

Table S1. Average values, F test and coefficient of variation (CV) for soil chemical attributes (0.0-0.2 m) as a function of different liming and gypsum rates in soybean (2019/2020 cropping season) in a Cerrado area. Currais, Piauí, Brazil.

Liming (t ha ⁻¹)	pH	pH	TOC	P	K	Ca	Mg	Al	H+Al	SB	CEC	V	m	Na	S-SO ₄ ²⁻	B	Cu	Fe	Mn	Zn
	CaCl ₂	H ₂ O	g Kg ⁻¹	- mg Kg ⁻¹ -				----- cmolc Kg ⁻¹ -----				- % -			----- mg Kg ⁻¹ -----					
0	3.63	4.82	10.88	4.77	38.28	0.13	0.05	0.50	3.48	0.27	3.76	8	64.70	0.80	6.17	0.27	0.10	220.31	37.50	1.89
5	4.49	5.83	10.42	14.22	38.28	0.68	0.38	0.20	2.23	1.16	3.38	34	15.50	1.05	8.28	0.23	0.10	153.91	35.16	1.97
10	5.13	6.24	10.42	22.73	44.53	1.02	0.63	0.04	1.62	1.77	3.39	52	2.20	1.59	9.22	0.23	0.10	93.75	24.22	1.93
15	5.36	6.42	10.88	18.05	42.97	1.28	0.71	0.00	1.52	2.11	3.63	58	0.20	1.12	6.95	0.25	0.11	65.63	31.25	1.67
20	5.56	6.14	11.33	8.52	37.50	1.44	0.84	0.00	1.28	2.39	3.67	65	0.00	1.34	7.19	0.25	0.10	39.84	25.00	1.54
F test	**	**	ns	**	**	**	**	**	**	**	ns	**	**	ns	*	ns	ns	**	*	*
Gypsum (t ha ⁻¹)																				
0	4.81	5.89	10.88	13.28	41.41	0.81	0.52	0.16	2.05	1.45	3.49	42	17	1.43	5.78	0.24	0.10	121.88	36.72	1.84
1	4.79	5.81	10.88	11.88	44.53	0.88	0.52	0.17	2.09	1.52	3.59	42	22	1.06	6.64	0.26	0.10	119.53	24.22	1.77
2	4.89	5.93	11.33	16.33	35.16	0.91	0.52	0.15	1.99	1.54	3.53	44	16	1.18	8.05	0.22	0.10	110.94	32.81	1.84
4	4.85	5.83	10.88	13.28	41.41	1.02	0.53	0.13	1.98	1.66	3.64	46	12	1.05	9.69	0.25	0.11	106.25	30.47	1.75
F test	ns	ns	ns	ns	ns	*	ns	ns	ns	*	ns	ns	**	ns	**	ns	ns	ns	ns	ns
C x G	ns	ns	ns	*	**	ns	ns	ns	ns	ns	ns	ns	**	ns	*	ns	ns	ns	ns	ns
CV(%)	5.4	5.97	16.3	39.2	17.6	18.8	18.6	34.0	19.1	15.5	10.1	14.4	19.6	55.0	36.4	28.9	9.5	30.4	48.6	22.8

Ns, * and ** - Non-significant, significant at 5 and at 1% of probability by the F test.

Table S2: Average values, F test and coefficient of variation (CV) for soil chemical attributes (0.2-0.4 m) as a function of different liming and gypsum rates in soybean (2019/2020 cropping season) in a Cerrado area. Currais, Piauí, Brazil.

