
30-60	Clay Loam	1.5	0.2	0.3	0.4	306	1.05	0.831	6.3
60-100	Clay Loam	1.5	0.2	0.3	0.4	285	0.3	0.976	6
100-150	Clay Loam	1.5	0.2	0.3	0.4	174	0.25	0.999	6.15
150-210	Clay Loam	1.5	0.15	0.3	0.35	25.5	0.1	0.999	7.1
210-300	Clay Loam	1.5	0.1	0.3	0.3	0.7	0.1	0.999	7.2
300-390	Clay Loam	1.5	0.1	0.3	0.3	0.4	0.1	0.999	7.2

Site = IN1 (Indiana, lat = 39.03, long = -85.54)

depth_inc	texture	BD	LL	DUL	SAT	KS	OM	F-inert	pH
cm	-	g/cm3	mm/mm	mm/mm	mm/mm	mm/d	%	fraction	
0-30	Clay Loam	1.4	0.1	0.3	0.4	278	1.1	0.545	5.7
30-60	Clay Loam	1.7	0.1	0.3	0.4	150	0.6	0.831	4.5
60-100	Clay Loam	1.6	0.2	0.3	0.4	87	0.15	0.976	4.4
100-150	Clay Loam	1.6	0.2	0.3	0.4	70	0.1	0.999	4.4
150-210	Clay Loam	1.6	0.2	0.3	0.4	45.5	0.05	0.999	4.4
210-300	Clay Loam	1.6	0.2	0.3	0.4	15	0	0.999	4.4
300-390	Clay Loam	1.6	0.2	0.3	0.3	8,3	0	0.999	4.4

Site = IN2 (Indiana, lat = 40.47, long = -86.99)

depth_inc	texture	BD	LL	DUL	SAT	KS	OM	F-inert	pH
cm	-	g/cm3	mm/mm	mm/mm	mm/mm	mm/d	%	fraction	
0-30	Clay Loam	1.4	0.1	0.3	0.4	282	1.4	0.545	7.2
30-60	Clay Loam	1.4	0.2	0.3	0.4	115	0.7	0.831	6.9
60-100	Clay Loam	1.5	0.2	0.3	0.4	59	0.4	0.976	7.7
100-150	Clay Loam	1.8	0.1	0.3	0.3	8	0.2	0.999	8.2
150-210	Clay Loam	1.8	0.1	0.3	0.3	0.6	0.2	0.999	8.2
210-300	Clay Loam	1.8	0.1	0.3	0.3	0.2	0.2	0.999	8.2
300-390	Clay Loam	1.8	0.1	0.3	0.3	0.03	0.2	0.999	8.2

Supplementary Table 4: Soybean cultivar details for simulations

Cultivar Parameters	Units	Array of Values
Maturity Group 1 (MN1, MN2, WI, MI)		
node_sen_rate	°C-days/node	120
x_pp	Daylight	13.84, 15.1, 16.3, 17.5
tt_end_of_juvenile	°C-days	100, 133, 200, 400
tt_floral_initiation	°C-days	120, 160, 240, 480
tt_flowering	°C-days	239, 318, 478, 1274
tt_start_grain_fill	°C-days	485, 646, 970, 2586
Maturity Group 2 (IA, IN1, IN2)		
node_sen_rate	°C-days/node	120
x_pp	Daylight	13.59, 14.6, 15.6, 16.6
tt_end_of_juvenile	°C-days	100, 133, 200, 400
tt_floral_initiation	°C-days	128, 171, 256, 512
tt_flowering	°C-days	246, 328, 492, 1312
tt_start_grain_fill	°C-days	499, 666, 999, 2664
Maturity Group 3 (MI)		
node_sen_rate	°C-days/node	120
x_pp	Daylight	13.4, 14.3, 15.2, 16.0
tt_end_of_juvenile	°C-days	100, 133, 200, 400
tt_floral_initiation	°C-days	160, 213, 320, 640
tt_flowering	°C-days	253, 338, 506, 1350
tt_start_grain_fill	°C-days	514, 685, 1028, 2741

