

POSSIBLE IMPLICATIONS OF THE VARIABILITY OF THE MOST ALLERGENIC PLANT POLLEN SEASONS IN POLAND

¹Dorota Myszkowska, ²Agnieszka Kubik-Komar, ³Katarzyna Piotrowicz, ⁴Katarzyna Dąbrowska-Zapart, ⁵Łukasz Grewling, ⁶Idalia Kasprzyk, ⁶Katarzyna Kluska, ⁷Katarzyna Leśkiewicz, ⁸Barbara Majkowska-Wojciechowska, ⁹Małgorzata Malkiewicz, ¹⁰Krystyna Piotrowska-Weryszko, ¹¹Małgorzata Puc, ¹Małgorzata Sacha, ¹Monika Ziemianin, ¹Ewa Czarnobilska

Table S1. The calculated season parameters in the selected stations in details.

Station	Taxon	ALDER						HAZEL						BIRCH						GRASSES						MUSWORT					
		Statistics	Start	Duration	Max day	SPin	Max value	Start	Duration	Max day	SPin	Max value	Start	Duration	Max day	SPin	Max value	Start	Duration	Max day	SPin	Max value	Start	Duration	Max day	SPin	Max value				
KRAKÓW	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20				
	Mean	64.55	23.55	71.38	2624.60	552.47	53.20	32.70	68.90	610.73	99.40	97.10	30.90	106.65	7586.12	1378.33	129.10	93.15	176.95	2780.51	147.15	204.25	34.25	215.50	577.68	66.00					
	Median	68	21	72	1933	450.5	52	30.5	70	556.57	91.5	97.5	31.5	107	5805.5	1071	128	90.5	178.5	2660.835	141.5	203	33	217	535.302	52.5					
	Min	31	15	34	474	61	10	15	38	385.394	17	87	22	93	1433	119	117	65	149	1823.312	77	198	21	171	164	19					
	Max	98	53	103	7553.50	1483.77	85	67	103	1261.00	221.00	109	39	122	20316.16	4199.00	151	126	192	4233.00	294.00	216	54	224	1290.00	194.00					
	SD	17.01	9.54	15.70	2244.40	491.27	20.57	12.83	18.57	220.82	53.34	5.87	5.49	6.99	5495.15	1158.64	8.64	19.77	11.73	678.15	55.07	4.25	8.80	11.07	290.67	45.68					
	V%	26.36	40.51	22.00	85.51	88.92	38.66	39.23	28.96	36.16	53.66	6.04	17.75	6.55	72.44	84.06	6.70	21.16	6.63	24.39	37.42	2.08	25.70	5.14	50.32	69.22					
	N	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18				
ŁÓDŹ	Mean	65.39	25.67	74.11	4062.61	913.17	60.67	23.83	72.00	328.56	69.17	99.83	30.72	107.67	13202.86	2748.78	133.33	100.56	178.06	3877.46	267.56	196.61	40.83	217.28	795.97	68.83					
	Median	68.5	25	75	3564.25	951	62.5	22.5	71.5	321.6667	69.5	99	28	107	11328.5	2153.5	134.5	98.5	179.5	3743	244.5	196	40.5	218.5	767	63					
	Min	35	13	53	733	185	18	6	47	66	16	87	18	94	2954	628	119	74	156	2401	160	191	30	204	396	20					
	Max	100	56	103	16891.50	3781.00	99	56	103	674.50	111.00	110	53	119	31241.00	8665.00	146	141	190	5938.00	513.00	208	49	232	1335.00	138.00					
	SD	17.90	11.37	13.82	3580.76	819.17	20.77	14.31	15.33	142.92	23.57	6.24	8.98	6.43	9307.17	2188.03	6.62	16.55	7.67	781.32	106.73	4.43	4.95	6.51	287.32	31.95					
	V%	27.37	44.30	18.65	88.14	89.71	34.24	60.05	21.29	43.50	34.07	6.25	29.24	5.97	70.49	79.60	4.97	16.46	4.31	20.15	39.89	2.26	12.12	2.99	37.35	46.41					
	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20				
	Mean	64.05	31.10	75.95	5533.46	1349.85	56.05	35.55	72.55	1081.75	260.91	99.40	33.30	108.00	16736.36	3816.27	131.60	118.25	182.80	5843.15	408.50	198.50	47.40	219.10	1476.98	129.65					
LUBLIN	Median	67.5	29	72.5	4849.65	1247.7	55	33.5	72	1018.75	258.85	99	35.5	108	15040.45	2888.8	132	116.5	183.5	5616.3	395.15	198	43	216	1339.35	110.5					
	Min	33	12	58	955.6	175.5	13	15	48	718.95	104.3	87	19	95	2204.1	367.6	117	105	170	4216.1	234	183	29	211	830.9	69					
	Max	101	66	102	11376.50	3391.50	87	70	102	2042.50	470.90	111	46	116	37635.56	12832.00	143	144	191	8234.26	642.50	206	74	269	2490.00	267.80					
	SD	18.85	14.85	12.18	2804.27	792.59	22.62	12.59	14.54	326.62	121.98	6.35	7.87	5.77	11385.99	3309.94	7.58	9.22	6.11	1156.81	122.99	4.96	13.30	4.63	451.42	56.22					
