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SUPPLEMENTARY MATERIALS

Sulfur added to cattle slurry as a means to improve the nitrogen economy of maize during the grain filling period

Katarzyna Przygocka-Cyna[1], Agnieszka Zawieja-Roszak[2]

[1] Department of Agricultural Chemistry and Environmental Biogeochemistry Poznan University of Life Sciences, Poznan
[2] Research Centre for Cultivar Testing, 63-022 Słupia Wielka, Poland

Table S1

Correlation matrix of the mass of N in maize parts and nitrogen indicators in critical stages of yield formation and maize grain yield, *n*=24

Traits	Nc15	N60L	Nc60	N89S	N89L	N89CL	N89CC	GN	Nc89	NHI	Ncv89	NRQ	CRN-G	GFP-N	CFGPN-G
GY	-0.20	-0.05	0.21	-0.81***	-0.82***	-0.77***	-0.30	0.26	-0.50*	0.83***	-0.82***	0.53**	0.50*	-0.57**	-0.50*
Nc15	1.00	0.69***	0.59**	0.16	0.26	0.06	0.38	0.52**	0.50*	0.04	0.22	0.41	0.30	-0.29	-0.30
N60L		1.00	0.88***	0.11	0.26	0.09	0.32	0.90***	0.73***	0.20	0.20	0.65**	0.47*	-0.46*	-0.47*
Nc60			1.00	-0.25	-0.10	-0.22	0.13	0.90***	0.43*	0.52**	-0.17	0.91***	0.80***	-0.79***	-0.80***
N89S				1.00	0.98***	0.92***	0.49*	-0.14	0.72***	-0.94***	0.99***	-0.64**	-0.71***	0.76***	0.71***
N89L					1.00	0.90***	0.54**	0.01	0.81***	-0.88***	0.99***	-0.52**	-0.62**	0.67***	0.62**
N89CL						1.00	0.41*	-0.09	0.70***	-0.87***	0.93***	-0.58**	-0.65**	0.71***	0.65**
N89CC							1.00	0.18	0.55**	-0.37	0.54**	-0.12	-0.18	0.23	0.18
GN								1.00	0.58**	0.46*	-0.05	0.77***	0.57**	-0.57**	-0.57*
Nc89									1.00	-0.45*	0.78***	0.02	-0.18	0.22	0.18
NHI										1.00	-0.91***	0.82***	0.82***	-0.87***	-0.82***
Ncv89											1.00	-0.57**	-0.66***	0.71***	0.66***
NRQ												1.00	0.95***	-0.97***	-0.95***
CRN-G													1.00	-0.99***	1.00***
GFP-N														1.00	0.99***

*, **, *** – significant at $P \leq 0.05$; 0.01; 0.001. respectively. Key: 15, 60, 89 – stages of maize growth. BBCH 15, 60 and 89, respectively; Nc – total biomass; S – stem; L – leaves; CL –maize cob cover leaves; CC – cob core; G – grain; NHI – nitrogen harvest index. GY – grain yield; Ncv89 – N mass in vegetative maize parts at BBCH 89; NRQ – N remobilization quota; GFP-N – post-flowering soil N uptake; CRN-G – contribution of remobilized N into grain; CFGPN-G – contribution of post-flowering soil N uptake into grain

Katarzyna Przygocka-Cyna, PhD DSc Prof., Department of Agricultural Chemistry and Environmental Biogeochemistry, Poznan University of Life Sciences, Wojska Polskiego 28, 60-637 Poznan, Poland, e-mail: katarzyna.przygocka-cyna@up.poznan.pl, tel.: +48-61 8466285

Table S2

Mass of nitrogen in maize in critical stages of grain yield formation in consecutive years of study

Years	Factor	Factor level	Nc15	N60L	Nc60	N89S	N89L	N89CL	N89CC	N89G	Nc89	NHI	GY
			kg N ha^{-1}									%	t ha^{-1}
2017	Sulfur	S-S^0	23.3b	10.2	163.1	33.3	39.4	9.6	13.4	116.0	211.7a	54.4	8.06
	Fertilizer (S)	S-Ca	31.3a	10.2	159.9	33.6	38.7	8.3	13.0	103.7	197.3b	52.6	7.62
	Fc, p		90.9***	0.01	0.03	0.04	0.12	2.42	0.26	3.24	4.55*	1.00	1.80
	Sulfur dose (SD) kg S ha^{-1}	0	30.2a	10.0	132.6c	34.1	41.9	8.5	13.7	104.2	202.3	51.5	7.60
		22.5	26.9b	10.5	166.1b	34.8	37.5	9.7	13.7	105.9	201.6	52.5	7.76
		45	25.7b	10.1	152.1cb	33.3	38.8	8.6	12.8	122.4	215.9	56.4	8.35
		90	26.5b	10.3	195.2a	31.5	38.0	9.0	12.7	107.0	198.1	53.4	7.64
	Fc, p		5.55**	0.17	5.34*	1.25	1.13	0.46	0.66	1.54	1.35	1.35	1.12
2018	Sulfur	S-S^0	30.2a	11.5	221.5	8.8	6.1	4.0	12.3	132.9	164.0	81.0	10.01a
	Fertilizer (S)	S-Ca	26.3b	11.0	233.5	9.3	6.7	3.6	12.6	127.8	159.9	79.8	9.54b
	Fc, p		14.1***	1.67	0.81	0.46	0.94	3.17	0.23	2.58	1.36	2.15	8.59**
	Sulfur dose (SD) kg S ha^{-1}	0	26.0	11.8a	239.7	10.3	6.2	3.9	11.9	138.6a	170.9a	81.1	10.09a
		22.5	28.7	11.7ab	244.7	8.8	6.4	4.1	12.3	137.1ab	168.7ab	81.3	10.16a
		45	28.6	10.9ab	216.1	9.0	6.3	3.6	12.4	125.7bc	157.1ab	80.0	9.65ab
		90	29.8	10.4b	209.4	8.0	6.7	3.6	13.0	119.9c	151.1b	79.3	9.19b
	Fc, p		2.38	3.64*	1.71	1.66	0.12	1.07	0.45	8.03**	7.02**	1.36	7.85***

