

Table S1. Phenotypic variations for physiological traits, plant height (PH), thousand kernel weight (TKW) and grain yield (GY) in UI Platinum and SY Capstone and their DH population across four trials.

Traits	Trials	Parent			DH		
		UI	SY	Difference	Mean	SD	Range
CTa	AB15E1	21.1	20.3	NS	21.3	0.58	19.9 to 22.4
	AB15E2	21.0	20.7	NS	21.0	0.75	19.0 to 22.8
	AB15E3	23.5	23.7	NS	23.7	0.72	22.0 to 25.9
	AB16E4	17.8	16.6	1.2	17.3	1.39	13.6 to 20.3
	Mean	20.9	20.3	NS	20.8	2.83	13.6 to 25.9
CTg1	AB15E1	25.1	22.3	2.8	24.2	1.89	21.4 to 29.5
	AB15E2	24.0	24.1	NS	24.0	0.39	23.2 to 25.0
	AB15E3	23.2	22.8	0.4	23.0	0.76	21.3 to 26.6
	AB16E4	23.9	21.7	2.2	22.9	1.67	19.6 to 26.8
	Mean	24.1	22.7	1.4	23.5	1.44	19.6 to 29.5
CTg2	AB15E1	34.0	30.4	3.6	31.2	3.52	25.3 to 40.0
	AB15E2	27.3	26.5	0.8	27.1	0.45	25.9 to 28.2
	AB15E3	25.7	24.0	1.7	25.0	0.63	23.4 to 28.8
	AB16E4	25.4	25.3	NS	25.5	1.31	22.6 to 30.7
	Mean	28.1	26.6	1.5	27.2	2.77	22.6 to 40.0
CC1a	AB15E1	29.1	35.4	-6.3	34.6	5.49	21.5 to 47.8
	AB15E2	35.1	41.6	-6.5	37.0	4.46	29.1 to 50.2
	AB15E3	33.8	41.0	-7.2	37.4	3.85	29.8 to 49.0
	AB16E4	34.7	42.1	-7.4	37.3	4.67	23.8 to 51.6
	Mean	33.2	40.7	-7.5	36.6	4.64	21.5 to 51.6
CC1g1	AB15E1	41.4	48.4	-7.0	45.6	6.07	31.3 to 60.6
	AB15E2	38.0	46.3	-8.3	46.2	4.94	37.4 to 61.5
	AB15E3	41.5	44.7	-3.2	47.4	5.55	31.8 to 68.5
	AB16E4	38.3	44.6	-6.3	43.6	5.42	27.8 to 61.1
	Mean	39.8	46.0	-6.2	45.7	5.74	27.8 to 68.5
CC1g2	AB15E1	35.4	44.3	-8.9	39.8	5.16	27.5 to 52.5
	AB15E2	37.5	43.5	-6.0	41.3	4.90	30.5 to 58.0
	AB15E3	36.2	40.6	-4.4	41.9	4.43	32.4 to 56.5
	AB16E4	35.8	42.0	-6.2	39.8	5.30	25.5 to 58.5
	Mean	36.2	42.6	-6.4	40.7	5.03	25.5 to 58.5
PH	AB15E1	76.0	81.3	NS	82.8	4.80	71.1 to 94.0
	AB15E2	77.6	82.1	-4.5	82.8	5.26	66.0 to 101.6
	AB15E3	76.9	84.2	-7.3	77.1	5.69	66.0 to 91.4
	AB16E4	85.9	90.6	-4.7	84.9	5.94	70.0 to 102.0
	Mean	79.1	84.6	-5.4	81.9	5.42	66.0 to 102.0
TKW	AB15E1	40.8	34.2	6.6	38.5	3.66	29.4 to 48.4
	AB15E2	40.5	35.9	4.6	38.1	3.17	30.2 to 48.8
	AB15E3	38.9	35.9	3.0	36.6	3.47	28.0 to 47.8
	AB16E4	43.9	41.7	2.2	41.4	3.61	29.6 to 51.4
	Mean	40.1	36.9	4.1	38.7	3.48	28.0 to 51.4
GY	AB15E1	6.5	7.8	-1.3	6.7	0.68	5.06 to 8.29
	AB15E2	8.5	8.2	NS	7.8	0.71	5.30 to 9.23
	AB15E3	8.1	8.0	NS	7.8	0.71	5.96 to 9.39
	AB16E4	8.6	8.8	NS	8.1	1.04	4.18 to 10.17
	Mean	7.9	8.2	NS	7.6	0.79	4.18 to 10.17

