

Table S1. Analysis of variance for diameter, plant height, biomass, grain yield, stem dry matter (DM), and leaf DM of temperate and tropical maize during 2014 and 2015 growing seasons in Boone, IA.

Source of Variation	df	Diameter		Height		Biomass	
		2014	2015	2014	2015	2014	2015
Block	3	4.52**	0.69	2.35	4.36*	6.49***	4.52**
Row spacing (RS)	1	3.3	0.69	13.34**	7.8*	66.58***	7.82**
Planting density (PD)	1	1.8	0.04	1.04	0.1	12.22***	5.6*
RS × PD	1	0.42	2.2	0.4	0.52	0.59	3.98
Nitrogen level (N)	1	0.12	0.13	0.12	0.13	0.4	0.13
RS × N	1	0.59	0.01	0.59	0.01	2.69	0.01
PD × N	1	0.32	1.14	0.32	1.14	0.01	1.14
RS × PD × Nitro	1	0.05	0.05	0.05	0.05	<0.01	0.05
Germplasm (G)	5	1***	3.37**	48.96***	46.8***	5.43***	18.96***
RS × G	5	1.22	0.34	3.35**	0.53	0.4	1.12
PD × G	5	0.11	1.48	0.54	0.06	0.27	0.28
RS × PD × G	5	3.21*	2.72*	1.29	0.03	1.8	0.35
G × N	5	2.08	0.69	2.08	0.69	0.66	0.69
RS × G × N	5	0.42	0.06	0.42	0.06	0.75	0.06
PD × G × N	5	0.88	2.46*	0.88	2.46*	0.29	2.46*
RS × PD × G × N	5	1.08	1.84	1.08	1.84	1.41	1.84
Source of Variation	df	Grain Yield		Leaf DM		Stem DM	
		2014	2015	2014	2015	2014	2015
Block	3	4.17*	4.72**	0.81	4.78**	4.08**	3.77*
Row spacing (RS)	1	51.51***	84.97***	0.43	0.1	39.75***	0.14
Planting density (PD)	1	2.34	5.78*	4.07	0.07	16.38***	1*
RS × PD	1	0.2	15.96***	0.01	0.8	1.02	1.04
Nitrogen level (N)	1	0.02	0.1	1.03	0.13	5.11*	0.22
RS × N	1	4.3*	0.01	1.33	0.01	2.33	0.01
PD × N	1	0.7	1.3	0.6	1.14	0.37	0.51
RS × PD × Nitro	1	0.19	0	0.31	0.05	0.14	1.15
Germplasm (G)	5	3.83**	8.64***	14.16***	42.21***	33.63***	50.59***
RS × G	5	0.29	2.78*	1.33	1.67	0.13	1.89
PD × G	5	0.2	0.47	1.22	1.47	1.55	0.78
RS × PD × G	5	1.35	0.36	0.74	0.66	2.34*	0.88
G × N	5	0.83	0.61	0.44	0.69	0.52	0.93
RS × G × N	5	0.76	0.05	1.2	0.06	1.53	0.11
PD × G × N	5	0.33	1.86	0.62	2.46*	0.08	5.65***
RS × PD × G × N	5	1.14	1.21	0.45	1.84	0.84	5.18***

* Significant at the 0.05 probability level; ** Significant at the 0.01 probability level; ***Significant at the 0.001 probability level.

Table S2. Analysis of variance for grain ethanol yield (L L⁻¹), grain density (1,000 kg m⁻³), starch (g kg⁻¹ DM), protein (g kg⁻¹ DM), and oil (g kg⁻¹ DM) concentrations during 2014 and 2015 growing seasons in Boone, IA. There was a significant effect of year, all comparisons were made within each year.

