

Table 1 Suppl. The accession numbers of ABC transporters from wheat, *Arabidopsis*, and rice. Sequence identifier followed by amino acid sequence as reported by *IWGSC* (Mayer *et al.* 2014) [GenBank in *NCBI*, *IWGSC* (www.wheatgenome.org)].

Gene	GenBank	Sequence identifier
Lr34	ADK62371.1	
TaPDR1	ACL80650.1	
TaMDR1	BAB85651.1	
TaMRP1	AAL47686.1	
TaABCC1		Traes_2AL_0A38A0EFC.1
TaABCC2		Traes_3AL_D19BE3FD1.1
TaABCC3		Traes_3B_9A61DFBAA.1
TaABCC4		Traes_3B_292E8BD00.1
TaABCC5		Traes_1BL_D21E2A0BE.1
TaABCC6		Traes_2AL_2F9F6DB1A.1
TaABCC7		Traes_2BL_6FFD5A5E0.1 unnamed protein
TaABCC8		Traes_5BL_D71543428.1
TaABCC9		Traes_2BS_C52A9FD78.1
TaABCC10		Traes_2DS_1E247C42B.1
TaABCC11		Traes_7DL_A95F658D8.1
TaABCC12		Traes_7DS_B65B5CD47.1
TaABCC13		Traes_5AL_FA71552A8.1
TaABCC14		Traes_3B_74B89A214.1
TaABCC15		Traes_7AS_8CC30284A.1
TaABCC16		Traes_7AS_8CC30284A.2 unnamed protein
TaABCC17		Traes_7AS_86392D8DF.1

Table 2 Suppl. The accession numbers of 108 ABC transporters from rice [Locus ID in *RGAP* (<http://rice.plantbiology.msu.edu/>)].

Subfamilies	New systematic name	Synonyms	RAPDB locus	cDNA accession
Subfamily A	OsABCA1		Os02g0211000	-
	OsABCA2		Os06g0589300	AK065426
	OsABCA3		Os08g0398000	AK101910
	OsABCA4		Os08g0398300	AK122145
	OsABCA5		Os08g0398350	-
Subfamily B	OsABCB1	OsMDR4	Os01g0290700	AK058263
	OsABCB2	OsMDR6	Os01g0533900	AK106698
	OsABCB3	OsMDR5	Os01g0534700	-
	OsABCB4	OsMDR9	Os01g0695700	-
	OsABCB5	OsMDR7	Os01g0695800	AK108373
	OsABCB6	OsMDR8	Os01g0696600	AK111341
	OsABCB7	OsMDR17	Os01g0723800	AK061902
	OsABCB8	OsMDR10	Os01g0976100	AK069646
	OsABCB9		Os02g0190300	AK287504
	OsABCB10		Os02g0323000	AK064221
	OsABCB11	OsMDR11	Os02g0693700	AK106518
	OsABCB12		Os03g0181700	-
	OsABCB13		Os03g0280000	AK120269
	OsABCB14	OsMDR13	Os04g0459000	AK103526
	OsABCB15	OsMDR1 OsMDR2	Os04g0481700	AK107554
	OsABCB16	OsMDR12	Os04g0642000	AK069342
	OsABCB18		Os05g0548300	AK109784
	OsABCB19		Os05g0548500	-
	OsABCB20	OsMDR15	Os08g0153000	-
	OsABCB21	OsMDR16	Os08g0153200	-
	OsABCB22	OsMDR14	Os08g0564300	AK063134
	OsABCB23		Os06g0128300	AK102879
	OsABCB24		Os01g0911300	AK058462
	OsABCB25		Os03g0755100	AK066049
	OsABCB26		Os07g0464600	AK067140
	OsABCB27		Os04g0413000	-
Subfamily C	OsABCC1	OsMRP1	Os04g0620000	AK240686
	OsABCC2	OsMRP2	Os01g0902100	-
	OsABCC3	OsMRP3	Os01g0173900	AK121690
	OsABCC4	OsMRP4	Os02g0288733	-
	OsABCC5	OsMRP5	Os02g0288400	-
	OsABCC6	OsMRP6	Os04g0588600	-
	OsABCC7	OsMRP7	Os04g0588700	AK099941
	OsABCC8	OsMRP8ab	Os01g0356000	AK242094
	OsABCC9	OsMRP9	Os04g0209200	AK100406
	OsABCC10	OsMRP10	Os04g0209300	AK120122
	OsABCC11	OsMRP11	Os06g0561800	-
	OsABCC12	OsMRP12	Os06g0184700	-
	OsABCC13	OsMRP13	Os03g0142800	AK121451
	OsABCC14	OsMRP14	Os05g0196100	AK240722
	OsABCC15	OsMRP15	Os06g0158900	-
	OsABCC16	OsMRP16	Os11g0155600	AK065863
	OsABCC17	OsMRP17	Os12g0562700	-
Subfamily D	OsABCD1		Os01g0218700	AK064992
	OsABCD2		Os01g0966100	-
	OsABCD3		Os05g0107600	AK120821
Subfamily E	OsABCE1		Os02g0282900	AK121560
	OsABCE2		Os11g0546000	AK103366
Subfamily F	OsABCF1		Os02g0826500	AK099841
	OsABCF2		Os03g0441500	AK060827
	OsABCF3		Os04g0658400	-
	OsABCF4		Os08g0564100	AK063258
	OsABCF5		Os09g0572400	AK069041
	OsABCF6		Os11g0603200	AK059060
Subfamily G	OsABCG1		Os01g0121600	AK243657
	OsABCG2		Os01g0615500	-

