

Exogenous GA₃ Enhances Nitrogen Uptake and Metabolism under Low Nitrate Conditions in ‘Duli’ (*Pyrus betulifolia* Bunge) Seedlings

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Supplementary Data

Table S1 Effects of GA₃ and PAC on the growth, chlorophyll content and root length of ‘Duli’. Data are presented as means ± SD (n = 3). Values not followed by the same letter denote significant differences based on Tukey’s multiple-range tests ($P < 0.05$).

Concentration (mM)	Plant length	Leaf number	Leaf area per plant	Chlorophyll content	Main root length
CK	8.19±0.52c	7.40±0.52a	2.38±0.08b	2.21±0.04e	17.85±0.38cd
0	7.68±0.33d	6.60±0.52bc	1.910±0.07e	1.97±0.07g	18.21±0.45cd
GA ₃ (0.01)	7.82±0.34d	6.40±0.52bc	1.96±0.05e	1.94±0.02g	18.38±0.34bc
GA ₃ (0.05)	8.28±0.25c	6.80±0.42b	2.16±0.09d	1.98±0.05fg	18.91±0.49b
GA ₃ (0.1)	9.44±0.34a	7.40±0.84a	2.61±0.13a	2.04±0.05fg	19.82±0.70a
GA ₃ (0.15)	8.54±0.30b	7.60±0.52a	2.27±0.13c	2.10±0.05ef	18.92±0.53b
PAC (0.005)	7.70±0.09d	6.20±0.42cd	1.90±0.06e	2.73±0.09c	18.11±1.08cd
PAC (0.01)	7.31±0.10e	5.80±0.42de	1.55±0.04f	3.17±0.05a	17.66±0.85de
PAC (0.02)	7.06±0.14e	5.60±0.52e	1.30±0.08	3.00±0.09b	17.16±0.40e
PAC (0.04)	6.73±0.26f	5.40±0.52e	0.94±0.07h	2.92±0.06b	14.76±0.41f
PAC (0.1)	6.49±0.22f	5.30±0.48e	0.59±0.05i	2.48±0.10d	14.64±0.27f

Table S2 The membership function values and comprehensive evaluation of different GA₃/PAC concentration.

Concentration (mM)	Plant length	Leaf number	Leaf area per plant	Chlorophyll content	Main root length	Comprehensive assessment	Ranking
CK	0.58	0.91	0.89	0.22	0.62	0.64	3
0	0.45	0.48	0.74	0.00	0.72	0.48	8
GA ₃ (0.01)	0.45	0.48	0.74	0.00	0.72	0.48	8
GA ₃ (0.05)	0.61	0.65	0.83	0.03	0.82	0.59	6
GA ₃ (0.1)	1.00	0.91	1.00	0.08	1.00	0.80	1
GA ₃ (0.15)	0.69	1.00	0.85	0.13	0.83	0.70	2
PAC (0.005)	0.59	0.39	0.71	0.64	0.67	0.60	5
PAC (0.01)	0.72	0.22	0.57	1.00	0.58	0.62	4
PAC (0.02)	0.81	0.13	0.47	0.86	0.49	0.55	7
PAC (0.04)	0.92	0.04	0.35	0.80	0.02	0.43	10

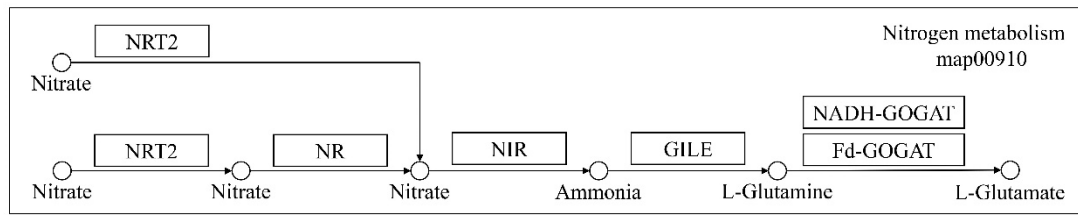


Figure S1. Map of key gene pathways involved in N uptake and metabolism.

