

Supplementary Material

Differential physiological responses of different rice (*Oryza sativa*) cultivars to elevated night temperature during vegetative growth

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Table S1. Cultivars of *Oryza sativa* L. used for HNT stress experiments

Cultivar	Species	Origin
DR2	<i>Oryza sativa ssp. indica</i>	IBT Vietnam, propagation MPIMP
IR57311	<i>Oryza sativa ssp. indica</i>	IRRI, propagation MPIMP
IR62266-42-6-2	<i>Oryza sativa ssp. indica</i>	IRRI, propagation MPIMP
IR64	<i>Oryza sativa ssp. indica</i>	IRRI, propagation MPIMP
IR72	<i>Oryza sativa ssp. indica</i>	IRRI
IRRI123	<i>Oryza sativa ssp. indica</i>	IRRI
CT9993-5-10-1	<i>Oryza sativa ssp. japonica</i>	IRRI, propagation MPIMP
LC-93-4	<i>Oryza sativa ssp. japonica</i>	IBT Vietnam, propagation MPIMP
M202	<i>Oryza sativa ssp. japonica</i>	IRRI
Moroberekan	<i>Oryza sativa ssp. japonica</i>	IRRI
Nipponbare	<i>Oryza sativa ssp. japonica</i>	IRRI, propagation MPIMP
Taipei 309	<i>Oryza sativa ssp. japonica</i>	IRRI, propagation MPIMP

Table S2. Temperature conditions in the climate chamber under control and HNT conditions

Treatment	Chamber settings (°C; day/night)	Air temperature (°C; day/night)	Leaf temperature (°C; day)	Water temperature (°C; day/night)
Control	26/22	28.2 ± 0.16/ 20.8 ± 0.05	28.6 ± 0.06	24.0 ± 0.3/ 20.8 ± 0.06
HNT	28/28	29.5 ± 0.09/ 27.7 ± 0.1	29.5 ± 0.08	29.0 ± 0.26/ 26.9 ± 0.16

Table S3. Results of ANOVA analysis (*P*-values) of the differences in sensitivity ranks of the different cultivars

P-values below 0.05 are highlighted boldfaced and indicate a significant difference between two cultivars in relation to the sensitivity rank parameter chlorosis

	IR72	Taipei 309	LC-93-4	Nipponbare	Moroberekan	IR57311	IR64	IRRI 123	CT9993-5-10-1M	M202	DR2
IR72											
Taipei309	0.996										
LC-93-4	0.893	0.975									
Nipponbare	0.900	0.983	0.987								
Moroberekan	0.299	0.739	0.989	0.986							
IR57311	0.013	0.086	0.568	0.565	0.972						
IR64	0.003	0.024	0.277	0.278	0.891	0.999					
IRRI123	< 0.001	< 0.001	0.005	0.005	0.101	0.765	0.918				
CT9993-5-10-1M	< 0.001	< 0.001	0.005	0.005	0.100	0.771	0.927	1.000			
M202	< 0.001	0.001	0.001								
DR2	< 0.001	0.998									
IR62266-42-6-2	< 0.001	0.999	1.000								

Table S4. Plant height (PH) and tiller number (TN) for all cultivars under control and HNT conditions at the beginning and end of the treatment phase

Average data from two independent control and HNT experiments are shown. The relative change in % during the treatment phase was calculated with standard errors (SE) and significance tested with two-sided t-test

	Control				HNT			
	PH Day 0 (cm)	SE	PH Day 21 (cm)	SE	PH Day 0 (cm)	SE	PH Day 21 (cm)	SE
IR72	30.56	0.776	67.72	1.140	27.46	1.712	74.43	1.608
Taipei 309	28.28	1.674	68.94	0.972	30.32	1.661	78.90	1.073
LC - 93 - 4	31.50	1.281	77.76	1.589	38.88	1.155	90.92	1.355
Nipponbare	24.50	2.216	70.54	2.546	33.41	1.243	83.19	0.964
Moroberekan	31.06	2.904	87.25	1.575	39.67	1.397	97.04	2.084
IR57311	27.28	1.044	60.28	0.892	24.27	1.556	62.75	2.086
IR64	32.94	1.203	67.94	1.685	29.22	2.060	72.62	1.625
IRRI123	32.50	0.890	72.11	0.816	32.00	1.442	76.17	1.606
CT 9993-5-10-1M	24.28	2.027	73.63	1.717	31.33	1.571	79.55	1.579
M 202	34.06	1.679	76.13	2.436	39.25	1.432	67.92	2.209
DR2	26.61	1.688	67.50	1.426	30.09	1.214	60.78	1.727
IR 62266-42-6-2	22.33	1.851	60.94	2.271	29.09	1.340	65.73	1.042

