Table S1a. Spearman's matrix of correlation coefficients for the pooled nitrogen fertilization systems at BBCH 30 of WOSR growth, $n = 30$

Variables	P_b	P_c	K_a	K_b	K_c	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{30}	PFP_{N30}	Yield
P_a	0.59**	0.50**	-0.39*	0.18	0.13	0.60**	0.11	-0.13	0.03	0.07	-0.06	0.26	-0.33	-0.24
P_b	1.00	0.71***	-0.25	0.36	0.21	0.52**	0.01	-0.42*	-0.11	-0.10	-0.30	0.42*	-0.21	-0.07
P_c		1.00	-0.09	0.41*	0.47**	0.23	-0.11	-0.33	-0.37*	-0.22	-0.38*	0.04	0.07	-0.45*
K_a			1.00	0.29	0.41*	-0.62**	-0.38*	-0.17	-0.29	-0.33	-0.23	0.20	-0.24	-0.02
K_b				1.00	0.62**	0.06	0.03	-0.40*	-0.29	0.05	-0.40*	-0.01	-0.07	-0.19
K_c					1.00	-0.30	-0.35	-0.23	-0.46*	-0.39*	-0.44*	-0.11	0.01	-0.54**
Mg_a						1.00	0.58**	0.08	0.52**	0.58**	0.29	0.29	-0.18	0.26
Mg_b							1.00	0.49**	0.32	0.86***	0.68***	-0.13	0.10	0.25
Mg_c								1.00	0.30	0.43	0.72***	-0.25	0.20	-0.10
Ca_a									1.00	0.55**	0.44*	0.14	-0.17	0.31
Ca_b										1.00	0.78***	-0.17	0.01	0.18
Ca_c											1.00	-0.21	0.09	0.08
N_{30}												1.00	-0.80***	0.52**
PFP_{N30}													1.00	-0.24

***, **, * significant at $p < 0.001$; < 0.01; < 0.05, respectively.

Table S1b. Spearman's matrix of correlation coefficients for the mineral nitrogen fertilization system at BBCH 30 of WOSR growth, $n = 10$

Variables	P_b	P_c	K_a	K_b	K_b	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{30}	PFP_{N30}	Yield
P_a	0.68*	0.72*	-0.28	0.21	0.10	0.68	-0.01	-0.34	-0.36	-0.08	-0.30	0.38	-0.44	-0.17
P_b	1.00	0.50	-0.20	0.19	-0.18	0.79**	0.11	-0.31	-0.04	0.12	-0.02	0.59	-0.49	0.14
P_c		1.00	0.11	0.70*	0.65*	0.26	-0.21	0.06	-0.72	-0.33	-0.61	0.14	-0.21	-0.72*
K_a			1.00	0.02	0.40	-0.61	-0.45	0.57	-0.14	-0.62	-0.27	0.43	-0.39	-0.34
K_b				1.00	0.59	0.13	0.19	0.32	-0.48	0.05	-0.43	-0.29	0.21	-0.60
K_c					1.00	-0.37	-0.47	0.23	-0.55	-0.45	-0.61	-0.23	0.09	-0.92***
Mg_a						1.00	0.51	-0.37	0.22	0.56	0.24	0.32	-0.33	0.41
Mg_b							1.00	0.34	0.41	0.89**	0.67*	-0.12	0.11	0.50
Mg_c								1.00	-0.11	0.08	0.22	-0.01	0.02	-0.20
Ca_a									1.00	0.60	0.73*	0.15	-0.09	0.74*
Ca_b										1.00	0.78**	-0.24	0.25	0.54
Ca_c											1.00	0.03	0.09	0.66*
N_{30}												1.00	-0.94***	0.30
PFP_{N30}													1.00	-0.23

***, **, * significant at $p < 0.001$; < 0.01; < 0.05, respectively

Table S1c. Spearman's matrix of correlation coefficients for the organic nitrogen fertilization system at BBCH 30 of WOSR growth, $n = 10$

