

Supplements

Table S1. Matrix of Spearman's correlation coefficients between yield and plant indices of N management by WOSR. n = 55.

Variables	N _a	N _r	TN	NHI	UNA	UNP	NFP _{Nin}	Y _{max}	YG
Y-CU	0.96***	0.87***	0.94***	0.21	-0.23	0.21	0.86***	-0.23	0.81***
N _a	1.00	0.89***	0.98***	0.26	0.05	-0.07	0.77***	-0.11	0.70***
N _r		1.00	0.96***	-0.19	-0.03	-0.01	0.74***	-0.10	0.67***
TN			1.00	0.06	0.02	-0.04	0.78***	-0.11	0.70***
NHI				1.00	0.16	-0.13	0.15	-0.03	0.14
UNA					1.00	-0.98***	-0.30*	0.40**	-0.41**
UNP						1.00	0.30*	-0.40**	0.39**
NFP _{N30}							1.00	-0.46**	0.97***
Y _{max}								1.00	-0.63***

***, **, * indicate significant differences at $p < 0.001$, $p < 0.01$, and $p < 0.05$.

Y-CU, yield expressed in cereals units. t ha^{-1} ; N_a – seed N. kg ha^{-1} ; N_r – residual N. kg ha^{-1} . TN – total N uptake. kg ha^{-1} ; UNA - Unit N Accumulation. $\text{kg N a}^{-1} \text{ seeds}^{-1}$; UNP – UNP - Unit N Productivity. $\text{kg seeds kg}^{-1} \text{ N a}^{-1}$; ²PFP_{Nin} – Partial Factor Productivity of N input. YG – yield gap. t ha^{-1} .

Table S2. Matrix of Spearman's correlation coefficients between yield and soil indices of N management by WOSR. n = 55.

Variables	N _{in}	N _{minr}	N _b	N _{gain}	N _{inT}	N _{Ein}	N _{EinT}	NG
Y-OSR-CU	-0.17	-0.14	-0.92***	0.81***	0.83***	0.92***	0.67***	0.89***
N _{in}	1.00	-0.16	0.41*	-0.44**	-0.12	-0.36**	0.12	-0.58***
N _{minr}		1.00	-0.01	0.36**	0.34*	-0.01	-0.75***	-0.10
N _b			1.00	-0.94***	-0.88***	-0.99***	-0.55***	-0.92***
N _{gain}				1.00	0.94***	0.92***	0.25	0.83***
N _{inT}					1.00	0.89***	0.32*	0.70***
N _{inE}						1.00	0.57***	0.90***
N _{inTE}							1.00	0.53***

***, **, * indicate significant differences at $p < 0.001$, $p < 0.01$, and $p < 0.05$.

N_{in} – N_{mins} + N_r in the soil at the WOSR spring regrowth; N_{minr} - Mineral N after harvest. kg ha^{-1} ; N_b - N balance. kg ha^{-1} ; N_{gain} - In-season mineralized N. kg ha^{-1} ; N_{inT} - Total N input. kg ha^{-1} ; N_{inE} - Efficiency of N input. %; N_{inTE} - Efficiency of total N input. %; NG - Nitrogen gap. kg ha^{-1} .

Table S3. Matrix of Spearman's correlation coefficients between yield and plant indices of N management by triticale, n = 51.

Variables	N _a	N _r	TN	NHI	UNA	UNP	NFP _{Nin}	Y _{max}	YG
Y-CU	0.95***	0.65***	0.95***	0.58***	-0.40**	0.35*	0.90***	0.10	0.82***
N _a	1.00	0.65***	0.99***	0.63***	-0.14	0.09	0.83***	0.18	0.74***
N _r		1.00	0.75***	-0.14	0.13	-0.17	0.46**	0.37**	0.36**
TN			1.00	0.52***	-0.10	0.05	0.80***	0.23	0.71***
NHI				1.00	-0.35*	0.34*	0.58***	-0.12	0.58***
UNA					1.00	-0.90***	-0.51***	0.36*	-0.56***
UNP						1.00	0.48***	-0.37*	0.52***
NFP _{Nin}							1.00	-0.32*	0.98***
Y _{max}								1.00	-0.48***

***, **, * indicate significant differences at $p < 0.001$, $p < 0.01$, and $p < 0.05$.

Y-CU, yield expressed in cereals units, t ha⁻¹; N_a – seed N, kg ha⁻¹; N_r – residual N, kg ha⁻¹. TN – total N uptake, kg ha⁻¹; UNA - Unit N Accumulation, kg N_a t⁻¹ seeds; UNP – Unit N Productivity, kg seeds kg⁻¹ N_a; ²PFP_{Nin} – Partial Factor Productivity of N input. YG – yield gap, t ha⁻¹.

Table S4. Matrix of Spearman's correlation coefficients between yield and soil indices of N management by triticale, n = 51.

Variables	N _{in}	N _{minr}	N _b	N _{gain}	N _{inT}	N _{inE}	N _{inTE}	NG
Y-CU	0.10	-0.22	-0.79	0.59	0.63	0.89	0.77	0.82
N _{in}	1.00	0.16	0.47	-0.29	0.34	-0.24	0.05	-0.48
N _{minr}		1.00	0.27	0.44	0.57	-0.23	-0.73	-0.32
N _b			1.00	-0.74	-0.43	-0.96	-0.65	-0.96
N _{gain}				1.00	0.80	0.73	0.09	0.67
N _{inT}					1.00	0.57	0.12	0.36
N _{inE}						1.00	0.71	0.92
N _{inTE}							1.00	0.65

***, **, * indicate significant differences at $p < 0.001$, $p < 0.01$, and $p < 0.05$.

N_{in} – N_{min} + N_r in the soil at the WOSR spring regrowth; N_{minr} - Mineral N after harvest, kg ha⁻¹; N_b - N balance, kg ha⁻¹; N_{gain} - In-season mineralized N, kg ha⁻¹; N_{inT} - Total N input, kg ha⁻¹; N_{inE} - Efficiency of N input, %; N_{intE} - Efficiency of total N input, %; NG - Nitrogen gap, kg ha⁻¹.