	Control		HNT		p value
	Increase of PH (%)	SE	Increase of PH (%)	SE	
IR72	122.9	3.940	192.8	22.860	0.006
Taipei 309	169.0	26.81	162.4	14.694	0.829
LC - 93 - 4	142.7	6.279	140.4	10.540	0.852
Nipponbare	229.0	48.35	150.5	8.225	0.134
Moroberekan	181.0	43.42	149.8	7.243	0.488
IR57311	125.8	7.854	155.4	11.757	0.042
IR64	108.4	3.936	153.7	18.624	0.027
IRRI123	124.2	5.536	148.9	11.687	0.064
CT 9993-5-10-1M	239.6	50.09	181.5	18.113	0.289
M 202	118.8	8.616	80.0	10.180	0.006
DR2	145.8	10.67	105.7	5.172	0.003
IR 62266-42-6-2	183.9	17.47	125.7	9.778	0.007

	Control				HNT			
	TN Day 0	SE	TN Day 21	SE	TN Day 0	SE	TN Day 21	SE
IR72	1.944	0.206	18.67	1.038	2.208	0.180	17.52	1.535
Taipei 309	1.222	0.101	10.00	0.767	1.545	0.157	9.19	0.576
LC - 93 - 4	1.556	0.145	11.35	0.844	2.292	0.127	12.04	0.781
Nipponbare	1.357	0.199	10.38	1.318	2.281	0.169	13.13	0.788
Moroberekan	1.167	0.090	8.44	0.821	1.167	0.078	7.54	0.507
IR57311	2.389	0.231	19.17	1.581	2.100	0.188	18.36	1.537
IR64	2.611	0.244	23.22	2.112	2.565	0.273	17.43	1.486
IRRI123	1.667	0.162	14.78	0.865	1.958	0.141	13.08	1.124
CT 9993-5-10-1M	1.167	0.090	8.13	0.836	1.303	0.092	8.33	0.539
M 202	1.176	0.095	10.75	0.809	1.458	0.134	10.67	0.711
DR2	1.722	0.177	14.38	0.785	2.174	0.205	14.35	1.228
IR 62266-42-6-2	1.611	0.200	16.65	1.847	2.438	0.142	22.73	1.239

	Control		HNT		p value
	Increase of TN (%)	SE	Increase of TN (%)	SE	
IR72	1020.4	107.69	693.5	68.60	0.016
Taipei 309	744.4	56.58	563.5	57.88	0.032
LC - 93 - 4	690.2	75.44	432.6	22.60	0.004
Nipponbare	691.0	65.99	518.0	41.74	0.037
Moroberekan	646.9	81.71	577.1	51.25	0.476
IR57311	771.3	65.05	783.9	61.41	0.888
IR64	837.0	83.20	588.5	48.54	0.015
IRRI123	900.9	94.31	582.6	49.20	0.006
CT 9993-5-10-1M	606.3	73.72	563.6	36.23	0.609
M 202	837.5	68.84	688.2	50.99	0.092
DR2	793.8	84.72	624.6	72.14	0.138
IR 62266-42-6-2	975.5	94.69	842.2	53.15	0.231

Table S5. Carbohydrate concentration under control and HNT conditions

Glucose, fructose, sucrose and starch concentration under control (a) or HNT (b) conditions. Carbohydrates at the end of day (EOD) and end of night (EON) 47 DAS or 66 DAS under control or HNT conditions. Log₂ fold change (c) of carbohydrates after 21/22 or 40/41 days of HNT in comparison to control conditions at EOD and EON. Values are averages with standard errors (SE) from five to eight plants. Cultivars are sorted from tolerant to sensitive (left to right)

