

Table S1: Average of the physical, compositional, breadmaking and starch quality traits in the individual spelt genotypes grown in Hungary (Martonvásár, 2017–2019).

Variety	Country	Spike morphology	Type of Spike	Colour of Spike	Form of spelt type	D all	D composition	D quality	D starch	Test weight	TK W	KW dth	KL en	Flour yield	Prot ein	Star ch	B glucan	Glut en	Gluten spread	GI	Zele Development Time	Dough Stability	Dough Softening at 12 min	Water absorption	Farinograph quality number	Falling Number	Peak Viscosity	Trough Viscosity	Breakdown	Final Viscosity	Setback	Pasting Time	Pasting Temperature	Starch Damage	
N=92, 3-years average		(based on combination of D-F columns)								kg/100l	g	mm	mm	%	%	%	mg/g	%	mm	ml	min	min		%		sec	cP	cP	cP	cP	cP	min	C	UCD	
ALBISPICATUM	AUS	5	AWN	WHITE	spelt type	3	3	7	2	72.80	33.90	2.75	7.20	56.52	19.95	52.50	6.12	50.83	14.00	50.33	31.00	1.70	2.00	88.00	56.75	46.85	332.00	3496.50	1745.50	1751.00	3918.50	2173.00	9.00	62.23	14.20
ALBI-SPICATUM	AUS	2	AWNLES S	WHITE	spelt type	4	5	3	3	66.25	35.72	3.00	7.27	56.71	19.45	52.00	7.25	45.22	8.67	73.27	47.00	2.13	2.87	113.67	57.80	42.30	385.00	3721.50	1875.50	1846.00	3944.00	2068.50	9.13	63.78	10.75
ALBUM	AUS	2	AWNLES S	WHITE	spelt type	8	2	5	6	71.10	37.00	2.77	7.57	53.26	18.81	52.37	6.73	47.83	8.17	61.53	34.33	9.17	13.50	43.33	57.33	75.70	423.00	3727.67	1707.00	2020.67	3641.00	1934.00	9.02	63.45	13.30
BA7415	DEU	1	AWNLES S	RED	spelt type	2	5	5	1	74.07	46.24	3.23	7.73	58.91	20.25	53.07	6.54	44.22	6.50	57.97	37.67	8.00	14.80	41.33	56.80	79.47	346.00	3629.00	1743.33	1885.67	3643.00	1899.67	9.13	63.13	13.57
BA7418	DEU	2	AWNLES S	WHITE	spelt type	7	6	2	5	75.47	38.07	2.87	7.07	61.11	17.73	55.37	5.76	37.23	6.00	66.04	29.00	7.47	8.77	53.67	54.67	65.93	406.67	3899.33	1793.00	2106.33	3844.67	2051.67	9.18	63.03	14.00
BA7423	DEU	1	AWNLES S	RED	spelt type	8	5	6	6	75.10	39.14	2.97	7.30	61.57	18.73	52.67	6.61	43.77	7.00	75.70	46.33	8.27	10.60	68.67	57.87	74.97	385.67	3782.00	1754.33	2027.67	3717.67	1963.33	9.02	62.93	11.00
BA7424	DEU	1	AWNLES S	RED	spelt type	8	7	8	6	71.77	41.46	3.10	7.53	54.97	18.12	54.33	5.99	41.15	6.50	50.38	25.67	5.90	6.23	124.67	55.50	53.83	380.67	3782.00	1699.33	2082.67	3706.00	2006.67	9.04	63.35	11.87
BADENKRONE	DEU	1	AWNLES S	RED	spelt type	7	7	5	6	60.10	32.29	3.00	7.40	55.40	16.55	52.70	6.40	40.95	7.50	41.58	30.00	0.55	6.25	70.00	53.40	27.10	327.00	3806.50	1721.00	2085.50	3792.00	2071.00	9.00	64.33	11.85
BADENSONNE	DEU	1	AWNLES S	RED	spelt type	1	4	5	1	69.40	32.03	2.90	7.45	52.69	17.17	53.10	6.59	44.75	13.25	32.34	28.50	3.35	15.85	30.50	54.35	78.50	407.50	3617.50	1723.00	1894.50	3756.50	2033.50	8.90	63.05	13.85
BALMEGG	CHE	1	AWNLES S	RED	spelt type	8	1	6	6	74.53	35.29	3.03	6.97	54.91	19.66	52.57	6.92	49.02	6.83	67.06	39.30	3.17	15.57	47.00	56.73	64.40	406.00	3825.67	1691.00	2134.67	3590.00	1899.00	9.11	63.63	13.23
BLACK-BEARDED	AUS	3	AWN	BROWN	spelt type	6	7	4	8	70.90	34.77	2.75	7.05	59.59	18.86	52.55	6.19	38.73	4.25	97.46	52.67	17.05	19.03	5.00	57.10	97.15	447.50	3880.50	1879.00	2001.50	4319.50	2440.50	9.10	65.08	11.45
BOHEMIA	CZ	3	AWN	BROWN	spelt type	6	7	4	8	71.35	35.14	2.75	7.10	60.13	18.48	52.30	6.56	38.10	4.25	92.44	52.83	14.05	18.60	5.50	55.05	88.25	485.00	3876.50	1942.50	1934.00	4272.50	2330.00	9.07	64.23	12.35
CH65384	CHE	2	AWNLES S	WHITE	spelt type	7	6	3	5	76.50	38.47	2.90	7.00	62.41	17.10	55.73	6.00	36.48	6.67	63.80	28.67	2.57	6.93	90.00	53.43	51.20	400.00	3908.00	1770.00	2138.00	3768.00	1998.00	9.13	62.80	12.57
CH65388	CHE	2	AWNLES S	WHITE	spelt type	2	2	8	1	75.93	39.63	3.03	6.83	60.23	18.54	54.80	5.97	44.65	9.50	30.93	20.33	1.87	2.43	140.33	54.53	26.63	390.33	3607.00	1685.00	1922.00	3667.00	1982.00	9.20	63.62	11.73
COSMOS	BEL	1	AWNLES S	RED	spelt type	8	7	2	6	68.03	36.63	3.00	7.17	61.69	17.79	53.53	7.39	40.18	5.67	79.53	40.00	3.30	7.57	71.67	53.10	59.10	387.67	3789.33	1681.33	2108.00	3774.67	2093.33	9.02	63.78	13.83
D-7-004-99-01	DEU	1	AWNLES S	RED	spelt type	8	6	6	6	72.67	38.01	3.00	7.30	61.61	18.21	54.63	6.65	38.47	3.83	78.26	38.00	1.97	14.97	54.33	54.03	62.93	340.33	3789.33	1710.33	2079.00	3687.00	1976.67	9.13	63.60	12.17
D-7-004-99-02	DEU	1	AWNLES S	RED	spelt type	2	5	2	1	69.90	35.95	2.93	7.30	58.73	20.10	52.17	6.62	44.50	6.33	64.54	38.33	4.60	9.43	78.67	56.33	62.47	386.00	3623.33	1664.33	1959.00	3625.00	1960.67	9.00	62.77	13.10
D-7-005-99-01	DEU	1	AWNLES S	RED	spelt type	5	3	8	4	65.73	37.49	2.97	7.83	59.22	20.83	51.53	6.66	51.97	7.00	51.98	35.00	3.33	6.83	124.33	56.90	52.83	319.00	3493.33	1669.33	1824.00	3636.67	1967.33	9.20	64.67	12.83
D-7-005-99-04	DEU	1	AWNLES S	RED	spelt type	1	5	2	1	69.83	37.39	3.03	7.30	58.70	19.45	52.27	6.79	44.65	7.17	65.85	36.67	3.57	13.93	61.67	55.90	64.27	382.00	3637.00	1727.33	1909.67	3798.33	2071.00	9.13	63.35	12.30
D-7-005-99-06	DEU	1	AWNLES S	RED	spelt type	2	5	1	1	71.07	39.42	3.03	7.40	57.37	19.96	52.83	6.64	44.77	9.17	54.41	31.33	2.40	7.20	80.33	56.37	53.70	365.67	3636.67	1670.00	1966.67	3697.67	2027.67	9.09	63.20	13.60
D-7-010-99-02	DEU	1	AWNLES S	RED	spelt type	4	7	2	3	69.77	36.28	2.83	7.53	58.41	19.41	52.97	5.62	39.02	5.50	70.52	34.00	2.70	5.73	79.67	52.90	55.27	378.00	3596.67	1763.00	1833.67	4005.00	2242.00	9.07	63.65	13.67
D-7-014-98-01	DEU	1	AWNLES S	RED	spelt type	4	5	6	3	67.13	36.10	3.03	7.37	58.33	19.38	52.23	6.35	44.73	6.50	72.81	41.00	2.53	14.93	42.33	55.97	65.73	391.00	3739.67	1772.00	1967.67	3897.67	2125.67	9.20	64.17	12.73
D-7-014-99-02	DEU	1	AWNLES S	RED	spelt type	4	5	5	3	67.90	35.57	3.00	7.33	58.77	20.08	52.53	6.76	43.65	4.83	74.13	42.00	12.60	17.40	24.33	55.00	84.37	412.33	3744.00	1753.67	1990.33	3848.67	2095.00	9.13	63.12	11.00
D-7-014-99-03	DEU	1	AWNLES S	RED	spelt type	6	6	2	7	69.37	32.89	2.90	6.97	59.05	18.96	53.00	6.71	37.38	2.50	86.57	42.67	2.67	12.17	71.00	52.90	48.93	399.33	3809.33	1829.33	1980.00	4091.33	2262.00	9.00	63.28	11.83
D-7-019-99-02	DEU	1	AWNLES S	RED	spelt type	7	4	2	5	70.50	37.43	2.90	7.50	60.02	18.20	53.60	6.93	42.68	4.67	65.99	34.00	2.97	8.00	74.67	55.67	59.33	380.33	3894.33	1700.00	2194.33	3770.33	2070.33	9.09	63.13	13.80
DUHAMELIANUM	AUS	1	AWNLES S	RED	spelt type	3	2	7	1	76.45	38.17	2.87	7.30	57.09	18.35	52.77	6.61	46.83	8.83	50.88	31.33	3.20	5.83	91.67	56.77	52.83	442.33	3522.33	1748.00	1774.33	3804.33	2056.33	9.11	62.45	13.63
DUHAMELIANUM-MAZZ	AUS	6	AWNLES S	GREY	spelt type	6	4	6	7	74.00	33.78	2.83	6.90	57.57	17.06	53.33	7.47	44.08	7.33	77.55	42.00	9.97	13.93	41.00	62.50	76.97	520.00	4104.33	1887.33	2217.00	4030.33	2143.00	8.84	61.65	18.00
EBNERS-ROTKORN	DEU	1	AWNLES S	RED	spelt type	5	3	7	4	69.70	39.07	2.95	7.60	57.13	18.45	52.40	6.95	54.25	16.25	25.08	28.00	2.60	7.60	90.50	57.15	55.65	307.50	3292.50	1535.50	1757.00	3381.50	1846.00	9.03	62.73	12.75
FRANCKENKORN	DEU	1	AWNLES S	RED	spelt type	8	7	2	6	67.93	37.81	3.00	7.53	60.98	19.20	52.77	6.70	41.13	7.00	76.69	37.67	3.07	10.90	68.67	53.90	63.33	397.00	3782.67	1668.67	2114.00	3715.67	2047.00	9.02	64.13	11.13
GEOFFS-RED-SPELT	AUS	1	AWNLES S	RED	spelt type	1	2	5	1	68.43	33.29	2.73	7.33	57.66	20.61	51.50	6.22	47.48	5.33	69.31	42.33	9.30	12.87	47.67	57.07	76.43	398.33	3623.67	1715.00	1908.67	3802.67	2087.67	9.13	64.62	12.97
GEOFFS-WHITE-SPELT	AUS	2	AWNLES S	WHITE	spelt type	7	6	6	5	73.43	32.10	2.73	6.73	57.02	17.74	54.50	7.14	35.88	4.33	87.83	33.67	9.73	15.43	51.67	53.60	74.00	392.33	3847.67	1714.33	2133.33	3724.67	2010.33	9.04	64.50	13.50
HERCULE	BEL	2	AWNLES S	WHITE	spelt type	4	2	8	3	67.90	33.03	2.87	7.10	60.69	18.30	53.03	6.21	46.45	16.50	11.86	17.00	0.80	0.73	216.67	55.60	0.00	343.00	3545.67	1594.33	1951.33	3800.00	2205.67	9.02	63.82	11.23
HOLSTENKORN	DEU	1	AWNLES S	RED	spelt type	4	1	8	3	65.70	32.03	2.73	7.27	59.10	18.58	52.70	6.93	49.02	8.17	52.60	31.33	2.30	4.20	109.67	53.93	35.03	425.00	3619.33	1653.00	1966.33	3870.00	2217.00	9.04	64.65	12.63
HUBEL	CHE	1	AWNLES S	RED	spelt type	8	7	3	6	73.77	36.12	3.00	6.97	62.45	18.05	53.93	6.29	41.35	6.33	68.25	35.67	4.03	5.73	118.67	52.80	50.83	385.00	3734.67	1673.33	2061.33	3557.00	1883.67	9.13	64.87	9.93
LUEG	CHE	1	AWNLES S	RED	spelt type	1	4	6	1	66.90	28.01	2.85	6.50	53.87	18.99	51.15	6.11	42.13	8.50	60.08	41.50	4.10	13.45	52.00	54.65	71.60	346.50	3599.00	1760.50	18					