Supplementary Table 6: Maize cultivar details for simulations

Cultivar Parameters	Units	Array of Values
95 Day Relative Maturity (MN1, MI)		
tt_emerg_to_endjuv	°C-days	190
tt_flower_to_maturity	°C-days	680
head_grain_no_max	°C-days	750
grain_gth_rate	°C-days	7.7
100 Day Relative Maturity (IN2)		
tt_emerg_to_endjuv	°C-days	228
tt_flower_to_maturity	°C-days	745
head_grain_no_max	°C-days	770
grain_gth_rate	°C-days	7.7
103 Day Relative Maturity (MN2)		
tt_emerg_to_endjuv	°C-days	230
tt_flower_to_maturity	°C-days	660
head_grain_no_max	°C-days	700

grain_gth_rate	°C-days	7.7
105 Day Relative Maturity (IA, WI)		
tt_emerg_to_endjuv	°C-days	240
tt_flower_to_maturity	°C-days	785
head_grain_no_max	°C-days	770
grain_gth_rate	°C-days	7.7
110 Day Relative Maturity (IN1)		
tt_emerg_to_endjuv	°C-days	250
tt_flower_to_maturity	°C-days	820
head_grain_no_max	°C-days	770
grain_gth_rate	°C-days	7.7
115 Day Relative Maturity (MI)		
tt_emerg_to_endjuv	°C-days	262
tt_flower_to_maturity	°C-days	860
head_grain_no_max	°C-days	770
grain_gth_rate	°C-days	7.7

Supplementary Table 5: Model evaluation Statistics

Site ID	r ²	ME	RSME _{Yield}	RSME _{Drain}	RSME _{FlowWtNO3}	RSME _{LeachLoad}
MN1	0.79	0.74	2.15	2.43	2.43	2.66
MN2	0.94	0.94	1.35	1.28	1.28	1.2
IA	0.95	0.93	2.38	4.65	1.26	2.67
WI	0.88	0.88	2.97	1.28	1.28	2.7
MI	1	0.46	N/A	N/A	N/A	N/A
IL	0.96	0.95	1.58	3.94	3.94	1.44
IN1	0.75	0.71	2.77	1.66	1.66	2.86
IN2	0.92	0.9	11.22	2.29	2.29	1.76

Supplementary Table 6: AONR (kg N ha⁻¹) calculated using the bi-linear model and the quadratic plateau model. "N/A" indicated that the model did not converge.

Site	Year	Continuous Maize		Maize-Soybean Rotation	
		Bi-linear AONR (kg N ha ⁻¹)	Quadratic Plateau AONR (kg N ha ⁻¹)	Bi-linear AONR (kg N ha ⁻¹)	Quadratic Plateau AONR (kg N ha ⁻¹)
MN1	2000	82	127	57	68
MN1	2001	71	100	57	85
MN1	2002	80	121	57	68
MN1	2003	96	148	81	125
MN1	2004	119	179	72	104
MN1	2005	118	176	59	75
MN1	2006	116	171	68	96
MN1	2007	139	210	91	144
MN1	2008	103	155	71	104
MN1	2009	130	196	70	101
MN1	2010	127	194	63	84
MN1	2011	98	148	60	73
MN1	2012	107	162	79	129
MN1	2013	97	149	60	73
MN1	2014	138	209	91	144
MN1	2015	136	204	66	95
MN1	2016	106	167	61	80
MN1	2017	96	145	59	70
MN1	2018	104	158	69	100
MN1	2019	103	157	71	104
MN2	2000	94	143	68	98
MN2	2001	84	125	24	N/A
MN2	2002	93	143	76	119
MN2	2003	103	152	78	121
MN2	2004	116	171	68	100
MN2	2005	121	180	83	133
MN2	2006	109	164	61	82
MN2	2007	122	181	99	159

Site	Year	Continuous Maize		Maize-Soybean Rotation	
		Bi-linear AONR (kg ha ⁻¹)	Quadratic Plateau AONR (kg ha ⁻¹)	Bi-linear AONR (kg ha ⁻¹)	Quadratic Plateau AONR (kg ha ⁻¹)
MN2	2008	103	151	59	70
MN2	2010	134	203	77	117
MN2	2011	103	157	71	102
MN2	2012	106	176	98	165
MN2	2013	112	158	74	109
MN2	2014	119	176	91	142
MN2	2015	126	189	76	113
MN2	2016	121	177	74	111
MN2	2017	120	171	74	108
MN2	2018	130	196	92	142
MN2	2019	105	152	67	90
IA	2000	67	92	56	66
IA	2001	74	109	37	66
IA	2002	115	167	62	78
IA	2003	106	158	82	132
IA	2004	130	199	89	136
IA	2005	96	148	61	78
IA	2006	82	127	68	96
IA	2007	97	151	71	102
IA	2008	104	156	57	64
IA	2009	124	186	82	128
IA	2010	133	205	70	101
IA	2011	82	125	57	60
IA	2012	110	162	79	127
IA	2013	113	168	82	130
IA	2014	118	173	82	129
IA	2015	113	162	58	65
IA	2016	97	149	59	69
IA	2017	103	154	79	121

