Supplementary Materials

Association mapping in durum wheat grown across a broad range of water regimes

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Figure captions.

Figure S1. Phenotypic distribution for heading date (HD), plant height (PH), ear peduncle length (PdL), grain yield (GY), kernel weight (TKW), number of kernels per square meter (Kpsm) and test weight (TW) in the 189 elite durum wheat accessions (IDuWUE panel). The distributions refer to the mean values of each accession across the 15 field trials carried out in six Mediterranean countries (Italy, Lebanon, Morocco, Spain, Syria and Tunisia) and two years (2004 and 2005) under different soil moisture conditions. The overall mean value is indicated with an arrow.

Figure S2. Clustering of the 189 elite durum wheat accessions (IDuWUE panel) used in the association mapping study. The dendrogram has been obtained with the distance-based cluster analysis method (SAHN and UPGMA) using the pairwise genetic similarities values (simple-matching genetic similarity coefficient for multi-state markers) between accessions.
Additionally, the model based-cluster analysis (STRUCTURE software) results are reported: each accession has been assigned to one of the five subgroups (from S1 to S5) labeled with white- and black-filled diamonds (S1 and S2), black-filled triangles (S3), grey- and black-filled circles (S4 and S5).
The founder of each subgroup is indicated in the right side of the figure.

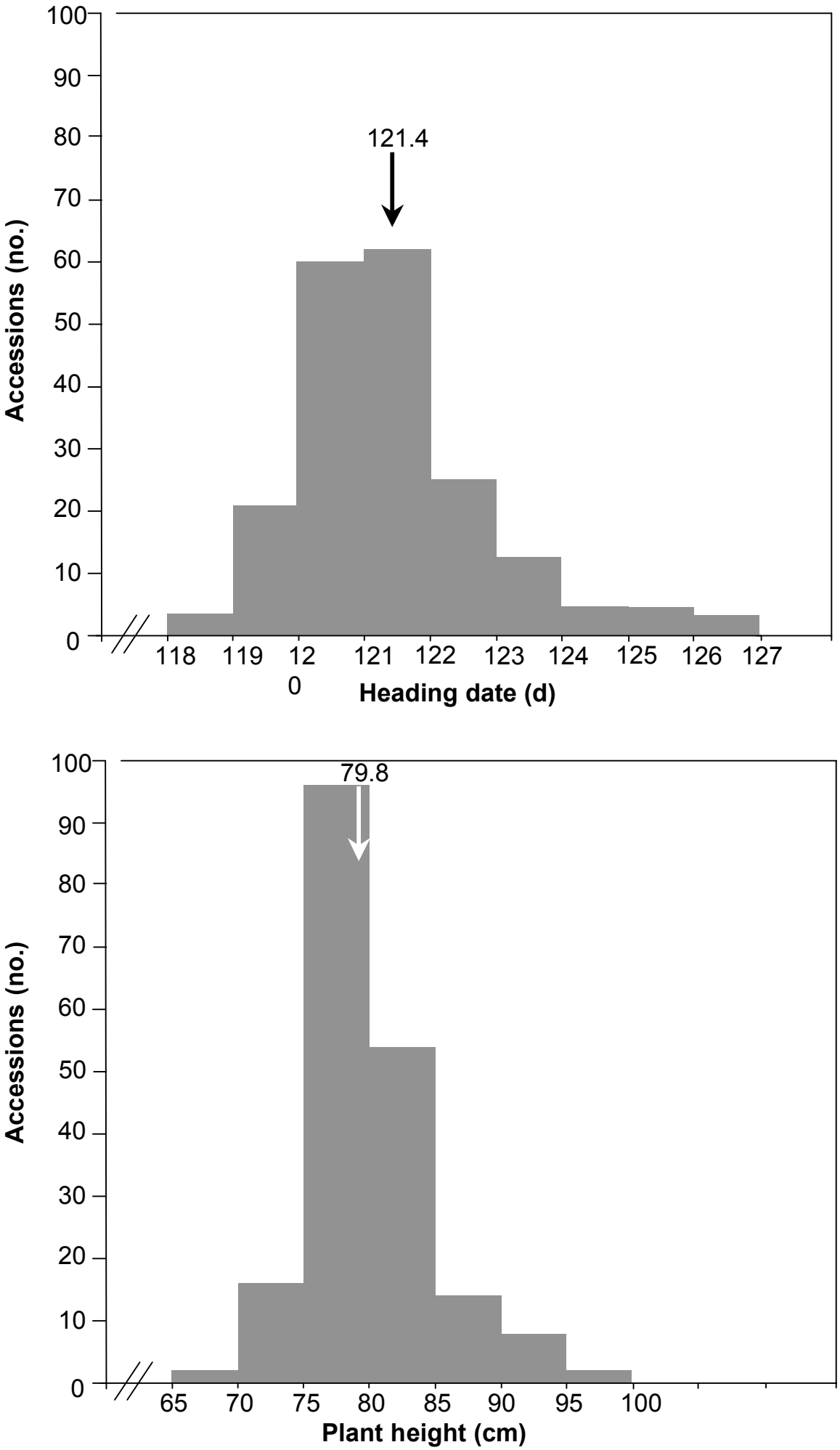
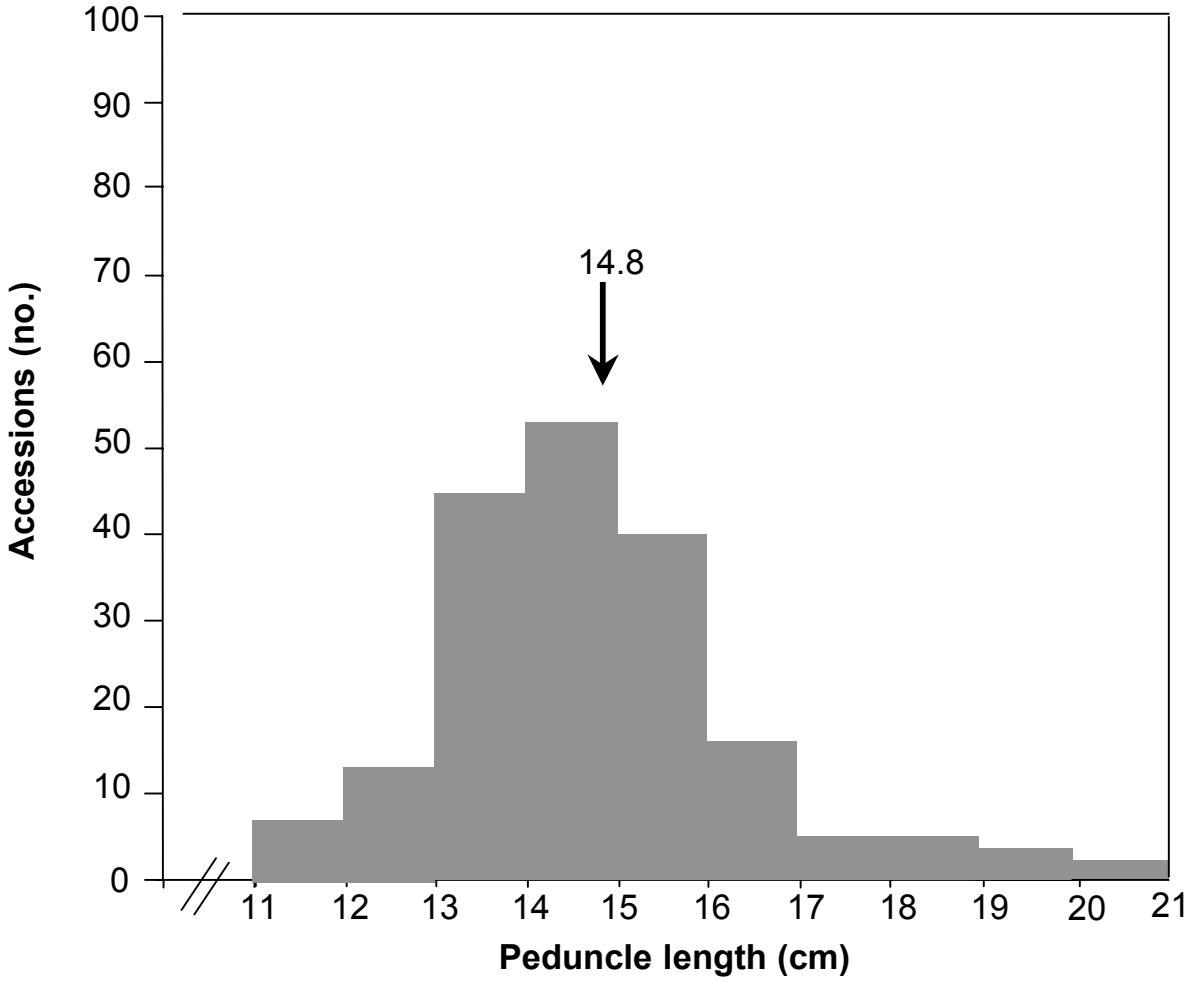


Figure S1. **Maccaferri *et al.***



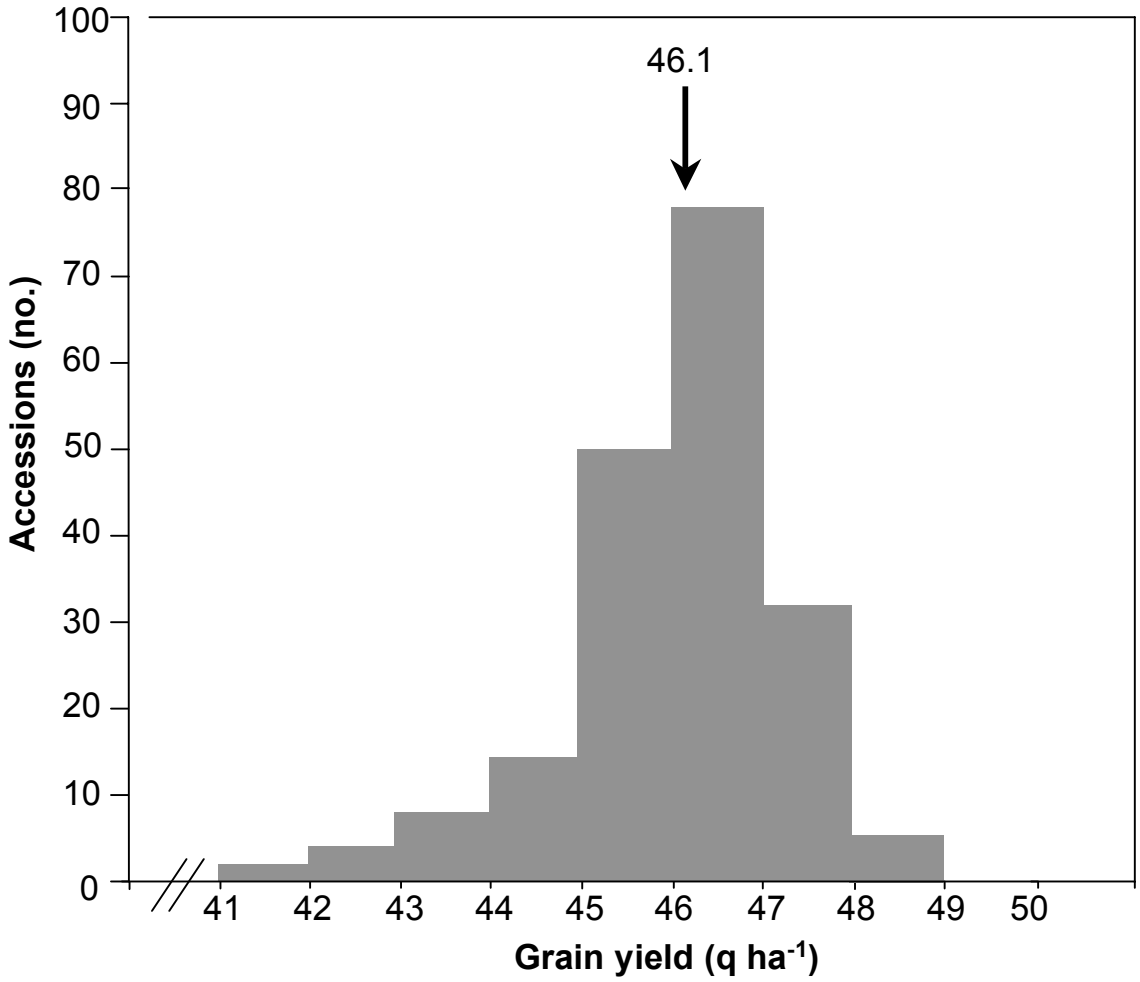
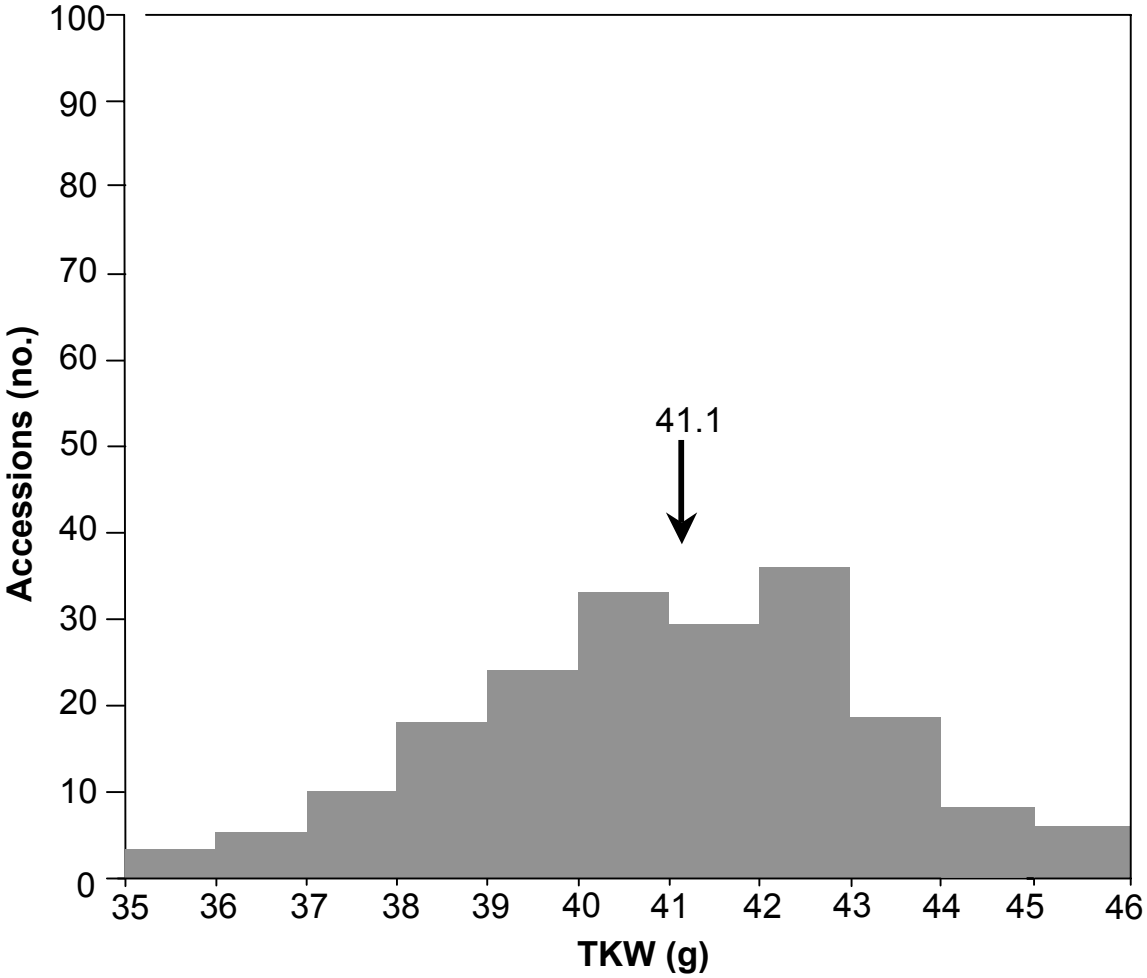