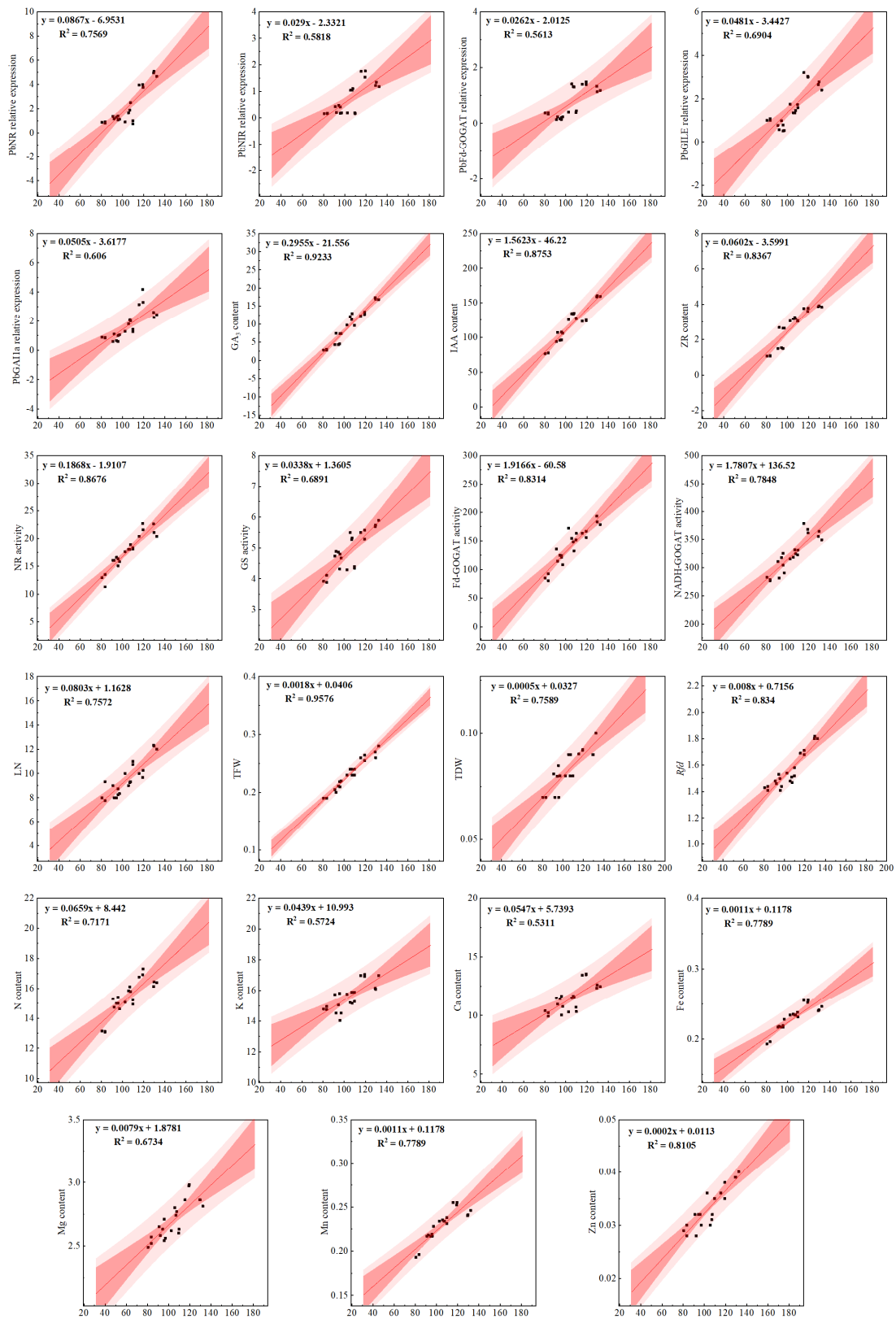


Figure S2. Relationships between the aboveground index and plant length (Pearson's correlation analysis). Only the aboveground indices that are significantly correlated with plant length are shown in the figure.