MVGB141	HUN	4	AWN	RED	spelt type	7	2	2	5	64.00	33.19	2.73	7.30	57.12	19.57	52.47	6.48	46.87	7.50	59.37.085	2.55	7.50	73.00	55.80	59.65	445.00	3984.50	1893.50	2091.00	3910.50	2017.00	9.08	64.58	13.05
MVGB142	HUN	6	AWNLES S	GREY	spelt type	4	5	4	3	69.33	29.51	2.70	6.63	58.12	20.41	51.20	5.28	44.57	3.83	84.49.090	9.60	16.10	32.67	56.43	83.97	351.67	3621.00	1721.33	1899.67	3957.67	2236.33	8.96	63.35	13.40
MVGB143	HUN	4	AWN	RED	spelt type	4	4	6	3	63.80	29.63	2.63	7.13	55.89	19.52	52.30	6.16	42.78	6.25	65.39.026	2.70	11.05	44.50	55.70	64.10	439.00	3689.00	1740.50	1948.50	3923.00	2182.50	8.93	62.73	11.90
MVGB144	HUN	2	AWNLES S	WHITE	spelt type	7	7	3	5	72.10	34.72	3.03	6.53	60.90	18.85	53.60	6.46	39.52	4.00	76.39.078	1.50	6.17	101.00	53.50	43.23	406.33	3886.67	1749.33	2137.33	3830.67	2081.33	9.02	64.18	11.40
MVGB145	HUN	4	AWN	RED	spelt type	6	4	5	7	64.75	28.22	2.60	7.00	57.55	19.20	52.45	6.54	42.10	6.25	66.43.068	6.85	17.00	30.00	55.20	77.00	439.67	3865.00	1795.00	2070.00	4029.00	2234.00	9.07	63.48	13.40
MVGB146	HUN	5	AWN	WHITE	spelt type	3	2	1	2	70.07	30.88	2.60	7.13	56.12	21.11	50.97	6.03	46.07	6.50	35.33.314	5.50	11.73	64.33	57.33	69.47	385.33	3457.00	1744.00	1713.00	3821.50	2077.50	9.00	63.03	13.90
MVGB308	HUN	2	AWNLES S	WHITE	spelt type	6	6	8	8	75.63	41.22	3.37	6.50	62.38	16.20	56.03	7.90	33.42	7.17	27.26.622	2.67	4.23	125.00	54.50	42.47	269.33	3899.67	1960.33	1939.33	4153.67	2193.33	9.16	63.82	12.23
MVGB318	HUN	1	AWNLES S	RED	spelt type	6	3	7	7	68.40	37.56	3.00	7.70	56.27	19.92	52.30	6.24	50.83	7.67	46.30.362	1.67	4.10	104.00	57.23	46.17	340.00	3815.00	1815.67	1999.33	3974.33	2158.67	9.13	63.65	12.33
MVGB319	HUN	4	AWN	RED	spelt type	4	5	2	3	71.37	31.59	2.70	7.13	58.22	19.88	52.37	6.92	45.55	7.83	70.43.342	3.57	12.63	65.00	55.83	64.37	454.67	3748.67	1810.33	1938.33	3899.00	2088.67	9.20	64.80	10.17
MVGB353	HUN	1	AWNLES S	RED	spelt type	8	4	4	6	71.53	34.34	2.73	7.47	53.42	20.11	52.33	6.91	42.03	4.50	81.44.664	13.90	13.97	33.00	56.77	82.73	391.33	3816.33	1754.33	2062.00	3684.00	1929.67	9.07	63.80	13.53
MVGB523	HUN	2	AWNLES S	WHITE	spelt type	7	4	5	5	72.17	37.23	2.80	7.53	53.31	19.89	52.27	6.57	43.10	6.50	65.33.626	12.53	14.87	36.00	56.63	83.47	444.67	3849.00	1740.00	2109.00	3693.00	1953.00	9.00	63.33	14.03
MVGB524	HUN	3	AWN	BROWN	spelt type	6	4	4	7	70.85	33.01	2.75	7.05	62.15	19.54	51.85	6.31	42.83	4.00	87.53.578	6.95	18.85	14.00	56.75	85.25	412.50	3808.00	1876.00	1932.00	4100.50	2224.50	9.03	63.95	11.20
MVGB525	HUN	3	AWN	BROWN	spelt type	4	5	4	3	66.00	33.34	2.80	7.15	59.19	19.90	51.30	6.15	44.13	4.50	92.57.023	6.45	18.70	18.00	57.65	82.95	438.50	3629.00	1831.00	1798.00	4124.00	2293.00	9.17	65.50	10.10
MVGB526	HUN	5	AWN	WHITE	spelt type	3	3	1	2	72.35	33.14	2.70	7.15	59.10	20.93	51.65	6.15	53.80	10.50	48.35.048	8.40	10.30	74.50	57.00	69.50	381.00	3506.50	1780.50	1726.00	3989.50	2209.00	8.93	62.00	13.35
MVGB527	HUN	1	AWNLES S	RED	spelt type	4	5	6	3	70.67	36.99	2.90	7.60	58.12	19.85	52.33	6.42	45.05	5.50	67.41.072	8.47	14.77	50.00	56.50	73.37	381.67	3727.00	1751.67	1975.33	3828.33	2076.67	9.07	62.82	14.30
MVGB528	HUN	2	AWNLES S	WHITE	spelt type	7	5	5	7	69.63	36.32	2.77	7.63	51.13	20.46	51.57	6.45	44.32	7.83	64.36.615	11.83	13.07	39.33	57.40	76.87	413.67	3849.67	1768.67	2081.00	3902.00	2133.33	9.00	63.83	13.47
MVGB529	HUN	5	AWN	WHITE	spelt type	3	2	6	2	71.13	31.46	2.67	7.03	55.94	20.29	51.70	5.85	48.30	8.17	57.36.042	8.83	12.53	57.00	57.17	74.73	391.67	3545.67	1787.33	1758.33	3938.67	2151.33	9.00	63.02	13.57
MVGB557	HUN	2	AWNLES S	WHITE	spelt type	6	7	3	7	69.20	33.76	2.97	6.90	62.75	18.51	52.97	5.98	41.37	5.17	84.42.042	2.53	6.47	84.00	54.77	51.30	308.33	3814.67	1848.00	1966.67	3984.33	2136.33	9.22	63.82	10.93
MVGB855	HUN	5	AWN	WHITE	spelt type	6	6	8	7	77.20	38.40	3.10	6.40	55.27	15.86	55.30	7.08	37.95	6.50	52.26.361	2.57	4.40	119.67	55.27	46.07	368.33	3796.00	1853.33	1942.67	3973.33	2120.00	9.16	62.80	12.13
MV-MARTONGOLD	HUN	1	AWNLES S	RED	spelt type	5	2	6	4	77.33	42.48	3.13	7.40	57.15	18.24	54.47	5.89	46.60	10.50	54.31.014	3.43	12.43	49.67	57.30	65.67	371.33	3512.33	1651.00	1861.33	3532.33	1881.33	9.09	62.98	13.13
MV-VITALGOLD	HUN	1	AWNLES S	RED	spelt type	5	1	8	4	70.57	42.63	3.10	7.83	58.86	19.38	53.30	6.24	49.92	13.50	22.25.387	1.43	2.67	127.67	56.33	36.03	363.33	3486.33	1678.33	1808.00	3628.00	1949.67	9.16	63.47	11.97
OBERKULMER/BAU LANDER-SPELZ_1	HUN	1	AWNLES S	RED	spelt type	2	3	8	1	71.33	42.54	3.03	7.93	60.98	20.57	52.27	6.24	53.82	12.50	39.27.694	2.50	5.17	118.00	58.93	48.20	345.33	3595.00	1717.50	1877.50	3718.50	2001.00	9.18	62.65	13.20
OBERKULMER/BAU LANDER-SPELZ_2	HUN	1	AWNLES S	RED	spelt type	1	1	1	1	68.47	40.03	2.97	7.83	59.86	19.87	52.93	6.05	48.83	6.17	54.33.682	2.57	6.23	81.33	55.87	55.27	411.67	3548.67	1685.67	1863.00	3719.67	2034.00	9.09	63.60	12.53
OBERKULMER/ROU QUIN	HUN	1	AWNLES S	RED	spelt type	5	1	7	4	69.93	41.38	3.03	7.67	55.40	19.57	53.50	5.95	49.07	10.83	44.26.088	2.43	5.60	104.33	56.43	49.83	368.33	3379.33	1606.00	1773.33	3655.00	2049.00	9.09	63.17	13.53
OBERKULMER/SCH WABENKORN_1	HUN	1	AWNLES S	RED	spelt type	5	3	7	4	72.03	41.03	2.97	7.83	58.99	20.43	52.37	6.55	52.98	9.33	47.27.044	2.73	6.73	95.33	57.90	55.17	374.00	3470.67	1691.67	1779.00	3709.33	2017.67	9.11	62.85	12.37
OBERKULMER/SCH WABENKORN_2	HUN	1	AWNLES S	RED	spelt type	3	1	8	2	71.53	43.02	3.00	7.97	57.74	19.88	53.03	6.85	49.65	7.17	38.26.392	1.83	3.97	110.67	56.87	42.50	353.33	3419.33	1698.00	1721.33	3813.67	2115.67	9.13	62.47	14.37
OBERKULMER/SCH WABENKORN_3	HUN	1	AWNLES S	RED	spelt type	4	1	7	3	71.13	46.91	3.03	8.03	57.80	19.34	54.03	6.86	49.20	5.67	35.25.339	2.70	5.73	91.00	56.13	53.97	359.67	3592.00	1779.00	1813.00	3891.33	2112.33	9.18	62.97	14.43
OBERKULMER/SCH WABENKORN_4	HUN	1	AWNLES S	RED	spelt type	7	5	1	5	70.80	41.08	3.03	7.57	56.68	19.50	52.67	7.84	43.67	8.83	54.30.650	3.63	10.97	75.33	55.43	60.27	396.33	3840.67	1751.67	2089.00	3815.33	2063.67	9.09	63.15	13.13
OBERKULMER/SCH WABENKORN_5	HUN	1	AWNLES S	RED	spelt type	3	1	7	2	71.97	45.19	3.07	7.97	57.92	19.91	53.03	6.96	49.72	11.50	44.31.087	2.53	5.00	99.67	57.37	50.63	353.67	3418.67	1738.33	1680.33	3778.67	2040.33	9.16	61.93	13.80
OBERKULMER/SER TEL_1	HUN	1	AWNLES S	RED	spelt type	4	1	8	3	72.03	42.86	3.03	7.80	60.32	19.66	53.30	6.17	48.78	6.33	51.29.368	1.67	4.23	119.33	56.87	41.30	375.33	3622.00	1756.67	1865.33	3912.33	2155.67	9.09	62.95	13.60
OBERKULMER/SER TEL_2	HUN	1	AWNLES S	RED	spelt type	4	5	2	3	73.00	41.74	3.00	7.83	60.71	19.73	53.50	6.78	43.92	5.00	69.36.312	4.80	11.10	69.00	56.23	66.43	398.33	3566.33	1719.67	1846.67	3885.67	2166.00	9.13	63.17	13.53
OBERKULMER- ROTKORN	CHE	1	AWNLES S	RED	spelt type	5	3	7	4	72.53	45.07	3.07	7.83	60.65	19.89	53.47	6.54	54.27	9.33	39.28.336	2.30	5.00	99.67	57.47	51.17	319.67	3327.67	1619.33	1708.33	3566.33	1947.00	9.16	62.68	13.27
OKO-10	HUN	1	AWNLES S	RED	spelt type	5	3	8	4	71.67	43.37	3.00	7.73	56.43	18.77	53.40	6.95	52.87	14.33	26.24.330	1.80	2.90	118.33	57.53	41.23	311.33	3347.67	1616.67	1731.00	3599.00	1982.33	9.11	62.00	13.80
OSTAR	CHE	1	AWNLES S	RED	spelt type	4	5	7	3	69.53	42.01	3.13	7.80	56.68	19.39	52.83	6.75	44.45	7.50	47.30.620	3.30	5.47	86.00	54.63	48.07	336.00	3688.00	1829.67	1858.33	3926.67	2097.00	9.16	63.10	13.00
OSTRO	CHE	1	AWNLES S	RED	spelt type	5	1	8	3	71.60	44.49	3.00	7.90	58.52	19.37	52.97	6.76	49.12	13.67	25.23.027	2.57	3.93	125.00	57.70	44.47	353.33	3436.33	1704.00	1732.33	3630.67	1926.67	9.13	62.13	13.97
POEME	BEL	1	AWNLES S	RED	spelt type	2	5	6	1	69.43	35.16	2.97	7.37	62.61	19.04	52.17	6.99	45.18	8.83	56.35.099	4.47	14.53	49.00	54.70	70.10	385.67	3605.00	1642.00	1963.00	3665.67	2023.67	9.09	63.35	12.10
RED WINTER	AUS	1	AWNLES S	RED	spelt type	1	5	6	1	69.60	33.00	2.77	7.37	56.11	19.72	51.93	6.44	45.85	6.33	71.41.098	6.87	14.47	51.33	56.57	74.37	457.00	3612.33	1699.67	1912.67	3735.67	2036.00	9.11	63.97</	