OsABCG3		Os01g0836600	AK067556
OsABCG4		Os03g0157400	AK066035
OsABCG5		Os03g0281900	AK072135
OsABCG6		Os03g0282100	-
OsABCG7		Os03g0859500	AK070637
OsABCG8		Os04g0194500	AK121164
OsABCG9		Os04g0528300	AK058387
OsABCG10		Os05g0120000	-
OsABCG11		Os05g0120200	AK287932
OsABCG12		Os05g0222200	AK068591
OsABCG13		Os05g0384600	
OsABCG14		Os06g0503100	AK105826
OsABCG15		Os06g0607700	AK106792
OsABCG16		Os06g0731200	AK071489
OsABCG17		Os07g0288700	AK100175
OsABCG18		Os08g0167000	AK243528
OsABCG19		Os09g0125900	AK065634
OsABCG20		Os09g0250800	-
OsABCG21		Os09g0401100	-
OsABCG22		Os09g0472100	AK120390
OsABCG23		Os09g0472200	-
OsABCG24		none	-
OsABCG25		Os10g0442900	-
OsABCG26		Os10g0494300	AK072452
OsABCG27		Os11g0177400	AK120669
OsABCG28		Os11g0416900	AK069444
OsABCG29		Os12g0409700	-
OsABCG30		Os12g0411700	AK067639
OsABCG31	OsPDR6	Os01g0177900	AK058355
OsABCG32	OsPDR16	Os01g0342700	-
OsABCG33	OsPDR14	Os01g0516800	-
OsABCG34	OsPDR10	Os01g0609066	-
OsABCG35	OsPDR11	Os01g0609200	-
OsABCG36	OsPDR9	Os01g0609300	AK100135
OsABCG37	OsPDR8	Os01g0609900	AK065988
OsABCG38	OsPDR15	Os01g0724500	AK067653
OsABCG39	OsPDR7	Os02g0208300	AK073104
OsABCG40	OsPDR4	Os02g0318500	-
OsABCG41	OsPDR2	Os02g0528900	AK105293
OsABCG42	OsPDR12	Os06g0554800	AK058448
OsABCG43	OsPDR5	Os07g0522500	AK105311
OsABCG44	OsPDR17	Os08g0384500	AK100858
OsABCG45	OsPDR1	Os08g0544400	-
OsABCG46	OsPDR21	Os09g0332360	-
OsABCG47	OsPDR19	Os09g0333000	-
OsABCG48	OsPDR3	Os11g0587600	AK121517
OsABCG49	OsPDR22	Os12g0239900	AK107869

Table 3 Suppl. The accession numbers of 106 ABC transporters from *Arabidopsis* [AGI code in *TAIR* (<http://arabidopsis.org/Blast/>)].