Source of Variation	Ethanol Yield		Kernel Density	
	2014	2015	2014	2015
Block	2.57	3.59	0.06	1.85
Row spacing (RS)	1.44	2.18	1.08	2.81
Planting date (PD)	2.19	0.42	0.2	2.99
RS × PD	0.31	0.66	1.33	6.04*
Nitrogen level (N)	6.22*	6.25*	0.04	10.26**
RS × N	0.19	2.03	0.63	0.73
PD × N	0.4	0.11	0.05	0.43
RS × PD × Nitro	2.02	1.52	3.61	1.21
Germplasm (G)	0.51	6.8***	36.72***	44.05***
RS × G	0.63	1.46	1.64	1.65
PD × G	0.88	0.71	0.52	1.17
RS × PD × G	0.97	0.23	1.63	0.88
G × N	0.5	0.23	1.25	1.14
RS × G × N	0.34	1.28	1.47	1.52
PD × G × N	0.86	0.81	0.63	0.5
RS × PD × G × N	0.93	0.4	1.93	1.41

Source of Variation	Starch g kg ⁻¹		Protein g kg ⁻¹		Oil g kg ⁻¹	
	2014	2015	2014	2015	2014	2015
Block	4.92*	0.84	11.86**	3.44	0.68	0.76
Row spacing (RS)	7.31*	6.46*	2.79	1.94	1.6	1.72
Planting date (PD)	1.7	0.22	0.85	0.29	0.27	2.35
RS × PD	2.65	1.09	0.16	1.16	0.35	0.06
Nitrogen level (N)	82.28***	0.3	114.33***	6.87*	1.19	8.34**
RS × N	29.27***	0.11	25.35***	1.84	1.06	0.11
PD × N	1.21	<0.01	0.64	0.09	0.18	0.07
RS × PD × Nitro	1.08	1.81	1.76	1.7	0.37	0.44
Germplasm (G)	56.44***	24.28***	3.11*	8.58***	60.33***	23.36***
RS × G	3.59**	2.5*	2.97*	2.1	2.07	0.79
PD × G	0.9	0.36	2.59*	0.97	1.85	0.9
RS × PD × G	1.04	0.3	0.79	0.29	1.33	0.05
G × N	0.55	1.42	1.32	0.52	1	4.62**
RS × G × N	1.51	1.09	0.96	0.9	1.97	0.85
PD × G × N	1.62	0.5	2.06	0.73	1.42	0.67
RS × PD × G × N	0.3	1.88	0.82	0.47	0.74	0.8

* Significant at the 0.05 probability level; ** Significant at the 0.01 probability level; *** Significant at the 0.001 probability level.

Table S3. Analysis of variance for cellulose, hemicellulose, lignin, ash concentrations and total nitrogen in cobs, husks, leaves, and stems of temperate and tropical maize during 2014 and 2015 growing seasons in Boone, IA. There was a significant effect of year in each tissue, except husk lignin and leaf hemicellulose; therefore, all comparisons were made within each year.