SAHARENSE	AUS	7	AWNLES S	GREY	wheat type	6	6	3	8	72.07	32.31	2.87	6.20	62.23	14.87	54.53	6.75	38.65	10.50	69.28	63.0	4.63	6.50	88.33	58.67	58.77	416.00	4009.67	2075.67	1934.00	4533.00	2457.33	8.93	62.10	14.83
SCHWABENKORN	DEU	1	AWNLES S	RED	spelt type	4	6	1	3	70.53	36.77	3.00	6.97	60.93	16.25	55.13	6.95	39.53	10.00	49.26	71.3	2.67	4.37	73.67	53.27	56.93	383.00	3670.00	1751.67	1918.33	3893.67	2142.00	9.07	64.30	14.83
SERTEL	CHE	2	AWNLES S	WHITE	spelt type	7	6	3	5	76.37	38.52	2.93	7.00	63.14	17.39	55.43	5.65	39.02	7.17	73.31	04.0	2.73	5.77	85.00	53.10	51.40	389.00	3933.67	1776.33	2157.33	3733.67	1957.33	9.18	62.98	11.73
SPY	BEL	1	AWNLES S	RED	spelt type	7	4	1	5	68.00	39.52	3.20	7.53	56.87	17.97	53.40	6.07	44.40	7.17	53.29	71.0	7.97	9.90	73.67	55.17	63.33	343.33	3918.67	1797.67	2121.00	3877.33	2079.67	9.09	63.80	11.97
STONE	BEL	1	AWNLES S	RED	spelt type	8	5	6	6	68.10	37.50	3.07	7.33	57.60	19.31	52.10	6.92	44.18	7.83	58.37	43.0	4.67	13.23	60.33	55.77	66.57	412.33	3743.50	1653.00	2090.50	3720.50	2067.50	9.10	64.00	13.15
TSP04-09	HUN	1	AWNLES S	RED	spelt type	8	2	2	3	69.47	35.49	2.90	7.53	56.36	20.66	51.57	7.14	46.90	7.33	63.32	27.7	4.50	10.97	64.00	56.73	65.30	407.67	3715.67	1705.00	2010.67	3782.33	2077.33	9.09	63.82	13.50
TSP06-10	HUN	1	AWNLES S	RED	spelt type	1	1	7	1	70.93	40.84	3.03	7.67	58.78	19.49	52.83	6.61	49.73	11.83	35.27	59.0	2.67	7.03	96.33	56.87	50.50	416.33	3624.00	1735.67	1888.33	3829.00	2093.33	9.09	62.80	12.50
TSP07-09	HUN	1	AWNLES S	RED	spelt type	6	1	7	6	68.20	36.56	2.97	7.70	56.54	20.03	52.23	6.58	48.88	10.33	39.30	99.0	2.27	7.73	86.67	57.37	54.27	361.67	3871.00	1828.33	2042.67	3947.33	2119.00	9.13	63.80	13.10
VAVILOVII	AUS	5	AWN	WHITE	spelt type	6	6	8	8	75.20	35.33	3.07	6.40	53.31	14.51	56.30	6.11	33.23	9.25	57.29	25.7	1.80	4.55	127.00	54.25	39.90	251.33	3979.50	2092.50	1887.00	4259.00	2166.50	9.27	64.78	10.90
VULPINUM ALEF.	AUS	4	AWN	RED	spelt type	6	7	3	6	73.90	44.79	3.10	7.70	58.45	16.96	54.20	6.48	41.23	6.83	73.41	79.0	3.30	9.83	80.67	56.63	61.83	347.33	3894.67	1892.00	2002.67	3942.33	2050.33	9.16	63.83	13.97
WEIHENSTEPHAN	HUN	2	AWNLES S	WHITE	spelt type	6	4	8	8	69.50	32.98	2.97	6.60	60.99	17.64	53.53	6.51	43.02	10.33	61.36	51.0	2.10	5.47	128.00	55.37	34.73	286.00	3955.67	1958.67	1997.00	4086.00	2127.33	9.22	64.32	7.60
WHITE BEARDLESS	AUS	2	AWNLES S	WHITE	spelt type	7	6	4	5	72.77	32.03	2.73	6.77	57.56	18.10	53.97	7.35	37.25	2.67	91.39	81.7	7.63	16.00	29.67	54.43	80.67	398.67	4011.33	1753.67	2257.67	3714.67	1961.00	9.02	64.70	13.50
ZOLLERNPELZ	DEU	1	AWNLES S	RED	spelt type	2	3	1	1	64.95	33.42	2.85	7.50	59.34	18.36	51.40	6.33	50.50	5.50	60.40	593.0	2.45	7.25	80.00	56.70	51.90	425.00	3618.50	1618.50	2000.00	3656.50	2038.00	8.93	62.38	12.65
GLENLEA	CAN	8	AWNLES S	WHITE	wheat type	8	6	4	6	79.57	42.63	3.24	7.08	60.17	16.30	55.73	5.95	35.97	2.50	97.48	32.0	19.87	17.47	45.00	62.90	100.00	416.00	3817.00	1783.67	2033.33	3528.00	1744.33	8.96	61.60	17.35
UKRAINKA	UKR	9	AWN	WHITE	wheat type	6	6	4	8	75.60	38.31	3.18	6.70	54.72	14.53	55.57	6.79	28.90	1.17	99.45	70.7	1.94	18.17	30.33	60.00	76.90	428.00	3939.00	2072.00	1867.00	4157.00	2085.00	8.91	61.17	18.85
mean of spelt										70.51	36.93	2.93	7.32	58.22	18.99	52.94	6.54	44.71	7.80	59.34	28.8	4.75	9.54	76.06	55.95	59.73	383.28	3706.24	1751.42	1954.81	3824.95	2073.53	9.08	63.48	12.75
sd of spelt										3.28	4.25	0.15	0.41	2.58	1.32	1.16	0.47	4.78	2.95	18.08	7.54	3.46	4.71	35.24	1.62	16.22	44.64	177.15	95.24	137.52	187.53	116.40	0.08	0.80	1.38
min of spelt										60.10	28.01	2.60	6.20	51.13	14.51	50.87	5.28	33.23	2.50	11.86	0	0.55	0.73	5.00	52.80	0.00	251.33	3292.50	1535.50	1680.33	3381.50	1846.00	8.84	61.65	7.60
max of spelt										77.33	46.91	3.37	8.03	63.14	21.11	56.30	7.90	54.27	16.50	97.57	46.0	17.05	19.03	216.67	62.50	97.15	520.00	4104.33	2092.50	2257.67	4533.00	2457.33	9.27	65.50	18.00
max-avg/avg										9.68	27.01	15.00	9.81	8.46	11.19	6.34	20.79	21.38	111.61	64.40	63.89	258.91	99.49	184.87	11.70	62.64	35.67	10.74	19.47	15.49	18.51	18.51	2.02	3.18	41.15