Subfamilies	New systematic name	Name in Sánchez-Fernández	Synonyms	AGI code
Subfamily A	AtABCA2	AtATH1		At3g47730.1
	AtABCA3	AtATH2		At3g47740.1
	AtABCA4	AtATH3		At3g47750.1
	AtABCA5	AtATH4		At3g47760.1
	AtABCA6	AtATH5		At3g47770.1
	AtABCA7	AtATH6		At3g47780.1
	AtABCA8	AtATH7		At3g47790.1
	AtABCA9	AtATH11		At5g61730.1
	AtABCA10	AtATH14		At5g61740.1
	AtABCA11	AtATH15		At5g61690.1
	AtABCA12	AtATH16		At5g61700.1
Subfamily B	AtABCB1	AtMDR1	AtPGP1	At2g36910.1
	AtABCB2	AtMDR2	AtPGP2	At4g25960.1
	AtABCB3	AtMDR3	AtPGP3	At4g01820.1
	AtABCB4	AtMDR4	AtPGP4	At2g47000.1
	AtABCB5	AtMDR5	AtPGP5	At4g01830.1
	AtABCB6	AtMDR6	AtPGP6	At2g39480.1
	AtABCB7	AtMDR7	AtPGP7	At5g46540.1
	AtABCB9	AtMDR9	AtPGP9	At4g18050.1
	AtABCB10	AtMDR10	AtPGP10	At1g10680.1
	AtABCB11	AtMDR8	AtPGP11	At1g02520.1
	AtABCB12	AtMDR16	AtPGP12	At1g02530.1
	AtABCB13	AtMDR15	AtPGP13	At1g27940.1
	AtABCB14	AtMDR12	AtPGP14	At1g28010.1
	AtABCB15	AtMDR13	AtPGP15	At3g28345.1
	AtABCB16	AtMDR18	AtPGP16	At3g28360.1
	AtABCB17	AtMDR19	AtPGP17	At3g28380.1
	AtABCB18	AtMDR20	AtPGP18	At3g28390.1
	AtABCB19	AtMDR11	AtPGP19 AtMDR1	At3g28860.1
	AtABCB20	AtMDR14	AtPGP20	At3g55320.1
	AtABCB21	AtMDR17	AtPGP21	At3g62150.1
	AtABCB22	AtMDR21	AtPGP22	At3g28415.1
	AtABCB23	AtATM1	STA2	At4g28630.1
	AtABCB24	AtATM2		At4g28620.1
	AtABCB25	AtATM3	STA1	At5g58270.1
	AtABCB26	AtTAP1		At1g70610.1
	AtABCB27	AtTAP2	ALS1	At5g39040.1
	AtABCB28_1 AtABCB28_2	AtNAP8		At4g25450.1
	AtABCB28_3			At4g25450.2
				At4g25450.3
	AtABCB29	AtATH12		At5g03910.1
Subfamily C	AtABCC1_1 AtABCC1_2	AtMRP1	AtMRP1	At1g30400.1
				At1g30400.2
	AtABCC2	AtMRP2	AtMRP2	At2g34660.1
	AtABCC3_1 AtABCC3_2	AtMRP3	AtMRP3	At3g13080.1
	AtABCC3_3			At3g13080.2
				At3g13080.3
	AtABCC4	AtMRP4	AtMRP4	At2g47800.1
	AtABCC5	AtMRP5	AtMRP5	At1g04120.1
	AtABCC6	AtMRP8	AtMRP6	At3g13090.1
	AtABCC7	AtMRP7	AtMRP7	At3g13100.1
	AtABCC8	AtMRP6	AtMRP8	At3g21250.1
	AtABCC9	AtMRP9	AtMRP9	At3g60160.1
	AtABCC10	AtMRP14	AtMRP10	At3g59140.1
	AtABCC11	AtMRP12	AtMRP11	At1g30420.1
	AtABCC12	AtMRP13	AtMRP12	At1g30410.1
	AtABCC13	AtMRP11	AtMRP13	At2g07680.1
	AtABCC14	AtMRP10	AtMRP14	At3g62700.1
	AtABCC15	AtMRP15	AtMRP15	At3g60970.1
Subfamily D	AtABCD1	AtPMP2	AtPXA1	At4g39850.1
			CTS	