Hemicellulose		2014				2015			
Source of Variation	Cobs	Husk	Leaves	Stems	Cobs	Husk	Leaves	Stems	
Block	1.12	0.79	2.7	6.21***	1.92	1.17	11.86**	8.05**	
Row spacing (RS)	1.26	0.75	0.04	18.38***	3.25	<0.01	2.11	3.6	
Planting date (PD)	0.05	0.36	<0.01	0.46	0.7	1.31	0.1	0.28	
RS × PD	0.11	0.03	0.05	0.64	0.74	0.38	0.13	4.33	
Nitrogen level (N)	2.72	0.04	1.84	12.38***	0.76	0.18	9.87**	23.67***	
RS × N	0.25	0.85	2.55	4.54*	0.14	0.39	4.93*	1.36	
PD × N	0.31	<0.01	0.4	2.2	0.06	2.04	0.64	1.13	
RS × PD × Nitro	0.04	4.1*	0.34	0.33	0.46	1.89	1.16	9.59**	
Germplasm (G)	22.42***	3.18*	3.17*	13.43***	13.08***	7.4***	5.38***	15.57***	
RS × G	0.42	0.82	0.43	0.5	5.61***	2.35	1.95	3.72**	
PD × G	1.56	2.28	0.51	1.21	1.91	0.4	0.55	0.4	
RS × PD × G	0.86	1.5	0.43	1.75	0.67	0.7	1.11	0.34	
G × N	0.66	0.15	1.23	3.76**	0.65	2.85*	3.21*	0.36	
RS × G × N	0.37	0.91	1.7	0.66	0.93	0.25	2.06	1.37	
PD × G × N	0.38	2.2	2.4*	0.54	0.33	0.69	0.82	0.97	
RS × PD × G × N	0.59	0.69	1.36	0.09	1.18	0.26	0.78	1.47	
Cellulose		2014				2015			
Source of Variation	Cobs	Husk	Leaves	Stems	Cobs	Husk	Leaves	Stems	
Block	2.51	0.67	0.29	1.21	0.98	3.94*	0.65	0.74	
Row spacing (RS)	2.48	13.07**	13.64**	10.49**	4.02*	6.33*	2.23	5.35*	
Planting date (PD)	0.23	0.44	0.07	0.24	0.54	0.2	5.71*	1.1	
RS × PD	0.64	0.05	2.38	1.16	0.19	2.26	0.28	0.48	
Nitrogen level (N)	1.27	0.43	11.12**	6.57*	1.02	0.73	0.33	5.16*	
RS × N	3.5	0.07	0.14	3.11	0.13	0.94	0.59	0.8	
PD × N	0.73	2.05	0.18	0.01	0.02	0.01	1.48	0.8	
RS × PD × Nitro	2.78	2.68	2.92	0.78	0.02	1.07	0.25	0.3	
Germplasm (G)	91.04***	14.28***	20.82***	49.4***	66.47***	22.95***	17.77***	65.06***	
RS × G	0.87	1.76	1.26	6.28	2.37*	1.64	1.2	4.39**	
PD × G	2.28	1.2	0.52	1.75	0.17	0.36	1.58	0.42	
RS × PD × G	1.38	1.07	0.66	0.77	0.94	0.93	0.27	0.59	
G × N	0.9	0.88	1.17	0.8	0.2	1.65	1.16	0.11	
RS × G × N	0.96	0.62	0.94	1.22	0.27	0.45	0.98	0.19	
PD × G × N	0.9	1.92	1.87	1.93	0.28	0.64	0.41	1.52	
RS × PD × G × N	0.73	1.11	0.9	0.64	0.82	0.23	1.2	0.94	
Lignin		2014				2015			
Source of	Cobs	Husk	Leaves	Stems	Cobs	Husk	Leaves	Stems	