Blue - winter wheat

**Table S2.** Growing and environmental conditions in Hungary (Martonvásár, 2017-2019)

<b>Growing conditions</b>		<b>2017, 2018, 2019</b>
<b>Location</b>	geographic coordinates	47°18'N, 18°47'E
	altitude	115 m
<b>Growing parameters</b>	previous crop:	facelia, oil radish, facelia
	sowing density	280 seeds/m <sup>2</sup>
<b>Soil parameters</b>	soil type	chernozem
	pH (KCl)	7.25
	humus (m/m%)	2.8
	P <sub>2</sub> O <sub>5</sub> (mg/kg)	210
	K <sub>2</sub> O (mg/kg)	210
	yearly average N input through NPK combined fertilizer (active ingredient, kg/ha)	120

**Table S3.** Meteorological conditions in Hungary (Martonvásár, 2017-2019)

		2016/2017	2017/2018	2018/2019
<b>full season</b>	Growing period (days)	288	282	279
	Cumulative precipitation (mm)	254.7	494.5	365.6
	Mean temperature (°C)	8.3	9.67	9.3
	Absolute min temperature (°C)	-20.7	-20.2	-14.4
	Absolute max temperature (°C)	35.6	32	36.0
<b>last 100 days</b>	Cum. precipitation before harvest (mm)	125.3	189.7	225.0
	Mean temperature (°C)	17.1	19.39	17.1
	Absolute min temp(°C)	-0.6	2.6	-0.7
	Absolute max temp (°C)	35.6	32.0	36.0
<b>abs. min-max</b>	No of days with Tmin $\leq$ 0 °C	95	82	90
	No of days with Tmin $\leq$ -10 °C	14	3	6
	No of days with Tmax $\geq$ 25 °C	49	68	42
	No of days with Tmax $\geq$ 30 °C	17	8	16
	No of days with Tmax $\geq$ 35 °C	1	0	1

**Table S4.** Mean values of the parameters for each of the dendrogram groups distinguished by quality parameters (a), starch properties (b), country of origin (c.) and spike morphology (d.) where the significant differences are shown by Tukey test results.