(a)

Control																									
		IR72		Taipei 309		LC - 93 - 4		Nipponbare		Moroberekan		IR57311		IR64		IRRI123		CT 9993-5-10-1M		M202		DR2		IR62266-42-6-2	
		$\mu\text{mol/g}$ FW	SE	$\mu\text{mol/g}$ FW	SE																				
47DAS	Glc EOD	0.141	0.070	0.296	0.056	0.363	0.148	0.329	0.170	0.374	0.066	0.072	0.049	0.300	0.124	0.216	0.094	0.108	0.073	0.366	0.136	1.580	0.873	0.277	0.105
	Glc EON	0.122	0.069	0.239	0.083	0.197	0.078	0.353	0.197	0.117	0.063	0.228	0.050	0.250	0.094	0.133	0.068	0.037	0.037	0.361	0.143	1.178	0.671	0.523	0.211
	Frc EOD	0.890	0.078	1.077	0.227	0.706	0.150	1.037	0.202	0.903	0.106	0.530	0.153	0.948	0.224	1.072	0.121	0.674	0.092	1.197	0.254	1.653	0.677	0.831	0.096
	Frc EON	0.250	0.135	0.295	0.139	0.412	0.113	0.568	0.366	0.341	0.091	0.349	0.174	0.177	0.065	0.247	0.073	0.152	0.064	0.367	0.127	1.025	0.501	0.922	0.438
	Suc EOD	43.89	3.017	44.85	3.855	34.67	3.121	45.67	6.847	41.96	2.735	30.19	3.601	40.18	1.605	42.47	1.922	42.87	4.168	36.82	3.575	42.38	3.040	39.58	2.624
	Suc EON	23.02	1.501	24.84	1.917	20.00	1.263	16.99	1.333	18.42	1.904	16.11	1.243	25.81	1.836	18.00	3.124	20.89	2.779	19.74	1.390	22.28	2.186	19.07	1.568
	Starch EOD	9.260	2.322	6.142	1.240	7.817	1.369	13.14	6.259	9.306	1.597	5.154	1.176	2.673	0.446	5.033	1.401	4.388	1.777	8.924	2.158	16.32	7.653	10.22	1.909
	Starch EON	0.852	0.337	2.236	1.802	2.858	0.406	0.731	0.388	1.212	0.554	0.431	0.186	1.126	0.394	0.324	0.194	0.517	0.429	1.733	1.088	4.352	2.330	1.195	0.912
66DAS	Glc EOD	0.245	0.071	0.325	0.114	0.708	0.295	0.960	0.316	1.837	0.574	0.084	0.042	0.938	0.348	1.131	0.634	2.058	0.698	2.750	1.211	9.457	1.651	4.207	1.641
	Glc EON	0.873	0.091	1.012	0.210	1.251	0.602	1.853	1.114	1.977	0.492	0.525	0.104	1.743	0.401	0.870	0.079	1.799	0.418	3.086	1.249	3.915	1.004	3.679	1.196
	Frc EOD	0.215	0.056	0.416	0.099	0.869	0.271	1.059	0.367	2.113	0.610	0.207	0.101	0.794	0.130	1.015	0.487	1.908	0.675	2.248	0.879	7.997	1.718	3.731	1.756
	Frc EON	0.349	0.074	0.598	0.259	0.848	0.592	1.543	1.102	1.218	0.452	0.170	0.070	1.099	0.328	0.389	0.123	1.404	0.497	2.160	1.153	3.540	1.129	3.050	1.262
	Suc EOD	37.79	1.790	35.53	1.639	33.79	2.194	40.55	2.681	34.01	2.261	35.52	2.600	36.09	1.154	38.87	2.221	33.68	3.280	39.22	1.482	37.05	3.084	40.02	3.216
	Suc EON	31.01	1.116	29.15	1.816	24.67	1.918	27.70	1.958	25.25	0.801	24.75	1.890	31.45	1.793	25.18	1.863	30.83	4.532	28.46	2.621	29.23	4.659	31.15	2.558
	Starch EOD	4.974	1.585	3.258	0.794	10.40	5.058	6.833	2.130	6.774	1.473	3.908	1.411	3.361	0.587	6.024	1.839	3.189	0.822	7.128	2.071	46.99	4.382	9.494	2.857
	Starch EON	4.900	1.544	4.743	1.665	7.837	3.206	4.183	1.062	4.169	1.073	1.921	0.854	4.288	3.026	2.470	1.256	4.686	1.796	4.800	1.708	24.48	16.764	10.16	2.821

