SUPPLEMENTARY MATERIAL

Detection of multi-nutrients deficiency in cereal plants by the use of chlorophyll fluorescence

Zuzanna M. Jaszczuk[1)], Wojciech Bąba[2)]

[1)] Warsaw University of Life Sciences SGGW, Faculty of Agriculture and Ecology, Warsaw, Poland
[2)] Institute of Technology and Life Sciences – National Research Institute, Falenty, 3 Hrabska Ave, 05 –090, Raszyn, Poland

Table S1. Chlorophyll *a* parameter averages ±standard errors (n = 3) in maize plants growing in control (no nutrient deficiency), single and multiple nutrient deficiency treatments (TRT)

Time	ND	F_v/F_m	ABS/CS_o	Di_o/CS_o	Tr_o/CS_o	E_{to}/CS_o	PI_{total}
t_0	control	0.79 ±0a	580.00 ±5.01a	120.17 ±1.12a	459.82 ±3.96a	267.16 ±4.72a	1.45 ±0.1a
	–N	0.79 ±0a	570.33 ±15.75a	114.54 ±4.98a	455.79 ±11.82a	258.78 ±8.26a	1.33 ±0.08a
	–P	0.80 ±0.01a	550.48 ±11.05a	109.07 ±6.11a	441.41 ±7.62a	257.93 ±5.7a	1.29 ±0.12a
	–K	0.80 ±0a	389.59 ±14.43b	76.80 ±3.45b	312.78 ±11.38b	186.40 ±7.81b	2.11 ±0.13b
	–NP	0.80 ±0.01a	599.85 ±22.09a	117.81 ±7.88a	482.04 ±15.53a	275.52 ±10.42a	1.34 ±0.09a
	–NK	0.80 ±0a	587.92 ±11.54a	117.34 ±4.39a	470.58 ±7.68a	254.49 ±4.57a	1.24 ±0.07a
	–KP	0.79 ±0.01a	557.74 ±17.38a	113.87 ±13.48a	443.86 ±9.12a	245.39 ±7.66a	1.21 ±0.07a
	–NPK	0.80 ±0.01a	607.29 ±12.59a	120.90 ±5.52a	486.38 ±8.95a	280.29 ±7.24a	1.38 ±0.15a
t_1	control	0.75 ±0a	557.88 ±17.83a	137.60 ±4.05a	420.28 ±14.53a	244.26 ±10.14a	1.42 ±0.19a
	–N	0.74 ±0.03a	572.25 ±29.67b	148.71 ±7.49a	423.54 ±25.51a	235.07 ±16.5a	0.98 ±0.09b
	–P	0.72 ±0.03a	588.55 ±24.58b	160.20 ±24.49b	428.35 ±21.27a	230.98 ±14.63a	0.99 ±0.1b
	–K	0.74 ±0.03a	568.22 ±23.94b	143.37 ±13.97a	424.84 ±19.37a	240.74 ±13.54a	1.18 ±0.19b
	–NP	0.74 ±0.02a	583.07 ±23.87b	152.07 ±15.54a	431.00 ±19.97a	243.23 ±12.35a	0.83 ±0.68b
	–NK	0.74 ±0.03a	585.11 ±37.90b	151.15 ±16.18a	433.95 ±32.29a	239.43 ±18.95a	0.9 ±0.07b
	–KP	0.74 ±0.02a	575.74 ±26.36b	147.48 ±17.00a	428.25 ±18.53a	248.38 ±12.88a	0.95 ±0.24ab
	–NPK	0.73 ±0.03a	564.81 ±32.87b	145.54 ±19.16a	419.26 ±24.66a	250.20 ±16.75a	1.07 ±0.16ab
t_2	control	0.74 ±0.01a	580.66 ±8.54a	145.84 ±3.13a	434.82 ±7.93a	254.50 ±6.47a	1.84 ±0.18a
	–N	0.73 ±0.01a	580.62 ±29.40a	153.27 ±8.98a	427.35 ±22.24a	242.78 ±13.03a	1.15 ±2.23b
	–P	0.72 ±0.01a	596.00 ±8.23a	163.40 ±4.99b	432.59 ±5.08a	232.19 ±4.71a	1.18 ±0.09b
	–K	0.72 ±0.02a	625.29 ±18.94b	177.21 ±22.1c	448.08 ±14.25a	234.82 ±11.15a	1.14 ±0.28b
	–NP	0.72 ±0.05a	574.37 ±38.74a	156.85 ±11.13a	417.51 ±33.34a	215.59 ±19.24b	0.97 ±0.10c
	–NK	0.72 ±0.03a	609.88 ±34.05b	173.17 ±17.13c	436.70 ±25.93a	223.22 ±15.34a	0.98 ±0.09c
	–KP	0.73 ±0.01a	572.59 ±10.97a	155.49 ±4.00a	417.09 ±8.55a	223.27 ±5.83a	1.13 ±0.07b
	–NPK	0.74 ±0.03a	586.92 ±21.90a	149.22 ±5.40a	437.69 ±18.31a	261.51 ±11.82c	1.61 ±0.13b
t_3	Control	0.75 ±0.04a	527.81 ±7.20a	132.98 ±3.40a	394.83 ±4.55a	209.81 ±3.64a	1.47 ±0.14a
	–N	0.72 ±0.02b	486.25 ±18.44b	135.75 ±12.90a	350.49 ±10.21a	167.32 ±6.43b	0.81 ±0.09b
	–P	0.71 ±0.03b	538.91 ±36.39a	155.16 ±29.16b	383.75 ±24.79a	181.56 ±16.78b	0.99 ±0.06c
	–K	0.75 ±0a	544.07 ±7.54a	141.67 ±2.13a	402.40 ±5.83b	200.51 ±4.13a	1.03 ±0.13c
	–NP	0.72 ±0.03b	513.07 ±28.91a	143.97 ±13.72a	369.10 ±25.35a	168.74 ±16.22b	0.75 ±0.13b
	–NK	0.70 ±0.03a	510.33 ±16.28a	154.45 ±17.94b	355.88 ±16.45a	165.75 ±11.83b	0.76 ±0.13b
	–KP	0.72 ±0.02b	517.34 ±35.95a	141.72 ±9.27a	375.61 ±28.23a	194.24 ±18.74a	1.04 ±0.13c
	–NPK	0.71 ±0.01b	540.11 ±6.83a	163.13 ±3.74c	406.97 ±5.51b	230.81 ±6.84a	1.57 ±0.15b

