

Supplementary Material

Phylogenetic, structural, functional characterisation and effect of exogenous spermidine on rice (*Oryza sativa*) HAK transporters under salt stress

Jayita Saha^{A,B,*}, Dwaipayan Chaudhuri^B, Anirban Kundu^C, Saswati Bhattacharya^D, Sudipta Roy^E, and Kalyan Giri^{B,*}

^ADepartment of Botany, Rabindra Mahavidyalaya, Champadanga, Hooghly, West Bengal, India.

^BDepartment of Life Sciences, Presidency University, 86/1 College Street, Kolkata 700073, West Bengal, India.

^CPlant Genomics and Bioinformatics Laboratory, P.G. Department of Botany, Ramakrishna Mission Vivekananda Centenary College (Autonomous), Rahara, Kolkata 700118, West Bengal, India.

^DDepartment of Botany, Dr. A.P.J. Abdul Kalam Government College, New Town, Rajarhat, Kolkata, West Bengal, India.

^EDepartment of Botany, University of Kalyani, Kalyani, Nadia, West Bengal, India.

*Correspondence to: Jayita Saha Department of Botany, Rabindra Mahavidyalaya, Champadanga, Hooghly, West Bengal, India Email: ijayita@gmail.com; Kalyan Giri Department of Life Sciences, Presidency University, 86/1 College Street, Kolkata 700073, West Bengal, India Email: kalyan.dbs@presiuniv.ac.in

Supplementary Table S1: List of plant name, gene name and Locus IDs of HAK transporters.

Plant Name	Gene Name	Locus ID
<i>Arabidopsis thaliana</i>	AtKUP1/AtKT1	At2g30070
	AtKUP2/AtKT2	At2g40540
	AtKUP4/AtKT3/AtTRH1	At4g23640
	AtKUP3/AtKT4	At3g02050
	AtKUP5/AtKT5	At4g33530
	AtHAK5	At4g13420
	AtKUP6/AtKT6/AtHAK6	At1g70300
	AtKUP7/AtKT7/AtHAK7	At5g09400
	AtKUP8/AtKT8/AtHAK8	At5g14880
	AtKUP9/AtKT9/AtHAK9	At4g19960
	AtKUP10/AtKT10/AtHAK10	At1g31120
	AtKUP11/AtKT11/AtHAK11	At2g35060
AtKUP12/AtKT12/AtHAK12	At1g60160	
<i>Musa acuminata</i>	MaHAK1	GSMUA_Achr8T15870
	MaHAK2	GSMUA_Achr4T33190
	MaHAK3	GSMUA_Achr7T12380
	MaHAK4	GSMUA_Achr3T23510
	MaHAK5	GSMUA_Achr8T10010
	MaHAK6	GSMUA_Achr11T18160
	MaHAK7	GSMUA_Achr5T00220
	MaHAK8	GSMUA_Achr3T06140
	MaHAK9	GSMUA_Achr11T24920
	MaHAK10	GSMUA_Achr8T07030
	MaHAK11	GSMUA_Achr1T09670
	MaHAK12	GSMUA_Achr8T33490
	MaHAK13	GSMUA_Achr5T07370
	MaHAK14	GSMUA_Achr10T05360
	MaHAK15	GSMUA_Achr7T20040
	MaHAK16	GSMUA_Achr7T22120
	MaHAK17	GSMUA_Achr5T08010
	MaHAK18	GSMUA_Achr10T17070
	MaHAK19	GSMUA_Achr11T20420
	MaHAK20	GSMUA_Achr8T01760
	MaHAK21	GSMUA_Achr7T20060
	MaHAK22	GSMUA_Achr9T11540
	MaHAK23	GSMUA_Achr2T02640
	MaHAK24	GSMUA_Achr9T22670