Variables	P_b	P_c	K_a	K_b	K_b	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{30}	PFP_{N30}	Yield
P_a	0.56	0.43	-0.62	0.14	-0.68	0.67*	0.45	-0.15	0.54	0.50	0.10	0.24	-0.23	-0.01
P_b	1.00	0.86**	-0.60	-0.12	-0.24	0.44	0.26	-0.24	0.23	0.15	-0.03	0.03	-0.24	-0.40
P_c		1.00	-0.37	0.05	0.06	0.21	0.00	-0.36	0.12	0.08	-0.10	-0.20	-0.16	-0.71*
K_a			1.00	-0.36	0.60	-0.80**	-0.89**	-0.16	-0.38	-0.77	-0.41	-0.02	0.13	0.15
K_b				1.00	0.15	0.40	0.52	0.26	0.32	0.77	0.50	-0.42	0.26	-0.29
K_c					1.00	-0.47	-0.51	0.18	-0.14	-0.32	0.04	-0.54	0.48	-0.39
Mg_a						1.00	0.83	0.16	0.85**	0.79**	0.33	0.20	-0.08	0.16
Mg_b							1.00	0.39	0.50	0.90**	0.57	-0.03	0.06	0.06
Mg_c								1.00	0.14	0.44	0.91***	-0.62	0.88**	-0.11
Ca_a									1.00	0.58	0.20	0.17	0.07	0.24
Ca_b										1.00	0.68	-0.26	0.25	-0.15
Ca_c											1.00	-0.73*	0.82**	-0.32
N_{30}												1.00	-0.84**	0.77**
PFP_{N30}													1.00	-0.37

***, **, * significant at p < 0.001; < 0.01; < 0.05, respectively

Table S1d. Spearman's matrix of correlation coefficients for the organic-mineral nitrogen fertilization system at BBCH 30 of WOSR growth, $n = 10$

Variables	P_b	P_c	K_a	K_b	K_b	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{30}	PFP_{N30}	Yield
P_a	0.42	0.09	-0.83**	-0.37	0.06	0.49	-0.03	0.22	0.39	-0.10	0.05	0.07	-0.23	-0.44
P_b	1.00	0.74*	-0.56	0.18	0.30	0.45	-0.32	-0.36	-0.13	-0.51	-0.43	0.45	0.06	0.14
P_c		1.00	-0.39	0.26	0.24	0.19	-0.24	-0.46	-0.50	-0.51	-0.49	-0.01	0.55	0.13
K_a			1.00	0.42	0.13	-0.75	-0.26	-0.39	-0.30	-0.02	-0.15	0.05	-0.17	0.26
K_b				1.00	0.75	-0.49	-0.54	-0.66	-0.59	-0.65*	-0.80**	0.28	-0.04	0.33
K_c					1.00	-0.51	-0.83	-0.58	-0.49	-0.93***	-0.91**	0.05	0.02	-0.29
Mg_a						1.00	0.51	0.50	0.63	0.44	0.46	0.34	-0.12	0.26
Mg_b							1.00	0.76	0.36	0.88**	0.85**	-0.23	0.16	0.25
Mg_c								1.00	0.58	0.73*	0.80*	-0.29	0.04	-0.17
Ca_a									1.00	0.60	0.61	0.31	-0.58	-0.01
Ca_b										1.00	0.96	-0.05	-0.17	0.29
Ca_c											1.00	-0.14	-0.11	0.08
N_{30}												1.00	-0.75*	0.65*
PFP_{N30}													1.00	-0.28

***, **, * significant at p < 0.001; < 0.01; < 0.05, respectively

Table S2a. Spearman's matrix of correlation coefficients for the pooled nitrogen fertilization systems at BBCH 60 of WOSR growth, $n = 30$

Variables	P_b	P_c	K_a	K_b	K_b	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{60}	PFP_{N30}	Yield
P_a	0.65***	0.49**	-0.03	0.17	-0.29	-0.33	-0.33	-0.27	-0.13	-0.17	-0.07	-0.06	-0.09	-0.21
P_b	1.00	0.76***	-0.43*	0.28	-0.35	-0.68***	-0.62***	-0.59**	-0.26	-0.17	0.02	-0.30	-0.06	-0.14
P_c		1.00	-0.44	0.24	-0.08	-0.63***	-0.56**	-0.61***	-0.02	-0.12	-0.14	-0.15	-0.31	-0.01
K_a			1.00	0.15	0.20	0.63***	0.39	0.31	0.18	-0.03	-0.21	0.19	-0.09	-0.13
K_b				1.00	0.13	-0.09	-0.11	-0.13	0.00	-0.17	-0.06	0.08	-0.05	-0.17
K_c					1.00	0.44	0.21	0.26	0.27	-0.31	-0.36	0.36	0.19	0.03
Mg_a						1.00	0.60	0.60***	0.23	0.03	-0.04	0.32	0.14	-0.05
Mg_b							1.00	0.66***	0.23	0.50**	0.38	0.40	0.05	-0.09
Mg_c								1.00	0.06	0.17	0.49*	0.43	0.25	0.02
Ca_a									1.00	0.39	-0.10	0.23	-0.16	0.39
Ca_b										1.00	0.62	-0.17	0.03	0.07
Ca_c											1.00	-0.07	0.31	-0.04
N_{60}												1.00	-0.33	0.38*
PFP_{N30}													1.00	-0.24