continues Table S1

Time	ND	F_v/F_m	ABS/CS_o	Di_o/CS_o	Tr_o/CS_o	E_{to}/CS_o	PI_{total}
t_4	control	0.75 ±0a	509.70 ±5.42a	127.22 ±1.95a	382.48 ±4.13a	227.26 ±5.70a	2.11 ±0.18a
	–N	0.70 ±0.01b	471.58 ±11.65b	139.72 ±8.97b	331.85 ±9.13b	166.70 ±8.73b	0.82 ±0.11b
	–P	0.64 ±0.01c	559.56 ±12.87a	203.31 ±5.00c	356.25 ±9.51a	168.56 ±6.64b	0.84 ±0.08b
	–K	0.73 ±0a	532.44 ±6.31a	147.33 ±3.03b	385.10 ±4.01a	210.60 ±2.86a	1.45 ±0.13c
	–NP	0.67 ±0.02c	522.59 ±13.03a	172.79 ±8.09d	349.80 ±16.36a	149.19 ±12.92c	0.67 ±0.12d
	–NK	0.67 ±0.02c	475.05 ±14.39b	146.93 ±9.02b	328.12 ±13.76b	152.87 ±10.13c	0.80 ±0.12b
	–KP	0.71 ±0.01b	504.15 ±10.82a	146.00 ±5.27b	358.14 ±6.61a	177.94 ±4.54d	0.96 ±0.07b
	–NPK	0.70 ±0.01b	525.45 ±6.61a	157.84 ±5.37e	367.60 ±4.58a	220.41 ±6.44a	1.65 ±0.14c
t_5	control	0.75 ±0a	518.51 ±3.20a	127.04 ±1.04a	391.47 ±2.33a	238.32 ±3.32ab	2.25 ±0.11a
	–N	0.72 ±0.03b	475.13 ±35.72c	128.68 ±6.62a	346.45 ±31.84b	180.24 ±19.69c	0.95 ±0.12b
	–P	0.64 ±0.01c	604.23 ±8.79b	226.62 ±8.48b	377.61 ±5.30b	195.54 ±5.86ab	1.07 ±0.10b
	–K	0.74 ±0a	512.44 ±8.26a	131.11 ±3.88a	381.32 ±4.94a	215.91 ±3.14a	1.73 ±0.15c
	–NP	0.71 ±0.01b	513.90 ±9.11a	147.10 ±3.92d	366.80 ±7.19b	184.73 ±6.08b	0.88 ±0.08d
	–NK	0.70 ±0.02b	491.74 ±25.72c	147.78 ±9.52d	343.95 ±24.10b	172.11 ±16.14c	0.85 ±0.17d
	–KP	0.71 ±0.01b	505.06 ±7.95a	144.87 ±4.38d	360.19 ±7.73b	186.75 ±7.27b	0.98 ±0.08b
	–NPK	0.70 ±0b	572.70 ±7.71b	177.26 ±2.12bc	395.43 ±6.10a	223.28 ±5.16a	1.65 ±0.09c
t_6	control	0.75 ±0a	499.85 ±23.89a	120.81 ±4.66a	379.04 ±19.29a	233.66 ±11.95a	2.56 ±6.32a
	–N	0.71 ±0b	444.77 ±15.46a	121.35 ±5.41a	323.41 ±10.98b	172.52 ±6.86b	0.84 ±0.06b
	–P	0.63 ±0.03c	656.92 ±32.50a	246.27 ±34.69b	410.64 ±20.13c	203.10 ±13.72a	0.97 ±0.12c
	–K	0.74 ±0a	522.70 ±5.80b	133.65 ±1.80c	389.04 ±4.32c	219.63 ±3.15a	1.93 ±0.08a
	–NP	0.72 ±0.01b	503.59 ±27.99a	136.18 ±7.71c	367.41 ±21.24a	187.67 ±12.03b	0.94 ±0.38c
	–NK	0.71 ±0.01b	470.07 ±4.83bc	133.71 ±5.31c	336.36 ±11.05b	169.31 ±6.77c	0.76 ±0.08d
	–KP	0.72 ±0b	437.29 ±25.33c	118.73 ±6.20a	318.55 ±19.68d	165.93 ±11.90c	0.75 ±1.2d
	–NPK	0.64 ±0b	592.55 ±17.00b	226.19 ±4.73b	366.35 ±13.29a	196.24 ±9.41a	1.31 ±0.1e
