

Supplementary Table 1. Primers used in this study for evaluating genetic mutations related to semi-dwarfing and grain size.

Gene	Primer	Sequence (5'-3')	Restriction Enzyme	Size (bp)	Annealing T _m (°C)	Reference	
<i>Rht-B1</i>	BF1	GGTAGGGAGGGGAGAGCGGAG	<i>Rht-B1a</i> : 237		66	Ellis et al. (2002)	
	WR1	CATCCCCATGGCCATCTCGAGCTG					
	BF2	TCTCCTCCCTCCCCACCCCAAC					
	MR1	CATCCCCATGGCCATCTCGAGCTA					
	DF2	GGCAAAGCAAAAAGCTTCGCG					
<i>Rht-D1</i>	WR2	GGCCATCTCGAGCTGCAC	<i>Rht-D1a</i> : 264		58	Ellis et al. (2002)	
	DF	CGCCAAATGGCCAGAGATAG	<i>Rht-D1b</i> : 254		67		
	MR2	CCCCATGGCCATCTCGAGCTGCTA					
<i>TaCWI-4A</i>	Ags-F	AGGGCGTCCGACCAAGTG	<i>Tai I</i>	Hap-4A-T: 885	60	Ma et al. (2012)	
	Ags-R	GCGACCTAGCGTGTATCAAGGAG		Hap-4A-C: 531, 354			
<i>TaCWI-5D</i>	Dgs-F	CATGTGCCTCTAAAATTAGGTTATG	<i>BstY I</i>	Hap-5D-C: 405, 244	51	Jiang et al. (2015)	
	Dgs-R	CGCCCAGATGATGTTCC		Hap-5D-G: 409, 143, 97			
<i>TaGW2-6A</i>	Hap-6A-P2-F	GAGAAAAGGCTGGTCTATGGA	<i>Taq I</i>	A: 167	57	Su et al. (2011)	
	Hap-6A-P2-R	GTAACGCTTGATAAACATAGGTAAT		G: 218			
<i>TaSus2-2B</i>	Sus2-SNP-227	CTATAGTATGAGCTGGATCAATGGC		L: 381	60	Jiang et al. (2010)	
	Sus2-SNP-589L2	GGTGTCCCTTGAGCTTCTGA					
<i>TaCwi-A1</i>	Sus2-SNP-185	TAAAGCGATGAAATTAATGGC		H: 423	60		
	Sus2-SNP-589H2	GGTGTCCCTTGAGCTTCTGG					
	CW122-F	GTGGTGATGAGTTTCATGGTTAAG		<i>TaCwi-A1a</i> : 402		55	Ma et al. (2012)
	CW122-R	AGAAAGCCCAACATTAATCAAC					
	CW121-F	GGTGATGAGTTTCATGGTTAAT		<i>TaCwi-A1b</i> : 404	57		
	CW121-R	AGAAAGCCCAACATTAAT CAA C				57	

Supplementary Table 2. Seminal root characteristics, length, depth and angle of 37 Korean wheat varieties for two years.