Liming (t ha ⁻¹)	pH	pH	TOC	P	K	Ca	Mg	Al	H+Al	SB	CEC	V	m	Na	S-SO ₄ ²⁻	B	Cu	Fe	Mn	Zn
	CaCl ₂	H ₂ O	g Kg ⁻¹	- mg Kg ⁻¹ -																
0	3.64	4.43	5.63	1.86	12.14	0.25	0.06	0.39	2.58	0.35	2.95	12	52	0.53	11.69	0.19	0.10	206.45	38.71	1.52
5	3.88	4.63	5.63	1.94	12.95	0.40	0.17	0.29	2.35	0.59	2.95	20	34	0.52	10.65	0.17	0.11	187.10	33.06	1.40
10	4.07	5.08	5.63	2.51	12.95	0.54	0.27	0.24	2.09	0.83	2.92	29	23	0.56	11.94	0.18	0.10	161.29	30.65	1.73
15	4.24	5.21	6.10	2.02	18.61	0.68	0.40	0.19	2.09	1.00	3.15	32	18	0.62	12.02	0.18	0.11	145.16	29.03	1.44
20	4.24	5.05	5.63	1.86	14.57	0.64	0.38	0.19	2.06	0.99	3.10	32	16	0.52	11.29	0.15	0.11	145.97	28.23	1.36
F test	**	*	ns	ns	**	**	**	**	**	**	**	**	**	ns	ns	ns	ns	**	ns	ns
Gypsum (t ha ⁻¹)																				
0	4.04	4.95	5.63	2.19	15.38	0.49	0.28	0.25	2.23	0.79	3.02	26	28	0.54	7.26	0.19	0.11	188.71	37.90	1.59
1	4.02	4.92	5.63	2.10	15.38	0.48	0.23	0.25	2.22	0.74	2.95	25	29	0.59	12.58	0.18	0.10	152.42	25.81	1.48
2	4.01	4.91	6.10	2.02	12.95	0.53	0.28	0.28	2.21	0.70	2.99	23	30	0.59	12.66	0.16	0.10	156.45	33.06	1.41
4	3.98	4.72	6.10	1.94	14.57	0.52	0.25	0.26	2.27	0.78	3.10	25	27	0.49	13.63	0.17	0.11	179.03	32.26	1.52
F test	ns	Ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	**	ns	ns	ns	ns	ns
C x G	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV(%)	3.8	6.28	13.0	37.5	28.4	24.0	38.4	21.7	11.0	30.1	7.8	28.3	23.9	35.5	19.6	19.9	16.7	23.3	42.4	31.8

Ns, * and ** - Non-significant, Significant at 5 and at 1% of probability by the F test.

Table S3: Average values, F test and coefficient of variation (CV) for soil chemical attributes (0.4-0.6 m) as a function of different liming and gypsum rates in soybean (2019/2020 cropping season) in a Cerrado area. Currais, Piauí, Brazil.

Liming (t ha ⁻¹)	pH	pH	TOC	P	K	Ca	Mg	Al	H+Al	SB	CEC	V	m	Na	S-SO ₄ ²⁻	B	Cu	Fe	Mn	Zn
	CaCl ₂	H ₂ O	g Kg ⁻¹	-	mg Kg ⁻¹	----- cmolc Kg ⁻¹ -----					- % -			----- mg Kg ⁻¹ -----						
0	3.79	4.09	4.12	1.76	15.27	0.17	0.05	0.38	1.85	0.25	2.11	12	60	0.81	11.30	0.09	0.12	164.89	50.38	1.37
5	3.88	4.24	4.16	1.76	16.03	0.21	0.10	0.33	1.67	0.35	2.02	17	48	0.92	10.53	0.14	0.14	158.02	54.96	1.22
10	3.97	4.38	4.65	1.60	14.50	0.27	0.14	0.33	1.63	0.44	2.06	21	42	0.77	12.98	0.12	0.11	143.51	53.44	1.64
15	4.11	4.57	4.96	1.76	12.98	0.34	0.19	0.29	1.63	0.57	2.21	26	34	0.84	13.82	0.18	0.11	140.46	50.38	1.51
20	4.11	4.53	4.29	2.06	12.21	0.34	0.21	0.28	1.56	0.59	2.16	28	32	0.86	12.21	0.15	0.14	171.76	77.86	1.32
F test	**	**	ns	ns	*	**	**	*	*	**	ns	**	**	ns	ns	ns	ns	ns	ns	ns
Gypsum (t ha ⁻¹)																				
0	3.98	4.45	4.34	1.68	14.50	0.24	0.12	0.34	1.70	0.40	2.11	19	47	0.86	9.01	0.16	0.13	159.54	58.02	1.33
1	3.98	4.35	4.34	1.68	14.50	0.25	0.14	0.32	1.66	0.43	2.08	20	44	0.83	11.37	0.15	0.13	150.38	47.33	1.50
2	3.96	4.34	4.34	1.68	13.74	0.25	0.14	0.34	1.62	0.43	2.05	21	44	0.83	12.67	0.14	0.11	154.96	58.02	1.54
4	3.99	4.31	4.74	1.91	15.27	0.32	0.15	0.29	1.70	0.51	2.21	22	37	0.83	15.65	0.15	0.12	158.02	67.18	1.29
F test	ns	ns	ns	ns	ns	**	ns	ns	ns	*	ns	*	*	ns	**	ns	ns	ns	ns	ns
C x G	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV(%)	2.9	3.5	26.6	24.4	23.1	27.7	35.0	29.7	13.8	25.4	12.4	2.2	21.6	26.7	28.4	43.4	33.9	27.3	34.1	41.6