Figure S1. Maccaferri *et al.*



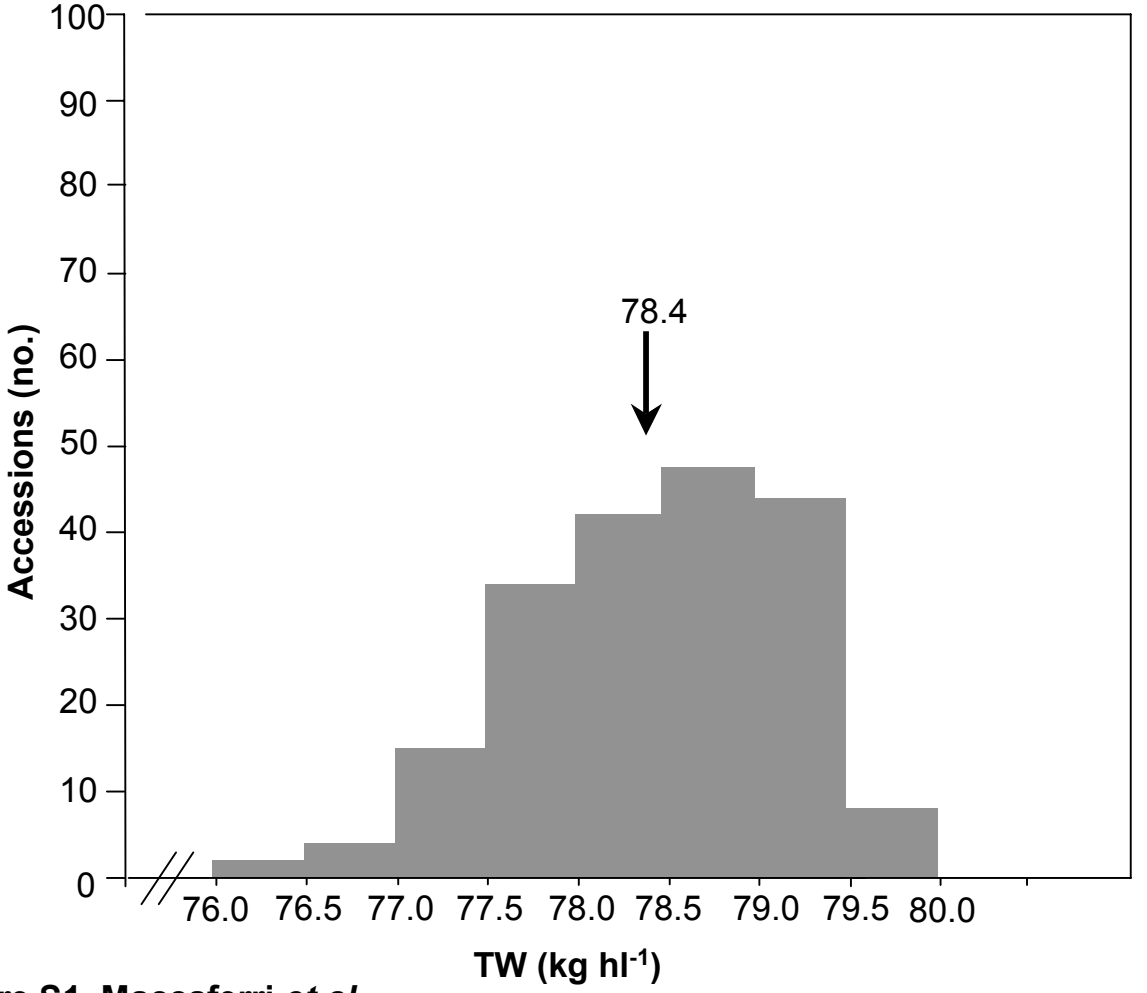


Figure S1. Maccaferri *et al.*

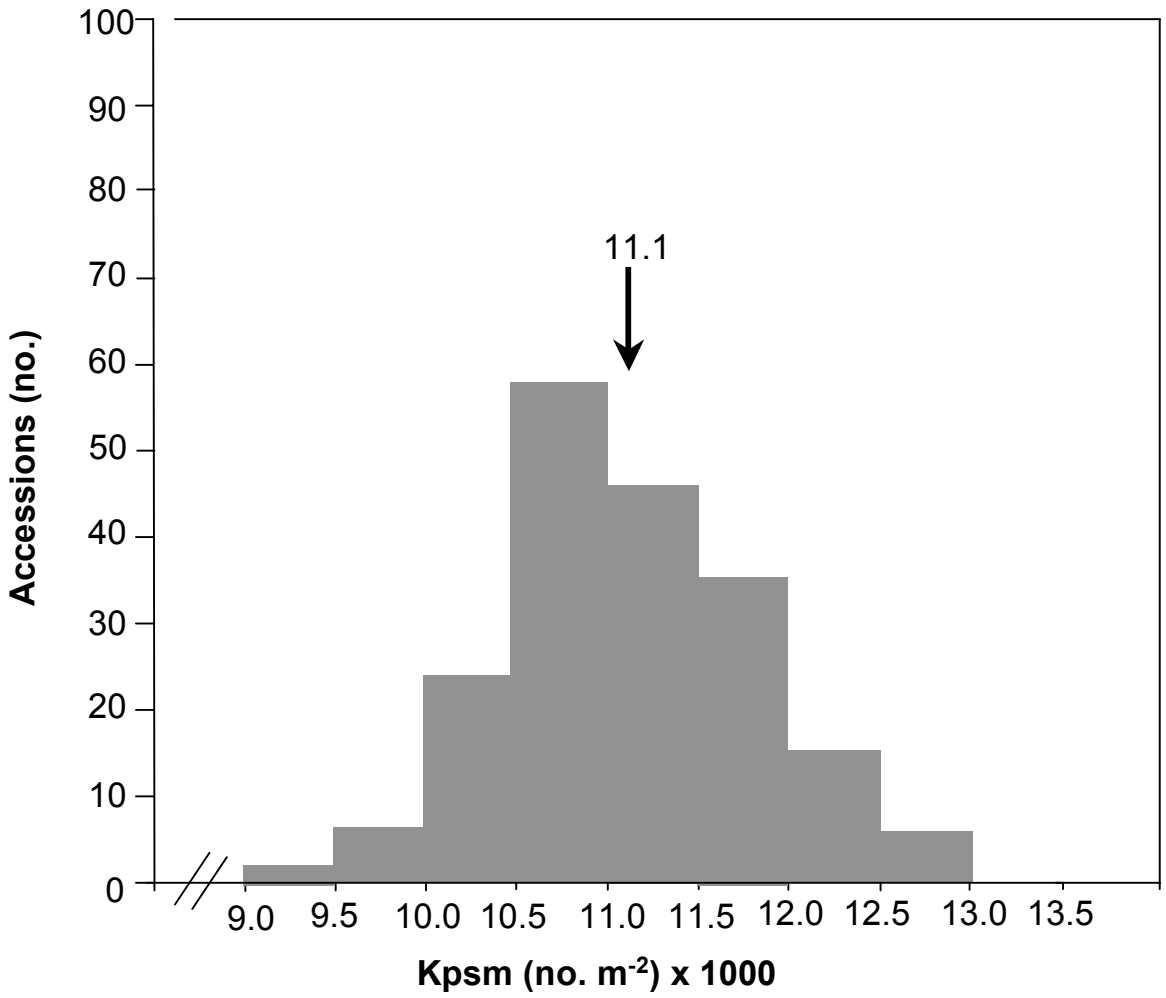


Figure S1. Maccaferri *et al.*

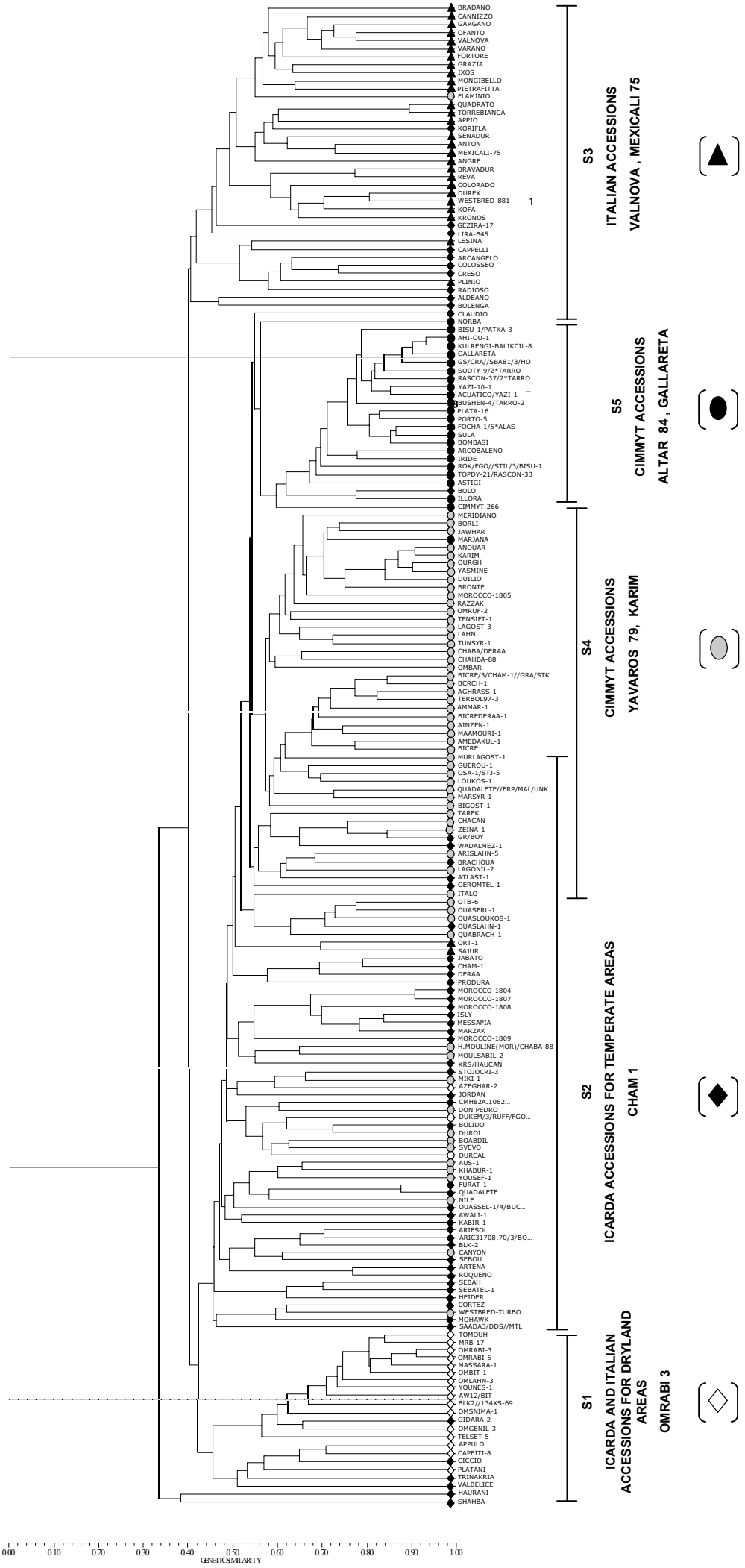


Figure S2.