No	Year/Cultivar	No Root	Root Length (cm)	Maximum Depth (cm)	Total Root Length (cm)	Root Angle α ($^{\circ}$)	Root Angle β ($^{\circ}$)
1	Alchan	3.6	18.2	17.3	49.9	55.3	94.9
2	Anbaek	5.0	17.0	15.1	42.1	76.7	129.9
3	Baekchal	5.0	18.5	16.7	71.0	77.1	96.9
4	Baekjoong	5.3	16.3	16.4	60.9	46.5	126.4
5	Baekgang	4.8	18.4	16.2	62.8	52.2	87.3
6	Chunggye	4.5	16.2	15.8	45.6	60.2	135.1
7	Dabun	4.9	19.1	17.5	58.5	56.1	123.0
8	Dajoong	4.5	19.6	17.4	64.1	64.9	114.2
9	Eunpa	4.3	16.9	15.2	51.1	60.3	102.9
10	Gobun	5.0	17.3	15.4	60.8	56.9	133.3
11	Goso	4.5	19.1	16.4	52.5	75.9	119.4
12	Hanbaek	4.4	16.5	14.5	44.8	66.3	101.0
13	Hojoong	5.3	17.9	16.7	71.8	49.3	110.8
14	Jeokjoong	5.3	16.6	16.2	63.6	54.9	138.8
15	Jinpoom	5.3	16.4	15.7	53.5	43.8	138.0
16	Joa	4.8	17.5	15.0	57.8	56.4	116.2
17	Joeun	5.4	15.7	13.6	36.4	43.7	110.7
18	Johan	4.8	20.3	17.8	59.2	54.5	94.8
19	Jojoong	4.6	18.8	18.0	62.0	57.1	95.1
20	Jokyung	4.5	18.2	15.5	53.5	71.9	116.5
21	Jonong	4.8	17.5	14.9	43.4	79.9	115.1
22	Jopoom	4.9	19.3	17.0	66.2	59.0	107.0
23	Keumgang	4.6	19.1	17.9	68.1	54.4	105.1
24	Milsung	4.6	16.6	15.1	48.1	54.8	115.1
25	Namhae	4.9	16.0	14.8	58.0	58.6	134.9
26	Olgeuru	4.3	16.3	14.1	43.5	59.5	118.6
27	Saekeumgang	5.0	19.9	17.8	79.1	28.6	113.4
28	Saeol	4.9	16.3	13.5	49.8	75.8	141.8
29	Shinmichal	3.6	20.9	16.3	52.3	66.6	102.3
30	Shinmichal1	4.6	17.8	15.5	51.4	67.8	118.1
31	Suan	4.4	18.9	16.2	59.3	71.9	99.4
32	Sudoon	5.1	16.4	15.5	50.9	53.8	134.9
33	Sukang	4.3	19.9	17.6	61.4	65.7	102.6
34	Taejoong	5.4	17.5	16.2	53.9	49.8	109.6
35	Tapdong	3.5	18.1	17.4	47.3	51.3	88.7
36	Uri	4.8	18.2	17.0	54.3	49.6	142.6
37	Younbaek	5.4	18.9	16.6	70.3	51.8	121.9

Supplementary Table 3. Embryo characteristics- (length, width, and area), coleoptile length, test weight, and 1000-kernel weight of 37 Korean wheat varieties for two years.

No	Year/Cultivar	Embryo Length (mm)	Embryo Width (mm)	Embryo Area (mm ²)	Coleoptile Length (cm)	Test Weight	1000 Kernel Weight
1	Alchan	1.4	1.4	6.2	2.7	824	38.9
2	Anbaek	1.6	1.8	8.9	3.4	815	49.0
3	Baekchal	1.6	2.0	10.1	3.4	804	39.2
4	Baekjoong	1.6	1.7	8.8	3.1	802	42.3
5	Baekgang	1.7	2.2	11.6	3.4	813	49.9
6	Chunggye	1.5	1.5	7.2	2.5	809	36.0
7	Dabun	1.6	1.7	8.2	3.3	779	39.3
8	Dajoong	1.6	2.0	10.4	4.2	797	33.6
9	Eunpa	1.8	1.9	10.2	3.0	810	38.5
10	Gobun	1.6	1.8	9.5	3.2	814	39.1
11	Goso	1.6	1.6	8.2	3.1	814	44.7
12	Hanbaek	1.8	1.9	10.9	3.7	773	49.4
13	Hojoong	1.7	1.8	10.9	3.4	811	45.6
14	Jeokjoong	1.6	1.9	9.4	3.0	803	45.2
15	Jinpoom	1.7	1.8	9.6	2.9	830	39.2
16	Joa	1.5	1.7	7.9	3.1	773	42.9
17	Joeun	1.6	1.9	9.8	4.3	823	40.0
18	Johan	1.4	1.8	7.8	4.0	821	39.6
19	Jojoong	1.4	1.7	7.9	3.2	799	36.7
20	Jokyung	1.6	2.2	10.7	3.3	797	39.6
21	Jonong	1.4	1.7	7.4	4.0	826	44.6
22	Jopoom	1.4	1.6	7.1	4.2	797	40.2
23	Keumkang	1.7	1.9	10.0	3.9	799	48.9
24	Milsung	1.5	1.6	7.7	3.1	825	36.0
25	Namhae	1.7	1.8	9.8	3.2	794	39.5
26	Olgeuru	1.6	1.5	7.2	2.8	822	44.9
27	Saekeumkang	1.8	2.0	11.3	3.5	822	48.2
28	Saeol	1.5	1.9	8.8	3.3	803	38.3
29	Shinmichal	1.6	1.6	8.1	2.7	855	39.5
30	Shinmichall	1.6	2.0	10.1	3.5	812	34.4
31	Suan	1.6	1.6	8.1	3.9	813	43.8
32	Sudoon	1.7	1.7	8.6	3.0	824	38.3
33	Sukang	1.6	1.6	8.0	3.4	831	38.9
34	Taejoong	1.8	1.9	10.5	3.8	766	54.2
35	Tapdong	1.7	1.7	8.9	3.1	806	39.6
36	Uri	1.5	1.6	7.7	2.9	805	40.9
37	Younbaek	1.5	1.8	8.4	2.9	815	41.6