			PED3 ACN2	
	AtABCD2	AtPMP1		At1g54350.1
Subfamily E	AtABCE1	AtRLI1	AthaRLI1	At3g13640.1
	AtABCE2	AtRLI2	AthaRLI2	At4g19210.1
Subfamily F	AtABCF1	AtGCN1		At5g60790.1
	AtABCF2	AtGCN2		At5g09930.1
	AtABCF3	AtGCN3		At1g64550.1
	AtABCF4	AtGCN4		At3g54540.1
	AtABCF5	AtGCN5		At5g64840.1
Subfamily G	ABCG1	AtWBC1		At2g39350.1
	ABCG2	AtWBC2		A2g37360.1
	ABCG3	AtWBC3		At2g28070.1
	ABCG4	AtWBC4		At4g25750.1
	ABCG5	AtWBC5		At2g13610.1
	ABCG6	AtWBC6		At5g13580.1
	ABCG7_1	AtWBC7		At2g01320.1
	ABCG7_2			At2g01320.2
	ABCG7_3			At2g01320.3
	ABCG7_4			At2g01320.4
	ABCG8	AtWBC8		At5g52860.1
	ABCG9	AtWBC9		At4g27420.1
	ABCG10	AtWBC10		At1g53270.1
	ABCG11	AtWBC11	COF1, DSO, CER5	At1g17840.1
	ABCG12	AtWBC12,		At1g51500.1
	ABCG13	AtWBC13		At1g51460.1
	ABCG14	AtWBC14		At1g31770.1
	ABCG15	AtWBC15		At3g21090.1
		AtWBC22		
	ABCG16	AtWBC16		At3g55090.1
	ABCG17	AtWBC17		At3g55100.1
	ABCG18	AtWBC18		At3g55110.1
	ABCG19	AtWBC19		At3g55130.1
	ABCG20	AtWBC20		At3g53510.1
	ABCG21	AtWBC21		At3g25620.1
	ABCG22_1	ABCG22_2		At5g06530.1
	ABCG22_3	AtWBC23		At5g06530.2
				At5g06530.3
	ABCG23	AtWBC24		At5g19410.1
	ABCG24	AtWBC25		At1g53390.1
	ABCG25	AtWBC26		At1g71960.1
	ABCG26	AtWBC27		At3g13220.1
	ABCG27	AtWBC28		At3g52310.1
	ABCG28	AtWBC29		At5g60740.1
	ABCG29	AtPDR1	AtPDR1	At3g16340.1
	ABCG30	AtPDR2	AtPDR2	At4g15230.1
	ABCG31	AtPDR3	AtPDR3	At2g29940.1
	ABCG32	AtPDR4	AtPDR4	At2g26910.1
	ABCG33	AtPDR5	AtPDR5	At2g37280.1
	ABCG34	AtPDR6	AtPDR6	At2g36380.1
	ABCG35	AtPDR7	AtPDR7	At1g15210.1
	ABCG36	AtPDR8	AtPDR8	At1g59870.1
			PEN 3	
	ABCG37	AtPDR9	AtPDR9 (AtPDR12)	At3g53480.1
	ABCG38	AtPDR10	AtPDR10	At3g30842.1
	ABCG39	AtPDR11/ AtPDR13	AtPDR11	At1g66950.1
	ABCG40	AtPDR12	AtPDR12 (AtPDR9)	At1g15520.1
	ABCG41		AtPDR13	At4g15215.1
	ABCG42		AtPDR14	At4g15233.1
	ABCG43		AtPDR15	At4g15236.1

Table 4 Suppl. Primers of 13 *ABC* genes and *ACT* used for real time qPCR analysis.

