

## Supplementary Materials:

**Table S1.** Soil characteristics of study location

Location	Longitude and latitude	Reference Bulk Density (g cm <sup>-3</sup> )	Sand Fraction (%)	Clay Fraction (%)	Soil Nutrient Availability class (scale 5°)†	Available Water Capacity class(scale 5°)†	Soil Organic Carbon Stock (g m <sup>-2</sup> )	Calcium carbonates (g kg <sup>-1</sup> )	Cation Exchange Capacity (meq/100 g)	C:N (ratio)	Potassium content (g kg <sup>-1</sup> )	Nitrogen content (%)	Phosphorus content (g kg <sup>-1</sup> )	pH in CaCl	ph in H2O
Bezek	51.11; 23.15	1.73	87	4	3	3	47.86	4.89	14.94	11.19	124.94	1.32	35.38	5.42	6.21
Białogard	54.0; 15.59	1.41	37	19	2	1	55.89	13.37	10.30	11.70	108.89	1.44	44.81	5.23	5.91
Głubczyce Jelenia Góra	50.194,1782	1.41	42	20	1	5	126.21	3.15	10.41	22.55	110.05	1.56	13.33	3.19	3.93
Kawęczyn	50.856, 15.70	1.4	42	22	1	5	70.45	0.09	13.19	10.03	148.96	2.23	31.64	5.48	6.20
Kościelna Wieś	52.168, 20.34	1.62	80	8	1	1	46.25	1.84	5.85	10.23	52.50	1.17	40.00	5.06	5.42
Krzyżewo	51.48, 18.01	1.7	85	5	2	3	57.68	2.47	3.55	19.02	96.65	1.04	25.09	3.79	4.54
Lisewo	53.025, 22.75	1.4	32	19	3	1	53.59	5.38	6.73	13.00	83.79	0.93	35.83	4.87	5.59
Pawłowice	54.195, 18.52	1.25	23	48	1	5	49.37	20.14	15.09	12.71	124.34	1.68	25.16	5.17	5.61
Ruska Wieś	50.454, 22.75	1.73	39	21	3	1	53.17	13.47	7.82	12.39	134.24	1.38	40.86	4.71	5.60
Sulejów	53.79, 22.20	1.32	35	32	2	1	52.92	5.27	34.64	11.40	56.75	2.14	32.80	5.83	6.37
Węgrzce	51.351, 19.867	1.59	82	10	2	1	76.22	2.44	5.62	11.83	121.99	1.29	35.60	4.61	5.31
	50.119, 19.082	1.4	41	22	2	1	50.48	6.36	9.00	15.11	179.82	1.44	19.76	4.10	4.86

†According to Harmonized World Soil Database.

**Table S2.** Descriptions of study winter wheat cultivars.

Cultivars	Resistance (scale 9°)‡							
	Winter hardiness	Resistance to lodging	Powdery mildew	Brown rust	Septoria leaf blight	Chaff septoria	Diseases of the stem base	Fusarium ear blight
Admont	4.5	8	5	2	5	5	6	5
Ambicja	3.5	8	7.2	8.2	7.2	7.1	7.1	7
Apostel	4	7	7.6	7.6	6.9	7.2	7.2	7.4
Argument	3.5	7.4	8.5	8.8	7	8.4	8	8.5
Artist	4	7	7.7	7.1	6.5	7.5	7.8	7.5
Bataja	4.5	7.4	7.7	7.1	6.4	7.2	7.1	7.9
Błyskawica	4	8.1	7	8.1	7	7	8.1	7
Bonanza	4	7	8.15	7.75	6.1	6.85	8.2	7.45
Bosporus	4	7.5	8.9	6.8	7.4	8.1	7.5	7.9
Comandor	4.5	7.4	7.7	8	6.9	7.8	7.5	7.9
Euforia	5.5	8	8.1	6	6.9	7.6	8	7.5
Formacja	4.5	7.8	7.7	7.7	6.5	7.7	7.5	7.8
Hybery F1	3.5	5	4	5	5	5	6	5
Impresja	5	7.7	7.9	7.5	7.2	7.8	8.4	7.8
Kariatyda	4.5	7.5	7.8	7.3	6.8	7.4	7.5	7.6
Kometa	3	6.8	7	7	7	7	7	7
KWS Donovan	3	6.7	4	3	5	5	5	5
KWS Firebird	4	6	5	5	5	5	5	5
KWS Spencer	3.5	5	5	5	5	5	5	5
KWS Talium	4.5	7	5	5	5	4	5	5
KWS								
Universum	3	7	5	5	5	5	5	5
LG Jutta	5.5	7	8.4	8.2	7.2	7.5	7.4	8.2
LG Keramik	4	6	7.5	7.7	6.9	7.4	7.6	7.1
Lindbergh	2.5	6	8	8	7	7	7	5
Lokata	5.5	7	6	6	6	6	6	6
Medalistka	5.5	6.9	4	5	4	5	5	5
MHR								
Promienna	4	7	7	7	7	7	7	7
Moschus	4	8.5	9	8	8	8	6	8
Nordkap	4	6	5	5	5	5	5	5
Opcja	4	6	5	5	5	5	5	5
Opoka	4.5	7	8	7	7	8	9	7
Owacja	4.5	6.7	8.1	8.1	7.4	7.7	8.2	8.2

Patras	4	7	8	8	8	8	8	8
Plejada	5	7.6	6	6	5	6	5	6
Reduta	4.5	8	7.1	7.2	6.7	7.3	7.8	8
RGT Bilanz	4.5	8	8	7.5	7.5	7.5	8.5	7.5
RGT								
Kilimanjaro	4.5	8	8	7.5	7.5	7.5	8.5	7.5
RGT								
Metronom	4.5	9	8.5	7	7.5	7.5	8	7.5
RGT Provision	4	8	8.5	7	6.5	7.5	7.5	7.5
RGT Ritter	3	8.5	7.5	7.5	8.5	7.5	7.5	7.5
RGT Specialist	4	8	8.5	8	6.5	8	8.5	9
Rivero	3.5	8	8.1	7.9	7.3	7.4	7.4	7.6
Sfera	4	7.2	8.1	7.5	6.9	7.2	7.9	7.1
SU Mangold	3.5	8.4	7.7	6.5	7.4	8.2	8	7.8
SU Petronia	4	6	5	5	5	5	5	5
SU Tarroca	2.5	7.9	7.1	6.9	7.1	7.9	7.2	7.8
SU Viedma	4	6	5	5	5	5	5	5
SY Cellist	3	6	5	5	5	5	5	5
SY Dubaj	4.5	6	8	8	7	7.6	8	7.4
SY Orofino	4	6	8.1	8.6	7.7	8	8.1	7.9
SY Yukon	5	8.1	8.2	8.2	8	7.8	8	8
Symetria	4	6.6	6	6	6	4	4	4
Titanus	4	6	5	5	5	5	5	5
Tytanika	5	4	7	8.1	6	7.7	7.7	7.7
Venecja	4	7.6	7.6	7.1	5.9	7.6	8.1	6.5

‡ 9° scale 1-worst condition, 9-best condition.