	V%	29.43	47.75	16.04	50.68	58.72	40.35	35.42	20.04	30.19	46.75	6.39	23.65	5.34	68.03	86.73	5.76	7.79	3.34	19.80	30.11	2.49	28.07	5.53	30.56	43.37					
	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20				
	Mean	56.35	29.35	70.45	4512.15	845.20	53.80	22.80	62.40	272.70	56.55	98.60	31.50	107.60	11885.50	1975.80	135.35	109.25	175.55	3458.55	221.65	200.50	38.60	217.45	957.60	89.70					
	Median	60	26	72.5	3516.5	627.5	60.5	20	64.5	250	50	99	31	108	9770.5	1895.5	137	116	176.5	3207	195.5	200	39	218	855	75					
POZNĄ	Min	24	9	35	508	185	13	7	32	31	19	87	24	92	1713	239	125	78	149	2337	108	195	26	208	293	35					
	Max	84	56	103	21447.00	3628.00	86	61	103	745.00	138.00	114	43	120	27906.00	4355.00	143	132	194	5825.00	411.00	207	53	226	1874.00	173.00					
	SD	16.52	12.46	15.72	4473.09	782.15	20.01	14.28	19.95	167.85	34.97	6.94	6.42	7.24	7454.87	1099.16	4.22	17.48	9.99	862.89	81.45	3.56	6.38	4.63	463.38	49.50					
	V%	29.31	42.46	22.31	99.13	92.54	37.20	63.17	31.96	61.55	61.83	7.04	20.38	6.73	62.72	55.63	3.12	16.00	5.69	24.95	36.75	1.78	16.52	2.13	48.39	55.18					
	N	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18				
	Mean	65.89	25.44	76.33	3858.50	804.64	60.37	28.79	72.42	694.62	157.24	99.94	27.50	108.11	8936.82	1838.23	127.85	103.31	173.54	5172.46	314.35	209.60	27.07	220.27	505.11	66.65					
	Median	69.5	22.5	75.5	2695.085	605.61	65	26	71	663.4	120.15	99.5	28	109.5	6539.125	1326.975	128	104	176	5238.54	304.98	211	26	220	551	63					
	Min	33	13	50	320.79	62.73	27	8	49	176	43	88	11	93	1032.57	167.79	116	77	155	3869.33	203.04	201	15	215	153.14	24.18					
RZESZÓW	Max	98	51	104	8496.00	2387.00	84	77	106	1440.45	396.45	115	44	118	25346.55	7279.80	142	128	190	6141.22	527.00	222	43	230	894.00	172.36					
	SD	19.10	11.07	12.62	2614.27	675.10	20.15	17.27	14.72	360.77	98.70	7.35	8.91	6.55	7299.69	1814.56	7.97	14.22	12.29	705.70	81.04	5.38	8.38	4.01	241.52	39.46					
	V%	28.99	43.52	16.53	67.75	83.90	33.38	59.99	20.32	51.94	62.77	7.36	32.39	6.06	81.68	98.71	6.23	13.77	7.08	13.64	25.78	2.57	30.96	1.82	47.82	59.21					
	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20				
	Mean	61.30	25.75	71.80	2347.65	535.85	50.15	33.05	67.30	578.20	110.00	99.85	28.20	108.50	10252.93	2586.30	128.55	124.55	173.80	3892.74	188.50	202.40	35.90	219.40	831.93	98.15					
	Median	60.5	23.5	71	1822.08	330.5	51	27.5	68	579.52	99.5	98.5	27	109	9715.2	1795.5	127.5	125.5	179.5	3687.36	176.5	202.5	33	220	555.2	64					
	Min	26	8	50	142.08	70	10	5	40	284.8	36	90	10	95	1289.6	150	113	93	149	2017.92	84	189	14	202	129.28	22					
	Max	99	56	102	6628.48	1914.00	83	82	94	963.20	214.00	114	44	122	28662.00	9967.00	147	140	190	6444.00	328.00	222	73	227	2435.64	321.00					
ŚOSNOWIEC	SD	20.76	12.19	13.75	1710.25	488.93	22.62	18.16	15.55	166.76	51.47	6.47	7.77	6.17	8374.48	2862.08	7.78	11.93	12.91	1141.31	69.48	7.46	14.01	5.84	681.42	90.04					
	V%	33.67	47.33	19.15	72.65	91.24	45.11	54.94	23.11	28.84	46.79	6.46	27.55	5.69	81.68	110.66	6.05	9.58	7.43	29.32	36.96	39.03	2.66	36.96	81.91	91.74					
	N	20	20	20	20	20	20	19	19	20	19	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20				
	Mean	50.80	36.30	68.20	4245.61	670.35	44.00	36.95	61.15	491.30	96.65	99.20	31.20	108.90	9046.90	1719.80	133.20	126.30	160.75	4340.54	258.30	199.95	39.40	217.90	773.66	84.05					
	Median	49	37.5	70.5	2909.5	622.5	39	31	64	503	75	98.5	30	106.5	8409.5	1220.5	134.5	126.5	164.5	4313.8	192.5	202	36.5	217	635	55.5					
	Min	21	16	36	686	124	8	10	31	67	17	88	14	98	2270	337	119	108	16	2492.2	91	179	23	209	231	25					
	Max	85	60	103	15235																										