Gene name	Forward primer	Reverse primer
<i>TpABCA3</i>	F: CAATCAAGTCGGTAGCAGAACA	R: CCAATTAGAGCAATCGCAACAC
<i>TpABCA4</i>	F: ATTAAGGAGATTGCGACACTAAGC	R: GGAAACATTGACGGGAAGAGAG
<i>TpABCB13</i>	F: GCACAGCACGAGCAATAGAA	R: CAGATAGAAGAAGCAGCCAAGAC
<i>TpABCB26</i>	F: GTCGTTTCTCGCCACCAAA	R: CCTCATAGTCTCTGTCTCCGTAAT
<i>TpABCC1</i>	F: CTCAGAAAGGCAACTCAATGTATGT	R: CCAACGAGCAGAGAATCAGAAG
<i>TpABCC9</i>	F: TCCGCTTCTGCTATTGAACATT	R: GGTGCCTTGGTTACTCCTTC
<i>TpABCD1</i>	F: AGAAGATAGACCAACCGAACATTC	R: GGAGGAAGCAGAGATGAAGATTC
<i>TpABCD2</i>	F: CCAGCCTAACAACCTCAAGT	R: CAGATACGCATCAGTCACCAA
<i>TpABCE2</i>	F: CAATTCAAGGTCAACGCACAG	R: GCAATCATCAAGCCACAGTATG
<i>TpABCF4</i>	F: AGACGCCACAACCACTA	R: GCTCTCATCTTCTCCTCTTCATTC
<i>TpABCF6</i>	F: AAGTTACAACGACCAAGGAGAC	R: CGAGCAGAATCAGGCAGAAG
<i>TpABCG8</i>	F: GCCAGACCACTACATTGACATT	R: CCAGACATTGAGCGGTTGAT
<i>TpABCG42</i>	F: ATATGCCATTGCTCAGGTTGTC	R: CGTAGTAGGTGAAGTAGAGGAAGG
<i>ACT</i>	F: CCGATTGCTTGTTATCTGTT	R: GAGGATGAAGACGAGAGTTT

Table 5 Suppl. The gene names, accession numbers, groups and genomic information and overlapping genes for the 30 *TpABC* genes.

Gene name	Accession number	Group	Overlapping gene (s)	Chromosomal location
TpABCA3	KU860103	Subfamily A	Traes_1AL_AAB83FA9B	1AL,1BL,1DL
TpABCA4	KU860104		Traes_1BL_2964F774E Traes_1DL_56C09DCA8 Traes_1AL_3564C0828 Traes_1BL_9FCB31A4D Traes_1DL_A6FE85E09	1AL,1BL,1DL
TpABCB1	KU860105	Subfamily B	Traes_1AS_3610062CB Traes_1BS_6C40DD844 Traes_1DS_9C041C718	1AS, 1BS,1DS
TpABCB7	KU860106		Traes_3AL_EF19996B2 Traes3BF048900170CFD_g Traes_3DL_47DECD49E	3AL, 3B, 3DL
TpABCB13	KU860107		Traes_4AS_0852A882E Traes_4BL_8A8D56D7B Traes_4DL_14327AF39	4AS,4BL,4DL
TpABCB14	KU860108		Traes_2AL_CB95E606C Traes_2BL_05498B97F Traes_2DL_E566C63F1	2AL,2BL,2DL
TpABCB24	KU860109		Traes_3AL_32C9EEC67 Traes3BF066400030CFD_g Traes_3DL_0253F1D11	3AL,3B,3DL
TpABCB25	KU860110		Traes_5AL_6A2992B63 Traes_5BL_D22690682 Traes_5DL_3EFE422D4	5AL,5BL,5DL
TpABCB26	KU860111		Traes_7AL_D94EE789C Traes_7BL_A7D3D1B41 Traes_7DL_E29468A4B	7AL,7BL,7DL
TpABCB27	KU860112		Traes_2AL_DC1F10E33 Traes_2BL_C4457E395 Traes_2DL_71A41640C	2AL,2BL,2DL
TpABCC1	KU860113	Subfamily C	Traes_2AL_0A38A0EFC Traes_2BL_2E1918E7F Traes_2DL_5F40C7E14	2AL,2BL,2DL
TpABCC3	KU860114		Traes_3AS_FD018268B Traes3BF066100080CFD_g Traes_4AS_53C6E4470	3AS, 3B, 4AS
TpABCC7	KU860115		Traes_2AL_2F9F6DB1A Traes_2BL_6FED5A5E0 Traes_2DL_E79ECCBC9	2AL,2BL,2DL
TpABCC8	KU860116		Traes_5AL_81602ECE9 Traes_5BL_D71543428 Traes_5DL_7514D124D	5AL,5BL,5DL
TpABCC9	KU860117		Traes_2AS_FE3FAFAE1 Traes_2BS_C52A9FD78 Traes_2DS_44A7F70FB	2AS,2BS, 2DS
TpABCC13	KU860118		Traes_5AL_FA71552A8 Traes_4BL_7091749BF Traes_4DL_B138DF6FC	5AL,4BL,4DL
TpABCD1	KU860119	Subfamily D	Traes_3AL_68C8F32D8 Traes3BF040600070CFD_g Traes_3DL_BE78029A	3AL, 3B, 3DL
TpABCD2	KU860120		Traes_3AS_B7FEC8871 Traes_3B_52F31A4E4 Traes_3DS_941A6AEFA	3AS, 3B, 3DS
TpABCE2	KU860121	Subfamily E	Traes_4AS_F238AFB04 Traes_4BS_B5519C4BF Traes_4DL_82BC827A6	4AS,4BS,4DL
TpABCF1	KU860122	Subfamily F	Traes_6AL_5E2427983 Traes_6BL_CED3DB508 Traes_6DL_EB9C728A7	6AL,6BL,6DL