UI, UI Platinum; SY, SY Capstone; Difference, difference between UI Platinum and SY Capstone (UI Platinum - SY Capstone); 15ABE1, 15ABE2, 15ABE3: trial 1, 2 and 3 in Aberdeen in 2015, respectively; 16ABE4, trial 4 in Aberdeen in 2016; CTa, CTg1, CTg2, canopy temperature during anthesis, mid- and late grain-filling stage, respectively; CCIa, CCIg1, CCIg2, chlorophyll content index during anthesis, mid- and late grain-filling stage, respectively; PH, plant height; TKW, thousand kernels weight; GY, grain yield; NS means not significant at $\alpha = 0.05$, numbers mean significant at $\alpha = 0.05$; -, not measured.

Table S2. Summary of the genetic linkage maps constructed with SNP, SSR and STS markers using DH population derived from UI Platinum / SY Capstone.

Chromosome	No of Linkage groups	No. of SNP	No. of SSR	Length (cM)	Density (cM/marker)
1A	1	523	3	178.89	0.34
2A	2	579	2	204.41	0.35
3A	3	490	2	165.34	0.34
4A	2	490	4	141.23	0.29
5A	1	279	1	261.51	0.93
6A	2	1124	1	208.99	0.19
7A	3	816	5	260.14	0.32
1B	2	647	6	243.02	0.37
2B	4	968	4	338.75	0.35
3B	2	674	2	214.70	0.32
4B	1	216	1	214.70	0.99
5B	2	807	2	175.04	0.22
6B	1	397	1	133.83	0.34
7B	1	640	1	251.11	0.39
1D	2	59	0	54.61	0.93
2D	2	713	4	196.41	0.27
3D	2	14	1	83.34	5.56
4D	2	31	1	57.33	1.79
5D	3	86	1	76.74	0.88
6D	3	102	0	58.33	0.57
7D	2	31	2	114.77	3.48
A genome	14	4301	18	1420.51	0.33
B genome	13	4349	17	1571.15	0.36
C genome	16	1037	9	641.53	0.61
Total	43	9687	44	3633.19	0.37

Table S3. The names and positions of 357 newly mapped SNP markers.

