

Table S2. Details of 116 SNPs and their corresponding genes associated with four traits under NP and LP conditions.

S. No	Trait ^a	P level	Chr ^b	SNP ID	SNPs	MLM	MLM	CMLM	CMLM	Gene ID	Protein description
						<i>P</i> value	R ^{2c}	<i>P</i> value	R ^{2c}		
1	TDW	NP	11	S11_9561310	A/G	1.5×10^{-4}	17.36	1.5×10^{-4}	17.35	VRADI11G08620	Uncharacterized gene
2	TDW	NP	11	S11_7038391	T/G	1.8×10^{-4}	17.03	1.8×10^{-4}	17.02	VRADI11G06980	Isocitrate dehydrogenase [NAD] regulatory subunit 1, mitochondrial isoform X1
3	TDW	LP	7	S7_47267454	A/G	1.2×10^{-5}	19.43	1.2×10^{-5}	19.43	VRADI07G24040	5'-nucleotidase domain-containing protein 4
4	TDW	LP	3	S3_3615439	G/A	1.6×10^{-5}	18.98	1.5×10^{-5}	18.98	VRADI03G02610	Xyloglucan galactosyltransferase MUR3
5	TDW	LP	7	S7_48141848	C/T	4.0×10^{-5}	17.26	4.0×10^{-5}	17.26	VRADI07G24790	Calmodulin-binding transcription activator 5
6	TDW	LP	3	S3_3624245	A/T	6.5×10^{-5}	16.39	6.5×10^{-5}	16.39	VRADI03G02620	ABC transporter C family member 5
7	TDW	LP	3	S3_3624308	T/A	9.6×10^{-5}	15.69	9.6×10^{-5}	15.69	VRADI03G02620	ABC transporter C family member 6
8	TDW	LP	7	S7_51333983	C/T	1.0×10^{-4}	15.60	1.0×10^{-4}	15.60	VRADI07G27850	Leaf rust 10 disease-resistance locus receptor-like protein kinase-like 2.1
9	TDW	LP	3	S3_3624244	A/G	1.7×10^{-4}	14.65	1.7×10^{-4}	14.65	VRADI03G02620	ABC transporter C family member 6
10	TDW	LP	3	S3_3624311	A/G	1.7×10^{-4}	14.65	1.7×10^{-4}	14.65	VRADI03G02620	ABC transporter C family member 6
11	TDW	LP	9	S9_3206946	A/G	1.9×10^{-4}	14.44	1.9×10^{-4}	14.43	VRADI09G02970	Uncharacterized protein
12	TDW	LP	11	S11_9561310	A/G	2.3×10^{-4}	14.19	2.3×10^{-4}	14.19	VRADI11G08620	Uncharacterized protein
13	TDW	LP	8	S8_33521208	C/A	2.4×10^{-4}	14.10	2.4×10^{-4}	14.10	VRADI08G13810	Uncharacterized protein
14	TDW	LP	7	S7_46607147	T/C	3.1×10^{-4}	13.62	3.2×10^{-4}	13.62	VRADI07G23500	Pollen receptor-like kinase 3
15	TDW	LP/NP	11	S11_8384218	C/T	6.6×10^{-5}	13.64	6.7×10^{-5}	13.64	VRADI11G07980	Formin-like protein
16	TDW	LP/NP	4	S4_16220597	C/A	8.4×10^{-5}	13.20	8.5×10^{-5}	13.20	VRADI04G07960	Acyl-coenzyme A thioesterase 9, mitochondrial
17	TDW	LP/NP	4	S4_16220621	A/T	1.4×10^{-4}	12.32	1.4×10^{-4}	12.32	VRADI04G07960	Acyl-coenzyme A thioesterase 9, mitochondrial