Maccaferri *et al.*

Accessions' subpopulation assignments as obtained from the population genetics model based - cluster analysis (STRUCTURE software) are reported with white, grey and black filled triangles, circles and diamonds.

Table S1. List of the 189 durum wheat elite accessions of the IDuWUE panel used in the association mapping study. Name, origin and individual coefficient of memberships to the five population subgroups (from S1 to S5) as obtained in the STRUCTURE analysis based on 96 loosely linked SSRs are reported. Each accession was assigned to the subgroup with the highest membership coefficient. Within each subgroup the accessions are listed in decreasing order based on the membership coefficient. For each subgroup, the main founder accession name has been reported within brackets.

Accession	Origin	Germplasm genetic structure: main subgroups and individual subgroup membership				
		S1	S2	S3	S4	S5
		ICARDA germplasm for dryland areas	ICARDA germplasm for temperate areas	Italian and early '70 CIMMYT germplasm	CIMMYT germplasm (late '70-early '80)	CIMMYT germplasm (late '80-early '90)
Subgroup S1 - ICARDA dryland (Omrabi 3)						
TOMOUH	Syria [a]	**0.971**	0.007	0.006	0.011	0.005
OMBIT 1	Syria	**0.968**	0.010	0.009	0.009	0.004
MASSARA 1	Syria	**0.956**	0.009	0.006	0.018	0.012
MRB 17	Syria	**0.949**	0.023	0.006	0.016	0.005
OMRABI 3	Syria	**0.948**	0.010	0.009	0.027	0.006
OMRABI 5	Syria	**0.944**	0.012	0.011	0.012	0.020
AW12/BIT	Syria	**0.940**	0.013	0.031	0.009	0.006
YOUNES 1	Syria	**0.789**	0.014	0.014	0.173	0.010
Blk2//134xS-69-186/368-1/3/Mrb5/4/Albit3	Syria	**0.703**	0.059	0.176	0.042	0.020
OMLAHN 3	Syria	**0.679**	0.132	0.025	0.093	0.072
OMSNIMA 1	Syria	**0.606**	0.204	0.016	0.159	0.016
CAPEITI 8	Italy	**0.598**	0.076	0.314	0.005	0.007
TELSET 5	Syria	**0.514**	0.435	0.022	0.015	0.013
AZEGHAR 2	Syria	**0.483**	0.056	0.050	0.384	0.026
OMGENIL 3	Syria	**0.421**	0.117	0.029	0.415	0.017
APPULO	Italy	**0.408**	0.225	0.354	0.008	0.005
Subgroup S2 - ICARDA temperate (Cham 1)						
ISLY	Morocco	0.011	**0.959**	0.009	0.009	0.012
MOROCCO 1808	Morocco	0.015	**0.942**	0.015	0.017	0.011
MESSAPIA	Italy	0.010	**0.940**	0.024	0.017	0.010
MOROCCO 1809	Morocco	0.012	**0.934**	0.011	0.025	0.018
MOROCCO 1804	Morocco	0.017	**0.921**	0.021	0.021	0.020
SHABHA	Syria	0.016	**0.920**	0.038	0.014	0.012
ARTENA	Spain	0.014	**0.920**	0.026	0.014	0.026
MOROCCO 1807	Morocco	0.011	**0.914**	0.014	0.051	0.010
COLOSSEO	Italy	0.012	**0.902**	0.007	0.063	0.015
ALDEANO	Spain	0.016	**0.898**	0.060	0.016	0.010

Table S1. (continued)

Accession	Origin	Germplasm genetic structure: main subgroups and individual subgroup membership				
		S1	**S2**	**S3**	**S4**	**S5**
		ICARDA germplasm for dryland areas	**ICARDA germplasm for temperate areas**	**Italian and early '70 CIMMYT germplasm**	**CIMMYT germplasm (late '70-early '80)**	**CIMMYT germplasm (late '80-early '90)**
Subgroup S2 - ICARDA temperate (Cham 1)						
ROQUENO	Spain	0.027	**0.897**	0.013	0.042	0.021
PRODURA	Italy	0.007	**0.890**	0.015	0.082	0.006
SEBOU	Spain	0.022	**0.884**	0.016	0.048	0.030
FURAT 1	Syria	0.015	**0.880**	0.063	0.033	0.008
Aric 31708.70/3/Bo//C.de Chile/Br/4/Cit/Gta	Syria	0.059	**0.855**	0.022	0.042	0.022
Ouassel-1/4/Buc/Chrc//Prl/3/Pvn/5/Hel/3/Bit/Corm//Shwa	Syria	0.007	**0.847**	0.011	0.090	0.045
JABATO	Spain	0.035	**0.841**	0.020	0.072	0.032
ARIESOL	Spain	0.010	**0.827**	0.050	0.078	0.035
JORDAN	Syria	0.022	**0.825**	0.052	0.090	0.011
SAADA 3/DDS//MTL 1	Syria	0.013	**0.824**	0.060	0.076	0.027
SEBAH	Syria	0.010	**0.809**	0.011	0.160	0.010
HEIDER	Syria	0.020	**0.804**	0.006	0.155	0.014
RADIOSO	Italy	0.029	**0.787**	0.140	0.032	0.012
CMH82A.1062/3/GG0VZ394/ /SBA81/PLC/4/AAZ	Mexico [b]	0.047	**0.784**	0.014	0.127	0.029
CHAM 1	Syria	0.028	**0.779**	0.033	0.149	0.011
BOLIDO	Spain	0.073	**0.769**	0.011	0.109	0.038
SEBATEL 1	Syria	0.035	**0.762**	0.010	0.184	0.010
HAURANI	Syria	0.238	**0.712**	0.032	0.009	0.009
APPIO	Italy	0.164	**0.706**	0.046	0.015	0.069
QUADALETE	Syria	0.023	**0.698**	0.197	0.076	0.007
BOLO	Spain	0.013	**0.690**	0.010	0.041	0.246
MARZAK	Morocco	0.276	**0.683**	0.016	0.014	0.011
BOLENGA	Spain	0.026	**0.653**	0.255	0.060	0.006
DERAA	Syria	0.017	**0.630**	0.034	0.272	0.047
STOJOCRI 3	Syria	0.122	**0.617**	0.023	0.228	0.010
BLK2	Syria	0.016	**0.615**	0.020	0.287	0.062
KRS/HAUCAN	Syria	0.018	**0.608**	0.013	0.340	0.021
LIRA B 45	Italy	0.047	**0.598**	0.332	0.016	0.007
VALBELICE	Italy	0.261	**0.591**	0.133	0.010	0.006

Table S1. (continued)

Accession	Origin	Germplasm genetic structure: main subgroups and individual subgroup membership				
		S1	**S2**	**S3**	**S4**	**S5**
		ICARDA germplasm for dryland areas	**ICARDA germplasm for temperate areas**	**Italian and early '70 CIMMYT germplasm**	**CIMMYT germplasm (late '70-early '80)**	**CIMMYT germplasm (late '80-early '90)**
Subgroup S2 - ICARDA temperate (Cham 1)						
ATLAST 1	Syria	0.014	**0.583**	0.020	0.328	0.056
MOROCCO 1805	Morocco	0.097	**0.559**	0.010	0.308	0.026
CRESO	Italy	0.020	**0.554**	0.023	0.393	0.009
ARCANGELO	Italy	0.196	**0.548**	0.168	0.077	0.011
MURLAGOST 1	Syria	0.008	**0.532**	0.009	0.391	0.059
GEROMTEL 1	Syria	0.023	**0.521**	0.029	0.386	0.041
CAPPELLI	Italy	0.053	**0.517**	0.384	0.016	0.030
DURCAL	Spain	0.032	**0.507**	0.015	0.412	0.033
KABIR 1	Syria	0.028	**0.489**	0.204	0.261	0.018
AWALI 1	Syria	0.081	**0.465**	0.115	0.323	0.017
KORIFLA	Syria	0.060	**0.458**	0.260	0.033	0.188
MOHAWK	USA [e]	0.018	**0.457**	0.291	0.218	0.015
GIDARA 2	Syria	0.429	**0.449**	0.014	0.100	0.007
BRACHOUA	Syria	0.032	**0.448**	0.042	0.359	0.118
DUKEM/3/RUFF/FGO//YAV79	Mexico	0.027	**0.448**	0.064	0.331	0.013
OUASLAHN	Syria	0.015	**0.444**	0.158	0.292	0.090
TRINAKRIA	Italy	0.224	**0.440**	0.299	0.025	0.011
GEZIRA 17	Syria	0.022	**0.427**	0.487	0.055	0.009
CORTEZ	USA [c]	0.071	**0.419**	0.079	0.383	0.048
WADALMEZ 1	Syria	0.010	**0.370**	0.245	0.207	0.169
GR/BOY	Syria	0.034	**0.365**	0.277	0.269	0.054
CLAUDIO	Italy	0.009	**0.360**	0.260	0.149	0.222
Subgroup S3 – Italian / CIMMYT germplasm (Valnova, Mexicali 75)						
VALNOVA	Italy	0.006	0.010	**0.970**	0.006	0.008
BRADANO	Italy	0.012	0.012	**0.949**	0.012	0.015
ANTON	Spain	0.046	0.013	**0.907**	0.009	0.025
DUREX	USA	0.015	0.053	**0.897**	0.019	0.017
OFANTO	Italy	0.038	0.040	**0.895**	0.008	0.019

Table S1. (continued)

Accession	Origin	Germplasm genetic structure: main subgroups and individual subgroup membership				
		S1	**S2**	**S3**	**S4**	**S5**
		ICARDA germplasm for dryland areas	**ICARDA germplasm for temperate areas**	**Italian and early '70 CIMMYT germplasm**	**CIMMYT germplasm (late '70-early '80)**	**CIMMYT germplasm (late '80-early '90)**
Subgroup S3 – Italian / CIMMYT germplasm (Valnova, Mexicali 75)						
GARGANO	Italy	0.091	0.022	**0.870**	0.007	0.010
WB 881	USA	0.011	0.105	**0.857**	0.007	0.020
BRAVADUR	USA	0.021	0.086	**0.829**	0.052	0.012
CANNIZZO	Italy	0.086	0.027	**0.803**	0.064	0.020
IXOS	Italy	0.018	0.117	**0.790**	0.063	0.012
VARANO	Italy	0.109	0.014	**0.767**	0.099	0.011
GRAZIA	Italy	0.018	0.022	**0.765**	0.161	0.034
FORTORE	Italy	0.111	0.134	**0.735**	0.006	0.013
MEXICALI 75	Mexico	0.020	0.015	**0.729**	0.041	0.195
MONGIBELLO	Italy	0.013	0.094	**0.715**	0.041	0.136
KRONOS	USA	0.008	0.115	**0.679**	0.193	0.006
CICCIO	Italy	0.338	0.014	**0.639**	0.005	0.005
KOFA	USA	0.026	0.339	**0.614**	0.013	0.008
PLINIO	Italy	0.035	0.210	**0.606**	0.109	0.041
PIETRAFITTA	Italy	0.009	0.019	**0.598**	0.365	0.010
REVA	USA	0.010	0.304	**0.584**	0.090	0.011
LESINA	Italy	0.136	0.248	**0.568**	0.038	0.011
PLATANI	Italy	0.389	0.019	**0.561**	0.009	0.021
TORREBIANCA	Italy	0.012	0.270	**0.538**	0.013	0.168
QUADRATO	Italy	0.045	0.357	**0.514**	0.030	0.053
COLORADO	USA	0.011	0.275	**0.511**	0.186	0.017
SENADUR	Spain	0.014	0.397	**0.430**	0.020	0.138
ANGRE	Spain	0.022	0.250	**0.383**	0.158	0.187
SAJUR	Syria	0.022	0.158	**0.365**	0.259	0.196
ORT 1	Syria	0.044	0.281	**0.330**	0.061	0.284
Subgroup S4 – CIMMYT (Yavaros 79, Karim)						
KARIM	Tunisia	0.006	0.008	0.004	**0.975**	0.007
DUILIO	Italy	0.007	0.008	0.004	**0.973**	0.008

Table S1. (continued)