Newly mapped marker	Linkage group	Position (cM)	Newly mapped marker	Linkage group	Position (cM)	Newly mapped marker	Linkage group	Position (cM)
IWB10291	1A	2.73	IWB60218	2B-2	99.62	IWB60512	4D-2	2.73
IWB11804	1A	2.73	IWB28725	2B-3	42.53	IWB15768	5A	69.42
IWB21142	1A	2.73	IWB29229	2B-3	74.71	IWB14149	5A	91.35
IWB26563	1A	2.73	IWB7296	2B-3	83.9	IWB7875	5A	91.35
IWB31154	1A	2.73	IWB63643	2D-1	0	IWB73408	5A	116.87
IWB31610	1A	2.73	IWB50346	2D-1	41.73	IWB2417	5B-1	4.55
IWB35089	1A	2.73	IWB116	2D-1	59.93	IWB58504	5B-2	0
IWB41913	1A	2.73	IWB1177	2D-1	59.93	IWB27760	5B-2	7.29
IWB49352	1A	2.73	IWB12112	2D-1	59.93	IWB45252	5B-2	9.14
IWB74217	1A	2.73	IWB12113	2D-1	59.93	IWB64633	5B-2	9.14
IWB74220	1A	2.73	IWB12797	2D-1	59.93	IWB81374	5B-2	9.14
IWB74222	1A	2.73	IWB13678	2D-1	59.93	IWB20389	5B-2	62.93
IWB7460	1A	2.73	IWB14316	2D-1	59.93	IWB52145	5B-2	62.93
IWB74985	1A	2.73	IWB2103	2D-1	59.93	IWB57067	5B-2	62.93
IWB76209	1A	2.73	IWB21171	2D-1	59.93	IWB66747	5B-2	62.93
IWB30819	1A	7.28	IWB22617	2D-1	59.93	IWB58028	5B-2	94.84
IWB42785	1A	7.28	IWB23437	2D-1	59.93	IWB43768	5B-2	118.59
IWB54858	1A	7.28	IWB26606	2D-1	59.93	IWB57401	5B-2	128.6
IWB7091	1A	7.28	IWB27906	2D-1	59.93	IWB65598	5B-2	147.73
IWB8596	1A	7.28	IWB28050	2D-1	59.93	IWB73601	5B-2	169.58
IWB31616	1A	14.73	IWB29849	2D-1	59.93	IWB7675	5D-2	52.09
IWB59791	1A	14.73	IWB32019	2D-1	59.93	IWB74387	6A-1	5.46
IWB40024	1A	15.64	IWB32021	2D-1	59.93	IWB33850	6A-1	6.37
IWB36377	1A	33.94	IWB32022	2D-1	59.93	IWB66424	6A-1	9.1
IWB31504	1A	35.76	IWB32040	2D-1	59.93	IWB77603	6A-1	13.65
IWB55944	1A	35.76	IWB32196	2D-1	59.93	IWB10015	6A-1	14.56
IWB60186	1A	35.76	IWB32234	2D-1	59.93	IWB39504	6A-1	24.57
IWB77089	1A	52.15	IWB32894	2D-1	59.93	IWB40597	6A-1	29.12
IWB41444	1A	53.97	IWB34354	2D-1	59.93	IWB10077	6A-1	33.67
IWB59026	1A	80.43	IWB34659	2D-1	59.93	IWB33632	6A-1	33.67
IWB81300	1A	80.43	IWB5253	2D-1	59.93	IWB33650	6A-1	33.67
IWB31718	1A	155.15	IWB53323	2D-1	59.93	IWB33683	6A-1	33.67
IWB38851	1A	155.15	IWB55717	2D-1	59.93	IWB35301	6A-1	33.67
IWB26010	1B-1	18.01	IWB57311	2D-1	59.93	IWB53746	6A-1	33.67
IWB43094	1B-1	61	IWB60407	2D-1	59.93	IWB71125	6A-1	33.67
IWB54946	1B-1	63.73	IWB60719	2D-1	59.93	IWB48022	6A-2	3.68
IWB1012	1B-1	95.52	IWB62569	2D-1	59.93	IWB33855	6A-2	15.58
IWB32877	1B-1	95.52	IWB64180	2D-1	59.93	IWB18828	6A-2	21.04
IWB73804	1B-1	95.52	IWB66000	2D-1	59.93	IWB23999	6A-2	21.04
IWB24041	1B-1	101.89	IWB68895	2D-1	59.93	IWB54736	6A-2	61.71
IWB25669	1B-1	113.94	IWB81304	2D-1	59.93	IWB67936	6A-2	69.91