Ns, * and ** - Non-significant, significant at 5 and at 1% of probability by the F test.

Table S4: Average values, F test and coefficient of variation (CV) for soil chemical attributes (0.0-0.2 m) as a function of different liming and gypsum rates in soybean (2020/2021 cropping season) in a Cerrado area. Currais, Piauí, Brazil.

Liming (t ha ⁻¹)	pH	pH	TOC	P	K	Ca	Mg	Al	H+Al	SB	CEC	V	m	Na	S-SO ₄ ²⁻	B	Cu	Fe	Mn	Zn
	CaCl ₂	H ₂ O	g Kg ⁻¹	- mg Kg ⁻¹	-			cmolc Kg ⁻¹					- %			mg Kg ⁻¹				
0	3.65	4.36	9.97	7.58	31.25	0.20	0.09	0.69	3.21	1.11	4.34	26	39	0.52	2.42	0.30	0.10	197.66	46.09	1.72
5	4.61	5.23	10.88	8.83	32.03	0.97	0.52	0.16	2.27	2.33	4.60	50	7	0.44	3.20	0.30	0.10	154.69	52.34	1.41
10	5.1	6.03	10.88	9.45	39.06	1.23	0.66	0.09	1.74	2.92	4.67	62	2.9	0.62	3.36	0.28	0.10	112.50	50.00	1.72
15	5.5	6.45	10.88	11.41	43.75	1.52	0.93	0.00	1.34	3.58	4.91	73	0.1	0.49	3.91	0.31	0.10	77.34	46.88	1.56
20	5.63	6.73	11.33	9.77	39.06	1.54	0.86	0.02	1.08	3.41	4.49	76	0.5	0.63	3.05	0.28	0.11	53.91	45.31	1.33
F test	**	**	ns	*	**	**	**	**	**	**	**	**	**	ns	*	ns	ns	**	ns	ns
Gypsum (t ha ⁻¹)																				
0	4.93	5.73	10.88	8.67	40.63	1.08	0.63	0.17	1.84	2.78	4.62	59	9.5	0.49	3.20	0.32	0.10	96.88	53.91	1.56
1	4.89	5.69	10.42	10.78	37.50	1.03	0.62	0.23	2.02	2.62	4.64	56	11.1	0.55	2.97	0.27	0.11	126.56	44.53	1.48
2	4.95	5.89	10.88	10.00	32.03	1.14	0.63	0.19	1.88	2.62	4.49	58	9.6	0.59	2.97	0.30	0.10	130.47	42.97	1.48
4	4.84	5.72	10.88	8.05	37.50	1.10	0.57	0.18	1.98	2.66	4.64	57	9.5	0.52	3.67	0.29	0.10	123.44	53.13	1.64
F test	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
C x G	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV(%)	5.3	5.6	11.9	40.2	25.8	19.1	18.3	41.2	20.5	15.8	11.5	9.9	52.1	35.2	38.9	31.0	17.3	34.1	44.6	28.5

Ns, * and ** - Non-significant, significant at 5 and at 1% of probability by the F test. Obs.: Data of aluminum were square root transformed.