Supplementary Table 4. Allele frequency at loci for root, embryo, coleoptile, and grain traits in 37 Korean wheat varieties and phenotype variation depending on different alleles observed for two years.

Locus	Allele	Freq ¹ (%)	Seminal Root				Embryo			Coleoptile		Test Weight (g)	Thousand Kernel Weight (g)	
			No.	Length (cm)	Maximum Depth (cm)	Total Length (cm)	Angle α ($^{\circ}$)	Angle β ($^{\circ}$)	Width (mm)	Height (mm)	Area (mm ²)			Length (cm)
<i>Rht-B1</i>	<i>Rht-B1a</i>	64.9	4.7 ¹	17.6a	16.0a	55.9a	57.6a	116.7a	1.59a	1.74a	8.70a	3.3a	807a	40.9a
	<i>Rht-B1b</i>	35.1	4.6a	18.4a	16.2a	56.7a	61.3a	112.0a	1.61a	1.85a	9.38a	3.3a	812a	43.0a
<i>Rht-D1</i>	<i>Rht-D1a</i>	67.6	4.7a	18.3a	16.1a	56.5a	61.4a	110.6b	1.58a	1.81a	9.06a	3.5b	808a	42.5a
	<i>Rht-D1b</i>	32.4	4.7a	17.1b	16.1a	55.5a	53.6b	124.4a	1.61a	1.71a	8.69a	3.0a	811a	39.9a
<i>TaCwi-A1</i>	<i>TaCwi-A1a</i>	29.7	4.5a	17.7a	15.9a	54.0a	64.5a	107.1b	1.60a	1.87a	9.43a	3.3a	807a	41.4a
	<i>TaCwi-A1b</i>	70.3	4.8a	18.0a	16.2a	57.1a	56.5b	118.4a	1.59a	1.74a	8.73a	3.4a	810a	41.7a
<i>TaCWI-4A</i>	<i>Hap-4A-C</i>	18.9	4.8a	17.7a	15.7a	56.6a	56.6a	118.6a	1.66a	1.77a	9.29a	3.3a	800a	44.1a
	<i>Hap-4A-T</i>	73.0	4.7a	17.9a	16.3a	56.1a	59.0a	114.3a	1.57a	1.76a	8.73a	3.4a	812a	40.8a
<i>TaCWI-5D</i>	<i>Hap-4A-T/C</i>	8.1	4.8a	17.9a	15.5a	56.2a	63.3a	113.1a	1.61a	1.96a	10.0a	3.3a	795a	43.5a
	<i>Hap-5D-C</i>	89.2	4.7a	18.1a	16.3a	57.0a	57.9a	113.6a	1.60a	1.78a	9.00a	3.3a	808a	41.9a
<i>TaGW2-6A</i>	<i>Hap-5D-G</i>	10.8	4.8a	16.6b	14.6b	49.8a	67.3a	126.7a	1.53a	1.74a	8.42a	3.4a	812a	39.6a
	<i>A</i>	73.0	4.7a	17.6b	15.9a	54.2b	59.9a	117.1a	1.57a	1.72b	8.54b	3.3a	812a	40.6a
<i>TaSus2-2B</i>	<i>G</i>	27.0	4.8a	18.7a	16.7a	61.7a	56.1a	109.5a	1.65a	1.92a	10.0a	3.5a	799b	44.4a
	<i>H</i>	78.4	4.6b	18.1a	16.2a	56.3a	60.1a	115.3a	1.58a	1.73a	8.64b	3.3a	811a	40.6b
<i>L</i>	<i>L</i>	21.6	5.0a	17.3a	15.6a	55.8a	54.6a	114.0a	1.63a	1.94a	10.0a	3.4a	799a	45.3a

¹Frequency.

²Values followed by the same letters are not significantly different at $p < 0.05$.