TpABCF4	KU860123	Subfamily G	Traes_7AS_961F1236B Traes_7BS_3FE10DB62 Traes_7DL_3E7FAB7C0	7AS,7BS,7DL
TpABCF6	KU860124		Traes_4AS_63DC21A39 Traes_4BS_E811DB673 Traes_4DS_5BBCE1A2A	4AS,4BS,4DS
TpABCG1	KU860125		Traes_3AS_BB185F2EB Traes_3B_77C6EE076 Traes_3DS_6774BF63A	3AS, 3B, 3DS
TpABCG5	KU860126		Traes_4AS_D81176DF4 Traes_5BS_1274C6AC8 Traes_5DS_1749A7DF2	4AS,5BS,5DS
TpABCG7	KU860127		Traes_4AL_F1CD6BBBC Traes_5BL_CB26F3E25 Traes_5DL_3BFBC7706	4AL,5BL,5DL
TpABCG8	KU860128		Traes_2AS_537A8D6B5 Traes_2BS_C57F7F3AD Traes_2DS_A8B23EC52	2AS,2BS, 2DS
TpABCG9	KU860129		Traes_2AL_A63E7E7D1 Traes_2BL_A77ABD51C Traes_2DL_BEFA5F419	2AL,2BL,2DL
TpABCG12	KU860130		Traes_1AS_EB5297361 Traes_1BS_A4FD92A76 Traes_1DS_0176B897D	1AS,1BS, 1DS
TpABCG37	KU860131		Traes_2AL_FAA384931 Traes3BF083100030CFD_g Traes_3DL_920C6D20E	2AL, 3B, 3DL
TpABCG42	KU860132		Traes_7AL_7BD10B6C7 Traes_7BL_E4BC8AB8B Traes_7DL_63530C8FA	7AL,7BL,7DL