Table S5: Average values, F test and coefficient of variation (CV) for soil chemical attributes (0.2-0.4 m) as a function of different liming and gypsum rates in soybean (2020/2021 cropping season) in a Cerrado area. Currais, Piauí, Brazil.

Liming (t ha ⁻¹)	pH	pH	TOC	P	K	Ca	Mg	Al	H+Al	SB	CEC	V	m	Na	S-SO ₄ ²⁻	B	Cu	Fe	Mn	Zn
	CaCl ₂	H ₂ O	g Kg ⁻¹	- mg Kg ⁻¹ -		----- cmol. Kg ⁻¹ -----						- % -			----- mg Kg ⁻¹ -----					
0	3.61	3.79	9.39	6.31	22.66	0.22	0.10	0.44	2.43	0.37	2.80	13	54	0.68	6.29	0.19	0.11	204.03	83.87	1.13
5	4.02	4.25	8.45	4.37	17.81	0.43	0.28	0.24	2.14	0.76	2.90	26	26	0.63	6.53	0.20	0.13	197.58	115.32	1.29
10	4.45	4.61	8.45	5.34	21.04	0.69	0.54	0.17	1.74	1.29	3.03	42	14	0.59	4.52	0.18	0.11	125.00	95.16	0.97
15	4.65	4.82	9.39	4.05	25.09	0.99	0.69	0.11	1.60	1.75	3.35	51	8	0.56	4.60	0.20	0.13	113.71	114.52	1.05
20	4.74	4.81	9.39	5.18	18.61	1.17	0.77	0.06	1.58	1.99	3.57	54	5	0.77	4.27	0.15	0.10	121.77	87.90	1.29
F test	**	**	ns	ns	ns	**	**	**	**	**	**	**	**	ns	**	ns	ns	**	ns	ns
Gypsum (t ha ⁻¹)																				
0	4.26	4.47	8.92	4.05	22.66	0.67	0.47	0.22	1.94	1.20	3.14	36	22	0.62	4.27	0.19	0.12	160.48	97.58	1.21
1	4.26	4.54	9.39	5.26	20.23	0.70	0.50	0.23	1.89	1.25	3.14	37	24	0.70	5.56	0.19	0.11	144.35	89.52	1.13
2	4.3	4.51	8.45	4.69	17.81	0.66	0.44	0.17	1.75	1.15	2.90	38	21	0.62	6.45	0.17	0.11	149.19	102.42	1.13
4	4.39	4.30	9.86	6.07	22.66	0.77	0.51	0.19	2.02	1.33	3.34	38	18	0.65	4.76	0.19	0.13	155.65	108.06	1.21
F test	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	**	ns	ns	ns	ns	ns
C x G	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV(%)	5.3	9.13	23.7	43.9	33.8	38.3	32.7	47.9	17.4	34.4	14.8	23.1	40.1	42.7	27.6	26.4	33.9	32.6	33.4	20.1

Ns, * and ** - Non-significant, significant at 5 and at 1% of probability by the F test.

Table S6: Average values, F test and coefficient of variation (CV) for soil chemical attributes (0.4-0.6 m) as a function of different liming and gypsum rates in soybean (2019/2020 cropping season) in a Cerrado area. Currais, Piauí, Brazil.