Accession	Origin	Germplasm genetic structure: main subgroups and individual subgroup membership				
		S1	**S2**	**S3**	**S4**	**S5**
		ICARDA germplasm for dryland areas	**ICARDA germplasm for temperate areas**	**Italian and early '70 CIMMYT germplasm**	**CIMMYT germplasm (late '70-early '80)**	**CIMMYT germplasm (late '80-early '90)**
Subgroup S4 – CIMMYT (Yavaros 79, Karim)						
OURGH	Morocco	0.008	0.007	0.004	**0.969**	0.012
ANOUAR	Morocco	0.004	0.014	0.007	**0.967**	0.007
MAAMOURI 1	Syria	0.009	0.016	0.010	**0.951**	0.014
YASMINE	Morocco	0.031	0.008	0.004	**0.949**	0.008
TERBOL 97-3	Syria	0.023	0.013	0.013	**0.940**	0.011
AINZEN 1	Syria	0.006	0.028	0.013	**0.939**	0.014
BICRE	Syria	0.018	0.038	0.009	**0.927**	0.009
AGHRASS 1	Syria	0.021	0.008	0.026	**0.919**	0.025
BCRCH 1	Syria	0.035	0.029	0.007	**0.916**	0.012
BRONTE	Italy	0.023	0.020	0.069	**0.880**	0.008
LOUKOS 1	Syria	0.022	0.055	0.018	**0.872**	0.033
AMEDAKUL 1	Syria	0.022	0.115	0.011	**0.842**	0.011
AMMAR 1	Syria	0.010	0.044	0.093	**0.840**	0.013
CHABHA 88	Syria	0.024	0.101	0.010	**0.839**	0.026
LAHN	Syria	0.035	0.016	0.013	**0.829**	0.108
TENSIFT 1	Syria	0.042	0.078	0.054	**0.817**	0.009
OUASLOUKOS 1	Syria	0.087	0.059	0.027	**0.787**	0.041
TUNSYR 1	Syria	0.030	0.131	0.013	**0.757**	0.069
ADYT 02 - 505//OSA-1/STJ-5	Syria	0.016	0.174	0.007	**0.754**	0.049
WEST BRED TURBO	USA	0.143	0.064	0.024	**0.751**	0.018
OMRUF 2	Syria	0.011	0.102	0.016	**0.746**	0.124
BORLI	Spain	0.009	0.044	0.012	**0.723**	0.212
BIC/3/CHAM1//GRA//STK	Syria	0.207	0.043	0.010	**0.720**	0.021
SVEVO	Italy	0.047	0.216	0.017	**0.700**	0.020
QUAD//ERP/MAL/3/UNKN	Syria	0.274	0.027	0.006	**0.668**	0.025
BICREDERAA 1	Syria	0.022	0.270	0.037	**0.661**	0.010
MERIDIANO	Italy	0.173	0.131	0.031	**0.640**	0.025
GUEROU 1	Syria	0.008	0.292	0.023	**0.640**	0.037

Table S1. (continued)

Accession	Origin	Germplasm genetic structure: main subgroups and individual subgroup membership				
		S1	**S2**	**S3**	**S4**	**S5**
		ICARDA germplasm for dryland areas	**ICARDA germplasm for temperate areas**	**Italian and early '70 CIMMYT germplasm**	**CIMMYT germplasm (late '70-early '80)**	**CIMMYT germplasm (late '80-early '90)**
Subgroup S4 – CIMMYT (Yavaros 79, Karim)						
RAZZAK	Tunisia	0.020	0.233	0.013	**0.635**	0.100
CANYON	Spain	0.010	0.286	0.010	**0.632**	0.061
OTB 6	Syria	0.045	0.302	0.016	**0.624**	0.013
MIKI 1	Syria	0.034	0.301	0.036	**0.620**	0.008
YOUSEF 1	Syria	0.006	0.346	0.018	**0.610**	0.019
JAWHAR	Morocco	0.022	0.034	0.047	**0.599**	0.298
TAREK	Morocco	0.019	0.350	0.009	**0.591**	0.032
NILE	Syria	0.033	0.352	0.015	**0.589**	0.011
QUABRACH 1	Syria	0.065	0.128	0.213	**0.579**	0.015
MARSYR 1	Syria	0.234	0.152	0.038	**0.566**	0.010
BIGOST 1	Syria	0.041	0.372	0.010	**0.551**	0.026
FLAMINIO	Italy	0.010	0.010	0.431	**0.538**	0.011
ARISLAHN 5	Syria	0.071	0.106	0.274	**0.526**	0.023
LAGONIL 2	Syria	0.055	0.295	0.099	**0.514**	0.037
DUROI	Spain	0.042	0.378	0.009	**0.510**	0.062
DON PEDRO	Syria	0.078	0.353	0.025	**0.507**	0.036
CHABA/DERAA	Syria	0.038	0.339	0.028	**0.506**	0.089
H.MOUL(MOR)/CHABA 88	Syria	0.009	0.428	0.018	**0.501**	0.044
AUS 1	Syria	0.027	0.234	0.194	**0.501**	0.044
MOULSABIL 2	Syria	0.007	0.258	0.068	**0.499**	0.168
OMBAR	Syria	0.352	0.049	0.015	**0.489**	0.096
CHACAN	Syria	0.020	0.307	0.075	**0.477**	0.121
OUASERL 1	Syria	0.259	0.159	0.054	**0.469**	0.059
KHABUR 1	Syria	0.009	0.440	0.072	**0.461**	0.018
LAGOST 3	Syria	0.019	0.225	0.066	**0.422**	0.267
BOABDIL	Spain	0.054	0.362	0.008	**0.403**	0.172
ZEINA 1	Syria	0.039	0.314	0.216	**0.363**	0.069
ITALO	Italy	0.090	0.329	0.182	**0.352**	0.047

Table S1. (continued)

Accession	Origin	Germplasm genetic structure: main subgroups and individual subgroup membership				
		S1	**S2**	**S3**	**S4**	**S5**
		ICARDA germplasm for dryland areas	**ICARDA germplasm for temperate area**	**Italian and early '70 CIMMYT germplasm**	**CIMMYT germplasm (late '70-early '80)**	**CIMMYT germplasm (late '80-early '90)**
Subgroup S5 – CIMMYT (Altar 84, Gallareta)						
GALLARETA	Spain	0.004	0.005	0.004	0.006	**0.980**
AHI-OU 1	Mexico	0.007	0.014	0.006	0.005	**0.969**
GS/CRA//SBA81/3/HO/MEXI_1/5/MEMO/6/2*…	Mexico	0.005	0.010	0.007	0.028	**0.951**
KULRENGI-BALIKCIL 8	Mexico	0.012	0.018	0.006	0.020	**0.944**
SOOTY_9/2*TARRO 1	Mexico	0.080	0.010	0.011	0.008	**0.891**
BUSHEN 4/TARRO 2//BUSHEN 4	Mexico	0.015	0.099	0.007	0.013	**0.865**
PORTO 5	Mexico	0.021	0.018	0.014	0.103	**0.844**
ACUATICO/YAZI 1	Mexico	0.007	0.053	0.013	0.122	**0.805**
RASCON 37/2*TARRO 2	Mexico	0.013	0.155	0.007	0.031	**0.793**
FOCHA 1/5*ALAS	Mexico	0.005	0.008	0.006	0.206	**0.775**
BISU 1/PATKA 3	Mexico	0.008	0.192	0.042	0.025	**0.733**
YAZI 10.1	Mexico	0.014	0.067	0.015	0.172	**0.732**
ARCOBALENO	Spain	0.005	0.012	0.011	0.299	**0.673**
PLATA 16	Mexico	0.011	0.029*	0.010	0.282	**0.667**
BOMBASI	Spain	0.010	0.006	0.006	0.321	**0.657**
TOPDY 21/RASCON 33	Mexico	0.008	0.302	0.028	0.037	**0.625**
SULA	Spain	0.010	0.018	0.035	0.327	**0.609**
ASTIGI	Spain	0.015	0.202	0.011	0.200	**0.573**
MARJANA	Morocco	0.011	0.026	0.033	0.386	**0.544**
ROK/FGO//STIL/3/BISU 1	Mexico	0.012	0.176	0.023	0.245	**0.544**
ILLORA	Spain	0.013	0.416	0.019	0.033	**0.518**
IRIDE	Italy	0.010	0.193	0.038	0.302	**0.456**
NORBA	Italy	0.080	0.218	0.176	0.079	**0.448**
CIMMYT 266	Mexico	0.019	0.323	0.034	0.267	**0.358**

[a] All accessions from Syria were selected at ICARDA.

[b] All accessions from Mexico were selected at CIMMYT.

[c] All accessions from USA were selected in Arizona (desert durums).

Table S2. Thermo-pluviometrical data and soil moisture in critical growth stages in the field trials carried out in 15 environments of six Mediterranean countries (Italy, Lebanon, Morocco, Spain, Syria and Tunisia) and two years (2004 and 2005) under different soil moisture regimes.

Environment [a]	Water input (WI) [b]		Soil moisture (SM) [c]				Temperature (T) [d]			
							mean		max	
	EmHd	HdHt	JnHd	Hd	JnHt	HdHt	EmHd	HdHt	EmHd	HdHt
High yielding										
Tns-i05	277	39	14.2	12.7	14.2	15.2	13	19	9	26
Itl1-r04	526	58	56.9	18.2	57.0	17.9	11	20	7	27
Spn1-r04	195	54	19.8	7.3	19.8	6.6	14	21	9	29
Itl2-r04	227	107	15.1	10.4	15.1	11.8	15	19	10	26
Syr-i05	176	68	9.9	8.4	9.9	18.9	13	20	8	29
Itl2-r05	195	11	14.2	9.2	14.2	10.9	14	21	9	28
Lbn-i05	369	108	7.5	7.5	7.5	81.5	16	18	9	27
Medium yielding										
Syr-r05	200	14	8.0	6.7	8.1	7.4	15	22	9	31
Tns-r05	227	39	7.2	7.5	7.2	11.1	13	19	9	26
Lbn-i04	611	100	18.0	8.1	18.0	9.5	15	16	9	24
Lbn-r05	369	8	9.3	8.2	9.3	66.6	16	17	9	27
Mrc-i04	539	82	16.2	8.6	16.2	30.4	20	14	13	21
Low yielding										
Mrcr04	88	82	12.8	7.5	12.8	29.1	20	15	13	21
Lbn-r04	611	6	14.1	7.2	14.1	8.8	15	16	9	24
Spn2-r05	175	12	4.9	6.0	4.9	10.3	17	23	9	32

[a] Details on the environment acronyms are provided in Materials and Methods. Environments are listed in a decreasing order based on the mean grain yield values. High- (> 54 q ha^{-1}), medium- (from 30 to 46 q ha^{-1}) and low-yielding (< 30 q ha^{-1}) environments are reported in **bold,** *italic* and regular font, respectively.

[b] Water input as mm of water (rainfall + supplementary irrigation) measured from emergence to heading (EmHd) and from heading to harvest (HdHt).

[c] Soil moisture as area under the soil water content curve (from 0 to 30 cm deep) measured from jointing to heading (JnHd), from 1 week before heading to 3 weeks after heading (Hd), from jointing to maturity (JnHt) and from heading to maturity (HdHt).

[d] Temperatures (maximum and mean) as °C from emergence to heading (EmHd) and from heading to harvest (HdHt).

Table S3. Summary of the significant correlations between grain yield (GY) and heading date (HD), plant height (PH), peduncle length (PdL) and grain yield components (kernels per square meter, Kpsm; thousand kernel weight, TKW; test weight, TW) on a single environment basis. For each environment, significant correlation coefficients (*r*) are reported within brackets (*r* values have been listed from the lowest to the highest). High- (GY > 54 q ha^{-1}), medium- (from 30 to 46 q ha^{-1}) and low-yielding (< 30 q ha^{-1}) environments are reported in **bold**, *italic* and regular font, respectively.

Traits	**Correlations (no.)**		**Environments with significant correlations and corresponding *r* values**	
	Total	**Significant**	***P* 0.05**	***P* 0.01**
GY vs. HD	15	8		*Syr-r05* (- 0.40), **Syr-i05** (- 0.37), *Mrc-i04* (- 0.34), **Itl2-r05** (- 0.31), *Lbn-i04* (- 0.19), Mrc-r04 (- 0.20), **Tns-i05** (0.21), **Lbn-i05** (0.22)
GY vs. PH	13	5		**Tns-i05** (0.24), **Itl2-r04** (0.26), *Lbn-i04* (0.25), *Lbn-r05* (0.43), **Lbn-i05** (0.51)
GY vs. PdL	13	5	**Lbn-i05** (0.15), Syr-*r05* (0.16)	*Lbn-i04* (0.23), *Lbn-r05* (0.30), *Tns-r05* (0.33)
GY vs. Kpsm	15	13		**Itl2-r05** (0.19), Syr-*r05* (0.33), **Spn1-r04** (0.41), **Tns-i05** (0.46), **Syr-i05** (0.49), *Lbn-i04* (0.49), **Itl1-r04** (0.59), *Tns-r05* (0.67), *Lbn-r05* (0.71), Mrc-r04 (0.73), Spn2-r05 (0.77), Lbn-r04 (0.90), *Mrc-i04* (0.98)
GY vs. TKW	15	7	*Lbn-r05* (0.14), *Mrc-i04* (0.15), *Syr-r05* (0.17), Mrc-r04 (0.18)	**Syr-i05** (0.24), *Tns-r05* (0.36), Spn2-r05 (0.78)
GY vs. TW	11	7		Spn2-r05 (- 0.24), **Itl2-r04** (0.19), **Tns-i05** (0.20), **Itl1-r04** (0.21), *Lbn-r05* (0.24), **Lbn-i05** (0.25), *Tns-r05* (0.29)
HD vs. PH	13	4		Syr-*r05* (- 0.19), **Itl2-r05** (- 0.33), **Syr-i05** (- 0.36), **Lbn-i05** (0.25)
HD vs. PdL	13	7	**Itl2-r04** (- 0.16)	**Itl2-r05** (- 0.43), **Syr-i05** (- 0.38), Lbn-r04 (- 0.31), *Lbn-i04* (- 0.30), *Lbn-r05* (- 0.28), *Syr-r05* (- 0.19)
HD vs. Kpsm	15	10	*Lbn-i04* (- 0.18), Lbn-r04 (- 0.16), **Tns-i05** (0.16), **Spn1-r04** (0.17), **Itl2-r05** (0.17)	*Mrc-i04* (- 0.33), Mrc-r04 (- 0.23), **Syr-i05** (- 0.19), **Itl2-r04** (0.18), **Lbn-i05** (0.24)
HD vs. TKW	15	4	**Itl2-r04** (- 0.18), **Lbn-i05** (- 0.17)	**Itl2-r05** (- 0.27), **Spn1-r04** (- 0.19)
HD vs. TW	11	3	**Itl1-r04** (0.18)	**Itl2-r05** (- 0.27),*T ns-r05* (- 0.23)
PH vs. PdL	13	13		Lbn-r04 (0.36), Spn2-r05 (0.51), *Lbn-r05* (0.51), **Lbn-i05** (0.59), **Itl2-r05** (0.62), *Tns-r05* (0.65), **Tns-i05** (0.65), *Lbn-i04* (0.65), **Itl2-r04** (0.65), **Spn1-r04** (0.68), Syr-*r05* (0.71), **Syr-i05** (0.73), **Itl1-r04** (0.81)
PH vs. Kpsm	13	2		**Tns-i05** (- 0.33), Lbn-*r05* (0.30)
PH vs. TKW	13	4	**Lbn-i05** (0.16)	Spn2-r05 (0.19), **Tns-i05** (0.21), *Tns-r05* (0.25)
PH vs. TW	11	8	**Spn1-r04** (0.16), **Lbn-i05** (0.17), *Lbn-r05* (0.18)	*Lbn-i04* (0.19), **Itl2-r04** (0.29), **Itl2-r05** (0.23), **Tns-i05** (0.42), *Tns-r05* (0.45)
PdL vs. Kpsm	13	3	**Tns-i05** (- 0.17), **Syr-i05** (- 0.15)	*Lbn-r05* (0.33)
PdL vs. TKW	13	3	**Itl2-r05** (0.15)	**Tns-i05** (0.22), *Tns-r05* (0.22)