Newly mapped marker	Linkage group	Position (cM)	Newly mapped marker	Linkage group	Position (cM)	Newly mapped marker	Linkage group	Position (cM)
IWB53153	1B-1	127.09	IWB8402	2D-1	59.93	IWB27452	6A-2	72.64
IWB72955	1B-1	127.09	IWB56369	2D-1	63.57	IWB9290	6A-2	109.4
IWB51905	1B-1	150.26	IWB52950	2D-1	66.3	IWB52007	6A-2	123.06
IWB21655	1B-1	167.72	IWB15442	2D-1	133.01	IWB70480	6A-2	138.57
IWB30456	1B-1	175.04	IWB3207	2D-1	137.56	IWB40855	6A-2	139.48
IWB23767	1B-2	32.44	IWB46392	2D-2	0.91	IWB20886	6B	3.64
IWB3239	1B-2	32.44	IWB53165	2D-2	11.86	IWB38579	6B	3.64
IWB63134	1B-2	32.44	IWB9992	2D-2	11.86	IWB41697	6B	3.64
IWB9843	1B-2	32.44	IWB44003	3A-1	0	IWB61736	6B	3.64
IWB15678	1B-2	40.63	IWB14956	3A-1	15.59	IWB2246	6B	21.65
IWB43824	1B-2	40.63	IWB33232	3A-1	19.23	IWB38614	6B	21.65
IWB4247	1B-2	48.83	IWB69564	3A-1	24.69	IWB415	6B	21.65
IWB58702	1B-2	53.38	IWB20442	3A-1	27.42	IWB65321	6B	59.86
IWB11671	1B-2	60.66	IWB9827	3A-2	71.21	IWB44645	6B	60.77
IWB79029	1D-1	26.67	IWB12771	3A-2	78.5	IWB74520	6B	60.77
IWB65384	2A-1	36.66	IWB22595	3A-3	11.87	IWB10502	6B	63.5
IWB10000	2A-1	40.3	IWB36763	3A-3	11.87	IWB26801	6B	73.53
IWB20141	2A-1	40.3	IWB63635	3B-1	3.64	IWB28067	6B	91.75
IWB22219	2A-1	40.3	IWB57673	3B-1	46.88	IWB22604	6B	132.92
IWB30393	2A-1	40.3	IWB63069	3B-1	51.43	IWB35315	6D-1	29.99
IWB38305	2A-1	40.3	IWB49212	3B-1	91.37	IWB53821	6D-2	0
IWB46368	2A-1	40.3	IWB76601	3B-1	91.37	IWB2743	6D-2	1.82
IWB50726	2A-1	40.3	IWB5334	3B-1	129.04	IWB41346	6D-2	1.82
IWB59619	2A-1	55.86	IWB1965	3B-1	140.88	IWB513	6D-2	1.82
IWB22524	2A-1	80.88	IWB1966	3B-1	140.88	IWB55804	6D-3	0
IWB24213	2A-1	101.85	IWB3008	3B-1	140.88	IWB44173	7A-1	0
IWB3819	2A-1	105.49	IWB36716	3B-1	140.88	IWB51662	7A-1	17.9
IWB53033	2A-1	105.49	IWB36717	3B-1	140.88	IWB56096	7A-1	48.95
IWB66059	2A-1	105.49	IWB36815	3B-1	140.88	IWB5089	7A-1	55.35
IWB45854	2A-1	106.4	IWB36847	3B-1	140.88	IWB28436	7A-2	0
IWB31511	2A-1	110.04	IWB63427	3B-1	140.88	IWB36315	7A-2	0
IWB60057	2A-1	110.04	IWB75803	3B-1	140.88	IWB64425	7A-2	0
IWB60058	2A-1	110.04	IWB76078	3B-1	140.88	IWB73722	7A-2	0
IWB62761	2A-1	110.04	IWB80351	3B-1	140.88	IWB60011	7A-2	8.19
IWB71410	2A-1	110.04	IWB81047	3B-1	140.88	IWB48355	7A-2	10.01
IWB47814	2A-1	113.68	IWB1943	3B-1	173.26	IWB57023	7A-2	10.01
IWB60824	2A-1	152.33	IWB22248	3B-1	173.26	IWB228	7A-2	16.38
IWB81533	2A-1	155.06	IWB24274	3B-1	173.26	IWB5749	7A-2	21.84
IWB32318	2B-1	0.91	IWB64011	3B-1	179.65	IWB59033	7A-2	47.43
IWB58705	2B-1	3.64	IWB29718	3B-1	180.56	IWB4195	7A-2	59.27
IWB22970	2B-1	6.37	IWB53815	3B-1	180.56	IWB29243	7A-3	32.96
IWB18936	2B-1	19.11	IWB62401	3B-1	180.56	IWB24330	7A-3	41.15
IWB32753	2B-1	19.11	IWB78297	3B-1	180.56	IWB62687	7A-3	41.15