Table S2. The results of the post-hoc tests related to the Kruskal-Wallis test for pollen season parameters of five selected taxa in eight studied sites in Poland.

Taxon	Parameter	KR vs								LO vs								LU vs						PO vs				RZ vs			SO vs		SZ vs WR
		LO	LU	PO	RZ	SO	SZ	WR	LU	PO	RZ	SO	SZ	WR	PO	RZ	SO	SZ	WR	RZ	SO	SZ	WR	SO	SZ	WR	SZ	WR					
ALDER	Start	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-					
	Duration	NS	NS	NS	NS	NS	.032	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-					
	Date of max	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-					
	Max value	NS	.0032	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	.0019	NS	NS	NS	-	-	-	-	-	-	-					
	SPIn	NS	.0005	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	NS	NS	NS	NS	-	-	-	-	-	-					
HAZEL	Start	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-					
	Duration	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-						
	Date of max	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-						
	Max value	NS	.0013	NS	NS	NS	NS	NS	<.0001	-	.0268	-	-	-	<.0001	-	-	.0001	.0004	.0291	-	-	-	.0168	-	.0068	-	-					
	SPIn	.0214	.0139	.0015	NS	NS	NS	NS	<.0001	-	.0042	.0421	-	-	<.0001	-	.0065	-	-	-	.0001	.0004	-	-	-	-	-	-					
BIRCH	Start	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-	-					
	Duration	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-	-					
	Date of max	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-	-					
	Max value	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-	-					
	SPIn	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-	-					
GRASSES	Start	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	.0400	-	.0090	-	-	-	-	-					
	Duration	.0073	NS	NS	NS	<.0001	<.0001	NS	NS	NS	NS	.0004	.0001	NS	NS	NS	NS	NS	NS	NS	-	-	-	.0072	.0029	-	-	.0036	.0012				
	Date of max	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	.0015	.0450	-	-	-	-	-	-	-	-	-					
	Max value	.0044	<.0001	NS	<.0001	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-	-	-					
	SPIn	.0320	<.0001	NS	<.0001	.0465	<.0001	NS	.0107	<.0001	NS	.0033	NS	.0000	NS	-	-	-	-	.0041	-	-	.0000	-	-	-	-	.0063					
MUGWORT	Start	.0007	.0420	NS	NS	NS	NS	NS	NS	NS	<.0001	.0357	NS	.0043	NS	.0000	-	-	-	.0007	-	-	-	.0482	.0021	-	-	-					
	Duration	NS	.0095	NS	NS	NS	NS	NS	NS	NS	.0007	NS	NS	NS	NS	NS	.0000	.0153	-	-	.0083	-	.0284	-	-	-	-	-					
	Date of max	NS	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	.0150	-	-	-	-	-	-	-	-	-					
	Max value	NS	.0009	NS	NS	NS	NS	NS	NS	.0252	NS	NS	NS	NS	NS	NS	.0141	-	.0425	-	-	-	-	-	-	-	-	-					
	SPIn	NS	<.0001	NS	NS	NS	NS	.0480	.0146	NS	NS	.0000	NS	NS	NS	.0000	.0002	.0012	-	-	-	-	-	-	-	.0305	-	-					

The statistically significant results in bold with calculated p value.