cont. Table S2

Years	Factor	Factor level	Nc15	N60L	Nc60	N89S	N89L	N89CL	N89CC	N89G	Nc89	NHI	GY
			kg N ha^{-1}									%	t ha^{-1}
2019	Sulfur	S-S^0	21.5a	6.4a	111.8a	16.8a	10.6a	5.6a	12.8a	85.8	131.6a	65.2	9.43
	Fertilizer (S)	S-Ca	17.8b	5.9b	97.1b	14.7b	9.3b	4.6b	11.6b	80.4	120.6b	66.6	9.46
	Fc, p		62.9***	4.27*	8.24***	5.36*	6.97*	10.47**	10.70**	3.72	8.37**	2.87	0.09
	Sulfur dose (SD) kg S ha^{-1}	0	18.7b	5.9	102.0	14.8	10.0	5.0	12.1	74.7b	116.6b	64.1b	8.61b
		22.5	19.5ab	5.9	104.8	15.3	10.3	5.3	13.0	87.4a	131.3b	66.6ab	9.60ab
		45	21.1a	6.4	109.9	17.8	9.9	4.8	11.6	82.4a	126.3ab	65.1ab	9.57ab
		90	19.3ab	6.2	100.9	15.0	9.7	5.2	12.3	87.8a	130.0a	67.6a	9.99a
	Fc, p		4.95**	1.02	0.61	2.28	0.23	0.49	2.78	4.57**	3.04*	3.72*	3.29*
Source of variation for the studied interactions													
Y × S			***	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Y × SD			***	ns	*	ns	ns	ns	ns	*	**	ns	**
S × SD			***	*	ns	**	***	ns	*	ns	ns	ns	ns
Y × S × SD			***	ns	ns	***	***	ns	ns	ns	ns	ns	ns

Mean values within a column followed by the same letter indicate no significant difference between the treatments; ns – non-significant at $P \leq 0.05$; *, **, *** – significant at $P \leq 0.05$, 0.01, 0.001, respectively. Key: 15, 60, 89 – stages of maize growth, BBCH 15, 60 and 89, respectively; Nc – total biomass; S – stem; L – leaves; CL –maize cob cover leaves; CC – cob core; G – grain; NHI – nitrogen harvest index.

Table 6

Indices of nitrogen balance/economy in maize at the grain filling period (GFP) in consecutive years of study

Years	Factor	Factor level	Ncv89	NRQ	CRN-G	GFP-N	CGFPN-G
			kg N ha^{-1}		%	kg N ha^{-1}	%
2017	Sulfur	S-S^0	95.7	67.4	60.1	48.6	39.9
	Fertilizer (S)	Ca-S	93.6	66.3	64.1	37.4	35.9
	Fc, p		0.49	0.01	0.06	0.39	0.06
	Sulfur dose (SD) kg S ha^{-1}	0	98.1	34.4c	32.1b	69.7a	67.9a
		22.5	95.8	70.3b	68.3ab	35.5b	31.7ab
		45	93.5	58.7b	48.3ab	63.7a	51.7ab
		90	91.2	104.0a	99.6a	2.9c	0.4b
	Fc, p		1.03	3.79*	3.14*	3.93*	3.14*
2018	Sulfur	S-S^0	31.1	190.4	144.2	-57.5	-44.2
	Fertilizer (S)	Ca-S	32.1	201.4	157.3	-73.6	-57.3
	Fc, p		0.53	0.75	1.66	1.48	1.66
	Sulfur dose (SD) kg S ha^{-1}	0	32.3	207.4	149.2	-68.8	-49.2
		22.5	31.6	213.1	155.4	-76.1	-55.4
		45	31.4	184.8	148.9	-59.0	-48.9
		90	31.2	178.2	149.5	-58.3	-49.5
	Fc, p		0.14	1.78	0.09	0.41	0.09
2019	Sulfur	S-S^0	45.8a	66.0a	77.5	19.8	22.5
	Fertilizer (S)	Ca-S	40.2b	56.9b	71.7	23.5	28.3
	Fc, p		12.5***	6.15*	0.71	0.42	0.71
	Sulfur dose (SD) kg S ha^{-1}	0	41.9	60.1	80.4	14.6	19.6
		22.5	43.9	60.9	70.3	26.6	29.7
		45	44.0	65.9	81.2	16.4	18.8
		90	42.2	58.8	66.5	29.0	33.5
	Fc, p		0.47	0.36	1.15	1.15	1.15
Y × S			ns	ns	ns	ns	ns
Y × SD			ns	*	*	*	*
S × SD			***	ns	ns	ns	ns
Y × S × SD			ns	ns	ns	ns	ns

Mean values within a column followed by the same letter indicate no considerable difference between the treatments; *, **, *** – significant at $P \leq 0.05$, 0.01, 0.001, respectively. Key: Nc – total mass of N in maize biomass; Ncv89 – N mass in vegetative parts of maize at BBCH 89; NRQ – Nitrogen remobilization quota; CRN-G ─ contribution of remobilized N into grain N; GFP-N – nitrogen uptake by maize during the grain filling period; CGFPN-G ─ contribution of nitrogen uptake during GFP in total N accumulated in grain; GY – grain yield.