18	TDW	LP/NP	8	S8_31751778	C/T	2.2×10^{-4}	11.47	2.2×10^{-4}	11.47	VRADI08G12260	Glycine-rich domain-containing protein 2
19	TDW	LP/NP	5	S5_36307747	C/T	2.3×10^{-4}	11.39	2.3×10^{-4}	11.39	VRADI05G23400	Uncharacterized protein
20	TDW	LP/NP	9	S9_13579483	C/A	2.9×10^{-4}	11.00	2.8×10^{-4}	11.00	VRADI09G08000	Chromatin modification-related protein EAF1 B isoform X1
21	PC	NP	6	S6_34944346	C/T	6.3×10^{-5}	16.95	6.3×10^{-5}	16.95	VRADI06G14930	Low-temperature-induced cysteine proteinase
22	PC	NP	7	S7_683831	A/G	9.3×10^{-5}	16.26	9.3×10^{-5}	16.26	VRADI07G00170	Uncharacterized protein
23	PC	NP	7	S7_18823250	C/A	1.0×10^{-4}	16.07	1.0×10^{-4}	16.07	VRADI07G07770	Uncharacterized protein
24	PC	NP	7	S7_18823383	T/C	1.0×10^{-4}	16.07	1.0×10^{-4}	16.07	VRADI07G07770	Uncharacterized protein
25	PC	NP	6	S6_34944402	G/A	1.2×10^{-4}	15.86	1.1×10^{-4}	15.86	VRADI06G14930	Low-temperature-induced cysteine proteinase
26	PC	NP	6	S6_34944356	T/C	1.2×10^{-4}	15.85	1.1×10^{-4}	15.85	VRADI06G14930	low-temperature-induced cysteine proteinase
27	PC	NP	7	S7_683888	A/G	1.3×10^{-4}	15.70	1.3×10^{-4}	15.70	VRADI07G00170	Uncharacterized protein
28	PC	NP	7	S7_683984	C/T	1.3×10^{-4}	15.70	1.3×10^{-4}	15.70	VRADI07G00170	Uncharacterized protein
29	PC	NP	6	S6_17915743	T/C	1.3×10^{-4}	15.64	1.3×10^{-4}	15.64	VRADI06G09020	Integrase core domain containing protein
30	PC	NP	8	S8_43013582	C/A	1.6×10^{-4}	15.33	1.5×10^{-4}	15.33	VRADI08G20910	E3 ubiquitin-protein ligase RHA2A
31	PC	NP	1	S1_9481841	G/C	1.6×10^{-4}	15.32	1.5×10^{-4}	15.32	VRADI01G06080	UDP-glycosyltransferase 708D1-like
32	PC	NP	8	S8_30169847	C/T	1.8×10^{-4}	15.13	1.7×10^{-4}	15.13	VRADI08G11310	Transcription factor bHLH140
33	PC	NP	6	S6_34944400	A/G	2.6×10^{-4}	14.48	2.5×10^{-4}	14.48	VRADI06G14930	Low-temperature-induced cysteine proteinase
34	PC	NP	6	S6_34944407	C/T	2.6×10^{-4}	14.48	2.5×10^{-4}	14.48	VRADI06G14930	Low-temperature-induced cysteine proteinase
35	PC	NP	6	S6_17915670	C/T	2.3×10^{-4}	14.28	2.9×10^{-4}	14.28	VRADI06G09020	Integrase core domain containing protein
36	PC	NP	9	S9_15071845	C/T	2.9×10^{-4}	14.24	2.9×10^{-4}	14.24	VRADI09G08490	Senescence associated gene 20
37	PC	NP	8	S8_44919758	G/A	3.1×10^{-4}	14.18	3.0×10^{-4}	14.18	VRADI08G22670	Beta-hexosaminidase
38	PC	NP	9	S9_15071806	C/T	3.1×10^{-4}	14.17	3.1×10^{-4}	14.17	VRADI09G08490	Senescence associated gene 20