(b)

HNT																									
		IR72		Taipei 309		LC - 93 - 4		Nipponbare		Moroberekan		IR57311		IR64		IRRI123		CT 9993-5-10-1M		M202		DR2		IR62266-42-6-2	
		$\mu\text{mol/g}$ FW	SE																						
47DAS	Glc EOD	3.125	0.316	2.822	0.723	2.044	0.490	2.376	0.173	3.087	0.426	2.738	1.565	1.526	0.419	2.955	0.642	3.909	1.432	3.618	0.805	2.879	1.122	5.154	1.813
	Glc EON	2.006	0.246	1.304	0.190	2.738	0.585	1.865	0.254	2.148	0.399	1.222	0.209	1.929	0.336	1.918	0.385	1.552	0.201	2.486	0.829	5.351	1.415	2.798	0.798
	Frc EOD	2.462	0.560	2.714	0.684	2.514	0.586	1.921	0.338	3.083	0.369	2.347	1.295	2.731	0.941	2.944	0.733	3.441	0.973	3.095	0.935	3.476	1.271	4.473	1.578
	Frc EON	1.897	0.278	1.263	0.155	2.281	0.570	1.789	0.235	1.932	0.324	0.874	0.254	1.668	0.219	1.939	0.517	1.134	0.235	2.510	0.833	4.351	1.566	2.646	1.190
	Suc EOD	37.30	5.087	25.67	3.116	21.89	1.567	24.07	1.029	23.55	0.985	33.41	1.988	45.82	5.929	35.08	1.737	37.26	5.195	25.69	6.035	32.44	4.819	34.44	5.766
	Suc EON	25.39	1.819	21.60	1.513	20.85	1.670	20.19	1.561	20.58	0.698	17.62	1.894	21.73	2.010	21.11	1.059	22.84	1.276	24.01	3.158	24.91	1.940	26.76	3.027
	Starch EOD	55.16	10.22	36.70	12.35	35.10	5.236	43.16	9.784	26.36	3.172	52.82	11.47	38.12	5.442	39.25	8.454	22.23	5.012	32.12	8.619	30.57	5.397	59.40	12.61
	Starch EON	27.65	10.19	16.24	6.217	22.63	3.998	7.991	2.004	18.22	4.109	6.563	1.984	7.050	2.272	8.173	1.403	8.191	3.467	11.27	6.038	10.43	3.677	25.21	9.607
66DAS	Glc EOD	1.447	0.669	0.855	0.525	1.266	0.315	5.421	0.936	2.043	0.801	0.382	0.320	1.810	0.798	1.276	0.497	2.167	1.014	1.484	0.206	7.394	1.743	1.447	0.585
	Glc EON	0.326	0.097	0.256	0.147	1.064	0.388	0.707	0.449	1.073	0.362	1.390	1.192	0.901	0.562	1.885	0.824	1.187	0.438	3.389	1.867	11.82	4.092	3.63	1.290
	Frc EOD	1.996	0.830	1.402	0.456	1.859	0.405	6.099	0.758	2.430	0.873	0.687	0.277	2.176	0.755	1.334	0.466	1.955	0.534	1.704	0.323	5.198	1.173	1.623	0.350
	Frc EON	0.450	0.090	0.764	0.130	1.279	0.533	1.643	0.861	1.606	0.469	1.168	0.997	0.877	0.437	1.964	0.814	1.532	0.570	1.773	0.652	6.325	1.545	3.722	1.114
	Suc EOD	32.82	1.824	37.63	2.190	30.56	0.723	41.84	5.887	30.52	1.065	35.21	0.991	36.11	1.586	34.78	1.247	34.79	2.371	39.59	2.875	28.78	2.876	35.15	1.188
	Suc EON	30.47	1.067	32.96	0.277	29.86	1.032	37.20	1.622	26.72	1.855	25.85	1.706	32.75	0.410	27.57	0.790	27.45	1.376	34.93	3.093	24.89	1.384	36.36	5.440
	Starch EOD	26.45	14.18	16.73	3.249	21.17	3.213	69.87	2.821	10.87	2.191	10.83	3.892	11.11	2.425	8.933	2.054	20.18	10.51	12.59	5.689	55.70	21.70	16.43	5.254
	Starch EON	8.364	3.127	8.537	2.284	11.75	4.273	16.22	7.545	7.002	1.766	8.606	6.592	3.814	1.438	5.468	2.436	2.031	0.437	12.44	7.695	32.62	11.59	15.80	5.810