Table S3. Trend in pollen season parameters (per decade) in Poland, (2001-2020). Negative values indicate a decreasing trend, while positive values relate to an increasing trend (simple linear regression).

Stations	Start (days)	Duration (days)	SPIn (Pollen m ⁻³)	Max value (Pollen m ⁻³)	Max day (days)	No of days > TH**
Alder						
Szczecin	-9.16	6.11	2483.42	356.85*	-10.10	3.52
Poznań	-3.15	9.33*	3906.43*	563.58	-0.65	3.74
Wrocław	-13.30*	7.71	1174.06	469.67	-12.27*	-0.93
Sosnowiec	-6.93	2.58	15.19	-68.46	-8.19*	1.76
Kraków	-6.65	3.31	1753.92*	314.21*	-4.98	5.95*
Rzeszów	-4.82	5.98	1565.74	126.22	-0.06	4.93
Łódź	-16.19*	6.73	2030.47	276.23	-12.22*	4.05
Lublin	-6.51	3.83	1146.27	85.64	-6.19	2.94*
All stations	-7.32	5.16	1764.72	275.59	-6.94	3.54
Hazel						
Szczecin	-15.60	11.77	77.77	33.47	-14.77*	-0.12
Poznań	-5.41	1.86	123.13*	16.02	-4.79	0.13
Wrocław	-15.21*	8.54	160.29*	26.00	-10.99*	0.16
Sosnowiec	-5.45	-1.36	-79.32	-15.96	-7.30	-0.29
Kraków	0.50	-8.56*	79.39	38.24*	-0.47	0.55*
Rzeszów	-14.47	16.73*	430.56*	73.69	-8.63	0.45
Łódź	-16.35*	11.32*	146.93*	2.79	-15.69*	0.04
Lublin	-7.14	0.95	224.31	39.81	-10.58*	0.43
All stations	-8.02	3.79	124.45*	25.65	-7.26	0.42
Birch						
Szczecin	-5.63*	0.26	-1319.66	-987.06*	-4.74*	1.69
Poznań	-6.51*	2.94	3343.04	333.69	-7.46*	3.31
Wrocław	-3.07	-0.81	2654.39	771.32	-7.52*	2.16
Sosnowiec	-5.55*	1.26	-2756.57	-917.29	-5.96*	2.46
Kraków	-3.46	-2.17	4346.14*	876.68*	-6.34*	4.12
Rzeszów	-5.52	4.87	5785.77	1543.84	-7.10*	4.48
Łódź	-6.93*	8.09*	-546.86	-917.10	-6.00*	1.33
Lublin	-4.37*	3.83	2057.95	420.40	-4.60*	1.05
All stations	-5.13*	2.18	1934.77	176.49	-6.18*	2.63
Grasses						
Szczecin	0.44	1.71	-957.17*	-134.25*	-9.66*	-4.90*
Poznań	0.45	9.11*	-220.46	-44.12	-4.66	1.21
Wrocław	-9.39*	13.68	645.07*	13.90	-3.20	4.92*
Sosnowiec	3.15	-7.25*	-956.82*	-47.27	4.79	-7.16*
Kraków	8.51*	-12.69	95.24	17.53	0.44	1.39
Rzeszów	-1.45	5.38	773.28	-0.04	1.11	8.51
Łódź	-5.84	17.31*	12.03	-27.33	-4.34	2.68

Lublin	0.74	0.61	-963.34*	-49.50	-2.30	-3.73*
All stations	0.66	1.53	-482.32*	-46.30*	-2.37	-1.71
Mugwort						
Szczecin	4.08	-8.04	-399.13*	-54.79*	-0.99	-3.71*
Poznań	0.84	-0.39	-133.50	-14.36	0.42	0.19
Wrocław	1.33	-4.65	-418.40*	-33.87	0.33	3.92*
Sosnowiec	4.37	-13.06*	-691.44*	-90.29*	-0.88	-7.14*
Kraków	2.71	-10.49*	-264.88*	-25.79*	0.47	-4.92*
Rzeszów	2.07	-0.27	-129.27	-2.85	-1.23	-3.42
Łódź	1.70	-2.83	-136.49	-5.30	-3.72	-1.17
Lublin	2.64	-6.57	-528.76*	-24.67	-1.76	-4.25*
All stations	1.95	-5.49*	-313.43*	-27.04*	-0.7	-3.05

* - statistically significant with $p < 0.05$; ** Threshold value