***, **, * significant at $p < 0.001$; < 0.01; < 0.05, respectively.

Table S2b. Spearman's matrix of correlation coefficients for the mineral nitrogen fertilization system at BBCH 60 of WOSR growth, $n = 10$

Variables	P_b	P_c	K_a	K_b	K_c	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{60}	PFP_{N30}	Yield
P_a	0.70*	0.83**	-0.31	0.07	-0.40	-0.47	-0.51	-0.49	-0.45	-0.56	-0.23	-0.05	-0.48	-0.46
P_b	1.00	0.88**	-0.73	0.21	-0.48	-0.78**	-0.81**	-0.80**	-0.43	-0.50	-0.10	-0.22	-0.31	0.01
P_c		1.00	-0.64	0.30	-0.34	-0.66	-0.66	-0.68	-0.39	-0.41	-0.07	-0.15	-0.45	-0.18
K_a			1.00	-0.25	0.17	0.82**	0.75*	0.63	0.58	0.61	-0.06	0.29	-0.13	0.01
K_b				1.00	-0.32	-0.53	-0.38	-0.43	0.01	-0.04	-0.04	0.02	-0.29	0.07
K_c					1.00	0.55	0.56	0.55	0.44	0.39	0.11	0.20	0.58	-0.20
Mg_a						1.00	0.84**	0.77*	0.59	0.62	0.17	0.19	0.24	-0.08
Mg_b							1.00	0.94	0.51	0.61	0.39	0.60	0.07	0.21
Mg_c								1.00	0.26	0.35	0.46	0.65*	0.16	0.08
Ca_a									1.00	0.83**	0.09	0.07	0.23	0.25
Ca_b										1.00	0.05	0.05	-0.06	0.45
Ca_c											1.00	0.57	0.08	0.41
N_{60}												1.00	-0.24	0.26
PFP_{N30}													1.00	-0.23

***, **, * significant at $p < 0.001$; < 0.01; < 0.05, respectively

Table S2c. Spearman's matrix of correlation coefficients for the organic-mineral nitrogen fertilization system at BBCH 60 of WOSR growth, $n = 10$

Variables	P_b	P_c	K_a	K_b	K_c	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{60}	PFP_{N30}	Yield
P_a	0.80**	0.35	-0.06	0.04	-0.62	-0.84**	-0.23	-0.26	-0.41	0.08	0.16	-0.49	-0.13	-0.34
P_b	1.00	0.60	-0.34	0.35	-0.44	-0.85**	-0.22	-0.26	-0.57	0.06	0.35	-0.50	0.11	-0.14
P_c		1.00	-0.49	0.01	-0.04	-0.72*	-0.60	-0.62	-0.24	-0.23	-0.13	-0.31	-0.21	0.43
K_a			1.00	0.00	0.11	0.26	0.35	0.36	-0.29	0.05	0.01	-0.28	0.18	-0.43
K_b				1.00	0.15	-0.01	0.57	0.10	-0.22	0.33	0.49	-0.21	0.29	-0.37
K_c					1.00	0.43	-0.19	-0.09	-0.10	-0.61	-0.49	0.57	-0.15	0.34
Mg_a						1.00	0.52	0.42	0.48	0.14	-0.05	0.37	0.26	-0.16
Mg_b							1.00	0.41	0.22	0.70*	0.53	-0.27	0.38	-0.64
Mg_c								1.00	0.09	0.49	0.66*	-0.02	0.75	-0.24
Ca_a									1.00	0.35	-0.06	0.29	-0.08	0.08
Ca_b										1.00	0.83**	-0.55	0.53	-0.54
Ca_c											1.00	-0.52	0.76*	-0.41
N_{60}												1.00	-0.44	0.54
PFP_{N30}													1.00	-0.37