Site	Year	Continuous Maize		Maize-Soybean Rotation	
		Bi-linear AONR (kg ha ⁻¹)	Quadratic Plateau AONR (kg ha ⁻¹)	Bi-linear AONR (kg ha ⁻¹)	Quadratic Plateau AONR (kg ha ⁻¹)
IA	2018	84	127	61	77
WI	2000	109	160	40	61
WI	2001	102	163	56	62
WI	2002	115	171	73	111
WI	2003	88	132	91	144
WI	2004	138	220	89	142
WI	2005	138	206	119	180
WI	2006	88	135	70	101
WI	2007	133	211	100	155
WI	2008	133	202	82	137
WI	2009	97	145	79	120
WI	2010	129	201	57	69
WI	2011	86	131	73	108
WI	2012	109	146	61	75
WI	2013	129	191	72	104
WI	2014	130	197	74	112
WI	2015	115	164	71	100
WI	2016	120	178	62	78
WI	2017	116	165	69	98
WI	2018	98	147	73	108
WI	2019	91	151	58	68
MI	2000	123	202	61	77
MI	2001	126	196	95	150
MI	2002	71	100	57	67
MI	2003	104	154	83	131
MI	2004	114	168	72	104
MI	2005	114	167	73	108
MI	2006	88	140	70	99
MI	2007	116	166	88	136

Site	Year	Continuous Maize		Maize-Soybean Rotation	
		Bi-linear AONR (kg ha ⁻¹)	Quadratic Plateau AONR (kg ha ⁻¹)	Bi-linear AONR (kg ha ⁻¹)	Quadratic Plateau AONR (kg ha ⁻¹)
MI	2008	121	187	78	120
MI	2010	120	183	75	117
MI	2011	103	149	98	160
MI	2012	103	152	68	101
MI	2013	96	142	77	119
MI	2014	130	215	57	62
MI	2015	114	166	77	116
MI	2016	114	166	81	126
MI	2017	110	159	69	97
MI	2018	75	109	49	N/A
MI	2019	110	159	84	133
IL	2000	120	179	64	85
IL	2001	100	134	59	70
IL	2002	127	199	64	88
IL	2003	115	167	64	84
IL	2004	137	215	70	99
IL	2005	121	182	64	85
IL	2006	90	140	56	66
IL	2007	116	173	66	87
IL	2008	145	223	72	106
IL	2009	125	187	71	105
IL	2010	116	173	60	73
IL	2011	106	185	57	66
IL	2012	91	141	93	282
IL	2013	105	153	57	63
IL	2014	124	186	65	88
IL	2015	126	188	70	103
IL	2016	86	140	58	66
IL	2017	103	154	68	100

Site	Year	Continuous Maize		Maize-Soybean Rotation	
		Bi-linear AONR (kg ha ⁻¹)	Quadratic Plateau AONR (kg ha ⁻¹)	Bi-linear AONR (kg ha ⁻¹)	Quadratic Plateau AONR (kg ha ⁻¹)
IL	2018	114	165	63	81
IN1	2000	118	178	60	77
IN1	2001	119	180	58	67
IN1	2002	110	164	68	99
IN1	2003	113	159	58	67
IN1	2004	139	215	100	153
IN1	2005	117	168	57	67
IN1	2006	111	161	58	66
IN1	2007	99	159	64	87
IN1	2008	162	243	91	141
IN1	2009	110	171	58	66
IN1	2010	125	194	94	147
IN1	2011	155	233	91	143
IN1	2012	136	204	105	163
IN1	2013	120	182	56	62
IN1	2014	116	169	60	73
IN1	2015	96	143	58	71
IN1	2016	85	129	58	68
IN1	2017	107	154	63	83
IN1	2018	116	166	76	114
IN1	2019	120	178	62	78
IN2	2000	118	182	76	117
IN2	2001	86	235	63	84
IN2	2002	67	92	46	60
IN2	2003	118	178	59	71
IN2	2004	170	264	70	101
IN2	2005	66	89	63	84
IN2	2006	88	134	68	96
IN2	2007	108	152	36	N/A

Site	Year	Continuous Maize		Maize-Soybean Rotation	
		Bi-linear AONR (kg ha ⁻¹)	Quadratic Plateau AONR (kg ha ⁻¹)	Bi-linear AONR (kg ha ⁻¹)	Quadratic Plateau AONR (kg ha ⁻¹)
IN2	2008	155	236	74	109
IN2	2010	154	235	67	94
IN2	2011	110	167	57	64
IN2	2012	N/A	152	N/A	N/A
IN2	2013	105	129	56	N/A
IN2	2014	117	218	59	68
IN2	2015	139	116	69	100
IN2	2016	78	168	58	65
IN2	2017	116	174	57	63
IN2	2018	121	137	61	79
IN2	2019	91	N/A	72	107