Table S3. (Continued)

Traits	Correlations (no.)		Environments with significant correlations and corresponding *r* values	
	Total	Significant	*P* 0.05	*P* 0.01
PdL vs. TW	13	8	**Spn1-r04** (0.15), **Lbn-i05** (0.17)	**Itl2-r04** (0.23), *Lbn-i04* (0.24), *Lbn-r05* (0.27), **Itl2-r05** (0.28), **Tns-i05** (0.35), *Tns-r05* (0.42)
Kpsm vs. TKW	15	14		**Itl2-r04** (- 0.99), **Lbn-i05** (- 0.97), **Itl2-r05** (- 0.95), **Spn1-r04** (- 0.89), Syr-*r05* (- 0.87), *Lbn-i04* (- 0.84), **Tns-i05** (- 0.82), **Itl1-r04** (- 0.77), **Syr-i05** (- 0.73), *Lbn-r05* (- 0.60), Mrc-r04 (-0.54), *Tns-r05* (- 0.45), Lbn-r04 (- 0.39), Spn2-r05 (0.20)
Kpsm vs. TW	11	5	**Spn1-r04** (- 0.15), Spn2-r05 (- 0.14), **Itl1-r04** (0.16)	**Itl2-r04** (- 0.33), **Itl2-r05** (- 0.53)
TKW vs. TW	11	7		Spn2-r05(- 0.23), **Spn1-r04** (0.20), **Tns-i05** (0.22), **Itl2-r04** (0.32), *Tns-r05* (0.36), *Lbn-r05* (0.39), **Itl2-r05** (0.55)

Table S4. List of the 191 genomic SSR loci used to profile the 189 elite durum wheat accessions (IDuWUE panel). For each SSR locus, the total number of alleles and the number of non-rare alleles (i.e. with frequency > 10%) are reported.

SSR locus	Chr. location	Total alleles (no.)	Non-rare alleles (no.)	SSR locus	Chr. location	Total alleles (no.)	Non-rare alleles (no.)
Xgwm33-1	1AS	3	2	*Xgwm1198-3*	2AS	5	3
Xwmc24	1AS	3	2	*Xwmc522-1*	2AS	11	3
Xbarc119	1AS	3	1	*Xgwm1045*	2AS	6	3
Xwmc469	1AS	8	2	*Xgwm294*	2AL	5	3
Xcfa2129	1AL	13	4	*Xgwm265-1*	2AL	4	2
Xbarc213	1AL	8	2	*Xgwm410-1*	2BS	3	3
Xgwm497-1	1AL	6	2	*Xbarc183-1*	2BS	3	3
Xcfa2147-2	1AL	3	3	*Xbarc40*	2BS	5	3
Xbarc287	1AL	2	2	*Xbarc55-1*	2BS	6	4
Xbarc158-2	1AL	3	3	*Xbarc101-1*	2BL	3	2
Xgwm33-2	1BS	4	3	*Xgwm120*	2BL	6	2
Xwmc85-1	1BS	3	2	*Xwmc175*	2BL	4	2
Xbarc128-2	1BS	5	1	*Xgwm47-1*	2BL	7	3
Xwmc500-1	1BS	5	2	*Xwmc332*	2BL	5	4
Xbarc8	1BS	6	2	*Xgwm1070-1*	2BL	4	3
Xcfd65	1BS	2	2	*Xgwm846-2*	2BL	7	2
Xgwm131-1	1BL	9	2	*Xgwm1027*	2BL	5	2
Xwmc419	1BL	4	3	*Xwmc356*	2BL	3	3
Xgpw93013	1BL	8	3	*Xwmc361*	2BL	3	3
Xbarc81	1BL	3	2	*Xwmc532*	2BL	7	3
Xgwm124	1BL	4	2	*Xbarc12*	3AS	9	3
Xbarc188	1BL	2	2	*Xbarc45*	3AS	5	4
Xcfa2147-1	1BL	3	2	*Xcfa2234*	3AS	2	2
Xwmc59-2	1BL	3	3	*Xwmc664*	3AS	7	3
Xbarc80	1BL	4	3	*Xwmc388-2*	3AS	4	3
Xgwm1355	1BL	2	2	*Xgwm1620*	3AL	3	3
Xgwm140	1BL	3	2	*Xwmc264*	3AL	6	4
Xcfa2086	1BL	5	2	*Xgwm1159*	3AL	3	2
Xcfd251-1	1BL	2	2	*Xcfa2262*	3AL	2	2
Xbarc212	2AS	9	4	*Xbarc69*	3AL	3	2
Xgwm636	2AS	6	3	*Xcfa2193*	3AL	7	2
Xwmc177	2AS	7	3	*Xgwm1038 b*	3AL	5	1
Xgwm1198-2	2AS	3	2	*Xbarc1113*	3AL	9	2

Table S4. Continued

SSR locus	Chr. location	Total alleles (no.)	Non-rare alleles (no.)	SSR locus	Chr. location	Total alleles (no.)	Non-rare alleles (no.)
Xbarc1177	3AL	9	4	*Xgwm6*	4BL	10	4
Xgwm493	3BS	5	2	*Xcfd54-1*	4BL	5	2
Xbarc102	3BS	5	2	*Xgwm1574*	5AS	4	2
Xgwm779	3BS	8	4	*Xwmc489-1*	5AS	5	2
Xgwm685	3BS	4	3	*Xbarc303*	5AS	2	2
Xcfd4	3BS	3	2	*Xgwm293*	5AS	4	3
Xbarc203	3BL	6	3	*Xbarc360*	5AL	9	2
Xbarc164	3BL	5	3	*Xgwm1236*	5AL	4	2
Xbarc115	3BL	4	2	*Xbarc197*	5AL	8	2
Xksum157	3BL	2	2	*Xwmc388-1*	5AL	3	2
Xbarc84	3BL	3	2	*Xbarc151*	5AL	5	3
Xgwm299	3BL	6	2	*Xgwm1570*	5AL	5	2
Xgwm1093	4AS	11	3	*Xcfa2141*	5AL	8	2
Xgwm165-2 b	4AS	2	1	*Xwmc524*	5AL	2	2
Xwmc89-2 b	4AS	2	1	*Xwmc727*	5AL	4	3
Xgwm894	4AL	6	2	*Xgwm410-2*	5AL	2	2
Xwmc468 b	4AL	4	1	*Xgwm335*	5BL	5	2
Xbarc155	4AL	4	2	*Xdupw205*	5BL	3	2
Xwmc161	4AL	6	3	*Xwmc537*	5BL	6	2
Xwmc336	4AL	2	2	*Xcfd7*	5BL	2	2
Xcfd31	4AL	4	3	*Xwmc326*	5BL	7	2
Xbarc78-2	4AL	3	2	*Xgwm408*	5BL	3	3
Xwmc219	4AL	3	2	*Xcfa2121*	5BL	3	2
Xwmc313	4AL	6	2	*Xbarc232-1*	5BL	8	3
Xbarc193	4BS	5	3	*Xbarc232-2*	5BL	2	2
Xgwm1278	4BS	2	2	*Xgwm459*	6AS	3	2
Xwmc254	4BS	6	2	*Xgwm1009*	6AS	6	2
Xgwm856	4BS	5	4	*Xksum98*	6AS	4	2
Xbarc340-1	4BS	3	3	*Xgwm1296 b*	6AS	3	1
Xwmc89-1	4BL	5	2	*Xgwm82 b*	6AS	3	1
Xgwm165-1	4BL	7	4	*Xbarc37 b*	6AS	3	1
Xgwm495	4BL	6	5	*Xbarc171*	6AS	4	3
Xgwm1084	4BL	7	3	*Xgwm356*	6AL	4	2

Table S4. Continued

SSR locus	Chr. location	Total alleles (no.)	Non-rare alleles (no.)	SSR locus	Chr. location	Total alleles (no.)	Non-rare alleles (no.)
Xwmc256	6AL	3	2	*Xwmc323*	7BS	8	4
Xwmc553	6AL	5	2	*Xbarc1005 b*	7BS	3	1
Xgwm1017	6AL	9	4	*Xgwm400*	7BS	5	4
Xcfa2114	6AL	8	3	*Xwmc182-2*	7BS	5	4
Xgwm617-1	6AL	4	3	*Xgwm573*	7BS	5	4
Xdupw167	6AL	8	4	*Xgwm1184*	7BS	5	2
Xdupw217	6BS	5	3	*Xgwm3019*	7BS	5	3
Xwmc486	6BS	4	2	*Xgwm46*	7BS	8	2
Xgwm494	6BS	5	3	*Xbarc72 b*	7BS	3	1
Xgwm518	6BS	7	3	*Xgwm297*	7BS	5	2
Xbarc14	6BS	6	2	*Xgwm333*	7BL	7	3
Xgwm193	6BS	4	3	*Xwmc396*	7BL	8	3
Xgwm88-1	6BL	6	2	*Xbarc176 b*	7BL	7	1
Xbarc198	6BL	3	3	*Xbarc278*	7BL	3	3
Xgwm1682	6BL	6	3	*Xwmc517*	7BL	8	3
Xgwm219	6BL	8	2	*Xgwm577*	7BL	10	3
Xgwm889-1	6BL	5	2	*Xgwm611-1*	7BL	6	4
Xbarc134	6BL	6	2	*Xgwm611-2*	7BL	6	4
Xwmc621	6BL	5	3	*Xwmc276*	7BL	5	4
Xgwm735	7AS	5	2	*Xwmc273-1*	7BL	5	4
Xwmc479	7AS	7	3	*Xcfa2040-1*	7BL	7	3
Xgwm1187	7AS	6	4	*Xbarc32-1*	7BL	7	3
Xwmc179	7AS	7	2	*Xbarc50*	7BL	2	2
Xbarc174	7AS	5	2	*Xwmc526-1*	7BL	5	3
Xwmc488	7AL	3	3	*Xwmc526-2*	7BL	5	3
Xcfa2123	7AL	12	3	*Xbarc340-2*	7BL	5	3
Xwmc273-2	7AL	10	3	*Xgwm146*	7BL	6	3
Xgwm344-1	7AL	5	3	*Xcfa2257-2*	7BL	2	2
Xcfa2257-1	7AL	5	2	*Xgwm344-2*	7BL	3	2
Xcfa2040-2	7AL	10	3				
				Mean		**5.1**	**2.5**

Table S5. Allele frequencies at *VRN-A1* (intron 1 region), *Ppd-A1* and *Rht-B1* in the IDuWUE panel and in the five subgroups (from S1 to S5) obtained with the model-based clustering method.

Germplasm	**Accession (no.)**	***VRN-1*** **(intron 1 deletion)**		***Ppd-A1***			***RhtB1***	
		vrn-A1	***Vrn-A1c***	**Wild-type**	**1,027 bp deletion**	**1,117 bp deletion**	***RhtB1a***	***RhtB1b***
		Vernalization-		**Photoperiod-**			**Plant height**	
		sensitive	**insensitive**	**sensitive**	**insensitive**	**insensitive**	**Tall**	**Semidwarf**
Entire panel	189	0.03	0.97	0.33	0.17	0.50	0.13	0.87
Subgroups								
S1 [a]	16	0.13	0.87	1.00	0.00	0.00	0.87	0.13
S2 [b]	61	0.07	0.93	0.30	0.25	0.45	0.10	0.90
S3 [c]	30	0.00	1.00	0.62	0.34	0.04	0.00	1.00
S4 [d]	58	0.00	1.00	0.18	0.05	0.77	0.05	0.95
S5 [e]	24	0.00	1.00	0.00	0.09	0.91	0.04	0.96

[a] ICARDA germplasm for dryland areas (founder: Omrabi 3).
[b] ICARDA germplasm for temperate areas (founder: Cham 1).
[c] Italian and early ’70 CIMMYT germplasm (founders: Valnova, Mexicali 75).
[d] CIMMYT germplasm (late ’70 – early ’80; founders: Yavaros 79, Karim).
[e] CIMMYT germplasm (late ’80 – early ’90; founders: Altar 84, Gallareta).