t_7	control	0.74 ±0.03a	510.44 ±24.63a	129.43 ±5.10a	381.00 ±19.74a	232.42 ±11.37a	2.72 ±0.09a
	–N	0.70 ±0b	423.50 ±16.97b	116.17 ±3.55b	307.32 ±13.61b	158.50 ±7.81b	0.73 ±0.05b
	–P	0.58 ±0.01c	620.25 ±17.05c	262.52 ±3.85c	357.73 ±13.33c	188.68 ±7.52c	0.90 ±0.04c
	–K	0.73 ±0.01a	535.07 ±8.17a	145.17 ±2.26d	389.90 ±6.35a	211.8 ±5.41a	1.85 ±0.05d
	–NP	0.73 ±0.03a	472.81 ±18.03b	124.49 ±3.76a	348.31 ±14.36c	176.31 ±8.37c	0.85 ±0.03ab
	–NK	0.72 ±0.02b	470.66 ±24.3b	129.19 ±5.14a	341.47 ±19.27c	171.80 ±11.14c	0.79 ±0.12b
	–KP	0.73 ±0.02a	454.14 ±26.64b	119.83 ±5.45b	334.30 ±21.30c	175.68 ±12.49c	0.74 ±0.04b
	–NPK	0.65 ±0.01c	604.51 ±17.63c	208.69 ±3.66c	395.82 ±14.03a	204.22 ±7.97a	0.99 ±0.03c
t_8	control	0.74 ±0.01a	505.59 ±11.18a	131.22 ±2.72a	374.36 ±8.65a	216.57 ±6.32a	1.80 ±0.04a
	–N	0.72 ±0.02a	472.55 ±8.92b	129.78 ±2.52a	342.77 ±6.71b	165.58 ±5.86b	0.65 ±0.04b
	–P	0.59 ±0.01b	631.92 ±7.55c	264.66 ±2.22b	367.26 ±5.64b	177.94 ±4.34c	1.06 ±0.09c
	–K	0.64 ±0.01b	645.62 ±14.71c	237.11 ±3.57b	408.51 ±11.42c	190.25 ±8.17d	0.71 ±0.05d
	–NP	0.68 ±0.0c	487.14 ±11.61b	151.25 ±3.66a	335.89 ±8.24b	143.70 ±6.09e	0.59 ±0.06b
	–NK	0.70 ±0.0c	500.88 ±9.79a	146.38 ±3.74c	354.50 ±6.35b	170.03 ±3.88c	0.70 ±0.06d
	–KP	0.73 ±0.0a	466.77 ±12.12b	124.83 ±4.22a	341.93 ±9.13b	180.67 ±6.50d	0.72 ±0.06d
	–NPK	0.68 ±0.01c	623.77 ±17.32c	211.54 ±5.55b	412.23 ±13.23c	223.70 ±9.07a	1.30 ±0.10c
t_9	control	0.75 ±0a	483.66 ±10.83a	119.75 ±2.47a	363.91 ±8.93a	218.54 ±5.94a	2.26 ±0.08a
	–N	0.67 ±0b	471.07 ±21.79a	151.98 ±5.72b	319.08 ±16.37b	135.34 ±9.92b	0.41 ±0.06b
	–P	0.48 ±0.01c	621.18 ±15.86b	327.59 ±9.38c	293.58 ±13.91c	127.72 ±11.41b	0.67 ±0.13c
	–K	0.51 ±0c	761.00 ±24.92c	384.62 ±5.50d	376.37 ±19.76d	152.07 ±12.73c	0.28 ±6.16d
	–NP	0.69 ±0.01b	537.36 ±26.79d	163.44 ±14.92b	373.91 ±19.64d	155.18 ±11.63c	0.54 ±0.66b
	–NK	0.69 ±0b	514.80 ±18.15d	156.31 ±4.34b	358.49 ±14.28a	147.10 ±9.05b	0.52 ±0.07b
	–KP	0.71 ±0d	470.25 ±24.95a	132.49 ±6.18d	337.76 ±19.34e	160.72 ±11.97c	0.59 ±1.77b
	–NPK	0.64 ±0.01b	684.59 ±12.86b	265.07 ±3.14e	419.52 ±11.30f	200.24 ±7.81a	0.98 ±0.15e