Newly mapped marker	Linkage group	Position (cM)	Newly mapped marker	Linkage group	Position (cM)	Newly mapped marker	Linkage group	Position (cM)
IWB45765	2B-1	24.57	IWB78706	3B-1	180.56	IWB76132	7A-3	41.15
IWB67534	2B-2	10.93	IWB26470	4A-1	6.38	IWB79322	7A-3	41.15
IWB25394	2B-2	16.41	IWB35451	4A-1	6.38	IWB26609	7A-3	46.61
IWB64764	2B-2	16.41	IWB38808	4A-1	11.84	IWB40293	7A-3	46.61
IWB24942	2B-2	23.7	IWB48645	4A-1	11.84	IWB23867	7A-3	62.12
IWB16127	2B-2	30.98	IWB28060	4A-1	14.6	IWB60653	7A-3	62.12
IWB37145	2B-2	30.98	IWB5324	4A-1	19.15	IWB74177	7A-3	62.12
IWB3865	2B-2	30.98	IWB19978	4A-1	23.7	IWB10460	7B	6.37
IWB81587	2B-2	30.98	IWB25567	4A-1	23.7	IWB24373	7B	6.37
IWB50665	2B-2	32.8	IWB62168	4A-1	23.7	IWB29340	7B	42.37
IWB32342	2B-2	36.44	IWB22179	4A-1	31	IWB45782	7B	46.92
IWB32407	2B-2	36.44	IWB74480	4A-1	44.92	IWB38103	7B	70.72
IWB32408	2B-2	36.44	IWB52575	4A-1	62.48	IWB56505	7B	70.72
IWB39927	2B-2	36.44	IWB80497	4A-1	64.3	IWB61935	7B	70.72
IWB4937	2B-2	41.9	IWB12109	4A-1	79.86	IWB42643	7B	74.37
IWB78090	2B-2	41.9	IWB52825	4A-1	79.86	IWB65870	7B	94.66
IWB17472	2B-2	43.72	IWB59546	4A-1	115.39	IWB17364	7B	114.11
IWB24269	2B-2	49.18	IWB73762	4B	20.54	IWB36453	7B	167.02
IWB29569	2B-2	49.18	IWB47765	4B	22.36	IWB29897	7B	169.75
IWB23553	2B-2	50.09	IWB12723	4B	23.27	IWB37598	7B	171.57
IWB32418	2B-2	51.91	IWB13175	4B	23.27	IWB3766	7B	171.57
IWB13304	2B-2	53.73	IWB33016	4B	23.27	IWB19608	7B	177.03
IWB15055	2B-2	53.73	IWB5735	4B	23.27	IWB16302	7B	186.13
IWB26190	2B-2	53.73	IWB23386	4B	27.83	IWB66412	7B	186.13
IWB7138	2B-2	53.73	IWB10190	4B	29.65	IWB1890	7B	207.15
IWB72468	2B-2	53.73	IWB53167	4B	29.65	IWB51676	7B	208.06
IWB74911	2B-2	53.73	IWB6157	4B	29.65	IWB51123	7B	211.7
IWB43935	2B-2	54.64	IWB23476	4B	33.29	IWB34678	7B	215.34
IWB5845	2B-2	58.28	IWB30536	4B	35.11	IWB58030	7B	216.25
IWB17880	2B-2	62.83	IWB80008	4B	50.62	IWB35057	7D-1	0
IWB52182	2B-2	62.83	IWB42230	4B	52.44	IWB46586	7D-1	0
IWB56087	2B-2	62.83	IWB81032	4B	64.28	IWB35823	7D-1	8.26
IWB72535	2B-2	62.83	IWB15584	4D-1	40.86	IWB54677	7D-1	11.9
IWB34446	2B-2	79.26	IWB65592	4D-1	40.86	IWB44780	7D-2	28.08
IWB39236	2B-2	79.26	IWB53961	4D-1	41.77	IWB60929	7D-2	28.08