<b>a.Dendrogram quality group</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>N</b>	<b>27</b>	<b>36</b>	<b>24</b>	<b>27</b>	<b>30</b>	<b>48</b>	<b>36</b>	<b>48</b>
Test weight (kg/100L)	69.36 <sup>a</sup>	69.89 <sup>a</sup>	72.52 <sup>a</sup>	71.99 <sup>a</sup>	68.86 <sup>a</sup>	70.70 <sup>a</sup>	69.47 <sup>a</sup>	71.05 <sup>a</sup>
TKW (g)	37.20 <sup>abc</sup>	36.20 <sup>ab</sup>	36.80 <sup>ab</sup>	34.89 <sup>a</sup>	35.24 <sup>ab</sup>	35.27 <sup>ab</sup>	40.64 <sup>c</sup>	38.91 <sup>bc</sup>
KWidth (mm)	2.96 <sup>ab</sup>	2.90 <sup>ab</sup>	2.98 <sup>ab</sup>	2.85 <sup>a</sup>	2.86 <sup>a</sup>	2.90 <sup>ab</sup>	2.99 <sup>b</sup>	3.01 <sup>b</sup>
KLength (mm)	7.41 <sup>bc</sup>	7.35 <sup>b</sup>	6.95 <sup>a</sup>	7.00 <sup>a</sup>	7.42 <sup>bc</sup>	7.21 <sup>ab</sup>	7.69 <sup>c</sup>	7.31 <sup>b</sup>
FY (%)	58.32 <sup>abc</sup>	59.26 <sup>bc</sup>	61.13 <sup>c</sup>	58.34 <sup>abc</sup>	55.80 <sup>a</sup>	57.53 <sup>ab</sup>	57.48 <sup>ab</sup>	58.50 <sup>abc</sup>
B glucan (mg/g)	6.47 <sup>a</sup>	6.65 <sup>a</sup>	6.36 <sup>a</sup>	6.39 <sup>a</sup>	6.57 <sup>a</sup>	6.56 <sup>a</sup>	6.56 <sup>a</sup>	6.59 <sup>a</sup>
Starch (%)	52.72 <sup>ab</sup>	52.96 <sup>abc</sup>	54.05 <sup>d</sup>	52.98 <sup>abc</sup>	52.31 <sup>a</sup>	52.68 <sup>ab</sup>	52.86 <sup>ab</sup>	53.54 <sup>cd</sup>
Protein (%)	19.07 <sup>b</sup>	19.22 <sup>b</sup>	17.65 <sup>a</sup>	18.47 <sup>ab</sup>	19.34 <sup>b</sup>	19.08 <sup>b</sup>	19.56 <sup>b</sup>	18.53 <sup>ab</sup>
Gluten (%)	46.20 <sup>cd</sup>	42.50 <sup>abc</sup>	40.35 <sup>ab</sup>	39.17 <sup>a</sup>	44.66 <sup>c</sup>	43.96 <sup>bc</sup>	50.09 <sup>d</sup>	46.03 <sup>cd</sup>
Gluten sp (mm)	8.31 <sup>bc</sup>	6.04 <sup>ab</sup>	6.92 <sup>b</sup>	3.52 <sup>a</sup>	7.47 <sup>b</sup>	6.92 <sup>b</sup>	10.26 <sup>c</sup>	10.16 <sup>c</sup>
GI	51.28 <sup>bc</sup>	69.87 <sup>e</sup>	72.87 <sup>e</sup>	91.70 <sup>f</sup>	59.28 <sup>cd</sup>	68.12 <sup>de</sup>	42.30 <sup>ab</sup>	39.62 <sup>a</sup>
Zeleny (ml)	32.17 <sup>ab</sup>	36.81 <sup>bc</sup>	36.54 <sup>bc</sup>	49.22 <sup>d</sup>	36.32 <sup>bc</sup>	38.26 <sup>c</sup>	28.83 <sup>a</sup>	27.25 <sup>a</sup>
DevTime (min)	4.33 <sup>ab</sup>	3.81 <sup>ab</sup>	2.93 <sup>ab</sup>	10.83 <sup>d</sup>	8.57 <sup>cd</sup>	5.64 <sup>bc</sup>	2.51 <sup>a</sup>	2.35 <sup>a</sup>
Stability (min)	8.63 <sup>bc</sup>	9.89 <sup>c</sup>	6.28 <sup>ab</sup>	17.43 <sup>e</sup>	13.97 <sup>de</sup>	13.59 <sup>d</sup>	5.65 <sup>ab</sup>	4.11 <sup>a</sup>
Soft at 12 (FU)	75.69 <sup>cd</sup>	69.22 <sup>bcd</sup>	95.17 <sup>d</sup>	23.69 <sup>a</sup>	41.58 <sup>ab</sup>	51.59 <sup>abc</sup>	94.43 <sup>d</sup>	128.73 <sup>e</sup>
Wabs (%)	55.81 <sup>ab</sup>	55.00 <sup>a</sup>	55.09 <sup>a</sup>	57.45 <sup>c</sup>	56.05 <sup>abc</sup>	56.16 <sup>abc</sup>	56.84 <sup>bc</sup>	56.10 <sup>abc</sup>
HunQN	59.82 <sup>bc</sup>	61.20 <sup>bc</sup>	51.36 <sup>b</sup>	86.43 <sup>e</sup>	73.96 <sup>d</sup>	69.89 <sup>cd</sup>	51.26 <sup>b</sup>	38.66 <sup>a</sup>
FN (sec)	382.2 <sup>abc</sup>	401.8 <sup>cd</sup>	379.6 <sup>abc</sup>	418.8 <sup>d</sup>	404.1 <sup>d</sup>	399.5 <sup>cd</sup>	359.2 <sup>ab</sup>	345.3 <sup>a</sup>
PeakVisc (cP)	3675.0 <sup>ab</sup>	3753.9 <sup>bc</sup>	3862.9 <sup>c</sup>	3822.0 <sup>c</sup>	3756.2 <sup>bc</sup>	3736.6 <sup>bc</sup>	3541.4 <sup>a</sup>	3627.8 <sup>ab</sup>
TroughVisc (cP)	1730.1 <sup>a</sup>	1746.2 <sup>a</sup>	1832.5 <sup>b</sup>	1845.9 <sup>b</sup>	1739.5 <sup>a</sup>	1726.2 <sup>a</sup>	1722.7 <sup>a</sup>	1749.6 <sup>a</sup>
Breakdown (cP)	1944.9 <sup>bc</sup>	2007.6 <sup>c</sup>	2030.4 <sup>c</sup>	1976.1 <sup>bc</sup>	2016.7 <sup>c</sup>	2010.4 <sup>c</sup>	1818.7 <sup>a</sup>	1878.1 <sup>ab</sup>
FinalVisc (cP)	3809.9 <sup>ab</sup>	3841.8 <sup>ab</sup>	3911.6 <sup>ab</sup>	3984.2 <sup>b</sup>	3768.8 <sup>a</sup>	3769.8 <sup>a</sup>	3781.8 <sup>ab</sup>	3812.4 <sup>ab</sup>
Setback (cP)	2079.8 <sup>a</sup>	2095.5 <sup>a</sup>	2079.1 <sup>a</sup>	2138.2 <sup>a</sup>	2029.3 <sup>a</sup>	2043.5 <sup>a</sup>	2059.1 <sup>a</sup>	2062.7 <sup>a</sup>
PastingTime (min)	9.04 <sup>ab</sup>	9.08 <sup>abc</sup>	9.11 <sup>cd</sup>	9.03 <sup>a</sup>	9.05 <sup>ab</sup>	9.05 <sup>ab</sup>	9.11 <sup>cd</sup>	9.13 <sup>d</sup>
PastingTemp (°C)	63.25 <sup>ab</sup>	63.62 <sup>ab</sup>	63.54 <sup>ab</sup>	63.71 <sup>b</sup>	63.63 <sup>ab</sup>	63.51 <sup>ab</sup>	62.86 <sup>a</sup>	63.43 <sup>ab</sup>
Starch damage (UCD)	12.84 <sup>ab</sup>	12.83 <sup>ab</sup>	12.01 <sup>a</sup>	13.53 <sup>b</sup>	13.02 <sup>ab</sup>	13.17 <sup>ab</sup>	13.24 <sup>ab</sup>	12.29 <sup>ab</sup>

DevTime- Farinograph dough development time, FN- falling number, FY-flour yield, GI –gluten index, Gluten sp- gluten spread, HunQN- Farinograph quality number, KLength-kernel length, KWidth- kernel width, Soft at 12- dough softening at 12 min, Stability- Farinograph dough stability, Temp-Temperature, TKW- thousand kernel weight, Visc- Viscosity, Wabs- water absorption,

<b>b.Dendrogram starch group</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>N</b>	<b>45</b>	<b>18</b>	<b>54</b>	<b>27</b>	<b>39</b>	<b>45</b>	<b>24</b>	<b>24</b>
Test weight (kg/100L)	70.45 <sup>a</sup>	71.64 <sup>a</sup>	67.95 <sup>a</sup>	70.34 <sup>a</sup>	71.63 <sup>a</sup>	71.16 <sup>a</sup>	70.43 <sup>a</sup>	72.06 <sup>a</sup>
TKW (g)	37.01 <sup>ab</sup>	36.27 <sup>a</sup>	36.72 <sup>ab</sup>	40.51 <sup>b</sup>	37.06 <sup>ab</sup>	37.58 <sup>ab</sup>	34.24 <sup>a</sup>	35.85 <sup>a</sup>
KWidth (mm)	2.95 <sup>bc</sup>	2.80 <sup>a</sup>	2.91 <sup>abc</sup>	3.01 <sup>c</sup>	2.92 <sup>abc</sup>	2.98 <sup>bc</sup>	2.86 <sup>ab</sup>	2.99 <sup>bc</sup>