Explanations: The abbreviations and definitions of all measured and calculated chlorophyll-*a* fluorescence parameters in the table are presented in Table 3; different letters in columns within time steps (Time) denotes significant differences (at $p \leq 0.05$) of averages among treatments according to Tukey HSD test.

Table S2. Chlorophyll *a* parameter averages ±standard errors (n = 3) in wheat plants growing in control (no nutrient deficiency), single and multiple nutrient deficiency conditions (ND) during. Different letters in columns within time steps (TIME) denotes significant differences (at $p \leq 0.05$) of averages among treatments according to Tukey HSD test

Time	ND	F_v/F_m	ABS/CS_o	Di_o/CS_o	Tr_o/CS_o	E_{to}/CS_o	PI_{total}
t_0	control	0.80 ±15.12a	518.92 ±4.64a	102.08 ±5.10a	416.84 ±0a	232.34 ±0.12a	1.20 ±0.07a
	–N	0.80 ±21.67a	538.62 ±14.78a	106.06 ±10.97a	432.56 ±0.02a	237.20 ±0.10a	1.12 ±0.04a
	–P	0.79 ±16.78a	540.03 ±8.76a	110.29 ±9.35a	429.73 ±0.01a	237.14 ±0.09a	1.12 ±0.02a
	–K	0.79 ±17.02a	590.11 ±5.82a	119.10 ±4.67a	471.00 ±0a	261.80 ±0.09ba	1.12 ±0.03a
	–NP	0.80 ±16.17a	526.29 ±5.12a	103.70 ±7.23a	422.59 ±0a	252.13 ±0.10a	1.33 ±0.14b
	–NK	0.80 ±18.47a	544.48 ±7.95a	108.32 ±8.94a	436.15 ±0.01a	257.67 ±0.11a	1.48 ±0.08b
	–KP	0.79 ±16.42a	541.37 ±6.95a	108.64 ±12.47a	432.72 ±0.01a	251.45 ±0.10a	1.37 ±0.09b
	–NPK	0.80 ±19.68a	577.92 ±10.17a	114.59 ±10.12a	463.32 ±0.01a	267.58 ±0.11a	1.33 ±0.12b
t_1	control	0.80 ±0a	582.03 ±18.33a	115.62 ±5.96a	466.41 ±12.77a	279.09 ±5.38a	1.54 ±0.24a
	–N	0.79 ±0.02a	596.22 ±20.16a	121.52 ±11.77a	474.70 ±14.68a	276.87 ±11.22a	1.25 ±0.09b
	–P	0.80 ±0.01a	594.22 ±17.26a	117.99 ±7.69a	476.23 ±11.74a	283.11 ±9.65a	1.28 ±0.09b
	–K	0.79 ±0.01a	575.51 ±24.02a	117.13 ±11.35a	458.38 ±13.38a	270.81 ±4.01a	1.56 ±0.21a
	–NP	0.79 ±0.03a	608.48 ±19.72b	128.17 ±17.02a	480.30 ±17.45b	277.75 ±10.57a	1.18 ±0.17d
	–NK	0.78 ±0.02a	660.33 ±24.58b	143.34 ±16.21b	516.99 ±13.71b	303.74 ±10.93b	1.08 ±0.1d
	–KP	0.78 ±0.01abc	612.62 ±16.65b	129.95 ±7.15a	482.67 ±12.88b	287.66 ±10.40a	1.25 ±0.08b
	–NPK	0.78 ±0.03c	555.14 ±29.73a	117.99 ±26.22a	437.15 ±20.66a	269.29 ±13.31a	1.59 ±0.12a