Table S6. Phenotypic least square means (GLM) for the frequent allelic variants (indicated as A followed by a number) of some of the most valuable SSR-trait associations. Codes of environments are listed in decreasing order based on their mean grain yield values. High-, medium- and low-yielding environments are reported in **bold**, *italic* and regular font, respectively. Allelic mean values are reported only for the environments showing significant marker-trait associations.

a) ***Xwmc469*** **(chr. 1AS)**

Environment	Thousand kernel weight (g)		Test weight (kg hl^{-1})	
	A2	A7	A2	A7
High-yielding				
Tns-i05	33.6	33.2	78.3	78.9
Itl1-r04	43.8	44.2	**69.7**	**70.6**
Itl2-r04	40.2	40.6	78.2	78.7
Itl2-r05	32.6	32.7	**80.2**	**81.1**
Medium-yielding				
Tns-r05	27.9	27.5	**74.3**	**75.3**
Lbn-i04	36.9	37.0	81.1	81.4
Lbn-r05	35.1	35.2	75.7	76.1
Low-yielding				
Lbn-r04	**37.0**	**37.7**	**81.0**	**81.7**

b) ***Xbarc213*** **(chr. 1AL)**

Environment	Peduncle length (cm)		Kernels m^{-2} (no.)		Thousand kernel weight (g)	
	A5	A7	A5	A7	A5	A7
High-yielding						
Tns-i05	17.9	18.0	20160	20767	33.5	32.0
Itl1-r04	17.5	17.7	15397	15703	44.4	42.7
Spn1-r04	20.3	20.7	14324	14782	44.7	42.7
Itl2-r04	18.7	18.7	14552	14958	39.2	37.4
Itl2-r05	13.6	13.8	18229	18333	31.2	30.8
Lbn-i05	16.1	15.1	12468	12715	45.5	44.5
Medium-yielding						
Tns-r05	17.5	18.0	16665	16963	27.1	26.3
Lbn-i04	14.3	14.4	11402	11601	36.7	35.9
Lbn-r05	11.6	11.6	10429	10654	**35.1**	**34.0**
Mrc-i04	-	-	**8761**	**9286**	**38.8**	**38.2**
Low-yielding						
Mrc-r04	-	-	7282	7580	**38.5**	**36.5**
Lbn-r04	9.0	9.1	5800	5704	37.4	36.5
Spn2-r05	5.6	5.2	3260	3176	27.1	26.3

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at *P* 0.05 and *P* 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level.

Table S6. (Continued)

c) *Xbarc287* (chr. 1AL)

Environment	Kernels m^{-2} (no.)		Thousand kernel weight (g)	
	A1	A2	A1	A2
High-yielding				
Spn1-r04	13717	14158	47.6	45.9
Itl2-r04	13709	14084	42.7	41.0
Syr-i05	14641	15059	33.8	33.3
Itl2-r05	**16920**	**17605**	**34.5**	**33.0**
Medium-yielding				
Syr-r05	11652	12032	**39.1**	**37.7**
Tns-r05	16340	16818	27.8	27.4
Lbn-i04	**11037**	**11356**	38.3	37.4
Lbn-r05	10258	10388	**36.2**	**35.5**
Mrc-i04	8465	8734	39.5	39.1
Low-yielding				
Mrc-r04	6947	7095	**40.2**	**39.0**
Lbn-r04	**5521**	**5949**	**39.1**	**38.1**

d) *Xcfd65* (chr. 1B centromeric)

Environment	Peduncle length (cm)		Kernels m^{-2} (no.)		Thousand kernel weight (g)		Test weight (kg hl^{-1})	
	A1	A2	A1	A2	A1	A2	A1	A2
High-yielding								
Tns-i05	**18.7**	**17.7**	**20359**	**20924**	33.9	32.5	79.3	78.8
Itl1-r04	**19.1**	**17.5**	15661	15662	44.8	44.0	70.5	70.7
Spn1-r04	21.0	20.3	**13838**	**14413**	46.5	45.3	79.8	79.6
Itl2-r05	**14.7**	**13.6**	17460	17817	**33.5**	**32.5**	81.5	81.2
Medium-yielding								
Syr-r05	14.3	13.8	**11689**	**12138**	38.1	37.0	-	-
Tns-r05	18.5	17.5	16553	16840	27.7	27.0	75.5	75.4
Lbn-r05	11.5	11.6	10171	10326	35.5	35.2	76.1	76.0
Lbn-i04	14.7	14.4	11398	11456	37.0	36.9	**81.6**	**81.2**

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at *P* 0.05 and *P* 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level.

Table S6. (Continued)

e) *Xwmc419* (chr. 1BL)

Environment	Plant height (cm)			Peduncle length (cm)		
	A1	A2	A3	A1	A2	A3
High-yielding						
Tns-i05	94.5 a	91.2 b	86.9 c	18.4	17.9	16.7
Itl1-r04	**83.7 a**	**81.3 a**	**76.2 b**	**20.3 a**	**17.5 b**	**15.8 c**
Spn1-r04	**93.5 a**	**91.5 b**	**86.3 c**	**21.8 a**	**20.2 b**	**18.9 c**
Itl2-r04	81.0 a	79.6 ab	77.2 b	**20.5 a**	**18.9 b**	**17.7 b**
Syr-i05	90.4	90.2	87.3	20.6 a	19.3 b	18.0 c
Itl2-r05	**87.7**	**86.3**	**81.9**	15.0 a	13.7 b	12.9 b
Lbn-i05	77.8	78.9	77.7	16.4 a	15.2 b	14.2 c
Medium-yielding						
Syr-r05	83.2 a	83.0 a	79.1 b	15.3	14.7	13.6
Tns-r05	94.6 a	91.0 b	87.1 c	19.2	17.7	17.3
Lbn-i04	86.1 a	83.6 b	81.6 c	14.8 a	14.4 ab	14.1 b
Lbn-r05	65.3	65.6	64.3	**12.5 a**	**11.6 b**	**10.8 c**
Mrc-i04	-	-	-	-	-	-

f) *Xcfa2086* (chr. 1BL)

Environment	Heading date (d)		Peduncle length (cm)		Grain yield (q ha^{-1})	
	A4	A5	A4	A5	A4	A5
High-yielding						
Tns-i05	100.4	99.8	17.9	17.7	69.3	68.1
Itl1-r04	173.0	173.9	16.8	17.7	69.3	68.6
Spn1-r04	120.6	121.2	19.7	20.4	65.0	64.8
Itl2-r05	143.2	143.8	13.2	13.7	**58.3**	**57.5**
Lbn-i05	106.5	106.9	19.0	19.8	56.0	56.0
Medium-yielding						
Syr-r05	**136.0**	**136.9**	13.0	14.2	45.2	45.0
Lbn-i04	141.3	142.0	14.4	14.3	42.5	42.2
Lbn-r05	106.9	107.6	11.8	11.6	36.7	36.8
Mrc-i04	107.6	108.6	-	-	**35.9**	**33.7**
Low-yielding						
Mrc-r04	101.0	103.0	-	-	27.6	27.9
Lbn-r04	110.7	111.3	8.9	9.3	22.3	22.1

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at *P* 0.05 and *P* 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level. When significance was detected for loci with three or more non-rare alleles, the least significant difference between the allele means was calculated: means followed by different letters are significantly different.

Table S6. (Continued)

g) *Xgwm294* (chr. 2AL)

Env.	Heading date (d)			Plant height (cm)			Peduncle length (cm)			Kernels m^{-2} (no.)			Thousand kernel weight (g)			Test weight (kg hl^{-1})		
	A2	A4	A5	A2	A4	A5	A2	A4	A5	A2	A4	A5	A2	A4	A5	A2	A4	A5
High-yielding																		
Tns-i05	100.1	99.4	96.2	**88.4 b**	**90.7 b**	**97.6 a**	17.5	17.8	18.0	**20651 a**	**20543 a**	**18907 b**	**33.5 b**	**33.1 b**	**36.4 a**	78.0 b	78.9 a	79.5 a
Itl1-r04	173.7	173.7	172.9	**81.3 b**	**81.7 b**	**97.2 a**	**17.4 b**	**17.9 b**	**20.2 a**	15471	15577	15425	44.9	44.5	45.5	70.6	70.8	71.3
Spn1-r04	120.9	121.0	120.5	**90.5 b**	**91.8 b**	**96.8 a**	**20.0 b**	**20.7 b**	**22.3 a**	13987 a	14272 a	13605 b	46.8	45.8	47.9	79.3	79.7	80.3
Itl2-r04	111.1	111.1	110.2	79.5	80.2	82.4	**17.9 b**	**19.1 b**	**20.4 a**	13759	14069	13664	42.4	41.1	42.9	78.5	78.8	79.1
Syr-i05	110.7	110.3	109.9	**88.4 b**	**90.9 b**	**96.1 a**	**19.1 b**	**20.0 b**	**21.3 a**	14756	15063	14661	**40.0 b**	**38.8 c**	**41.4 a**	-	-	-
Itl2-r05	143.6	143.5	143.0	85.8 b	86.4 b	90.7 a	**13.7 b**	**14.0 b**	**16.0 a**	17359 a	17668 a	16917 b	**33.9 b**	**32.7 c**	**34.9a**	81.3 b	81.2 b	82.0 a
Lbn-i05	106.7	106.7	106.2	79.3	79.4	80.3	**16.1 b**	**16.0 b**	**17.6 a**	12142	12350	12226	46.5	45.6	45.7	80.5	80.5	80.5
Medium-yielding																		
Syr-r05	136.6 a	136.5 a	134.9 b	**80.6 b**	**81.7 b**	**87.1 a**	13.8 b	14.2 b	15.7 a	**11897 a**	**12225 a**	**11467 b**	**37.9 b**	**36.9 b**	**39.6 a**	-	-	-
Tns-r05	99.4	99.0	99.3	**87.9 b**	**89.9 b**	**97.4 a**	**17.7 b**	**17.7 b**	**20.0 a**	16305	16779	16525	27.7 b	27.3 b	28.5 a	75.2	75.3	76.0
Lbn-i04	141.6 a	141.6 a	140.5 b	82.9	83.1	84.3	14.5 b	14.4 b	14.8 a	11355	11289	11077	36.2	37.1	35.7	81.5	81.5	81.6
Lbn-r05	107.4 a	107.2 a	106.3 b	65.8	65.9	66.7	11.6 b	11.8 b	12.9 a	10356	10344	10242	35.8 b	35.4 b	36.2 a	76.3 b	76.1 b	76.6 a
Mrc-i04	108.5 a	108.1 a	106.2 b	-	-	-	-	-	-	8419	8865	8939	39.3	39.2	40.2	-	-	-
Low-yielding																		
Mrc-r04	102.4 a	102.1 a	99.1 b	-	-	-	-	-	-	6978	7208	7057	39.3	39.2	40.1	-	-	-
Lbn-r04	140.7	140.8	139.73	66.4	66.5	67.2	9.1 b	9.6 b	10.3 a	5870	5883	5798	38.5	38.0	38.5	-	-	-
Spn2-r05	120.9	121.0	120.5	53.0 a	52.1 b	52.4 b	5.6	5.6	5.6	3272	3315	3318	27.8	27.4	28.2	76.8	76.9	77.2

h) *Xgwm410.1* (chr. 2BS)

Environment	Thousand kernel weight (g)			Test weight (kg hl^{-1})			Grain yield (q ha^{-1})		
	A1	A2	A3	A1	A2	A3	A1	A2	A3
High-yielding									
Itl1-r04	44.1	44.3	43.4	70.5 a	70.5 a	69.7 b	69.0 a	69.0 a	68.3 b
Spn1-r04	45.3	45.2	45.2	79.6 a	78.8 b	79.2 ab	65.0	65.4	64.3
Itl2-r04	40.7 a	40.6 a	38.9 b	78.7	78.4	78.2	58.0	58.0	58.0
Syr-i05	37.2 a	37.4 a	35.9 b	-	-	-	**58.2 a**	**59.2 a**	**56.3 b**
Itl2-r05	32.9 a	32.1 a	31.6 b	81.1 a	80.7 b	80.6 b	57.9	58.2	57.8
Lbn-i05	45.9 ab	47.0 a	44.5 b	80.5	80.5	80.4	56.0	56.5	56.2
Medium-yielding									
Lbn-i04	37.1	37.2	36.6	81.4	81.2	81.1	**42.3 b**	**43.1 a**	**42.8 a**
Lbn-r05	**35.4 a**	**35.5 a**	**34.4 b**	76.2 a	76.3 a	75.8 b	36.8	37.2	36.9
Low-yielding									
Mrc-r04	**38.8 a**	**38.5 a**	**36.8 b**	-	-	-	27.8	28.0	27.4
Lbn-r04	**37.8 a**	**37.7 a**	**36.2 b**	81.7	81.6	81.5	22.7	22.8	21.9

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at *P* 0.05 and *P* 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level. When significance was detected for loci with three or more non-rare alleles, the least significant difference between the allele means was calculated: means followed by different letters are significantly different.