<i>Vitis vinifera</i>	VvHAK1	GSVIVG01013617001
	VvHAK2	GSVIVG01020217001
	VvHAK3	GSVIVG01032503001
	VvHAK4	GSVIVG01038736001
	VvHAK5	GSVIVG01032701001
	VvHAK6	GSVIVG01032959001
	VvHAK7	GSVIVG01019445001
	VvHAK8	GSVIVG01011951001
	VvHAK9	GSVIVG01010950001
	VvHAK10	GSVIVG01008480001
	VvHAK11	GSVIVG01010956001
	VvHAK12	GSVIVG01010949001
	VvHAK13	GSVIVG01024703001
	VvHAK14	GSVIVG01020219001
	VvHAK15	GSVIVG01010951001
	VvHAK16	GSVIVG01020263001
	VvHAK17	GSVIVG01012114001
	VvHAK18	GSVIVG01011572001
<i>Brachypodium distachyon</i>	BdHAK1	Bradi1g15610
	BdHAK2	Bradi2g60090
	BdHAK3	Bradi1g17830
	BdHAK4	Bradi1g63100
	BdHAK5	Bradi3g57080
	BdHAK6	Bradi1g43780
	BdHAK7	Bradi2g59757
	BdHAK8	Bradi3g37850
	BdHAK9	Bradi4g29347
	BdHAK10	Bradi3g17780
	BdHAK11	Bradi2g09280
	BdHAK12	Bradi5g21300
	BdHAK13	Bradi2g12980
	BdHAK14	Bradi1g32380
	BdHAK15	Bradi3g40040
	BdHAK16	Bradi4g31727
	BdHAK17	Bradi4g04010
	BdHAK18	Bradi3g44507
	BdHAK19	Bradi4g38070
	BdHAK20	Bradi5g08520
	BdHAK21	Bradi5g08527
	BdHAK22	Bradi1g18600
	BdHAK23	Bradi1g26560
	BdHAK24	Bradi1g59730
	BdHAK25	Bradi5g21677
	BdHAK26	Bradi2g59620

	BdHAK27	Bradi1g35620
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Supplementary Table S2: List of primers used for the Real-Time PCR analyses of OsHAK Genes.

Gene	Function		Sequence	References
Oshak1	Potassium Transporter	<i>F</i>	gttgatgatgctgatgttgaag	Okada T. et. al. 2008
		<i>R</i>	ccaacacttcagctgaaac	
Oshak4		<i>F</i>	gtaaagtagatttaggaaaccg	
		<i>R</i>	cgggtgtattatagatctgacgatc	
Oshak7		<i>F</i>	tgaatcttctgttggtcatcctca	
		<i>R</i>	ctcggcaactacattacatg	
Oshak10		<i>F</i>	gaagtttcgctgtatatcctcg	
		<i>R</i>	gagcccatgatccagctgccc	
Oshak16		<i>F</i>	catgccaacaatcagtaag	
		<i>R</i>	catttgaagtaagcaaacc	

Supplementary Table S3: Duplication analyses of OsHAK genes.

GENE NAME	GENE NAME	Duplication type	Ka	Ks	Ka/Ks	MYA	Selection
OsHAK2	OsHAK7	Segmental	0.18	1.93	0.10	148.20	Purifying
OsHAK4	OsHAK17	Segmental	0.16	3.38	0.05	260.18	Purifying
OsHAK25	OsHAK24	Segmental	0.13	0.79	0.16	60.65	Purifying
OsHAK8	OsHAK9	Segmental	0.18	1.34	0.14	102.87	Purifying
OsHAK27	OsHAK16	Tandem	0.23	1.50	0.56	115.74	Purifying
OsHAK19	OsHAK20	Proximal	0.05	0.33	0.14	25.45	Purifying
OsHAK16	OsHAK21	Proximal	0.23	1.38	0.17	106.48	Purifying

Supplementary Table S4: Structural Validation of OsHAK proteins.

Model	highly favored residues	favored residues	questionable residues	VoroMQA score
OsHAK1	95.7	4	0.3	0.5
OsHAK2	97.3	2.4	0.3	0.53
OsHAK3	98.2	1.5	0.3	0.5
OsHAK4	99.2	0.7	0.1	0.53
OsHAK5	95.4	3	1.6	0.52
OsHAK6	97.4	1.4	1.2	0.52
OsHAK7	97.6	2.1	0.3	0.52
OsHAK8	97.7	1.6	0.7	0.51
OsHAK9	97.3	1.9	0.8	0.5
OsHAK10	97.2	2	0.8	0.5
OsHAK11	95.2	2.7	2.1	0.51
OsHAK12	95.1	3.1	1.8	0.5
OsHAK13	97.3	1.8	0.9	0.5
OsHAK14	93.6	4.1	2.3	0.5
OsHAK15	96.7	3	0.3	0.5
OsHAK16	95.2	3.6	1.2	0.51
OsHAK17	99	0.8	0.2	0.53
OsHAK18	95.9	2	2.1	0.51
OsHAK19	96.8	2.7	0.5	0.52
OsHAK20	97.4	2	0.6	0.53
OsHAK21	96.6	2.2	1.2	0.5
OsHAK22	96.7	2.6	0.7	0.5
OsHAK23	92.8	4.8	2.4	0.5
OsHAK24	97.2	1.9	0.9	0.51
OsHAK25	96.4	2.3	1.3	0.51
OsHAK26	98.9	0.8	0.3	0.52
OsHAK27	96.3	2.9	0.8	0.5