t_2	control	0.80 ±0a	556.96 ±13.93a	109.61 ±4.65a	447.34 ±9.74a	274.85 ±4.42a	1.98 ±0.20a
	–N	0.78 ±0.02a	574.74 ±18.97b	125.57 ±16.91b	449.16 ±12.76a	257.62 ±9.07a	1.15 ±0.07b
	–P	0.77 ±0.01b	542.96 ±15.19a	121.37 ±9.64b	421.58 ±9.27a	244.14 ±8.37b	1.38 ±0.06c
	–K	0.79 ±0a	532.34 ±14.88a	108.15 ±5.29a	424.17 ±10.12a	261.75 ±5.37a	0.87 ±0.15d
	–NP	0.75 ±0.02a	591.33 ±22.56b	145.95 ±21.79c	445.37 ±14.43a	254.78 ±11.66a	1.61 ±0.18e
	–NK	0.77 ±0.01a	573.77 ±14.66b	127.31 ±6.17b	446.46 ±12.51a	258.55 ±10.37a	1.09 ±0.08b
	–KP	0.78 ±0.01a	551.22 ±20.10a	120.71 ±5.77b	430.50 ±16.79a	259.27 ±12.42a	1.06 ±0.08b
	–NPK	0.79 ±0.03b	523.18 ±19.30c	106.90 ±30.56a	416.27 ±18.25b	264.61 ±13.93a	1.89 ±0.13e
t_3	control	0.81 ±0a	550.18 ±15.89a	100.85 ±5.06a	449.33 ±11.20a	279.11 ±5.22a	2.27 ±0.23a
	–N	0.77 ±0.01b	599.48 ±14.47a	135.35 ±6.26b	464.12 ±10.26a	271.45 ±9.21a	1.03 ±0.06b
	–P	0.80 ±0a	561.18 ±14.19a	110.70 ±3.67a	450.48 ±11.15a	275.79 ±8.23a	1.57 ±0.04c
	–K	0.80 ±0a	563.29 ±17.74a	108.33 ±6.57a	454.95 ±11.83a	291.1 ±4.43b	1.41 ±0.26c
	–NP	0.76 ±0.04b	591.88 ±22.94a	140.22 ±32.35c	451.66 ±20.89a	250.78 ±16.13c	0.92 ±0.18d
	–NK	0.77 ±0.01b	624.59 ±14.84b	143.51 ±4.09c	481.07 ±12.00b	276.17 ±8.25a	0.85 ±0.07d
	–KP	0.75 ±0.01c	584.29 ±22.22a	144.58 ±5.20c	439.71 ±18.14a	255.05 ±12.68c	0.98 ±0.06d
	–NPK	0.79 ±0.03b	579.51 ±17.42a	122.29 ±24.02c	457.22 ±17.24a	287.1615.25b	1.71 ±0.14c
t_4	control	0.79 ±0a	560.22 ±18.41a	113.40 ±6.23a	446.81 ±12.74a	274.6 ±5.61a	2.05 ±0.40a
	–N	0.71 ±0.01b	540.69 ±17.84a	136.79 ±6.33b	403.89 ±13.40b	227.679.43b	0.85 ±0.05b
	–P	0.72 ±0b	521.91 ±19.77a	150.33 ±5.61b	371.58 ±14.22c	221.94 ±7.96b	1.20 ±0.03c
	–K	0.68 ±0.01c	615.77 ±18.38b	190.34 ±8.95c	425.43 ±11.98a	241.09 ±4.39b	1.20 ±0.29c
	–NP	0.68 ±0.02c	569.16 ±22.17a	179.33 ±15.45c	389.82 ±15.68c	208.13 ±8.58b	1.34 ±0.12c
	–NK	0.69 ±0c	493.67 ±17.70c	150.60 ±64.75b	343.00 ±13.32c	160.88 ±7.59c	0.84 ±0.06b
	–KP	0.68 ±0.02c	621.09 ±29.60b	203.17 ±6.37d	417.91 ±23.98a	219.59 ±14.81b	0.84 ±0.06b
	–NPK	0.69 ±0.04c	530.85 ±15.15a	146.33 ±26.98b	384.51 ±22.37c	229.33 ±16.33b	1.18 ±0.13c