***, **, * significant at p < 0.001; < 0.01; < 0.05, respectively

Table S2d. Spearman's matrix of correlation coefficients for the organic-mineral nitrogen fertilization system at BBCH 60 of WOSR growth, $n = 10$

Variables	P_b	P_c	K_a	K_b	K_b	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{60}	PFP_{N30}	Yield
P_a	0.27	-0.16	0.11	0.14	0.18	0.24	-0.07	0.17	0.43	-0.11	-0.19	0.29	0.40	0.34
P_b	1.00	0.52	-0.32	0.21	-0.14	-0.59	-0.60	-0.48	0.12	-0.05	-0.13	-0.67*	0.35	-0.44
P_c		1.00	-0.24	-0.13	0.11	-0.69*	-0.62	-0.67	0.50	0.25	-0.21	-0.38	-0.22	0.03
K_a			1.00	0.49	0.65*	0.61	-0.15	-0.02	0.03	-0.62	-0.71	0.53	-0.03	0.14
K_b				1.00	0.60	0.44	-0.53	0.22	-0.21	-0.68*	-0.28	-0.04	0.45	-0.16
K_c					1.00	0.53	-0.53	-0.01	0.07	-0.69*	-0.70	0.31	0.12	0.15
Mg_a						1.00	0.30	0.60	-0.26	-0.50	-0.25	0.70*	0.08	0.15
Mg_b							1.00	0.36	-0.27	0.50	0.49	0.38	-0.11	0.12
Mg_c								1.00	-0.21	-0.16	0.46	0.37	0.10	0.17
Ca_a									1.00	0.30	-0.18	0.38	-0.41	**0.75***
Ca_b										1.00	0.66*	-0.08	-0.16	0.35
Ca_c											1.00	-0.27	0.15	0.08
N_{60}												1.00	-0.46	**0.65***
PFP_{N30}													1.00	-0.28

*** , ** , * significant at $p < 0.001$; < 0.01; < 0.05, respectively

Table S3a. Spearman's matrix of correlation coefficients for the pooled nitrogen fertilization systems at BBCH 89 of WOSR growth, $n = 30$

Variables	P_b	P_c	K_a	K_b	K_b	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{89}	Yield
P_a	0.41*	0.12	0.03	0.10	0.37*	-0.27	-0.19	-0.21	0.00	0.00	-0.07	-0.19	-0.45*
P_b	1.00	0.71***	-0.33	-0.03	-0.06	0.11	-0.19	-0.07	-0.10	-0.52**	-0.57**	-0.03	-0.26
P_c		1.00	-0.23	-0.10	-0.23	0.17	-0.07	-0.20	-0.13	-0.49**	-0.58**	-0.21	-0.21
K_a			1.00	0.21	0.10	0.07	0.21	-0.17	0.07	0.43	0.20	-0.04	-0.02
K_b				1.00	0.32	0.20	0.38*	0.19	0.32	0.39*	0.40*	0.06	-0.14
K_c					1.00	-0.31	-0.16	-0.10	0.05	0.18	0.19	0.43*	-0.26
Mg_a						1.00	0.33	0.36	0.45*	0.23	0.17	0.16	0.18
Mg_b							1.00	0.62	0.10	0.53**	0.61***	-0.16	0.09
Mg_c								1.00	0.20	0.39	0.59**	0.08	0.16
Ca_a									1.00	0.57**	0.40*	0.12	-0.03
Ca_b										1.00	0.82***	-0.01	-0.01
Ca_c											1.00	0.08	0.09
N_{89}												1.00	0.49**

***, **, * significant at p < 0.001; < 0.01; < 0.05, respectively

Table S3b. Spearman's matrix of correlation coefficients for the mineral nitrogen fertilization system at BBCH 89 of WOSR growth, $n = 10$

