

**Table S1.** Soil conditions before establishing an experiment with winter rapeseed (2016-2018).

Location	Soil layer, cm	pH <sub>KCl</sub>	SOC, %	mg kg <sup>-1</sup>		Nmin, kg ha <sup>-1</sup>	mg kg <sup>-1</sup>							
				N-NO <sub>3</sub>	N-NH <sub>4</sub>		P	K	Mg	B	Cu	Fe	Mn	Zn
2016														
Sahryń	0-30	7.4	2.53	20.14	3.10	91	60	108	75	3.1	8.6	510	164	6.3
	30-60	7.4	1.20	9.28	1.21	41	33	62	77	0.9	6.1	520	56	3.8
Pagów	0-30	6.8	2.04	22.56	3.31	101	83	223	113	2.7	14.2	1721	517	22.7
	30-60	6.8	1.89	8.40	1.91	40	78	217	107	2.4	13.8	1678	514	21.0
Nowiny	0-30	7.4	0.78	15.90	4.59	40	97	221	129	1.0	3.2	1757	149	10,2
	30-60	7.4	0.70	16.10	1.26	68	176	203	212	1.7	4.5	2167	166	3.4
Sławice	0-30	6.0	1.96	15.03	2.36	78	94	178	47	0.2	2.7	707	132	16.3
	30-60	5.0	4.24	17.89	2.93	94	65	56	33	0.7	2.3	540	110	13.2
2017														
Sahryń	0-30	7.3	1.34	32.62	4.19	144	76	162	59	1.3	5.6	620	181	5.7
	30-60	7.1	0.83	9.32	1.00	36	75	71	51	0.9	6.2	725	118	5.2
Pagów*	0-30	6.5	0.97	11.86	0.69	54	118	193	110	1.4	2.5	977	164	16.2
	30-60	6.7	0.47	9.97	0.80	139	60	151	95	1.3	1.6	791	102	6.5
Pagów**	0-30	6.8	1.26	13.09	2.65	68	69	182	107	1.7	2.9	875	108	12.3
	30-60	6.7	0.55	6.90	2.31	40	19	58	102	0.7	1.5	779	49	6.4
Nowiny	0-30	6.4	1.07	7.62	1.34	37	43	167	53	1.7	1.8	1395	109	6.7
	30-60	6.1	0.97	11.62	<1.00	52	43	141	62	0.7	1.9	1448	109	7.1
2018														
Sahryń	0-30	7.2	4.98	84.25	1.54	335	12	37	64	5.8	8.8	900	159	9.0
	30-60	7.4	2.88	74.48	1.26	295	7	21	78	4.1	7.9	630	112	7.5

\*forecrop maize for graine; \*\*forecrop winter rapeseed

**Table S2.** Characteristics of winter wheat production technology in the experiment (2016/2017–2018/2019).

Location	Forecrop	Side yield of forecrop, t ha <sup>-1</sup>	Cultivar of winter wheat	Mineral fertilization, kg ha <sup>-1</sup>	Sowing date	Harvest date
2016/2017						
Sahryń	Winter rapeseed	3.95 (straw)	Bamberka	N – 150 (treatment 0) and 105 (treatments 1 and No 2); P – 44; K – 83; S – 8;	17.09	01.08
Pagów	Winter rapeseed	9.25 (straw)	Sailor	N – 111 (treatment 0) and 78 (treatments 1 and No 2); P – 15; K – 70; Ca – 1	10.10	04.08
Nowiny	Winter rapeseed	2.00 (straw)	Hondia	N – 181 (treatment 0) and 126 (treatments 1 and 2); P – 21; K – 50; S – 21	29.09	03.08
Ślawice	Winter rapeseed	3.80 (straw)	Praktik	N – 112 (treatment No 0) and 78 (treatments No 1 and No 2); P – 13; K – 25; S – 29	30.09	01.08
2017/2018						
Sahryń	Winter rapeseed	6.95 (straw)	Bamberka	N – 160 (treatment 0) and 112 (treatments 1 and 2); P – 35; K – 149; S – 11	18.09	20.07
Pagów*	Maize for graine	29.90 (straw)	Arktis	N – 238 (treatment 0) and 167 (treatments 1 and No 2); P – 17; K – 50; S – 32	18.10	22.07
Pagów**	Winter rapeseed	3.30 (straw)	Arktis	N – 192 (treatment 0) and 134 (treatments 1 and 2); P – 17; K – 50; S – 32	14.10	22.07
Nowiny	Winter rapeseed	4.80 (straw)	Arkadia	N – 185 (treatment 0) and 129 (treatments 1 and 2); P – 30; K – 100; S – 3	29.09	11.07
2018/2019						
Sahryń	Sugar beet	57.00 (leaves)	Bamberka	N – 156 (treatment 0) and 109 (treatments 1 and No 2); P – 44; K – 174; S – 14	22.09	23.07