39	PC	LP	9	S9_17743262	A/G	1.5×10^{-5}	19.93	1.5×10^{-5}	19.93	VRADI09G09030	Putative LRR receptor-like serine/threonine-protein kinase
40	PC	LP	1	S1_6743310	G/A	9.4×10^{-5}	16.66	9.4×10^{-5}	16.66	VRADI01G04370	Uncharacterized protein
41	PC	LP	5	S5_11740295	C/T	1.0×10^{-4}	16.52	1.0×10^{-4}	16.52	VRADI05G06040	Metallophos domain-containing protein
42	PC	LP	6	S6_4461309	T/C	1.3×10^{-4}	16.15	1.2×10^{-4}	16.15	VRADI06G03940	Heavy metal-associated isoprenylated plant protein 41-like
43	PC	LP	6	S6_4461289	A/G	1.5×10^{-4}	15.80	1.5×10^{-4}	15.80	VRADI06G03940	Heavy metal-associated isoprenylated plant protein 41-like
44	PC	LP	6	S6_4461200	G/A	1.5×10^{-4}	15.80	1.5×10^{-4}	15.80	VRADI06G03940	Heavy metal-associated isoprenylated plant protein 41-like
45	PC	LP	6	S6_4461398	T/C	1.5×10^{-4}	15.80	1.5×10^{-4}	15.80	VRADI06G03940	Heavy metal-associated isoprenylated plant protein 41-like
46	PC	LP	6	S6_4461191	G/C	1.7×10^{-4}	15.65	1.6×10^{-4}	15.65	VRADI06G03940	Heavy metal-associated isoprenylated plant protein 41-like
47	PC	LP	5	S5_11740306	A/C	1.8×10^{-4}	15.53	1.8×10^{-4}	15.53	VRADI05G06040	Metallophos domain-containing protein
48	PC	LP	10	S10_5782633	T/C	2.1×10^{-4}	15.25	2.1×10^{-4}	15.25	VRADI10G01990	Reverse transcriptase domain-containing protein
49	PC	LP	6	S6_4461373	T/A	2.8×10^{-4}	14.76	2.8×10^{-4}	14.76	VRADI06G03940	Heavy metal-associated isoprenylated plant protein 41-like
50	PC	LP	5	S5_11740502	T/C	2.9×10^{-4}	14.68	2.9×10^{-4}	14.68	VRADI05G06040	Metallophos domain-containing protein
51	PC	LP/NP	1	S1_2812576	G/C	1.5×10^{-4}	14.18	1.5×10^{-4}	14.18	VRADI01G01570	AAA-ATPase ASD, mitochondrial isoform X1
52	PC	LP/NP	1	S1_6743310	G/A	2.5×10^{-4}	13.26	2.5×10^{-4}	13.26	VRADI01G04370	Uncharacterized protein
53	TPU	NP	2	S2_18617115	C/T	1.9×10^{-4}	14.35	6.7×10^{-5}	16.34	VRADI02G10730	Albumin-1-like
54	TPU	NP	2	S2_18617136	G/A	1.4×10^{-4}	14.94	5.1×10^{-5}	16.84	VRADI02G10730	Albumin-1-like
55	TPU	NP	2	S2_21835373	C/T	2.2×10^{-4}	14.19	1.2×10^{-4}	15.43	VRADI02G11580	Glyco_hydro_18 domain-containing protein
56	TPU	NP	2	S2_2280085	T/A	2.7×10^{-4}	13.78	1.1×10^{-4}	15.43	VRADI02G02420	Uncharacterized protein