Liming (t ha ⁻¹)	pH	pH	TOC	P	K	Ca	Mg	Al	H+Al	SB	CEC	V	m	Na	S-SO ₄ ²⁻	B	Cu	Fe	Mn	Zn
	CaCl ₂	H ₂ O	g Kg ⁻¹	- mg Kg ⁻¹ -																
0	3.67	3.79	4.43	1.53	11.45	0.21	0.09	0.43	2.01	0.35	2.36	15	56	0.63	8.63	0.19	0.30	164.12	106.11	1.37
5	3.89	4.25	4.43	1.53	12.21	0.32	0.18	0.31	1.69	0.52	2.21	23	38	0.69	9.77	0.21	0.21	138.93	95.42	1.30
10	4.05	4.61	4.43	1.68	12.98	0.43	0.26	0.28	1.66	0.72	2.38	30	30	0.67	11.07	0.21	0.32	148.85	105.34	1.45
15	4.29	4.83	5.31	1.68	16.03	0.60	0.37	0.19	1.68	1.01	2.69	37	17	0.51	10.61	0.21	0.31	143.51	93.13	1.37
20	4.43	4.82	4.87	1.68	11.45	0.68	0.40	0.17	1.37	1.12	2.50	44	15	0.53	10.23	0.18	0.29	151.15	122.90	1.60
F test	**	**	ns	ns	ns	**	*	**	**	**	**	**	**	ns	ns	ns	ns	ns	ns	ns
Gypsum (t ha ⁻¹)																				
0	4.07	4.47	5.31	1.68	13.74	0.44	0.28	0.27	1.63	0.76	2.39	31	30	0.68	7.40	0.20	0.37	146.56	103.82	1.53
1	4.08	4.55	4.43	1.60	12.21	0.42	0.25	0.27	1.71	0.72	2.43	29	31	0.64	9.77	0.21	0.33	148.85	96.18	1.37
2	4.11	4.52	4.87	1.60	11.45	0.48	0.25	0.25	1.72	0.77	2.49	30	30	0.63	11.76	0.18	0.24	148.85	100.00	1.30
4	4.02	4.30	4.87	1.83	13.74	0.44	0.24	0.30	1.68	0.73	2.40	30	32	0.50	11.37	0.21	0.19	151.91	116.79	1.53
F test	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	**	ns	**	ns	ns	ns
C x G	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV(%)	4.4	9.13	22.1	32.4	33.3	35.3	40.8	22.7	15.6	35.2	13.8	25.3	24.5	44.3	28.2	21.9	44.3	23.6	40.9	24.2

ns, * and ** - Non-significant, significant at 5 and at 1% of probability by the F test.

Table S7: Average values, F test and coefficient of variation (CV) for non-exchangeable soil Ca, Mg and Ca + Mg (0.0-0.2 m) as a function of different liming and gypsum rates in soybean (2019/2020 and 2020/2021 cropping seasons) in a Cerrado area. Currais, Piauí, Brazil.

Liming (t ha ⁻¹)	Non- exchangeable	Non- exchangeable	Non- exchangeable	Non- exchangeable	Non- exchangeable	Non- exchangeable
	Ca	Mg	Ca + Mg	Ca	Mg	Ca + Mg
----- cmolc Kg ⁻¹ -----						
2019/2020 cropping season			2020/2021 cropping season			
0	0.08	0.05	0.13	0.34	0.05	0.39
5	0.61	0.44	1.05	0.67	0.26	0.94
10	1.60	1.08	2.68	0.98	0.43	1.41
15	2.62	1.65	4.27	1.52	0.89	2.41
20	3.73	2.52	6.25	2.13	1.16	3.30
Teste F	**	**	**	**	**	**
Gypsum (t ha ⁻¹)						
0	1.41	0.95	2.35	1.29	0.52	2.35
1	1.62	1.05	2.67	1.16	7.72	2.67
2	1.71	1.12	2.83	1.25	0.66	2.83
4	2.18	1.47	3.65	0.84	0.37	3.65
F test	**	**	*	ns	ns	ns
C x G	*	ns	*	ns	ns	ns
CV(%)	36.8	39.9	37.1	46.8	45.5	47.7

ns, * and ** - Non-significant, significant at 5 and at 1% of probability by the F test.

Table S8: Average values, F test and coefficient of variation (CV) for the concentration of macro and micronutrients in the soybean diagnostic leaf as a function of liming and gypsum rates (2019/2020 and 2020/2021 cropping seasons) in a Cerrado area. Currais, Piauí, Brazil.