Table S4. Summary of QTLs detected for physiological traits, plant height (PH), thousand kernels weight (TKW) and grain yield (GY) in the UI Platinum/SY Capstone DH population.

Traits	Linkage groups	No. of QTLs	Add ^a	R ^{2b}
CTa	1A, 2A-2, 2B-2, 2B-3, 3B-1, 4B, 5B-2, 6B	10	(-0.64) - 0.77	9.8 - 21.7
CTg1	1B-1, 2B-3, 2B-4, 3B-1, 3D-1, 5A, 5B-2, 6A-2, 6B, 7A-3	12	(-1.47) - 1.18	9.8 - 17.8
CTg2	1A, 1B-1, 2B-2, 2D-1, 2D-2, 3A-1, 4B, 5B-2, 5D-1, 6B, 7A-1	12	(-2.28) - 6.69	9.8 - 19.7
CCla	2A-1, 2B-3, 2D-1, 3A-1, 3A-2, 3D-1, 3D-2, 4A-1, 4D-1, 5A, 6A-2, 6B, 6D-3, 7A-2, 7B	15	(-3.44) - 3.26	9.9 - 19.2
CClg1	1D-1, 1D-2, 2B-2, 2D-1, 3A-2, 4A-1, 5A	9	(-6.80) - 9.26	11.0 - 31.3
CClg2	1A, 1B-1, 1B-2, 2D-1, 3A-2, 3B-1, 4A-1, 5A, 5B-2, 6D-3, 7A-3	13	(-4.33) - 4.99	10.2 - 25.2
PH	1A, 1B-1, 2B-1, 2D-1, 5A, 5B-2, 5D-3, 6A-2, 7A-2, 7B	12	(-3.55) - 3.75	9.9 - 21.8
KWT	2A-1, 2B-4, 2D-1, 3B-1, 3D-1 4A-2, 5A, 5B-2, 5D-1, 7B	15	(-2.83) - 2.16	10.2 - 31.1
GY	1A, 1B-1, 1B-2, 1D-1, 2A-1, 2B-2, 2B-4, 3B-1, 3D-1, 5A, 5B-2, 5D-3, 6A-2, 6B, 7A-1	18	(-2.04) - 1.16	9.8 - 20.8

^a Range of additive effect; positive “additive effect” indicated effect from SY Capstone, negative “additive effect” indicated effect from UI Platinum.

^b Range of percentage of phenotypic variation explained by individual QTL.

CTa, CTg1, CTg2, canopy temperature during anthesis, mid- and late grain-filling stage, respectively; CCla, CClg1, CClg2, chlorophyll content index during anthesis, mid- and late grain-filling stage, respectively; PH, plant height; TKW, thousand kernels weight; GY, grain yield.