(c)

Log ₂ fold change													
		IR72	Taipei 309	LC - 93 - 4	Nipponbare	Moroberekan	IR57311	IR64	IRRI123	CT 9993-5-10-1M	M 202	DR2	IR 62266-42-6-2
47DAS	Glc EOD	4.472	3.251	2.492	2.853	3.044	5.249	2.347	3.777	5.184	3.307	0.865	4.216
	Glc EON	4.039	2.446	3.796	2.399	4.201	2.420	2.950	3.851	5.410	2.783	2.184	2.419
	Frc EOD	1.467	1.334	1.831	0.890	1.771	2.147	1.526	1.457	2.351	1.370	1.072	2.429
	Frc EON	2.926	2.100	2.468	1.654	2.502	1.324	3.239	2.974	2.899	2.774	2.086	1.522
	Suc EOD	-0.235	-0.805	-0.664	-0.924	-0.833	0.146	0.189	-0.276	-0.202	-0.520	-0.385	-0.201
	Suc EON	0.141	-0.202	0.060	0.249	0.160	0.129	-0.249	0.230	0.128	0.283	0.161	0.489
	Starch EOD	2.575	2.579	2.167	1.716	1.502	3.357	3.834	2.963	2.341	1.848	0.905	2.540
	Starch EON	5.020	2.861	2.985	3.450	3.910	3.927	2.646	4.655	3.985	2.701	1.261	4.399
66DAS	Glc EOD	2.565	1.396	0.839	2.498	0.153	2.194	0.947	0.174	0.074	-0.890	-0.355	-1.539
	Glc EON	-1.421	-1.981	-0.234	-1.390	-0.881	1.404	-0.952	1.116	-0.600	0.135	1.594	-0.020
	Frc EOD	3.211	1.753	1.097	2.525	0.201	1.734	1.454	0.395	0.036	-0.400	-0.622	-1.201
	Frc EON	0.366	0.354	0.594	0.091	0.399	2.777	-0.326	2.337	0.126	-0.285	0.837	0.287
	Suc EOD	-0.203	0.083	-0.145	0.045	-0.156	-0.013	0.001	-0.160	0.047	0.014	-0.365	-0.187
	Suc EON	-0.025	0.177	0.275	0.425	0.082	0.063	0.058	0.131	-0.168	0.295	-0.232	0.223
	Starch EOD	2.411	2.360	1.025	3.354	0.683	1.471	1.725	0.568	2.661	0.821	0.245	0.791
	Starch EON	0.771	0.848	0.585	1.955	0.748	2.164	-0.169	1.146	-1.206	1.373	0.414	0.636

Table S6. Correlation analysis of biomass parameters, total seed weight, photosynthetic yield, respiration and values of mono- and disaccharides and starch (a) or correlation analysis of the log₂ fold change of the same parameters under HNT in comparison to control conditions (b) with the mean sensitivity rank of twelve cultivars

HNT tolerant cultivars are represented by low, sensitive ones by a high sensitivity rank. R and P-values are given from Spearman correlations for either control or HNT conditions (a) or the log₂ fold change HNT:control (b). P-values below 0.05 are highlighted italic, below 0.01 highlighted boldfaced and italic and below 0.001 highlighted in boldface numbers

(a)