Variation								
Block	1.65	0.59	1.44	3.56*	0.77	2.82	0.65	2.57
Row spacing (RS)	13.34**	0.72	2.1	8.85**	7.99*	4.61	0.98	5.17*
Planting date (PD)	0.04	0.28	0.06	<0.01	0.12	0.41	0.07	0.21
RS × PD	0.22	<0.01	0.04	0.78	0.4	4.43	0.57	0.86
Nitrogen level (N)	0.07	1.22	0.02	5.24*	5.76*	12.11***	3.02	41.51***
RS × N	0.14	0.01	0.19	1.02	0.93	0.28	1.13	0.27
PD × N	0.5	0.09	1.33	0.41	0.02	0.4	0.18	0.54
RS × PD × Nitro	0.02	1.55	4.41*	1.07	2.31	1.45	0.87	1.98
Germplasm (G)	44.33***	2.03	2.52*	5.68***	14.85***	6.04***	8.92***	19.32***
RS × G	1.9	1.13	0.93	5.52***	0.89	0.21	3.28**	5.39***
PD × G	1.15	0.67	0.98	1.14	0.91	1.73	0.5	0.54
RS × PD × G	0.24	1.43	0.92	0.39	0.96	0.3	0.6	1.19
G × N	0.13	0.64	1.12	0.49	1.21	2.85*	2.74*	1.45
RS × G × N	0.74	0.3	1.74	1.14	0.58	1.17	0.43	0.24
PD × G × N	0.35	0.71	1.49	1.01	0.47	0.65	1.56	0.68
RS × PD × G × N	1.12	3.02*	2.2	1.11	1.31	0.47	0.39	1.59
Ash		2014				2015		
Source of Variation	Cobs	Husk	Leaves	Stems	Cobs	Husk	Leaves	Stems
Block	0.29	0.41	3.75*	0.44	0.43	2.83*	1.28	0.12
Row spacing (RS)	0.09	1.97	3.54	5.35*	0.56	0.9	0.97	0.65
Planting date (PD)	0.23	1.29	0.08	1.14	0.2	2.24	1.64	0.72
RS × PD	1.07	2.84	0.15	1.39	0.64	0	0.23	1.97
Nitrogen level (N)	4.6*	0.7	9.54**	0.71	0.89	7.34**	16.54***	1.4
RS × N	7.43**	1.04	0.88	0.06	1	1.16	0.01	2.87
PD × N	0.01	0.2	0.12	0.08	0.93	0.27	0.1	2.18
RS × PD × Nitro	0.04	1.45	1.39	0.21	0.14	3.38	0	0.59
Germplasm (G)	5.73***	29.71***	72.55***	7.7***	3.49**	54.26***	17.11***	3.6**
RS × G	0.35	1.49	0.49	3.18*	0.24	0.67	1.53	1.04
PD × G	1.38	0.6	0.81	1.15	1.1	0.37	0.6	0.85
RS × PD × G	0.69	0.73	0.47	0.69	0.63	0.61	0.42	1.44
G × N	0.65	0.22	0.38	1.47	0.33	2.36*	0.86	0.35
RS × G × N	0.67	0.79	1.32	0.13	1.84	0.5	0.46	1.44
PD × G × N	0.88	0.37	0.8	0.59	0.62	0.52	0.66	0.86
RS × PD × G × N	1.22	0.94	1.3	0.76	1.77	1.23	0.89	0.45
Total Nitrogen		2014				2015		
Source of Variation	Cobs	Husk	Leaves	Stems	Cobs	Husk	Leaves	Stems
Block	0.85	0.65	3.39	4.1**	0.75	0.7	5.51*	2.75*
Row spacing (RS)	3.87	9.75**	15.84**	4.85*	1.43	1.03	2.64	3.1
Planting date (PD)	0.11	<0.01	0.01	0.19	0.09	1.35	4.66	1.8

RS × PD	1.95	1.06	3.01	0.02	0.2	3.75	0.66	4.22*
Nitrogen level (N)	3.27	2.7	39.18***	37.89***	4.88*	0.06	10.26**	2.15
RS × N	9.79**	0.39	0.66	13.23***	0.3	0.67	0.18	2.95
PD × N	0.24	0.22	0.98	0.26	0.9	0.13	0.21	0.16
RS × PD × Nitro	0.4	0.02	5.87*	3.02	0.97	0.21	0.34	1.86
Germplasm (G)	28.6***	24.81***	45.55***	13.29***	42.88***	7.93***	8.11***	14.17***
RS × G	1.26	1.02	0.18	3.9**	3.29*	2.19	2.14	5.54***
PD × G	0.98	0.97	0.75	1.56	0.19	0.58	1.31	0.13
RS × PD × G	1.09	0.45	0.5	1.25	1.26	1.76	1.21	0.09
G × N	0.84	0.62	0.49	0.64	1.5	1.12	3.5**	1.1
RS × G × N	0.59	0.57	0.1	1.34	0.35	0.21	1.02	0.83
PD × G × N	1.76	1.04	1.8	1.4	0.63	0.18	0.59	1.57
RS × PD × G × N	0.68	0.69	0.69	0.39	0.33	0.09	1.59	1.19

* Significant at the 0.05 probability level; ** Significant at the 0.01 probability level; ***Significant at the 0.001 probability level.