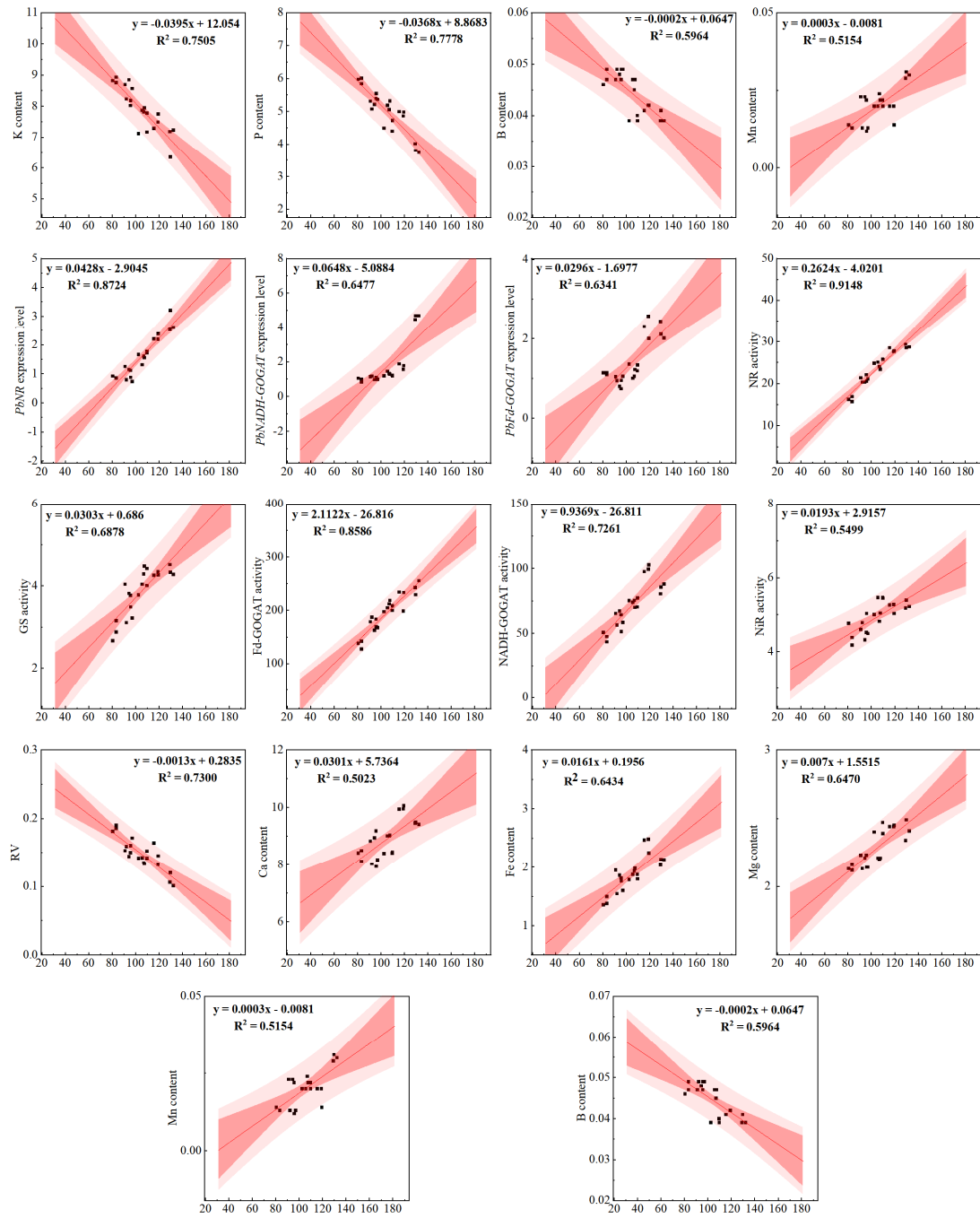


Figure S3. Relationships between the root index and plant length (Pearson's correlation analysis). Only the root indices that are significantly correlated with plant length are shown in the figure.

Table S3 Comprehensive score of exogenous GA₃ in ‘Duli’ under NO₃⁻ deficiency. SCK, 0.5 mM NO₃⁻ solution; SGT, 0.5 mM NO₃⁻ solution with 0.1 mM GA₃; SPT, 0.5 mM NO₃⁻ solution with 0.01 mM PAC; DCK, 8 mM NO₃⁻ solution; DGT, 8 mM NO₃⁻ solution with 0.1 mM GA₃; DPT, 8 mM NO₃⁻ solution with 0.01 mM PAC; CK, 16mM NO₃⁻ solution.