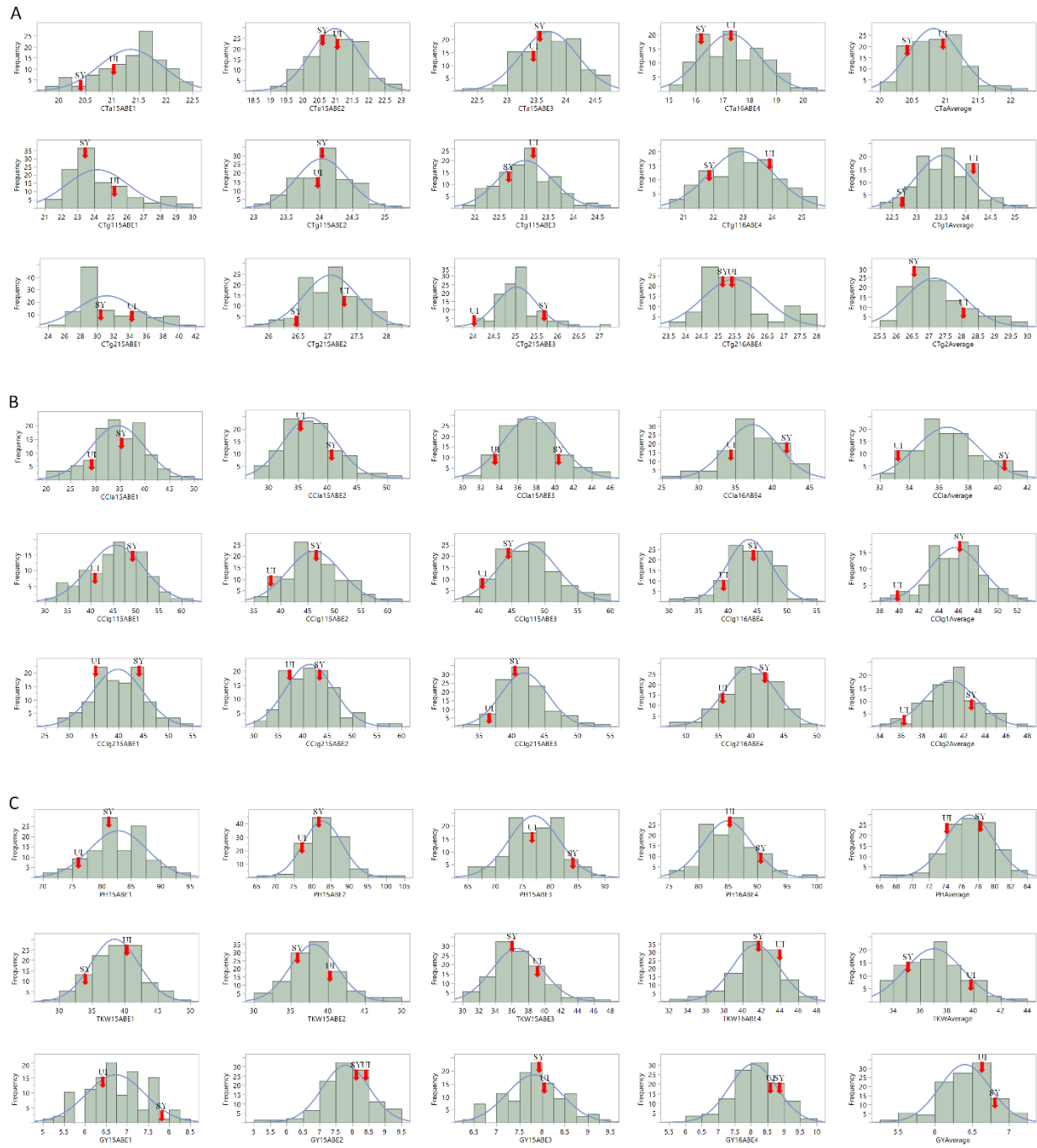


Figure S1. The frequency distribution of CT (A), CCI (B), PH, TKW and GY (C) in the DH population from UI Platinum / SY Capstone in the four environments.

15ABE1, 15ABE2, 15ABE3: trial 1, 2 and 3 in Aberdeen in 2015, respectively; 16ABE4, trial 4 in Aberdeen in 2016; CTa, CTg1, CTg2, canopy temperature during anthesis, mid- and late grain-filling stage, respectively; CCIa, CCIg1, CCIg2, chlorophyll content index during anthesis, mid- and late grain-filling stage, respectively; PH, plant height; TKW, thousand kernels weight; GY, grain yield.