KLength (mm)	7.39 <sup>cd</sup>	7.41 <sup>cd</sup>	7.41 <sup>cd</sup>	7.67 <sup>d</sup>	7.21 <sup>bc</sup>	7.35 <sup>bc</sup>	7.07 <sup>ab</sup>	6.76 <sup>a</sup>
FY (%)	58.20 <sup>a</sup>	57.23 <sup>a</sup>	58.49 <sup>a</sup>	57.87 <sup>a</sup>	58.34 <sup>a</sup>	58.16 <sup>a</sup>	57.72 <sup>a</sup>	58.98 <sup>a</sup>
B glucan (mg/g)	6.45 <sup>a</sup>	6.32 <sup>a</sup>	6.52 <sup>a</sup>	6.50 <sup>a</sup>	6.51 <sup>a</sup>	6.63 <sup>a</sup>	6.60 <sup>a</sup>	6.71 <sup>a</sup>
Starch (%)	52.48 <sup>a</sup>	52.15 <sup>a</sup>	52.68 <sup>ab</sup>	52.81 <sup>ab</sup>	53.79 <sup>bc</sup>	53.18 <sup>ab</sup> <sup>c</sup>	52.85 <sup>ab</sup>	54.10 <sup>c</sup>
Protein (%)	19.36 <sup>bc</sup>	20.34 <sup>c</sup>	19.40 <sup>bc</sup>	19.54 <sup>bc</sup>	18.42 <sup>b</sup>	18.55 <sup>b</sup>	18.69 <sup>b</sup>	16.85 <sup>a</sup>
Gluten (%)	46.53 <sup>cd</sup>	49.73 <sup>de</sup>	45.11 <sup>c</sup>	51.49 <sup>e</sup>	41.09 <sup>ab</sup>	42.96 <sup>bc</sup>	42.61 <sup>bc</sup>	37.18 <sup>a</sup>
Gluten sp (mm)	8.38 <sup>ab</sup>	9.64 <sup>bc</sup>	7.42 <sup>ab</sup>	11.69 <sup>c</sup>	6.44 <sup>a</sup>	6.62 <sup>a</sup>	5.91 <sup>a</sup>	6.59 <sup>a</sup>
GI	53.77 <sup>bc</sup>	45.86 <sup>ab</sup>	59.85 <sup>cd</sup>	38.29 <sup>a</sup>	66.79 <sup>cd</sup>	67.33 <sup>cd</sup>	70.80 <sup>d</sup>	73.00 <sup>d</sup>
Zeleny (ml)	34.19 <sup>abc</sup>	32.11 <sup>ab</sup>	35.85 <sup>abc</sup>	28.56 <sup>a</sup>	32.77 <sup>abc</sup>	37.51 <sup>bc</sup>	39.56 <sup>c</sup>	38.85 <sup>bc</sup>
DevTime (min)	4.13 <sup>ab</sup>	4.80 <sup>ab</sup>	4.23 <sup>ab</sup>	2.51 <sup>a</sup>	5.50 <sup>ab</sup>	6.33 <sup>b</sup>	5.63 <sup>ab</sup>	6.07 <sup>ab</sup>
Stability (min)	10.03 <sup>ab</sup>	7.59 <sup>ab</sup>	9.16 <sup>ab</sup>	5.96 <sup>a</sup>	10.22 <sup>ab</sup>	11.17 <sup>b</sup>	11.25 <sup>b</sup>	11.17 <sup>b</sup>
Soft at 12 (FU)	73.34 <sup>ab</sup>	82.36 <sup>ab</sup>	79.14 <sup>ab</sup>	103.91 <sup>b</sup>	67.44 <sup>ab</sup>	68.40 <sup>ab</sup>	62.88 <sup>a</sup>	70.10 <sup>ab</sup>
Wabs (%)	56.16 <sup>ab</sup>	57.08 <sup>b</sup>	55.83 <sup>ab</sup>	57.17 <sup>b</sup>	54.79 <sup>a</sup>	56.09 <sup>ab</sup>	56.50 <sup>b</sup>	56.10 <sup>ab</sup>
HunQN	61.08 <sup>a</sup>	58.95 <sup>a</sup>	57.11 <sup>a</sup>	48.99 <sup>a</sup>	63.04 <sup>a</sup>	65.22 <sup>a</sup>	63.57 <sup>a</sup>	63.48 <sup>a</sup>
FN (sec)	393.7 <sup>ab</sup>	366.1 <sup>ab</sup>	389.6 <sup>ab</sup>	347.1 <sup>a</sup>	397.8 <sup>b</sup>	386.0 <sup>ab</sup>	400.2 <sup>b</sup>	366.8 <sup>ab</sup>
PeakVisc (cP)	3606.6 <sup>b</sup>	3473.9 <sup>a</sup>	3648.4 <sup>b</sup>	3418.8 <sup>a</sup>	3910.7 <sup>d</sup>	3800.8 <sup>c</sup>	3857.7 <sup>cd</sup>	3902.2 <sup>cd</sup>
TroughVisc (cP)	1702.3 <sup>ab</sup>	1748.9 <sup>b</sup>	1750.6 <sup>b</sup>	1636.1 <sup>a</sup>	1766.5 <sup>b</sup>	1729.7 <sup>b</sup>	1834.1 <sup>c</sup>	1954.0 <sup>d</sup>
Breakdown (cP)	1904.2 <sup>b</sup>	1725.0 <sup>a</sup>	1897.7 <sup>b</sup>	1782.7 <sup>a</sup>	2144.2 <sup>f</sup>	2071.1 <sup>de</sup>	2023.5 <sup>cd</sup>	1948.1 <sup>bc</sup>
FinalVisc (cP)	3727.8 <sup>abc</sup>	3876.7 <sup>bcd</sup>	3890.0 <sup>cd</sup>	3583.7 <sup>a</sup>	3791.6 <sup>bc</sup>	3705.5 <sup>ab</sup>	4010.6 <sup>de</sup>	4189.8 <sup>e</sup>
Setback (cP)	2025.4 <sup>abc</sup>	2127.8 <sup>bcd</sup>	2139.3 <sup>cd</sup>	1947.5 <sup>a</sup>	2025.1 <sup>abc</sup>	1975.8 <sup>ab</sup>	2176.4 <sup>cd</sup>	2235.7 <sup>d</sup>
PastingTime (min)	9.09 <sup>a</sup>	9.04 <sup>a</sup>	9.10 <sup>a</sup>	9.10 <sup>a</sup>	9.08 <sup>a</sup>	9.07 <sup>a</sup>	9.06 <sup>a</sup>	9.08 <sup>a</sup>
PastingTemp (°C)	63.32 <sup>b</sup>	62.44 <sup>a</sup>	63.60 <sup>b</sup>	63.10 <sup>ab</sup>	63.65 <sup>b</sup>	63.67 <sup>b</sup>	63.31 <sup>b</sup>	63.74 <sup>b</sup>
Starch damage (UCD)	12.78 <sup>a</sup>	13.86 <sup>a</sup>	12.71 <sup>a</sup>	12.92 <sup>a</sup>	12.74 <sup>a</sup>	12.81 <sup>a</sup>	12.91 <sup>a</sup>	12.86 <sup>a</sup>