Variables	P$_b$	P$_c$	K$_a$	K$_b$	K$_b$	Mg$_a$	Mg$_b$	Mg$_c$	Ca$_a$	Ca$_b$	Ca$_c$	N$_{89}$	Yield
P$_a$	0.40	0.67*	-0.10	-0.16	0.59	-0.20	-0.35	-0.49	0.26	-0.31	-0.68*	-0.20	-0.47
P$_b$	1.00	0.44	-0.46	0.10	0.37	0.45	-0.55	-0.33	0.75*	-0.70	-0.73	0.58	-0.04
P$_c$		1.00	-0.18	0.09	0.45	0.16	-0.56	-0.78	0.58	-0.53	-0.65*	0.10	-0.05
K$_a$			1.00	0.35	0.07	0.02	0.54	0.04	-0.09	0.82	0.50	-0.38	-0.42
K$_b$				1.00	0.14	-0.02	0.24	-0.11	0.42	0.02	0.17	0.01	-0.12
K$_c$					1.00	-0.27	-0.46	-0.27	0.16	-0.20	-0.46	0.16	**-0.71***
Mg$_a$						1.00	-0.14	-0.17	0.67*	-0.05	-0.17	0.63	0.38
Mg$_b$							1.00	0.67	-0.39	0.77**	0.83**	-0.35	0.20
Mg$_c$								1.00	-0.57	0.50	0.68*	0.13	0.23
Ca$_a$									1.00	-0.47	-0.60	0.51	0.11
Ca$_b$										1.00	0.77*	-0.32	-0.17
Ca$_c$											1.00	-0.30	0.18
N$_{89}$												1.00	0.35

***, **, * significant at p < 0.001; < 0.01; < 0.05, respectively

Table S3c. Spearman's matrix of correlation coefficients for the organic nitrogen fertilization system at BBCH 89 of WOSR growth, $n = 10$

Variables	P_b	P_c	K_a	K_b	K_b	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{89}	Yield
P_a	0.70*	0.10	0.05	-0.09	-0.21	-0.45	-0.32	-0.03	-0.07	-0.17	-0.12	-0.64	**-0.70***
P_b	1.00	0.65	-0.19	0.05	-0.43	-0.19	-0.54	-0.12	-0.47	-0.50	-0.52	-0.58	**-0.71***
P_c		1.00	-0.24	-0.09	-0.42	-0.01	-0.40	-0.28	-0.38	-0.40	-0.60	-0.24	-0.41
K_a			1.00	-0.23	-0.03	-0.32	-0.41	-0.61	0.17	0.12	-0.28	-0.09	0.07
K_b				1.00	0.09	0.35	0.56	0.51	0.17	0.33	0.36	-0.03	-0.04
K_c					1.00	-0.30	0.11	0.17	-0.20	-0.20	0.21	0.79**	0.33
Mg_a						1.00	0.48	0.32	0.01	0.15	0.17	0.00	0.23
Mg_b							1.00	0.66	0.60	0.71*	0.81	0.12	0.31
Mg_c								1.00	0.40	0.44	0.83	0.10	0.04
Ca_a									1.00	0.96***	0.76**	-0.22	0.10
Ca_b										1.00	0.77	-0.14	0.27
Ca_c											1.00	0.10	0.20
N_{89}												1.00	**0.75****

***, **, * significant at p < 0.001; < 0.01; < 0.05, respectively

Table S3d. Spearman's matrix of correlation coefficients for the organic-mineral nitrogen fertilization system at BBCH 89 of WOSR growth, $n = 10$

Variables	P_b	P_c	K_a	K_b	K_b	Mg_a	Mg_b	Mg_c	Ca_a	Ca_b	Ca_c	N_{89}	Yield
P_a	0.36	0.14	-0.26	0.19	0.62	-0.52	-0.28	-0.39	-0.30	-0.06	0.09	0.19	-0.05
P_b	1.00	0.93	-0.23	0.11	-0.10	0.27	0.61	0.22	-0.26	-0.55	-0.48	-0.19	-0.15
P_c		1.00	-0.13	0.00	-0.18	0.29	0.67*	0.13	-0.28	-0.72*	-0.63*	-0.22	-0.25
K_a			1.00	-0.69	-0.38	0.14	-0.21	-0.21	-0.30	-0.05	-0.21	0.29	**0.52**
K_b				1.00	0.23	-0.36	0.01	0.19	-0.14	-0.20	-0.09	-0.24	-0.05
K_c					1.00	-0.67*	-0.50	-0.34	0.17	0.21	0.46	0.24	-0.18
Mg_a						1.00	0.74	0.76	0.32	0.07	0.07	-0.07	0.18
Mg_b							1.00	0.56	-0.10	-0.32	-0.23	-0.35	-0.05
Mg_c								1.00	0.45	0.15	0.26	-0.05	0.30
Ca_a									1.00	0.60	0.63	0.19	-0.19
Ca_b										1.00	0.85**	0.05	0.04
Ca_c											1.00	0.34	0.19
N_{89}												1.00	**0.63**