continues Table S2

Time	ND	F_v/F_m	ABS/CS_o	Di_o/CS_o	Tr_o/CS_o	E_{to}/CS_o	PI_{total}
t_5	control	0.78 ±0a	568.13 ±11.93a	120.73 ±4.26a	447.40 ±8.22a	275.54 ±3.85a	2.21 ±0.27a
	–N	0.73 ±0.01b	590.00 ±14.98a	155.38 ±5.69b	434.61 ±10.67a	240.71 ±8.31b	1.07 ±0.07b
	–P	0.77 ±0a	630.21 ±8.84c	140.47 ±2.32b	489.73 ±6.93b	295.3 ±4.61c	1.38 ±0.04b
	–K	0.74 ±0.03b	650.94 ±18.69c	179.76 ±22.40c	471.18 ±14.79b	277.45 ±7.56a	1.32 ±0.11b
	–NP	0.62 ±0.03c	492.72 ±25.34d	140.46 ±29.13b	352.25 ±11.16c	196.98 ±12.01c	0.76 ±0.13c
	–NK	0.68 ±0.02c	612.65 ±15.10c	176.64 ±11.60c	436.01 ±15.45a	236.84 ±10.23b	0.67 ±0.07c
	–KP	0.76 ±0a	585.98 ±16.14a	139.91 ±5.37c	446.07 ±11.43a	267.68 ±7.11d	1.22 ±0.04c
	–NPK	0.72 ±0.04b	583.58 ±17.90a	153.24 ±29.75b	430.33 ±24.05a	265.44 ±16.83d	0.44 ±0.17d
t_6	control	0.80 ±0a	573.37 ±7.51a	112.89 ±3.07a	460.47 ±5.24a	287.33 ±2.74a	2.13 ±0.19a
	–N	0.76 ±0.01b	573.85 ±13.13a	137.31 ±5.86b	436.53 ±8.99a	250.86 ±7.90b	1.23 ±0.06b
	–P	0.71 ±0c	602.33 ±15.59b	183.01 ±5.54c	419.32 ±10.74b	247.95 ±5.74b	0.85 ±0.05c
	–K	0.80 ±0.03a	576.29 ±22.85a	111.27 ±35.21a	465.02 ±19.34a	303.18 ±9.45c	1.00 ±0.04b
	–NP	0.70 ±0.03c	509.62 ±29.39c	141.33 ±37.98b	368.28 ±14.58c	209.26 ±15.17d	1.06 ±0.11b
	–NK	0.70 ±0.01c	596.92 ±15.34b	177.38 ±7.34c	419.54 ±9.81b	234.81 ±9.28b	0.93 ±0.06d
	–KP	0.71 ±0.02c	502.77 ±12.31c	125.82 ±7.86c	376.95 ±13.90c	221.48 ±10.83b	1.16 ±0.04b
	–NPK	0.78 ±0.04b	589.66 ±23.32b	126.60 ±29.78ab	463.05 ±23.66a	290.30 ±17.40a	1.79 ±0.17e
t_7	control	0.81 ±0.01a	566.85 ±18.48a	106.16 ±5.82a	460.68 ±14.11a	280.81 ±8.13a	2.20 ±0.07b
	–N	0.74 ±0.02a	592.00 ±4.52a	150.32 ±1.61a	441.67 ±3.51a	244.69 ±3.18a	0.90 ±0.06b
	–P	0.79 ±0.01a	601.92 ±13.31a	126.61 ±3.17a	475.31 ±10.41a	291.48 ±6.73a	1.42 ±0.04b
	–K	0.80 ±0.01a	592.18 ±35.19b	113.07 ±6.94b	479.10 ±28.27b	312.87 ±15.87b	0.79 ±0.27a