c. Country	1	2	3	4	5	6	7	8
N	39	63	27	3	24	114	3	3
Test weight (kg/100L)	72.07 <sup>ab</sup>	69.46 <sup>ab</sup>	73.07 <sup>abc</sup>	71.35 <sup>ab</sup>	67.41 <sup>a</sup>	70.59 <sup>ab</sup>	79.57 <sup>c</sup>	75.60 <sup>bc</sup>
TKW (g)	35.09 <sup>a</sup>	36.90 <sup>a</sup>	38.62 <sup>a</sup>	35.14 <sup>a</sup>	36.40 <sup>a</sup>	37.33 <sup>a</sup>	42.63 <sup>a</sup>	38.31 <sup>a</sup>
KWidth (mm)	2.84 <sup>a</sup>	2.96 <sup>ab</sup>	2.99 <sup>abc</sup>	2.75 <sup>a</sup>	3.02 <sup>abc</sup>	2.91 <sup>a</sup>	3.24 <sup>c</sup>	3.18 <sup>bc</sup>
KLength (mm)	7.06 <sup>a</sup>	7.39 <sup>a</sup>	7.20 <sup>a</sup>	7.10 <sup>a</sup>	7.36 <sup>a</sup>	7.39 <sup>a</sup>	7.08 <sup>a</sup>	6.70 <sup>a</sup>
FY (%)	57.16 <sup>a</sup>	58.68 <sup>a</sup>	59.21 <sup>a</sup>	60.13 <sup>a</sup>	59.20 <sup>a</sup>	57.83 <sup>a</sup>	60.17 <sup>a</sup>	54.72 <sup>a</sup>
B glucan (mg/g)	6.68 <sup>a</sup>	6.55 <sup>a</sup>	6.33 <sup>a</sup>	6.56 <sup>a</sup>	6.69 <sup>a</sup>	6.50 <sup>a</sup>	5.95 <sup>a</sup>	6.79 <sup>a</sup>
Starch (%)	53.27 <sup>ab</sup>	53.02 <sup>a</sup>	53.65 <sup>abc</sup>	52.30 <sup>a</sup>	52.58 <sup>a</sup>	52.72 <sup>a</sup>	55.73 <sup>c</sup>	55.57 <sup>bc</sup>
Protein (%)	18.08 <sup>bc</sup>	18.76 <sup>bc</sup>	18.71 <sup>bc</sup>	18.48 <sup>bc</sup>	18.75 <sup>bc</sup>	19.55 <sup>c</sup>	16.30 <sup>ab</sup>	14.53 <sup>a</sup>
Gluten (%)	42.55 <sup>bc</sup>	43.73 <sup>bc</sup>	44.50 <sup>bc</sup>	38.10 <sup>abc</sup>	44.95 <sup>c</sup>	46.16 <sup>bc</sup>	35.97 <sup>ab</sup>	28.90 <sup>a</sup>
Gluten sp (mm)	7.42 <sup>bc</sup>	7.20 <sup>abc</sup>	8.39 <sup>bc</sup>	4.25 <sup>abc</sup>	9.63 <sup>c</sup>	7.82 <sup>bc</sup>	2.50 <sup>ab</sup>	1.17 <sup>a</sup>
GI	71.74 <sup>ab</sup>	60.67 <sup>a</sup>	52.78 <sup>a</sup>	92.44 <sup>b</sup>	52.71 <sup>a</sup>	56.30 <sup>a</sup>	97.32 <sup>b</sup>	99.70 <sup>b</sup>
Zeleny (ml)	37.97 <sup>abc</sup>	34.95 <sup>ab</sup>	30.94 <sup>a</sup>	52.83 <sup>c</sup>	32.38 <sup>a</sup>	34.53 <sup>ab</sup>	48.00 <sup>bc</sup>	45.67 <sup>abc</sup>
DevTime (min)	6.65 <sup>a</sup>	4.09 <sup>a</sup>	2.96 <sup>a</sup>	14.05 <sup>b</sup>	3.93 <sup>a</sup>	4.81 <sup>a</sup>	19.87 <sup>b</sup>	1.94 <sup>a</sup>
Stability (min)	10.52 <sup>ab</sup>	9.88 <sup>ab</sup>	7.14 <sup>a</sup>	18.60 <sup>b</sup>	9.05 <sup>ab</sup>	9.45 <sup>ab</sup>	17.47 <sup>b</sup>	18.17 <sup>b</sup>
Soft at 12 (FU)	66.08 <sup>ab</sup>	71.56 <sup>ab</sup>	93.74 <sup>b</sup>	5.50 <sup>a</sup>	90.79 <sup>b</sup>	76.53 <sup>ab</sup>	45.00 <sup>ab</sup>	30.33 <sup>ab</sup>
Wabs (%)	56.88 <sup>ab</sup>	55.21 <sup>a</sup>	55.01 <sup>a</sup>	55.05 <sup>a</sup>	55.11 <sup>a</sup>	56.47 <sup>a</sup>	62.90 <sup>c</sup>	60.00 <sup>bc</sup>
HunQN	65.98 <sup>ab</sup>	59.64 <sup>ab</sup>	51.09 <sup>a</sup>	88.25 <sup>bc</sup>	52.51 <sup>a</sup>	60.46 <sup>ab</sup>	100.00 <sup>c</sup>	76.90 <sup>abc</sup>
FN (sec)	400.8 <sup>ab</sup>	378.3 <sup>a</sup>	369.5 <sup>a</sup>	485.0 <sup>b</sup>	370.2 <sup>a</sup>	383.3 <sup>a</sup>	416.0 <sup>ab</sup>	428.0 <sup>ab</sup>
PeakVisc (cP)	3802.4 <sup>a</sup>	3688.7 <sup>a</sup>	3673.3 <sup>a</sup>	3876.5 <sup>a</sup>	3702.3 <sup>a</sup>	3687.1 <sup>a</sup>	3817.0 <sup>a</sup>	3939.0 <sup>a</sup>
TroughVisc (cP)	1829.6 <sup>ab</sup>	1710.5 <sup>a</sup>	1723.2 <sup>a</sup>	1942.5 <sup>bc</sup>	1681.2 <sup>a</sup>	1763.7 <sup>a</sup>	1783.6 <sup>ab</sup>	2072.0 <sup>c</sup>



Breakdown (cP)	1972.8 <sup>a</sup>	1978.2 <sup>a</sup>	1950.0 <sup>a</sup>	1934.0 <sup>a</sup>	2021.1 <sup>a</sup>	1923.4 <sup>a</sup>	2033.3 <sup>a</sup>	1867.0 <sup>a</sup>
FinalVisc (cP)	3951.5 <sup>abc</sup>	3763.5 <sup>ab</sup>	3692.9 <sup>a</sup>	4272.5 <sup>c</sup>	3742.5 <sup>ab</sup>	3852.4 <sup>abc</sup>	3528.0 <sup>a</sup>	4157.0 <sup>bc</sup>
Setback (cP)	2121.8 <sup>bc</sup>	2053.0 <sup>abc</sup>	1969.7 <sup>ab</sup>	2330.0 <sup>c</sup>	2061.3 <sup>abc</sup>	2088.7 <sup>bc</sup>	1744.3 <sup>a</sup>	2085.0 <sup>bc</sup>
PastingTime (min)	9.07 <sup>abc</sup>	9.07 <sup>abc</sup>	9.14 <sup>c</sup>	9.07 <sup>abc</sup>	9.05 <sup>abc</sup>	9.09 <sup>bc</sup>	8.96 <sup>ab</sup>	8.91 <sup>a</sup>
PastingTemp (°C)	63.62 <sup>b</sup>	63.47 <sup>b</sup>	63.42 <sup>b</sup>	64.23 <sup>b</sup>	63.79 <sup>b</sup>	63.37 <sup>b</sup>	61.60 <sup>a</sup>	61.17 <sup>a</sup>
Starch damage (UCD)	13.32 <sup>a</sup>	12.72 <sup>a</sup>	12.36 <sup>a</sup>	12.35 <sup>a</sup>	12.41 <sup>a</sup>	12.75 <sup>a</sup>	17.35 <sup>b</sup>	18.85 <sup>b</sup>