***, **, * significant at $p < 0.001$; < 0.01; < 0.05, respectively
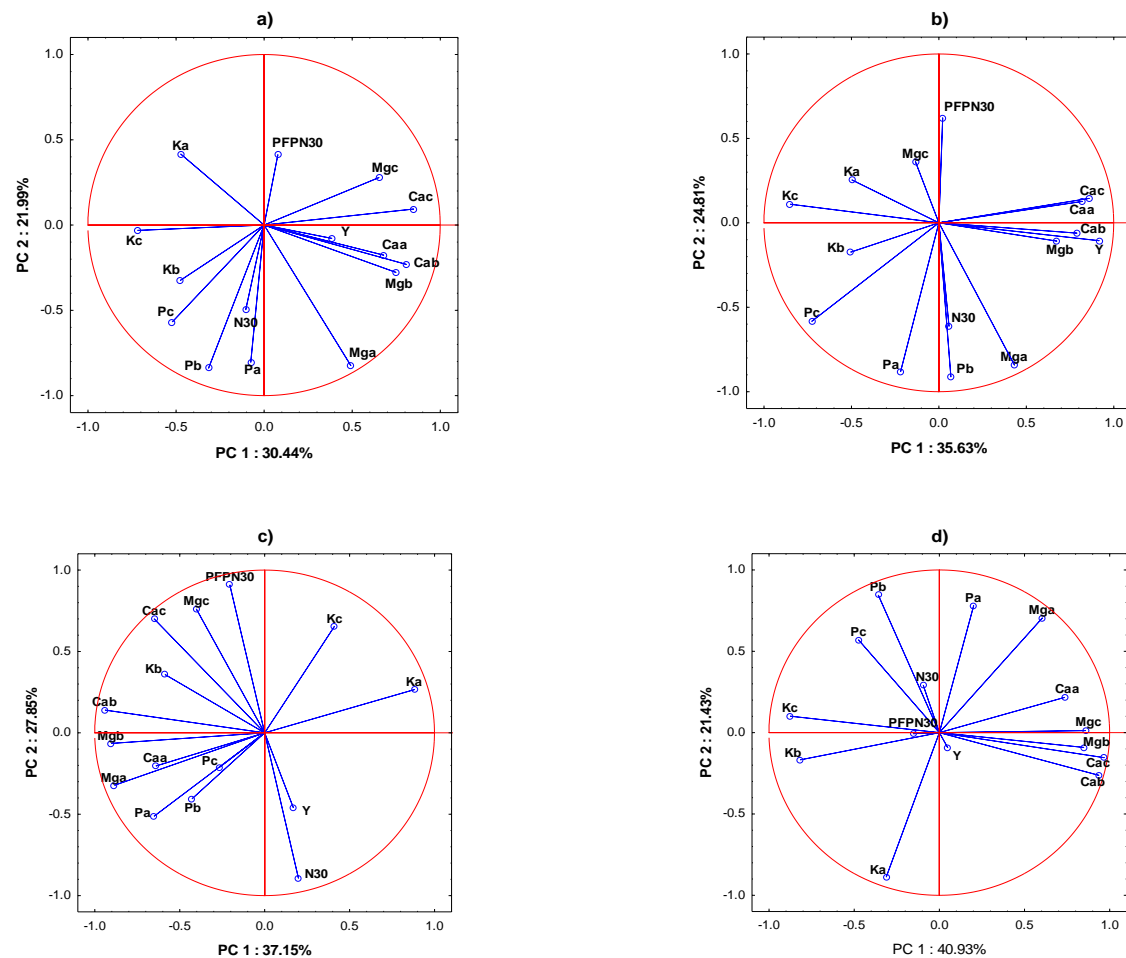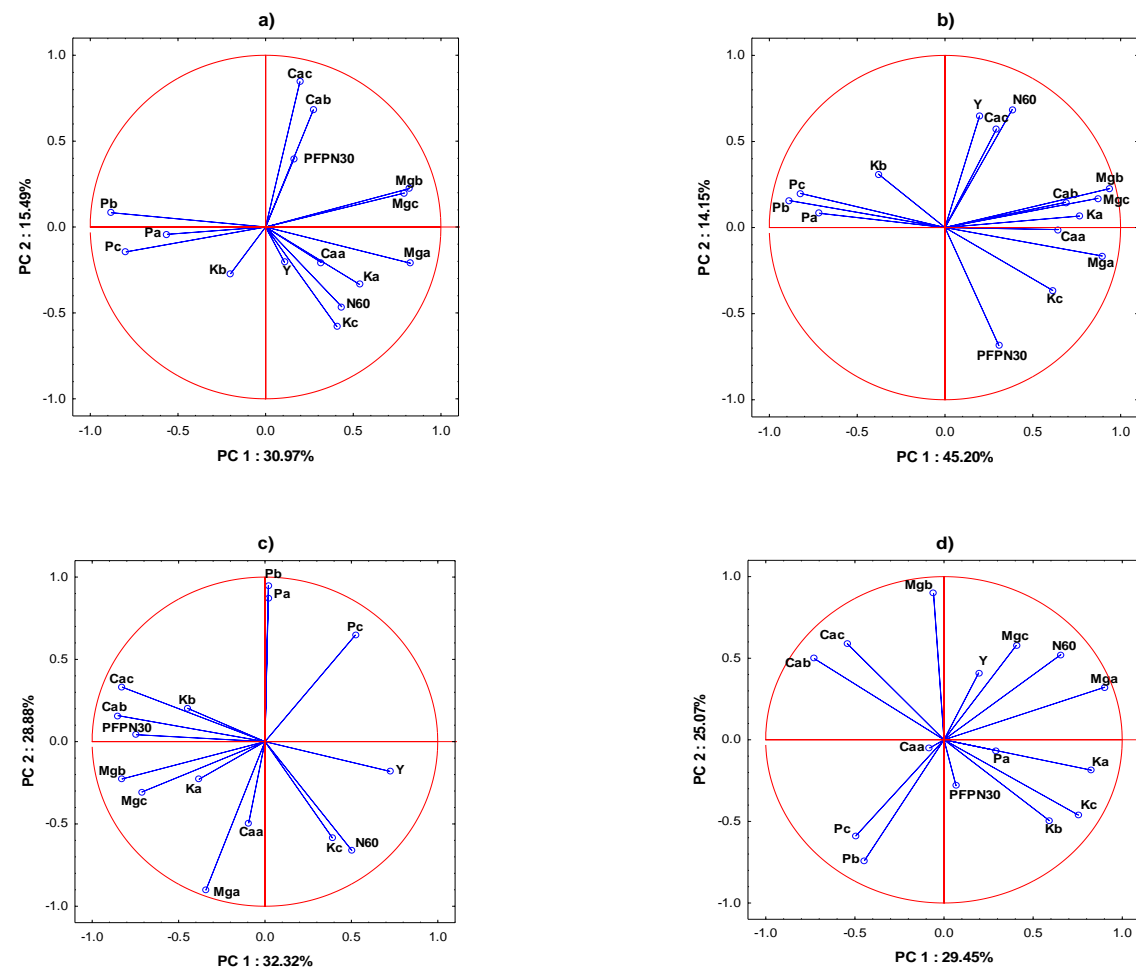
Figures S1