Parameter	control		HNT	
	r	p value	r	P-value
Fresh weight	0.064	0.6280	-0.462	0.0002
Dry weight	0.080	0.5440	-0.577	<0.0001
PH % increase	0.059	0.4090	-0.396	<0.0001
TN % increase	0.063	0.3730	0.213	0.0002
Total seed weight	-0.021	0.8190	-0.547	<0.0001
PAM (46 DAS)	0.155	0.0915	0.278	0.0023
Respiration (34 DAS)	-0.158	0.2340	-0.305	0.0100
Respiration (41 DAS)	0.093	0.4820	-0.265	<i>0.0210</i>
Respiration (66 DAS)	-0.164	0.1460	0.061	0.6020
Glucose EOD (46 DAS)	0.065	0.5720	0.130	0.3170
Glucose EON (47 DAS)	0.181	0.1090	0.180	0.1710
Fructose EOD (46 DAS)	0.052	0.6490	0.154	0.2280
Fructose EON (47 DAS)	0.094	0.4080	0.097	0.4620
Sucrose EOD (46 DAS)	-0.069	0.5480	0.258	0.0551
Sucrose EON (47 DAS)	-0.123	0.2810	0.167	0.2040
Starch EOD (46 DAS)	0.014	0.9020	-0.070	0.6040
Starch EON (47 DAS)	-0.137	0.2270	-0.220	0.0937
Glucose EOD (65 DAS)	0.526	<0.0001	0.167	0.1660
Glucose EON (66 DAS)	0.457	<0.0001	0.505	<0.0001
Fructose EOD (65 DAS)	0.496	<0.0001	0.109	0.3700
Fructose EON (66 DAS)	0.354	0.0015	0.443	0.0001
Sucrose EOD (65 DAS)	0.128	0.2610	0.076	0.5290
Sucrose EON (66 DAS)	0.062	0.5850	-0.148	0.2220

Starch EOD (65 DAS)	0.264	<i>0.0188</i>	-0.126	0.2970
Starch EON (66 DAS)	0.050	0.6640	0.053	0.6620
log ₂ FC Glucose EOD:EON (46/47 DAS)	0.223	0.1600	0.046	0.7380
log ₂ FC Fructose EOD:EON (46/47 DAS)	0.160	0.2020	0.033	0.8080
log ₂ FC Sucrose EOD:EON (46/47 DAS)	-0.048	0.6770	-0.100	0.4630
log ₂ FC Starch EOD:EON (46/47 DAS)	0.180	0.2050	-0.197	0.1500
log ₂ FC Glucose EOD:EON (65/66 DAS)	-0.316	0.0078	0.382	0.0035
log ₂ FC Fructose EOD:EON (65/66 DAS)	-0.180	0.1250	0.382	0.0017
log ₂ FC Sucrose EOD:EON (65/66 DAS)	-0.061	0.5950	-0.089	0.4680
log ₂ FC Starch EOD:EON (65/66 DAS)	-0.090	0.4560	0.166	0.1720

(b)

Parameter	log ₂ FC HNT:control	
	r	P-value
Fresh weight	-0.706	0.0090
Dry weight	-0.727	0.0062
PH % increase	-0.413	0.1730
TN % increase	0.427	0.1570
Total seed weight	-1.000	0.0167
PAM (46 DAS)	0.072	0.4360
Respiration (34 DAS)	-0.063	0.6430
Respiration (41 DAS)	-0.340	0.0092
Respiration (66 DAS)	0.113	0.3610
Glucose EOD (46 DAS)	0.021	0.9390
Glucose EON (47 DAS)	-0.280	0.3640
Fructose EOD (46 DAS)	0.210	0.4980
Fructose EON (47 DAS)	-0.105	0.7330
Sucrose EOD (46 DAS)	0.392	0.1970
Sucrose EON (47 DAS)	0.517	0.0795
Starch EOD (46 DAS)	-0.175	0.5720
Starch EON (47 DAS)	-0.147	0.6350
Glucose EOD (65 DAS)	-0.853	<0.0001
Glucose EON (66 DAS)	0.706	0.0090
Fructose EOD (65 DAS)	-0.888	<0.0001
Fructose EON (66 DAS)	-0.112	0.7160
Sucrose EOD (65 DAS)	-0.224	0.4700
Sucrose EON (66 DAS)	-0.133	0.6670
Starch EOD (65 DAS)	-0.531	0.0705
Starch EON (66 DAS)	-0.266	0.3890