\*forecrop maize for graine; \*\*forecrop winter rapeseed

0 – control; 1 – Penergetic (K + P); 2 – Penergetic (K + P) + Azoter

Table S3. Soil conditions after the harvest winter wheat (2017-2019).

Table 55. Soil conditions after the harvest winter wheat (2017–2019).															
Location	Treat- ment	Soil layer, cm	pH <sub>KCl</sub>	SOC, %	mg kg <sup>-1</sup>		Nmin, kg ha <sup>-1</sup>	mg kg <sup>-1</sup>							
					N-NO <sub>3</sub>	N-NH <sub>4</sub>		P	K	Mg	B	Cu	Fe	Mn	Zn
2017															
Sahryń	0	0-30	7.5	2.10	28.18	1.12	114	44	58	66	2.6	7.1	470	173	7.7
		30-60	7.8	1.28	19.45	3.43	89	4	25	68	1.7	6.2	520	107	4.9
	1	0-30	7.5	2.40	10.25	1.30	45	86	79	80	2.5	8.0	520	170	7.1
		30-60	7.6	2.04	6.14	1.35	29	33	33	93	2.0	7.9	690	99	5.5
	2	0-30	7.5	1.92	19.70	1.61	83	90	62	69	2.4	7.0	520	174	7.3
		30-60	7.7	1.36	19.82	1.86	85	5	21	69	1.8	6.4	570	112	5.6
Pagów	0	0-30	6.6	0.95	14.62	1.65	70	92	165	103	1.6	2.6	957	108	8.8
		30-60	6.4	0.26	3.59	0.94	20	19	67	69	0.6	1.2	620	33	2.6
	1	0-30	6.4	0.89	4.32	1.56	25	76	208	106	1.6	2.7	863	118	8.2
		30-60	6.4	0.32	13.78	1.14	64	26	114	95	0.6	1.7	782	43	3.0
	2	0-30	6.5	1.21	13.45	1.18	63	97	175	100	2.2	3.8	792	120	13.4
		30-60	6.8	0.38	5.61	1.13	29	45	72	105	0.7	3.7	785	63	7.4
Nowiny	0	0-30	6.7	1.72	9.90	<1.00	47	75	148	82	0.5	2.9	1528	137	8.2
		30-60	6.8	0.95	11.00	<1.00	52	76	162	51	0.8	3.1	1490	131	8.3
	1	0-30	6.5	1.37	11.80	<1.00	55	47	129	51	1.0	2.5	1376	104	7.4
		30-60	6.3	0.81	11.40	<1.00	53	41	151	92	1.0	2.5	1409	106	7.0
	2	0-30	6.4	1.19	14.40	<1.00	60	96	229	74	0.6	3.4	1779	144	11.7
		30-60	6.2	1.57	11.70	<1.00	50	92	253	52	0.5	3.2	1738	116	10.0
Sławice	0	0-30	5.5	1.12	31.05	1.34	126	27	139	53	1.5	3.0	895	150	12.8
		30-60	5.3	1.05	31.49	2.24	132	22	139	41	1.6	3.3	877	158	13.5
	1	0-30	5.7	0.49	26.92	1.28	106	72	74	68	0.9	2.4	577	103	12.2
		30-60	5.2	0.85	30.13	2.18	130	85	99	74	1.2	2.7	597	125	16.9
	2	0-30	5.7	0.49	28.61	1.42	116	72	74	68	0.9	2.4	577	103	12.2
		30-60	5.2	0.85	32.94	2.39	136	85	99	74	1.2	2.7	597	125	16.9
2018															
Sahryń	0	0-30	7.3	1.20	8.30	3.30	50	61	129	71	1.7	8.1	874	171	8.3
		30-60	7.4	0.79	5.56	2.67	35	21	52	59	1.4	7.1	1074	151	7.3