Figure S1. Principal components analysis (PCA) of nitrate N, available nutrients content and yield indices at the onset of WOSR stem elongation for a) total NFS, b) M-NFS, c) O-NFS, d) OM-NFS; NFS—nitrogen fertilization system; N_{30}—nitrate N content at BBCH 30 (rosette); PFP_{N30}—partial factor productivity of N-NO_3 at BBCH 30; P—phosphorus, K—potassium, Mg—magnesium, Ca—calcium; a, b, c—soil layers of 0.0–0.30, 0.30–0.60, 0.60–0.90 cm, respectively, Y—yield.

Figure S2. Principal components analysis (PCA) of nitrate N, available nutrients content and yield indices at the onset of WOSR flowering for a) total NFS, b) M-NFS, c) O-NFS, d) OM-NFS; NFS—nitrogen fertilization system; N_{60}—nitrate N content at BBCH 60; PFP_{N30}—partial factor productivity of N-NO_3 at BBCH 30; P—phosphorus, K—potassium, Mg—magnesium, Ca—calcium; a, b, c—soil layers of 0.0–0.30, 0.30–0.60, 0.60–0.90 cm, respectively; Y—yield.
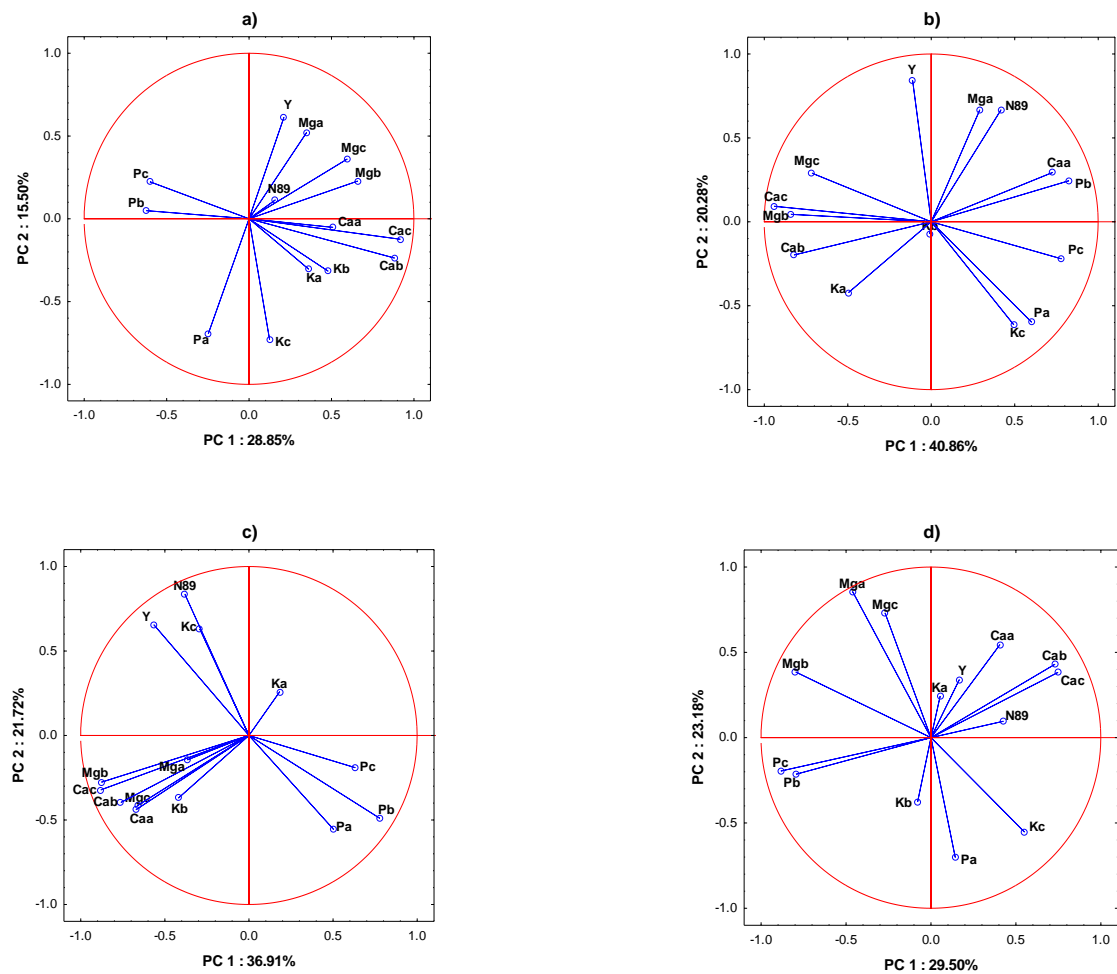
Figures S3

Figure S3. Principal components analysis (PCA) of nitrate N, available nutrients content and yield indices at WOSR ripening for a) total NFS, b) M-NFS, c) O-NFS, d) OM-NFS; NFS—nitrogen fertilization system; N_{89}—nitrate N content at BBCH 89; P—phosphorus, K—potassium, Mg—magnesium, Ca—calcium; a, b, c—soil layers of 0.0–0.30, 0.30–0.60, 0.60–0.90 cm, respectively, Y—yield.