	–NP	0.74 ±0.02a	553.29 ±5.81a	137.59 ±1.50a	415.69 ±4.53a	233.38 ±2.48a	1.09 ±0.02b
	–NK	0.75 ±0.02a	552.33 ±7.25a	134.89 ±1.54a	417.44 ±6.00a	240.17 ±4.11a	1.14 ±0.04b
	–KP	0.78 ±0.03a	566.07 ±15.00a	124.16 ±3.32a	441.9 ±11.78a	265.60 ±7.42a	0.77 ±0.05b
	–NPK	0.74 ±0.01a	571.67 ±21.92a	127.037 ±4.42a	444.64 ±17.58a	275.26 ±10.69a	0.47 ±0.05b
t_8	control	0.81 ±0a	570.18 ±12.67a	105.96 ±4.84a	464.21 ±8.21a	285.12 ±4.17a	2.24 ±0.08a
	–N	0.69 ±0.01b	441.66 ±19.64b	108.98 ±9.39a	332.67 ±10.79b	192.51 ±3.57b	0.98 ±0.06bc
	–P	0.77 ±0c	633.88 ±13.55c	146.76 ±5.13b	487.12 ±8.60a	288.91 ±4.49a	1.31 ±0.06bc
	–K	0.80 ±0a	593.77 ±15.44d	115.93 ±5.92a	477.84 ±9.82a	306.44 ±4.76c	1.14 ±0.09ab
	–NP	0.78 ±0.01c	553.37 ±16.13a	116.67 ±7.05a	436.69 ±10.1a	254.81 ±8.28a	1.29 ±0.08a
	–NK	0.71 ±0.01b	492.63 ±14.23b	133.11 ±6.78a	359.51 ±8.37b	198.23 ±5.00b	1.06 ±0.06c
	–KP	0.76 ±0c	563.33 ±16.02a	132.86 ±6.16a	430.47 ±10.40a	253.66 ±5.61a	1.18 ±0.07bc
	–NPK	0.80 ±0a	596.51 ±11.29d	116.39 ±5.73a	480.12 ±6.38a	302.21 ±3.75c	0.36 ±0.08bc
t_9	Control	0.80 ±0a	542.07 ±17.76a	104.56 ±5.37a	437.50 ±12.81a	275.42 ±6.02a	2.72 ±0.17a
	–N	0.78 ±0.01b	438.48 ±21.53b	96.43 ±10.72b	322.05 ±11.91b	186.00 ±4.87b	1.17 ±0.09b
	–P	0.70 ±0.01c	688.88 ±19.17c	221.17 ±7.79c	467.71 ±12.20a	271.20 ±5.43a	1.21 ±0.09b
	–K	0.80 ±0.01a	587.44 ±22.5a	113.82 ±10.22a	473.61 ±12.95a	308.31 ±4.45c	2.51 ±0.13c
	–NP	0.78 ±0b	505.00 ±16.40a	110.74 ±5.60a	394.25 ±11.72b	230.29 ±6.46d	1.66 ±0.16b
	–NK	0.78 ±0.01b	429.29 ±19.00a	163.09 ±8.07d	416.20 ±11.97a	244.27 ±6.60d	1.28 ±0.10c
	–KP	0.79 ±0ab	474.89 ±19.24c	150.05 ±6.85d	374.83 ±13.05b	227.62 ±6.47d	1.065 ±0.10b
	–NPK	0.79 ±0.01ab	583.03 ±18.87a	219.68 ±7.79c	463.35 ±12.8a	289.13 ±9.25bc	0.61 ±0.13d

Explanations as in Tab. S1.