	1	0-30	7.2	1.19	9.51	5.47	64	78	158	61	1.4	7.4	695	188	6.6
		30-60	7.2	0.59	4.68	2.86	32	9	62	56	2.3	6.9	953	127	6.8
	2	0-30	7.1	0.94	5.30	3.52	38	61	104	54	1.4	6.3	697	188	6.0
		30-60	7.0	0.40	1.67	2.60	18	32	71	46	0.5	6.7	889	75	4.4
Pagów*	0	0-30	7.4	0.97	8.58	1.91	41	140	340	82	1.4	3.7	1511	188	15.6
		30-60	7.7	0.38	8.46	1.88	40	141	357	85	0.6	2.3	1067	113	5.0
	1	0-30	7.0	1.19	10.13	2.15	48	73	224	85	1.5	3.8	1634	204	15.8
		30-60	7.5	0.50	8.39	1.39	38	151	114	75	0.9	3.2	1524	130	6.0
	2	0-30	6.8	0.16	8.30	2.19	41	79	173	95	0.90	2.1	1472	201	12.3
		30-60	6.8	0.96	6.66	1.51	32	174	171	97	1.0	2.4	1555	89	2.9
Pagów**	0	0-30	7.0	1.03	16.86	2.06	74	89	299	64	1.3	3.2	1680	158	10.8
		30-60	6.7	0.27	22.37	1.23	92	21	110	124	0.9	2.4	1154	90	5.4
	1	0-30	7.3	0.76	13.45	2.49	62	110	195	66	1.3	3.4	1723	168	10.6
		30-60	6.5	0.32	14.88	1.44	64	34	90	105	1.1	2.8	1628	91	6.4
	2	0-30	6.8	0.97	14.71	2.05	65	83	130	126	1.9	3.8	1786	149	14.3
		30-60	6.8	0.34	10.75	1.84	49	40	53	117	1.2	3.5	1938	111	8.8
Nowiny	0	0-30	6.1	1.35	19.20	<1.00	86	45	159	168	0.4	2.0	1457	107	6.8
		30-60	6.2	1.04	24.00	<1.00	108	40	133	161	0.5	1.6	1337	113	5.9
	1	0-30	6.1	1.13	12.80	<1.00	58	35	140	153	0.6	1.8	1440	109	7.1
		30-60	6.3	1.07	15.10	<1.00	68	38	140	150	0.6	1.9	1373	109	8.4
	2	0-30	6.2	1.63	13.30	<1.00	57	107	192	182	0.7	3.2	1461	107	7.8
		30-60	6.2	1.49	13.60	<1.00	59	72	144	173	0.8	3.0	1425	104	10.2

Location	Treat- ment	Soil layer, cm	pH <sub>KCl</sub>	SOC, %	mg kg <sup>-1</sup>		Nmin, kg ha <sup>-1</sup>	mg kg <sup>-1</sup>							
					N-NO <sub>3</sub>	N-NH <sub>4</sub>		P	K	Mg	B	Cu	Fe	Mn	Zn
2019															
Sahryń	0	0-30	7.5	2.82	18.40	<1.00	72	39	66	82	4.4	7.5	682	190	7.0
		30-60	7.5	2.52	31.00	<1.00	121	109	75	82	4.9	7.8	663	205	8.0
	1	0-30	7.6	1.74	21.70	2.53	95	10	25	123	2.6	6.7	486	63	5.2
		30-60	7.6	1.74	19.50	2.13	84	4	21	81	3.2	6.5	474	92	4.8
	2	0-30	7.5	2.34	21.10	<1.00	82	17	42	88	7.8	7.5	485	192	7.7
		30-60	7.7	1.42	11.50	2.05	53	4	<17	108	3.1	6.2	497	129	5.9

\*forecrop maize\*\*forecrop winter repeseed

0 – control; 1 – Penergetic (K + P); 2 – Penergetic (K + P) + Azoter