57	TPU	NP	2	S2_2280092	A/G	2.7×10^{-4}	13.78	1.1×10^{-4}	15.43	VRADI02G02420	Uncharacterized protein
58	TPU	NP	2	S2_2280143	T/C	2.7×10^{-4}	13.78	1.1×10^{-4}	15.43	VRADI02G02430	General transcription factor 3C polypeptide 3 isoform X3
59	TPU	NP	7	S7_13842360	A/G	5.2×10^{-5}	16.70	6.6×10^{-5}	16.36	VRADI07G06240	Zinc finger CCCH domain-containing protein 48-like
60	TPU	NP	7	S7_13842388	A/G	5.5×10^{-5}	16.61	8.1×10^{-5}	15.99	VRADI07G06240	Zinc finger CCCH domain-containing protein 48-like
61	TPU	NP	7	S7_13842524	A/G	1.7×10^{-4}	14.59	2.5×10^{-4}	14.05	VRADI07G06240	Zinc finger CCCH domain-containing protein 48-like
62	TPU	NP	7	S7_13842567	T/C	1.7×10^{-4}	14.59	2.5×10^{-4}	14.05	VRADI07G06240	Zinc finger CCCH domain-containing protein 48-like
63	TPU	LP	5	S5_11740295	C/T	2.8×10^{-5}	20.83	2.8×10^{-5}	20.83	VRADI05G06040	Metallophos domain-containing protein
64	TPU	LP	5	S5_11740306	A/C	2.9×10^{-5}	20.75	2.9×10^{-5}	20.74	VRADI05G06040	Metallophos domain-containing protein
65	TPU	LP	5	S5_11740502	T/C	4.7×10^{-5}	19.91	4.7×10^{-5}	19.91	VRADI05G06040	Metallophos domain-containing protein
66	TPU	LP	5	S5_11740255	A/G	5.6×10^{-5}	19.62	5.6×10^{-5}	19.62	VRADI05G06040	Metallophos domain-containing protein
67	TPU	LP	5	S5_11740269	G/A	5.6×10^{-5}	19.62	5.6×10^{-5}	19.62	VRADI05G06040	Metallophos domain-containing protein
68	TPU	LP	1	S1_5634511	G/T	2.0×10^{-4}	17.44	2.0×10^{-4}	17.44	VRADI01G03530	Protein DETOXIFICATION (Multi-drug and toxic compound extrusion protein)
69	TPU	LP	8	S8_133068	C/T	2.6×10^{-4}	17.00	2.6×10^{-4}	17.00	VRADI08G00070	Protein SIEVE ELEMENT OCCLUSION B
70	TPU	LP/NP	3	S3_7363529	G/C	8.5×10^{-5}	14.40	8.5×10^{-5}	14.40	VRADI03G05860	Pentatricopeptide repeat-containing protein At5g43790
71	TPU	LP/NP	2	S2_11102770	G/T	1.2×10^{-4}	13.71	1.2×10^{-4}	13.71	VRADI02G08530	Protein ACCELERATED CELL DEATH 6
72	TPU	LP/NP	5	S5_32030786	G/C	1.4×10^{-4}	13.55	1.3×10^{-4}	13.55	VRADI05G20860	Dof zinc finger protein DOF1.7