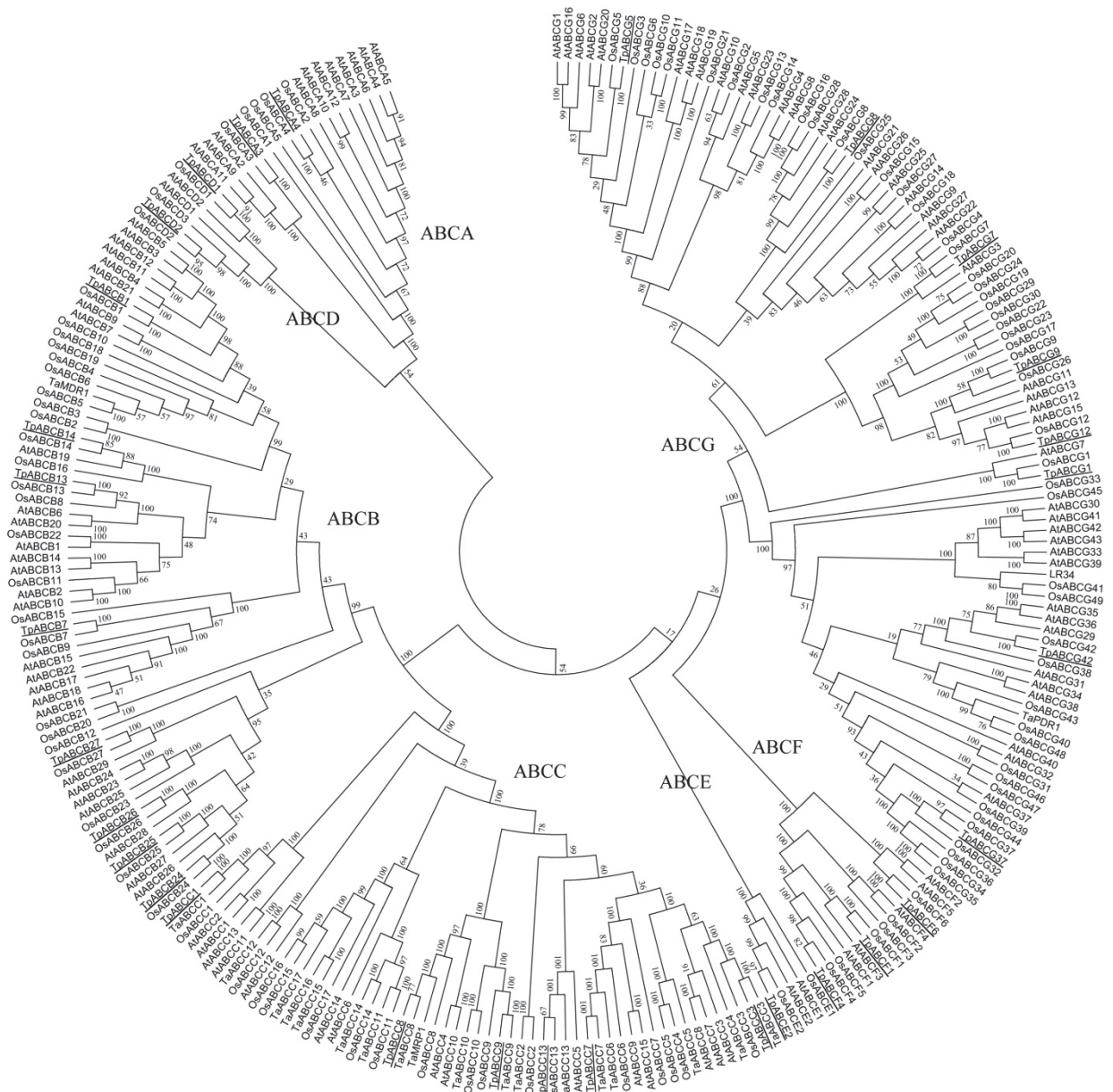


Fig. 1 Suppl. Phylogenetic relationship of 30, 21, 106, and 108 ABC genes in DPW, hexaploid wheat, *Arabidopsis*, and rice, respectively. The straight lines show the new 30 ABC transporters of DPW.

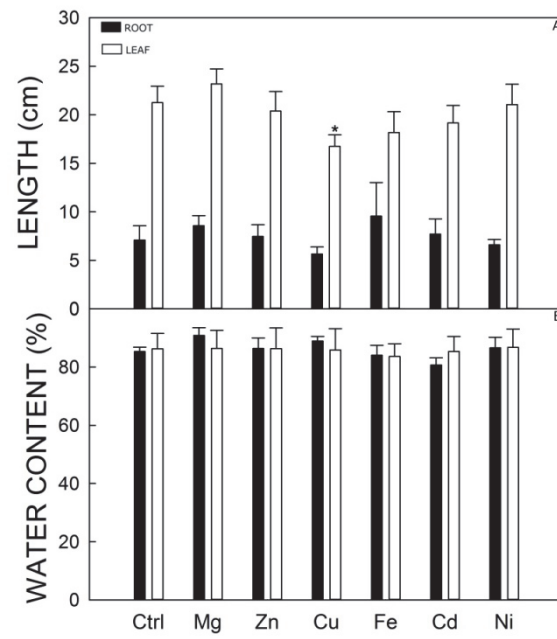


Fig. 3 Suppl. The length (A) and water contents (B) of roots and leaves of control plants and plants treated with different metals. Means $\pm$ SDs, $n = 3$, * - significant differences at $P \leq 0.05$.