<b>d. Spike morphology</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
<b>N</b>	<b>162</b>	<b>54</b>	<b>12</b>	<b>15</b>	<b>18</b>	<b>6</b>	<b>3</b>	<b>3</b>	<b>3</b>
Test weight (kg/100L)	70.10 <sup>ab</sup>	71.65 <sup>ab</sup>	69.78 <sup>ab</sup>	67.56 <sup>a</sup>	73.13 <sup>abc</sup>	71.67 <sup>ab</sup>	72.07 <sup>abc</sup>	79.57 <sup>c</sup>	75.60 <sup>bc</sup>
TKW (g)	38.41 <sup>ab</sup>	35.89 <sup>ab</sup>	34.31 <sup>ab</sup>	33.48 <sup>a</sup>	33.85 <sup>a</sup>	31.64 <sup>a</sup>	32.31 <sup>a</sup>	42.63 <sup>b</sup>	38.31 <sup>ab</sup>
KWidth (mm)	2.98 <sup>ab</sup>	2.90 <sup>a</sup>	2.76 <sup>a</sup>	2.75 <sup>a</sup>	2.81 <sup>a</sup>	2.77 <sup>a</sup>	2.87 <sup>a</sup>	3.24 <sup>b</sup>	3.18 <sup>b</sup>
KLength (mm)	7.51 <sup>c</sup>	7.06 <sup>bc</sup>	7.09 <sup>bc</sup>	7.25 <sup>bc</sup>	6.89 <sup>b</sup>	6.77 <sup>ab</sup>	6.20 <sup>a</sup>	7.08 <sup>bc</sup>	6.70 <sup>ab</sup>
FY (%)	58.21 <sup>a</sup>	58.54 <sup>a</sup>	60.27 <sup>a</sup>	57.45 <sup>a</sup>	56.04 <sup>a</sup>	57.84 <sup>a</sup>	62.23 <sup>a</sup>	60.17 <sup>a</sup>	54.72 <sup>a</sup>
B glucan (mg/g)	6.59 <sup>a</sup>	6.55 <sup>a</sup>	6.30 <sup>a</sup>	6.51 <sup>a</sup>	6.22 <sup>a</sup>	6.38 <sup>a</sup>	6.75 <sup>a</sup>	5.95 <sup>a</sup>	6.79 <sup>a</sup>
Starch (%)	52.84 <sup>ab</sup>	53.46 <sup>abc</sup>	52.00 <sup>a</sup>	52.76 <sup>ab</sup>	53.07 <sup>ab</sup>	52.27 <sup>ab</sup>	54.53 <sup>bc</sup>	55.73 <sup>c</sup>	55.57 <sup>c</sup>
Protein (%)	19.20 <sup>c</sup>	18.62 <sup>bc</sup>	19.19 <sup>c</sup>	19.03 <sup>c</sup>	18.77 <sup>bc</sup>	18.73 <sup>bc</sup>	14.87 <sup>a</sup>	16.30 <sup>ab</sup>	14.53 <sup>a</sup>
Gluten (%)	46.03 <sup>c</sup>	42.13 <sup>bc</sup>	40.94 <sup>bc</sup>	43.71 <sup>bc</sup>	45.03 <sup>bc</sup>	44.33 <sup>bc</sup>	38.65 <sup>abc</sup>	35.97 <sup>ab</sup>	28.90 <sup>a</sup>
Gluten sp (mm)	8.02 <sup>bc</sup>	7.81 <sup>bc</sup>	4.25 <sup>abc</sup>	6.93 <sup>abc</sup>	9.15 <sup>c</sup>	5.58 <sup>abc</sup>	10.50 <sup>c</sup>	2.50 <sup>ab</sup>	1.17 <sup>a</sup>
GI	55.64 <sup>ab</sup>	60.65 <sup>ab</sup>	92.48 <sup>cd</sup>	67.20 <sup>abc</sup>	50.20 <sup>a</sup>	81.23 <sup>bcd</sup>	69.63 <sup>abcd</sup>	97.32 <sup>cd</sup>	99.70 <sup>d</sup>
Zeleny (ml)	33.48 <sup>abc</sup>	32.93 <sup>ab</sup>	54.00 <sup>cd</sup>	40.67 <sup>abcd</sup>	31.89 <sup>ab</sup>	45.50 <sup>bcd</sup>	28.00 <sup>a</sup>	48.00 <sup>cd</sup>	45.67 <sup>bcd</sup>
DevTime (min)	3.94 <sup>ab</sup>	5.45 <sup>ab</sup>	11.13 <sup>b</sup>	3.79 <sup>ab</sup>	4.80 <sup>ab</sup>	9.78 <sup>b</sup>	4.63 <sup>ab</sup>	19.87 <sup>c</sup>	1.94 <sup>a</sup>
Stability (min)	9.07 <sup>abc</sup>	8.52 <sup>abc</sup>	18.80 <sup>c</sup>	11.60 <sup>abc</sup>	7.59 <sup>ab</sup>	15.02 <sup>abc</sup>	6.50 <sup>a</sup>	17.47 <sup>bc</sup>	18.17 <sup>c</sup>
Soft at 12 (FU)	78.63 <sup>a</sup>	87.28 <sup>a</sup>	10.63 <sup>a</sup>	58.63 <sup>a</sup>	88.42 <sup>a</sup>	36.83 <sup>a</sup>	88.33 <sup>a</sup>	45.00 <sup>a</sup>	30.33 <sup>a</sup>
Wabs (%)	55.88 <sup>a</sup>	55.40 <sup>a</sup>	56.64 <sup>abc</sup>	55.83 <sup>a</sup>	56.29 <sup>ab</sup>	59.47 <sup>bcd</sup>	58.67 <sup>abc</sup>	62.90 <sup>d</sup>	60.00 <sup>cd</sup>
HunQN	58.27 <sup>a</sup>	54.60 <sup>a</sup>	88.40 <sup>ab</sup>	65.39 <sup>ab</sup>	57.75 <sup>a</sup>	80.47 <sup>ab</sup>	58.77 <sup>a</sup>	100.00 <sup>b</sup>	76.90 <sup>ab</sup>
FN (sec)	375.8 <sup>a</sup>	383.1 <sup>a</sup>	445.9 <sup>a</sup>	425.1 <sup>a</sup>	351.6 <sup>a</sup>	435.8 <sup>a</sup>	416.0 <sup>a</sup>	416.0 <sup>a</sup>	428.0 <sup>a</sup>
PeakVisc (cP)	3646.6 <sup>a</sup>	3819.7 <sup>ab</sup>	3798.5 <sup>ab</sup>	3836.4 <sup>ab</sup>	3630.2 <sup>a</sup>	3862.7 <sup>ab</sup>	4009.7 <sup>b</sup>	3817.0 <sup>ab</sup>	3939.0 <sup>ab</sup>
TroughVisc (cP)	1712.0 <sup>a</sup>	1768.5 <sup>ab</sup>	1882.1 <sup>b</sup>	1826.3 <sup>ab</sup>	1833.9 <sup>ab</sup>	1804.3 <sup>ab</sup>	2075.7 <sup>c</sup>	1783.7 <sup>ab</sup>	2072.0 <sup>c</sup>
Breakdown (cP)	1934.6 <sup>a</sup>	2051.2 <sup>a</sup>	1916.4 <sup>a</sup>	2010.1 <sup>a</sup>	1796.3 <sup>a</sup>	2058.3 <sup>a</sup>	1934.0 <sup>a</sup>	2033.3 <sup>a</sup>	1867.0 <sup>a</sup>
FinalVisc (cP)	3757.4 <sup>ab</sup>	3800.2 <sup>abc</sup>	4204.1 <sup>cd</sup>	3940.8 <sup>abc</sup>	3983.4 <sup>bc</sup>	3994.0 <sup>bc</sup>	4533.0 <sup>d</sup>	3528.0 <sup>a</sup>	4157.0 <sup>bcd</sup>
Setback (cP)	2045.4 <sup>ab</sup>	2031.7 <sup>ab</sup>	2322.0 <sup>bc</sup>	2114.5 <sup>bc</sup>	2149.6 <sup>bc</sup>	2189.7 <sup>bc</sup>	2457.3 <sup>c</sup>	1744.3 <sup>a</sup>	2085.0 <sup>ab</sup>
PastingTime (min)	9.09 <sup>b</sup>	9.09 <sup>b</sup>	9.09 <sup>b</sup>	9.09 <sup>b</sup>	9.06 <sup>ab</sup>	8.90 <sup>a</sup>	8.93 <sup>ab</sup>	8.96 <sup>ab</sup>	8.91 <sup>a</sup>
PastingTemp (°C)	63.40 <sup>cde</sup>	63.71 <sup>cde</sup>	64.69 <sup>e</sup>	63.88 <sup>de</sup>	62.97 <sup>bcd</sup>	62.50 <sup>abcd</sup>	62.10 <sup>abc</sup>	61.60 <sup>ab</sup>	61.17 <sup>a</sup>
Starch damage (UCD)	12.87 <sup>abc</sup>	12.26 <sup>ab</sup>	11.28 <sup>a</sup>	12.50 <sup>ab</sup>	13.01 <sup>abc</sup>	15.70 <sup>cd</sup>	14.83 <sup>bcd</sup>	17.35 <sup>de</sup>	18.85 <sup>e</sup>

**Table S5.** Correlation of the compositional and breadmaking quality traits with starch related properties (n=90)

	Falling Number	Peak Viscosit y	Trough Viscosity	Breakdown Viscosity	Final Viscosit y	Setback Viscosity	Pasting Time	PastingTem perature	Starch Damage
Protein content	0.1753	-0.4648	-0.4297	-0.3011	-0.3236	-0.1697	-0.0283	-0.0582	0.0829
Starch content	-0.2877	0.3236	0.2813	0.2221	0.1283	-0.0235	0.3146	-0.0769	-0.0118
B glucan content	0.0707	0.1356	0.0134	0.1655	-0.0683	-0.1209	-0.0393	-0.0251	0.2123
Gluten content	-0.0664	-0.6947	-0.5178	-0.5363	-0.4518	-0.3042	-0.0294	-0.3746	0.1727
Gluten spread	-0.3245	-0.4745	-0.2438	-0.4424	-0.2712	-0.2375	-0.0037	-0.3551	0.0356
Gluten Index	0.4342	0.5465	0.3302	0.4753	0.3487	0.2916	-0.0987	0.3913	-0.1127
Zeleny sedimentation	0.4193	0.2985	0.2716	0.1965	0.3173	0.2889	-0.1312	0.3935	-0.1957
Dough Development Time	0.4750	0.3009	0.1772	0.2649	0.1780	0.1418	-0.2500	0.1435	0.1344
Dough Stability	0.4991	0.3048	0.0927	0.3285	0.1185	0.1151	-0.2383	0.2794	0.0369
Dough Softening at 12 min	-0.5288	-0.3013	-0.1300	-0.2981	-0.1549	-0.1432	0.2879	-0.1817	-0.1816
Water absorption	0.1807	-0.2287	0.0315	-0.3165	-0.0041	-0.0324	-0.1468	-0.4374	0.3456
Farinograph quality number	0.5060	0.2559	0.1341	0.2368	0.1198	0.0834	-0.2462	0.1429	0.2028

$r_{5\%} = 0.2050$ ,  $r_{1\%} = 0.2673$ ,  $r_{0.1\%} = 0.3375$