73	TPU	LP/NP	6	S6_30133081	G/A	2.6×10^{-4}	12.41	2.5×10^{-4}	12.41	VRADI06G12490	X8 domain-containing protein
74	TPU	LP/NP	2	S2_11102779	T/C	2.9×10^{-4}	12.20	2.9×10^{-4}	12.20	VRADI02G08530	Protein ACCELERATED CELL DEATH 6
75	PUtE	NP	8	S8_32561766	A/G	2.3×10^{-5}	17.80	2.3×10^{-5}	17.80	VRADI08G12960	Integrase catalytic domain-containing protein
76	PUtE	NP	9	S9_21006967	C/A	8.6×10^{-5}	15.45	8.6×10^{-5}	15.45	VRADI09G09940	BON1-associated protein 2-like
77	PUtE	NP	10	S10_12252438	A/C	1.8×10^{-4}	14.12	1.8×10^{-4}	14.12	VRADI10G05410	5'-3' exoribonuclease
78	PUtE	NP	6	S6_17915743	T/C	1.8×10^{-4}	14.10	1.8×10^{-4}	14.10	VRADI06G09020	Integrase core domain containing protein
79	PUtE	NP	6	S6_34944346	C/T	1.9×10^{-4}	13.99	1.9×10^{-4}	13.99	VRADI06G14930	Low-temperature-induced cysteine proteinase
80	PUtE	NP	6	S6_30983897	C/T	2.1×10^{-4}	13.84	2.1×10^{-4}	13.84	VRADI06G12840	Uncharacterized protein
81	PUtE	NP	10	S10_11990678	T/C	2.1×10^{-4}	13.83	2.1×10^{-4}	13.83	VRADI10G05220	Coiled-coil domain-containing protein SCD2
82	PUtE	NP	1	S1_28485909	G/A	2.4×10^{-4}	13.65	2.3×10^{-4}	13.65	VRADI01G12780	Retrovirus-related Pol polyprotein from transposon TNT 1-94
83	PUtE	NP	6	S6_17915670	C/T	2.8×10^{-4}	13.40	2.7×10^{-4}	13.40	VRADI06G09020	Integrase core domain containing protein
84	PUtE	NP	6	S6_34944402	G/A	3.1×10^{-4}	13.20	3.0×10^{-4}	13.20	VRADI06G14930	Low-temperature-induced cysteine proteinase
85	PUtE	LP	4	S4_17488574	C/T	9.5×10^{-6}	21.01	9.5×10^{-6}	21.01	VRADI04G08810	Pentatricopeptide repeat-containing protein At2g36730
86	PUtE	LP	4	S4_17488583	A/G	9.5×10^{-6}	21.01	9.5×10^{-6}	21.01	VRADI04G08810	Pentatricopeptide repeat-containing protein At2g36730
87	PUtE	LP	4	S4_17488674	A/G	9.5×10^{-6}	21.01	9.5×10^{-6}	21.01	VRADI04G08810	Pentatricopeptide repeat-containing protein At2g36730
88	PUtE	LP	4	S4_17488573	G/A	9.5×10^{-6}	21.01	9.5×10^{-6}	21.01	VRADI04G08810	Pentatricopeptide repeat-containing protein At2g36730
89	PUtE	LP	11	S11_16028642	G/C	4.7×10^{-5}	18.15	4.6×10^{-5}	18.15	VRADI11G11050	Peptidyl-prolyl cis-trans isomerase (PPIase) (EC 5.2.1.8)
90	PUtE	LP	4	S4_16440852	T/G	5.7×10^{-5}	17.79	5.7×10^{-5}	17.79	VRADI04G08160	ELMO domain-containing protein