Table S6. (Continued)

i) *Xgwm47.1* (chr. 2BL)

Environment	Plant height (cm)			Peduncle length (cm)			Kernels m^{-2} (no.)			Thousand kernel weight (g)		
	A2	A6	A7	A2	A6	A7	A2	A6	A7	A2	A6	A7
High-yielding												
Tns-i05	**91.9 b**	**92.9 b**	**98.8 a**	18.4	19.1	19.6	20579 a	19638 a	16203 b	33.2	35.0	34.8
Itl1-r04	82.0	80.9	83.1	17.8 b	17.3 b	19.1 a	15489	14945	15219	44.8	46.4	45.4
Spn1-r04	91.4	90.8	93.8	20.5 ab	19.8 b	21.2 a	14153	13876	14153	46.0	47.3	45.7
Itl2-r04	80.7	81.2	82.4	18.8 ab	18.0 b	19.9 a	14071	13784	14011	41.2	42.3	41.4
Syr-i05	91.8 b	92.9 b	96.5 a	19.9	19.8	21.3	15161	14825	14697	38.7	40.0	39.8
Itl2-r05	**87.0 b**	**87.6 b**	**92.5 a**	13.8 b	14.4 b	15.6 a	17680 a	16916 b	17306 a	32.6 b	34.7 a	33.0 b
Medium-yielding												
Syr-r05	**81.7 b**	**82.8 b**	**87.4 a**	**14.3 b**	**13.7 b**	**15.8 a**	12110	11791	11807	37.2	37.9	37.8
Tns-r05	**91.0 b**	**91.9 b**	**97.8 a**	17.7	17.8	18.6	16767	16540	16511	27.4	28.4	28.2
Lbn-i04	83.7	82.6	84.7	14.3	14.2	14.5	**11292 a**	**10821 b**	**11219 a**	**37.3 b**	**38.6 a**	**37.2 b**
Lbn-r05	66.0	65.8	66.8	11.7 b	11.8 b	12.3 a	10380	10248	10275	35.3	35.7	35.0
Low-yielding												
Mrc-r04	-	-	-	-	-	-	7154 a	6772 a	6969 b	39.2 b	40.6 a	40.8 a

j) *Xcfa2234* (chr. 3A)

Environment	Kernels m^{-2} (no.)		Thousand kernel weight (g)	
	A1	A2	A1	A2
High-yielding				
Tns-i05	20460	19860	33.4	34.5
Itl2-r04	14060	13688	41.1	42.7
Syr-i05	15202	15008	38.5	39.4
Itl2-r05	17503	17078	33.1	34.0
Medium-yielding				
Syr-r05	**12232**	**11831**	36.9	38.1
Lbn-i04	11349	11117	**37.3**	**38.3**
Low-yielding				
Mrc-r04	7157	6989	39.1	40.0

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at *P* 0.05 and *P* 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level. When significance was detected for loci with three or more non-rare alleles, the least significant difference between the allele means was calculated: means followed by different letters are significantly different.

Table S6. (Continued)

k) *Xgwm493* (chr. 3BS)

Environment	Heading date (d)		Plant height (cm)		Peduncle length (cm)		Test weight (kg hl^{-1})		Grain yield (q ha^{-1})	
	A3	A4	A3	A4	A3	A4	A3	A4	A3	A4
High-yielding										
Tns-i05	99.7	98.5	90.4	94.6	17.7	17.8	78.9	78.7	**68.4**	**65.9**
Itl1-r04	173.7	174.7	**81.6**	**85.9**	**17.7**	**19.3**	70.6	70.2	68.9	68.0
Spn1-r04	121.1	121.9	**91.2**	**95.2**	20.4	21.4	79.2	79.8	64.9	65.4
Itl2-r04	111.2	111.7	**80.0**	**82.0**	**18.7**	**20.8**	**78.8**	**79.5**	58.0	58.0
Syr-i05	110.3	109.9	90.7	91.7	19.6	20.8	-	-	58.4	59.0
Itl2-r05	143.6	144.1	86.1	87.4	13.9	15.2	57.8	57.7	81.2	81.7
Lbn-i05	106.8	107.0	79.4	79.8	15.9	17.4	80.5	80.6	56.0	56.1
Medium-yielding										
Syr-r05	136.8	137.3	81.6	86.5	14.1	15.4	-	-	44.9	45.1
Tns-r05	99.1	98.8	89.6	94.0	17.6	16.9	75.4	75.4	45.6	44.1
Lbn-i04	141.5	141.3	83.2	85.0	14.3	14.7	81.3	81.7	42.2	42.1
Lbn-r05	107.4	107.8	80.2	76.8	11.7	12.4	76.2	76.6	36.8	36.5
Mrc-i04	**108.5**	**110.9**	-	-	-	-	-	-	34.1	32.2
Low-yielding										
Lbn-r04	140.6	140.7	66.5	66.6	9.5	10.0	81.7	82.1	22.5	22.7
Spn2-r05	120.9	120.9	52.5	52.9	5.6	5.7	76.7	77.4	9.3	9.3

l) *Xbarc193* (chr. 4BS)

Environment	Plant height (cm)			Peduncle length (cm)		
	A2	A4	A5	A2	A4	A5
High-yielding						
Tns-i05	**84.4 b**	**90.4 a**	**87.1 a**	17.3	18.1	17.8
Itl1-r04	**76.6 b**	**81.7 a**	**79.2 ab**	16.9	17.8	17.2
Spn1-r04	**85.7 a**	**91.3 b**	**89.1 b**	**19.1 b**	**20.5 a**	**20.4 a**
Itl2-r04	77.1 b	80.1 a	78.7 ab	**16.7 b**	**18.8 a**	**18.6 a**
Syr-i05	**84.6 b**	**90.5 a**	**88.4 a**	**17.7 b**	**19.9 a**	**19.1 a**
Itl2-r05	82.9 b	86.5 a	84.7 ab	13.4	14.0	13.9
Medium-yielding						
Syr-r05	77.8	81.9	80.7	13.2 b	14.3 a	10.9 c
Tns-r05	**83.4 b**	**89.6 a**	**85.4 b**	17.2	17.6	17.4
Lbn-i04	80.0 b	83.1 a	81.9 a	14.4	14.4	14.4
Lbn-r05	65.2	65.9	66.1	10.9 a	11.7 b	11.3 b
Low-yielding						
Lbn-r04	**64.5 b**	**66.7 a**	**66.7 a**	**8.6 b**	**9.4 a**	**9.5 a**

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at *P* 0.05 and *P* 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level. When significance was detected for loci with three or more non-rare alleles, the least significant difference between the allele means was calculated: means followed by different letters are significantly different.

Table S6. (Continued)

m) *Xgwm1278* (chr. 4BS)

Environment	Plant height (cm)		Peduncle length (cm)		Kernels m^{-2} (no.)		Thousand kernel weight (g)		Grain yield (q ha^{-1})	
	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2
High-yielding										
Tns-i05	87.9	90.9	**16.6**	**18.0**	20489	20511	33.7	33.8	69.1	69.2
Itl1-r04	80.0	81.5	17.1	17.8	15475	15631	**45.3**	**43.6**	69.5	68.3
Spn1-r04	88.9	91.3	19.7	20.5	14079	14338	46.3	45.2	64.8	64.8
Itl2-r04	78.6	79.9	17.8	18.9	14092	14391	41.3	39.9	58.0	58.0
Syr-i05	88.7	90.1	18.5	19.3	14679	14921	**39.7**	**38.4**	57.8	57.0
Itl2-r05	84.0	85.9	13.0	13.7	17670	17725	33.0	32.5	58.0	57.5
Medium-yielding										
Syr-r05	81.6	82.6	14.0	14.4	11980	12302	**38.2**	**36.6**	45.3	44.9
Tns-r05	87.8	90.4	17.0	17.9	12303	12407	27.6	27.3	46.1	45.9
Lbn-i04	81.2	82.2	14.4	14.4	11148	11281	38.0	37.3	42.3	42.1
Lbn-r05	65.4	65.4	**11.1**	**11.7**	10267	10271	**35.7**	**35.1**	36.7	36.1
Low-yielding										
Mrc-r04	-	-	-	-	7074	7228	39.6	38.6	27.9	27.8
Lbn-r04	65.9	66.3	9.0	9.2	5660	5888	38.2	37.6	21.5	22.1

n) *Xbarc303* (chr. 5AS)

Environment	Plant height (cm)		Peduncle length (cm)		Kernels m^{-2} (no.)		Thousand kernel weight (g)		Grain yield (q ha^{-1})	
	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2
High-yielding										
Tns-i05	102.1	99.5	18.0	17.5	**22139**	**21169**	**30.9**	**32.3**	78.6	78.9
Itl1-r04	173.2	173.6	16.9	18.0	16141	15735	**42.0**	**44.0**	70.4	70.8
Spn1-r04	121.0	121.1	20.1	20.8	**15130**	**14462**	**43.1**	**45.3**	79.2	79.2
Itl2-r04	111.1	111.3	18.8	19.0	**14715**	**14141**	**38.4**	**40.9**	78.5	78.6
Syr-i05	110.1	110.1	19.5	19.9	**15545**	**15102**	**37.0**	**38.6**	-	-
Itl2-r05	143.3	143.6	13.5	14.0	**18440**	**17870**	30.9	32.3	80.7	81.0
Lbn-i05	106.5	106.7	15.4	15.8	12757	12558	37.0	38.6	80.6	80.4
Medium-yielding										
Syr-r05	136.5	136.6	19.5	19.9	**12958**	**12415**	**34.5**	**36.5**	-	-
Tns-r05	**101.1**	**98.8**	17.2	17.8	**17394**	**16849**	**25.5**	**27.0**	74.5	75.2
Lbn-i04	141.6	141.6	14.2	14.5	**11702**	**11373**	**36.3**	**37.4**	81.2	81.4
Lbn-r05	107.1	107.2	11.7	11.9	10568	10478	**34.4**	**35.1**	75.9	76.0
Low-yielding										
Mrc-r04	101.8	102.8	-	-	7584	7306	**37.2**	**38.6**	-	-

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at *P* 0.05 and *P* 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level.

Table S6. (Continued)

o) *Xbarc197* (chr. 5AL)

Environment	Heading date (d)		Kernels m^{-2} (no.)		Grain yield (q ha^{-1})	
	A5	A7	A5	A7	A5	A7
High-yielding						
Tns-i05	99.6	98.6	20678	19891	68.9	66.9
Itl1-r04	173.9	174.8	15426	15284	68.8	67.9
Itl2-r04	111.4	112.1	14116	14142	58.0	58.0
Syr-i05	**110.5**	**111.3**	**15035**	**14490**	**58.4**	**56.3**
Itl2-r05	143.7	144.4	17634	17505	57.8	57.4
Medium-yielding						
Syr-r05	136.9	138.2	11989	11669	44.9	43.9
Tns-r05	99.1	98.2	**16680**	**15928**	**45.7**	**43.6**
Lbn-i04	142.0	143.0	11296	11239	**42.3**	**41.6**
Low-yielding						
Mrc-r04	102.8	104.4	7066	6925	27.5	26.5
Lbn-r04	**141.1**	**142.3**	5882	6021	22.3	22.6
Spn2-r05	120.9	120.9	3369	3366	9.3	9.4

p) *Xgwm1570* (chr. 5AL)

Environment	Peduncle length (cm)		Kernels m^{-2} (no.)		Thousand kernel weight (g)	
	A4	A5	A4	A5	A4	A5
High-yielding						
Tns-i05	**18.2**	**19.6**	20540	20929	33.3	33.0
Itl1-r04	17.8	17.9	**15647**	**16247**	**44.1**	**41.9**
Spn1-r04	20.6	21.2	**14300**	**14913**	**45.5**	**43.5**
Itl2-r04	18.8	18.9	14159	14537	40.7	39.0
Syr-i05	19.8	20.5	15232	15873	38.4	36.6
Itl2-r05	14.0	14.2	**17771**	**18321**	**32.5**	**30.7**
Lbn-i05	15.6	16.4	**12334**	**12779**	45.7	43.7
Medium-yielding						
Syr-r05	14.8	15.4	12153	12533	**37.1**	**35.4**
Tns-r05	17.7	17.8	16737	17051	**27.1**	**26.2**
Lbn-i04	14.4	14.4	11406	11685	**37.1**	**35.9**
Lbn-r05	11.8	12.3	10412	10533	**35.3**	**34.3**
Mrc-i04	-	-	8743	8836	39.0	38.7
Low-yielding						
Mrc-r04	-	-	7189	7398	38.9	37.8

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at *P* 0.05 and *P* 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level.

Table S6. (Continued)

q) *Xwmc256* (chr. 6AL)

Environment	Heading date (d)		Grain yield (q ha^{-1})	
	A2	A3	A2	A3
High-yielding				
Itl1-r04	174.7	173.6	67.3	69.0
Spn1-r04	122.2	120.9	64.3	65.0
Itl2-r05	112.3	111.1	57.7	57.6
Medium-yielding				
Syr-r05	**138.2**	**136.3**	44.5	44.9
Lbn-i04	143.0	141.7	41.8	42.3
Mrc-i04	**110.2**	**108.2**	32.7	34.4
Low-yielding				
Mrc-r04	**105.9**	**102.1**	27.7	27.9
Lbn-r04	142.0	140.8	22.3	22.6

r) *Xdupw217* (chr. 6BS)

Environment	Kernels m^{-2} (no.)			Thousand kernel weight (g)			Test weight (kg hl^{-1})			Grain yield (q ha^{-1})		
	A1	A4	A5	A1	A4	A5	A1	A4	A5	A1	A4	A5
High-yielding												
Tns-i05	20738	20427	20065	33.0	33.4	34.9	79.0	79.0	78.8	68.5	68.3	67.6
Itl1-r04	15963	15481	15789	43.5	44.4	44.5	70.7ab	70.5b	71.0a	69.8a	68.5b	70.2a
Spn1-r04	14386	14292	14092	45.0	45.5	46.2	79.7	79.6	79.7	64.7	64.9	64.5
Itl2-r04	14364a	14156a	13847b	39.8c	40.7b	42.0a	78.4b	78.8a	78.8a	58.0	58.0	58.0
Syr-i05	15007	15369	15279	38.0	38.3	37.8	-	-	-	56.7b	58.7a	57.8a
Itl2-r05	18050a	17468b	17496b	31.6b	33.1a	32.9a	80.9	81.3	81.0	57.5	57.6	57.4
Lbn-i05	**12548a**	**12204ab**	**12105b**	**44.6b**	**46.4a**	**46.4a**	80.5	80.6	80.5	55.8ab	56.1a	55.6b
Medium-yielding												
Syr-r05	12382	12337	12240	36.2	36.5	37.4	-	-	-	44.9	44.9	45.6
Tns-r05	16778	16681	16537	27.2	27.5	27.2	75.4	75.4	75.2	45.7	45.9	45.1
Lbn-i04	11590a	11356b	11271b	36.6b	37.1ab	37.6a	81.5	81.4	81.3	42.6	42.1	42.3
Lbn-r05	10491	10344	10398	**34.6b**	**35.4a**	**35.3a**	75.8	76.2	75.9	36.4	36.6	36.7
Mrc-i04	8776	8722	8680	38.9	39.1	39.2	-	-	-	34.1	34.1	34.0
Low-yielding												
Mrc-r04	7356	7195	7179	**38.1b**	**39.2ab**	**39.5a**	-	-	-	30.0	28.1	28.2
Lbn-r04	5888	6035	5819	37.2	38.0	37.9	81.7	81.8	81.6	21.9	22.9	22.0
Spn2-r05	3279	3338	3295	27.2	27.9	27.3	77.3	76.8	77.3	8.9	9.3	9.0

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at *P* 0.05 and *P* 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level. When significance was detected for loci with three or more non-rare alleles, the least significant difference between the allele means was calculated: means followed by different letters are significantly different.