Treatment	PC1	PC2	PC3	PC4	PC5	Comprehensive score	Ranking
SCK	-0.19	-0.34	-0.07	0.02	0.02	-0.55	6
SGT	0.10	-0.35	0.04	-0.02	-0.04	-0.27	5
SPT	-0.98	0.04	0.01	-0.06	0.02	-0.96	7
DCK	0.31	0.05	-0.03	0.08	0.01	0.43	3
DGT	0.50	0.09	0.17	-0.01	0.01	0.77	2
DPT	-0.57	0.34	-0.02	0.04	-0.03	-0.25	4
CK	0.81	0.17	-0.11	-0.06	0.00	0.82	1

Table S4 The concentrations of nutrition solution and allogenic material of each treatment. SCK, 0.5 mM NO₃⁻ solution; SGT, 0.5 mM NO₃⁻ solution with 0.1 mM GA₃; SPT, 0.5 mM NO₃⁻ solution with 0.01 mM PAC; DCK, 8 mM NO₃⁻ solution; DGT, 8 mM NO₃⁻ solution with 0.1 mM GA₃; DPT, 8 mM NO₃⁻ solution with 0.01 mM PAC; CK, 16 mM NO₃⁻ solution.

Composition		Purity (≥%)	SCK	SGT	SPT	DCK	DGT	DPT	CK
Macroelement (mM)	KH ₂ PO ₄	99.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	MgSO ₄ ·7H ₂ O	99.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	KCl	99.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	Ca(NO ₃) ₂	98.50	0.50	0.50	0.50	8.00	8.00	8.00	16.00
	CaCl ₂	96.00	7.50	7.50	7.50	8.00	8.00	8.00	0.00
	KI	99.00	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Microelement (mg/L)	H ₃ BO ₃	99.50	6.20	6.20	6.20	6.20	6.20	6.20	6.20
	ZnSO ₄	99.50	8.60	8.60	8.60	8.60	8.60	8.60	8.60
	Na ₂ MoO ₄	99.00	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	CuSO ₄	99.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	CoCl ₂	99.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	MnSO ₄	99.00	22.30	22.30	22.30	22.30	22.30	22.30	22.30
Iron salt (mM)	EDTA-Fe	99.50	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Allogenic material(mM)	PAC	95.00	0	0	0.01	0	0	0.01	0
	GA ₃	99.00	0	0.10	0	0	0.10	0	0

Table S5 Sequences of primers used in qRT-PCR.

Gene	Primer sequence (5'-3')
<i>PbACTIN F</i>	TTGGTATGGGTCAGAGG
<i>PbACTIN R</i>	CTGTGAGCAGAACTGGGTG
<i>PbNRT2 F</i>	AAGATCATCGTGGTATGTTTGC
<i>PbNRT2 R</i>	GAAGGTGGAGAAGAAGTTGGAG

<i>PbNR</i> F	CCCACTCTGCGACTTGCTTA
<i>PbNR</i> R	AACCACTTCACCATCCGACC
<i>PbNiR</i> F	GCATTGACCCCCTCGAGATT
<i>PbNiR</i> R	TGAATCCGAACCTGCCATCC
<i>PbNADH-GOGAT</i> F	TAGAGGTTGGCGCTGCATAG
<i>PbNADH-GOGAT</i> R	CCACTTGTGTGCGTTCAAGG
<i>PbFd-GOGAT</i> F	CGGACTCTTCGTCGTCGATT
<i>PbFd-GOGAT</i> R	AGTGGCAATTCCTGGAGACG
<i>PbGILE</i> F	AGCAAAGCAAGGACTCTGCC
<i>PbGILE</i> R	AGCCCTCTTGTTGGTTGGAA
<i>PbGAI1a</i> F	TCCCTCCGAACCTCCTCTT
<i>PbGAI1a</i> R	GTAGCCGATCTGGGTCATC