	N	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn
Liming (t ha ⁻¹)	g kg ⁻¹					mg kg ⁻¹					
2019/2020 cropping season											
0	39.4	2.9	19.7	5.4	4.1	3.7	42	2.9	150	159	37
5	37.1	2.7	20.3	6.6	4.7	3.8	40	2.7	126	103	28
10	37.2	2.8	21.1	7.6	4.7	3.1	41	2.9	131	112	26
15	37.3	2.7	21.6	7.8	4.8	3.3	44	3.3	127	109	24
20	35.5	2.4	21.8	8.2	4.8	3.8	42	3.3	129	89	22
F test	**	**	**	**	**	ns	ns	*	**	**	**
Gypsum (t ha ⁻¹)											
0	36.9	2.8	20.4	7.0	4.7	2.9	43	2.9	136	114	26
1	37.3	2.7	20.9	7.0	4.6	3.2	43	2.9	136	113	27
2	36.9	2.6	20.2	7.5	4.8	3.0	40	2.9	133	120	28
4	38.0	2.7	22.0	7.1	4.3	4.4	41	3.2	126	112	30
F test	ns	ns	ns	**	**	**	ns	ns	ns	ns	**
C x G	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV (%)	4.6	5.1	6.8	7.9	7.5	43.4	9.9	22.2	10.6	23.2	8.9
2020/2021 cropping season											
Liming (t ha ⁻¹)											
0	36.8	3.02	21.9	5.42	3.47	1.62	47	4.2	164	74	36
5	39.9	3.54	23.2	6.15	5.13	1.82	40	3.8	89	31	26
10	40.0	3.92	25.0	6.42	5.70	1.88	41	3.4	80	25	23
15	38.6	3.94	23.2	6.54	5.50	1.64	40	3.2	68	24	23
20	38.0	4.38	23.2	6.82	6.05	1.71	41	4.7	81	22	21
F test	**	**	**	**	**	ns	ns	ns	**	**	**
Gypsum (t ha ⁻¹)											
0	39.0	3.94	24.5	6.08	5.13	1.77	43	4.2	91	34	26
1	39.4	3.66	23.6	6.21	5.03	1.69	43	3.9	101	36	24
2	38.2	3.67	22.3	6.54	5.52	1.68	42	3.9	103	34	24
4	38.2	3.77	23.0	6.25	5.00	1.84	40	3.5	92	38	29
F test	ns	ns	**	ns	ns	ns	**	ns	ns	ns	ns
C x G	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV (%)	6.0	15.2	7.5	14.6	17.1	17.6	6.8	38.4	30.7	15.2	10.9

ns, * and ** - Non-significant, significant at 5 and at 1% of probability by the F test.

Table S9: Average values, F test and coefficient of variation (CV) for the soybean grain yield as a function of liming and gypsum rates (2019/2020 and 2020/2021 cropping seasons) in a Cerrado area. Currais, Piauí, Brazil.

Liming t ha ⁻¹	Grain yield (kg ha ⁻¹)	
	2019/2020	2020/2021
0	971	557
5	1916	1788
10	2275	2063
15	2375	1956
20	2298	2054
F test	**	**
Gypsum (t ha ⁻¹)		
0	2008	1669
1	1868	1649
2	1945	1728
4	2048	1638
F test	ns	ns
C x G	ns	ns
CV(%)	12.8	10.9

ns, * and ** - Non-significant, significant at 5 and at 1% of probability by the F test.

Table S10: Average values (%) of residual limestone (non-exchangeable Ca and Mg) as a function of liming and gypsum rates in soybean at the 0.0-0.2 m soil layer in a Cerrado area. Currais, Piauí, Brazil.

Liming	Residual limestone (%)	
t ha ⁻¹	2019/2020	2020/2021
5	51	28
10	61	33
15	67	47
20	74	53
Gypsum (t ha ⁻¹)		
0	61	43
1	63	42
2	63	41
4	65	35