91	PUtE	LP	1	S1_22150358	A/G	6.6×10^{-5}	17.53	6.6×10^{-5}	17.53	VRADI01G11390	PXMP2/4 family protein 4-like
92	PUtE	LP	5	S5_24885881	G/A	6.9×10^{-5}	17.46	6.9×10^{-5}	17.46	VRADI05G16000	Uncharacterized protein
93	PUtE	LP	1	S1_22150422	G/A	8.3×10^{-5}	17.12	8.3×10^{-5}	17.12	VRADI01G11390	PXMP2/4 family protein 4-like
94	PUtE	LP	1	S1_22150353	C/T	8.4×10^{-5}	17.11	8.4×10^{-5}	17.11	VRADI01G11390	PXMP2/4 family protein 4-like
95	PUtE	LP	6	S6_32286556	A/T	8.8×10^{-5}	17.03	8.7×10^{-5}	17.03	VRADI06G13450	Histone-lysine N-methyltransferase
96	PUtE	LP	11	S11_16028669	C/T	8.8×10^{-5}	17.03	8.8×10^{-5}	17.03	VRADI11G11050	Peptidyl-prolyl cis-trans isomerase (PPIase)
97	PUtE	LP	5	S5_25069630	G/A	8.9×10^{-5}	17.01	8.8×10^{-5}	17.01	VRADI05G16200	Uncharacterized protein
98	PUtE	LP	6	S6_32286560	G/C	1.2×10^{-4}	16.43	1.2×10^{-4}	16.43	VRADI06G13450	Histone-lysine N-methyltransferase
99	PUtE	LP	1	S1_22150401	T/C	1.3×10^{-4}	16.28	1.3×10^{-4}	16.28	VRADI01G11390	PXMP2/4 family protein 4-like
100	PUtE	LP	11	S11_9958454	T/C	1.4×10^{-4}	16.19	1.4×10^{-4}	16.19	VRADI11G08830	Protein TORNADO 2
101	PUtE	LP	11	S11_9958495	T/A	1.4×10^{-4}	16.19	1.4×10^{-4}	16.19	VRADI11G08830	Protein TORNADO 2
102	PUtE	LP	11	S11_9958533	C/T	1.4×10^{-4}	16.19	1.4×10^{-4}	16.19	VRADI11G08830	Protein TORNADO 2
103	PUtE	LP	7	S7_33036625	T/G	2.3×10^{-4}	15.35	2.3×10^{-4}	15.35	VRADI07G13830	Protein EXECUTER 1, chloroplastic
104	PUtE	LP	8	S8_29032405	A/C	2.5×10^{-4}	15.24	2.4×10^{-4}	15.24	VRADI08G10870	Beta-carotene isomerase D27, chloroplastic
105	PUtE	LP	1	S1_6743310	G/A	2.5×10^{-4}	15.19	2.5×10^{-4}	15.19	VRADI01G04370	Uncharacterized protein
106	PUtE	LP	6	S6_28898687	C/T	2.9×10^{-4}	14.98	2.8×10^{-4}	14.98	VRADI06G12000	GTPase-activating protein gyp7 isoform X1
107	PUtE	LP	6	S6_29372894	C/T	2.9×10^{-4}	14.93	2.9×10^{-4}	14.93	VRADI06G12170	Centromere-associated protein E isoform X1
108	PUtE	LP/NP	1	S1_2812576	G/C	2.3×10^{-4}	13.80	2.4×10^{-4}	15.24	VRADI01G01570	AAA-ATPase ASD, mitochondrial isoform X1
109	PUtE	LP/NP	2	S2_11102770	G/T	1.1×10^{-4}	15.07	1.5×10^{-4}	16.08	VRADI02G08530	Protein ACCELERATED CELL DEATH 6
110	PUtE	LP/NP	2	S2_11102779	T/C	1.9×10^{-4}	14.19	2.1×10^{-4}	15.47	VRADI02G08530	Protein ACCELERATED CELL DEATH 6
111	PUtE	LP/NP	2	S2_709681	G/T	2.2×10^{-4}	13.92	2.2×10^{-4}	15.43	VRADI02G00720	Vacuolar fusion protein CCZ1 homolog B isoform X1
112	PUtE	LP/NP	5	S5_24885881	G/A	2.4×10^{-4}	13.79	2.7×10^{-4}	15.06	VRADI05G16000	Uncharacterized protein

113	PUtE	LP/NP	5	S5_33286862	C/G	1.5×10^{-4}	14.61	2.4×10^{-4}	15.29	<i>VRADI05G21880</i>	NAC domain-containing protein 7
114	PUtE	LP/NP	6	S6_28898687	C/T	8.9×10^{-5}	15.50	1.3×10^{-4}	16.35	<i>VRADI06G12000</i>	GTPase-activating protein gyp7 iso-form X1
115	PUtE	LP/NP	6	S6_32286556	A/T	5.3×10^{-5}	16.45	7.9×10^{-5}	17.20	<i>VRADI06G13450</i>	Histone-lysine N-methyltransferase
116	PUtE	LP/NP	6	S6_32286560	G/C	6.6×10^{-5}	16.06	9.7×10^{-5}	16.85	<i>VRADI06G13450</i>	Histone-lysine N-methyltransferase

^a Traits investigated in the study; TDW, total dry weight; PC, P concentration; TPU, total P uptake; PUtE, P utilization efficiency

^b Chr, chromosome

^c Percentage of phenotypic variation explained by SNP