Table S6. (Continued)

s) *Xwmc494* (chr. 6BS)

Environments	Test weight (kg hl^{-1})		
	A3	A4	A5
High-yielding			
Tns-i05	78.9a	78.3b	78.2b
Spn1-r04	79.4a	78.8b	79.0b
Itl2-r05	**80.9a**	**80.1b**	**80.2b**
Medium-yielding			
Tns-r05	**75.2a**	**74.5b**	**73.8c**
Low-yielding			
Spn2-r05	76.6a	75.9b	75.9b

t) *Xbarc14* (chr. 6BL)

Environments	Plant height (cm)		Kernels m^{-2} (no.)		Test weight (kg hl^{-1})		Grain yield (q ha^{-1})	
	A3	A5	A3	A5	A3	A5	A3	A5
High-yielding								
Itl1-r04	82.6	81.4	15183	15596	70.9	70.7	**66.9**	**68.9**
Spn1-r04	**94.4**	**91.4**	14177	14210	80.4	79.7	64.8	64.8
Syr-i05	93.6	90.8	14975	15169	-	-	58.1	57.9
Itl2-r05	87.5	86.1	17317	17526	81.8	81.2	57.2	57.4
Lbn-i05	80.7	79.0	12460	12347	80.6	80.6	56.0	55.9
Medium-yielding								
Tns-r05	83.6	81.8	16028	16503	75.6	75.3	43.9	45.3
Lbn-i04	84.1	82.8	11072	11302	81.6	81.5	41.5	42.1
Lbn-r05	66.9	65.7	10404	10301	76.2	76.1	36.8	36.4
Mrc-i04	-	-	8260	8662	-	-	32.3	33.9
Low-yielding								
Lbn-r04	67.1	66.3	5571	5902	81.8	81.7	21.1	22.4
Spn2-r05	94.4	91.4	3384	3285	77.0	76.9	9.6	9.1

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at $P \leq 0.05$ and ≤ 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level. When significance was detected for loci with three or more non-rare alleles, the least significant difference between the allele means was calculated: means followed by different letters are significantly different.

Table S6. (Continued)

u) *Xcfa2257.1* (chr. 7AL)

Environment	Kernels m^{-2} (no.)		Thousand kernel weight (g)		Test weight (kg hl^{-1})	
	A3	A4	A3	A4	A3	A4
High-yielding						
Itl1-r04	15435	15099	**44.9**	**46.6**	70.6	71.1
Spn1-r04	14047	13540	**46.5**	**48.5**	79.6	79.6
Itl2-r04	**13918**	**13378**	**41.8**	**44.2**	78.9	79.4
Syr-i05	15186	15011	38.7	40.0	-	-
Itl2-r05	17413	16979	33.3	34.5	81.3	81.5
Lbn-i05	12229	12014	46.0	46.7	80.5	80.4
Medium-yielding						
Syr-r05	12192	11869	37.1	38.6	-	-
Lbn-r05	10346	10304	35.4	35.9	76.1	76.2
Mrc-i04	8623	8345	39.2	39.5	-	-
Low-yielding						
Mrc-r04	7086	6856	39.4	40.4	-	-
Lbn-r04	5946	6015	**38.2**	**39.3**	81.7	81.9
Spn2-r05	3322	3265	27.6	27.8	77.1	77.9

v) *Xgwm333* (chr. 7BL)

Environments	Heading date (d)			Kernels m^{-2} (no.)			Thousand kernel weight (g)			Test weight (kg hl^{-1})		
	A2	A4	A5	A2	A4	A5	A2	A4	A5	A2	A4	A5
High-yielding												
Itl1-r04	172.6	173.5	172.9	15578 b	15558 b	16268 a	44.2 a	44.5 a	42.1 b	71.4	70.7	70.9
Spn1-r04	119.4 c	120.9 a	120.1 b	13519 c	14214 b	14764 a	46.4 a	45.8 a	43.5 b	80.6 a	79.7 b	79.1b
Itl2-r04	110.6	111.1	110.1	14498	14120	14628	39.4 b	40.9 a	38.8 b	78.7	78.8	78.6
Syr-i05	110.5	110.6	110.4	19756	20480	20825	37.0	38.3	37.0	-	-	-
Itl2-r05	143.3	143.7	143.5	18000 a	17598 b	18347 a	32.2 a	32.9 a	31.0 b	81.6	81.1	80.7
Lbn-i05	106.0	106.9	106.6	12459	12284	12513	44.8	45.9	45.1	80.5	80.5	80.5
Medium-yielding												
Syr-r05	135.10	136.5	135.5	12159	12272	12446	36.7	36.7	36.3	-	-	-
Tns-r05	102.0	99.5	100.8	17402	16693	17264	27.9	27.5	26.6	76.9	75.4	74.8
Lbn-i04	139.5 c	141.6 a	140.6 b	11523 a	11367 b	11747 a	36.2 b	37.1 a	35.7 c	**81.6 a**	**81.4 a**	**80.7 b**
Lbn-r05	105.9 c	107.4 a	106.9 b	10212	10308	10549	35.0 a	35.3 a	34.6 b	76.4	76.1	75.9
Mrc-i04	107.2	108.3	107.1	9041	8761	8874	38.6 b	39.1 a	38.7 b	-	-	-
Low-yielding												
Mrc-r04	99.6	102.3	99.8	7443 a	7190 b	7460 a	38.2	39.0	38.3	-	-	-
Lbn-r04	139.8 b	140.7 a	139.6 b	**6497 a**	**5970 b**	**6517 a**	36.9 b	37.8 a	36.6 b	81.9 a	81.7 a	81.3 b
Spn2-r05	121.0	121.0	121.0	3086	3306	3278	26.9	27.6	27.7	78.9 a	76.8 c	77.5 b

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at *P* 0.05 and *P* 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level. When significance was detected for loci with three or more non-rare alleles, the least significant difference between the allele means was calculated: means followed by different letters are significantly different.

Table S6. (Continued)

z) *Xgwm577* (chr. 7BL)

Environments	Heading date (d)			Peduncle length (cm)			Thousand kernel weight (g)		
	A2	A4	A5	A2	A4	A5	A2	A4	A5
High-yielding									
Tns-i05	99.5	100.1	98.7	18.2	18.0	16.3	34.0	33.3	33.6
Itl1-r04	173.9 b	173.7 b	176.1 a	18.4	17.6	18.0	44.1	44.6	46.8
Spn1-r04	121.5 b	121.1 b	122.6 a	21.0	20.2	20.8	45.6	45.9	47.0
Itl2-r04	**111.6 b**	**111.3 b**	**113.8 a**	19.5	18.5	18.6	41.1	41.3	42.8
Syr-i05	110.4 b	110.6 b	111.7 a	20.4 a	19.5 a	18.6 b	39.5 b	38.4 c	40.8 a
Itl2-r05	144.0	143.7	144.3	14.6	13.8	14.0	33.9	33.0	34.6
Lbn-i05	107.2	106.9	107.1	16.3	15.3	15.3	46.4	46.1	47.5
Medium-yielding									
Syr-r05	136.4	136.5	137.9	15.9 a	14.5 b	15.8 a	38.6 a	36.7 b	38.7 a
Tns-r05	99.7	99.5	101.1	18.3 a	17.4 b	15.7 c	28.5 a	27.4 b	28.0 a
Lbn-i04	**141.8 b**	**141.8 b**	**144.0 a**	14.7	14.3	14.3	36.9	37.4	37.7
Lbn-r05	107.2	107.4	108.2	12.0 a	11.6 b	11.4 b	35.8 a	35.2 b	36.1 a
Mrc-i04	**108.8 b**	**108.5 b**	**111.4 a**	-	-	-	39.2	39.1	39.2
Low-yielding									
Mrc-r04	**103.2 b**	**102.8 b**	**107.7 a**	-	-	-	38.9	39.2	40.4
Lbn-r04	**141.2 b**	**140.9 b**	**143.6 a**	9.2	9.3	8.9	37.6	38.0	38.9
Spn2-r05	121.0	121.0	121.0	5.6	5.6	5.6	28.5	27.6	27.8

w) *Xwmc276* (chr. 7BL) part 1

Environments	Plant height (cm)				Peduncle length (cm)			
	A1	A2	A3	A5	A1	A2	A3	A5
High-yielding								
Itl1-r04	81.8 b	84.3 a	80.6 b	79.4 b	**17.8 b**	**20.0 a**	**17.2 b**	**17.7 b**
Spn1-r04	91.5 b	94.1 a	90.4 b	90.9 b	20.5 b	21.9 a	20.0 b	20.2 b
Itl2-r04	**80.2 b**	**82.3 a**	**78.7 b**	**76.6 c**	**18.9 b**	**20.7 a**	**18.3 b**	**18.9 b**
Syr-i05	90.9	91.4	89.2	90.3	19.6	19.7	18.4	19.0
Itl2-r05	86.4	87.2	85.0	83.9	13.9	14.4	13.6	13.7
Lbn-i05	78.9	78.9	77.8	78.5	15.6 b	16.7 a	15.2 b	16.2 a
Medium-yielding								
Syr-r05	81.9 b	83.4 a	81.4 b	80.4 b	14.7	15.5	14.5	14.8
Tns-r05	90.5	91.4	88.4	87.5	17.4	17.3	16.2	15.7
Lbn-i04	83.2 a	84.5 a	82.6 b	82.7 b	14.4	14.3	13.9	14.3
Lbn-r05	65.9	65.6	65.6	65.3	11.7	12.2	11.5	11.7
Mrc-i04	-	-	-	-	-	-	-	-
Low-yielding								
Mrc-r04	-	-	-	-	-	-	-	-
Lbn-r04	66.5 b	67.4 a	65.6 b	65.9 b	9.4 a	9.7 a	8.8 b	8.7 b

Least square means reported in underlined and in **bold underlined** font refer to marker-environment associations significant (marker-wise level) at $P \leq 0.05$ and P 0.01, respectively. Values reported in **red bold underlined** are significant at the experiment-wise level. When significance was detected for loci with three or more non-rare alleles, the least significant difference between the allele means was calculated: means followed by different letters are significantly different.

Table S6. (Continued)

w) *Xwmc276* (chr. 7BL) part 2

Environments	Kernels m^{-2} (no.)				Test weight (kg hl^{-1})				Grain yield (q ha^{-1})			
	A1	A2	A3	A5	A1	A2	A3	A5	A1	A2	A3	A5
High-yielding												
Itl1-r04	15506	15293	15399	15557	70.5	70.3	70.3	69.7	68.8	67.8	69.9	69.0
Spn1-r04	14180 a	13879 b	14125 a	14225 a	**79.5 a**	**78.7 b**	**78.4 b**	**79.2 a**	64.8	62.8	65.0	65.6
Itl2-r04	14038	13957	13746	13771	78.8	78.5	78.3	78.9	58.0	58.0	58.0	58.0
Syr-i05	15124	14481	14875	15049	-	-	-	-	**57.9 b**	**55.8 c**	**57.1 b**	**58.1 a**
Itl2-r05	17419	16851	17286	16912	81.2 a	80.9 b	80.8 b	81.8 a	57.5	57.0	57.2	57.0
Lbn-i05	12240	12182	12267	12309	80.5	80.4	80.3	80.5	55.9	55.8	56.0	56.1
Medium-yielding												
Syr-r05	**12185 a**	**11570 b**	**12034 a**	**11987 a**	-	-	-	-	44.9	44.1	45.2	45.0
Tns-r05	16484 a	15465 b	16064 a	15579 b	75.4	74.9	74.9	75.7	45.6	44.2	44.9	43.6
Lbn-i04	11292	10984	10976	10942	81.4	81.3	81.2	81.5	**42.1 b**	**41.2 b**	**41.9 a**	**41.6 a**
Lbn-r05	10341	10190	10356	10400	76.1	76.1	76.0	76.1	36.6	36.5	37.2	37.2
Mrc-i04	8675	8371	8439	8226	-	-	-	-	33.9	32.6	32.9	32.3
Low-yielding												
Mrc-r04	7109	6912	6774	6725	-	-	-	-	27.7 a	26.9 b	26.7 b	26.4 b
Lbn-r04	5910	5858	5812	5738	81.7	81.2	81.4	81.8	22.4	21.8	22.0	21.8

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