Supplementary material

S1 Surface material of pollen grains

Pollen grains contain gluing material on their surface. Gluing material, also called polencoat, derives from secretion and degeneration of the anther tapetum, and includes pollenkitt, tryphine and elastovoscin (Pacini, E., and Franchi, 1993). Pollenkitt is formed when tapetal cell plasmamembranes rupture after complete degeneration of tapetal protoplasts (Piffanelli et al., 1998). It is the most common pollen glue for angiosperm plants, like rapeseed and birch used in this study (Fig. S1). Pollenkitt consist of a number of organic compounds including saturated and unsaturated lipids, carotenoids, flavonoids, proteins and sugars (Chichiriccò et al., 2019). The tapetal cytoplasm may disappear without giving rise to any fatty substance and is therefore reabsorbed by the pollen grains surface. Elaioplats, spherosomes and other cell components are mainly present on the surface of the gymnosperm grains, such as pine pollen (Pacini and Hesse, 2005).

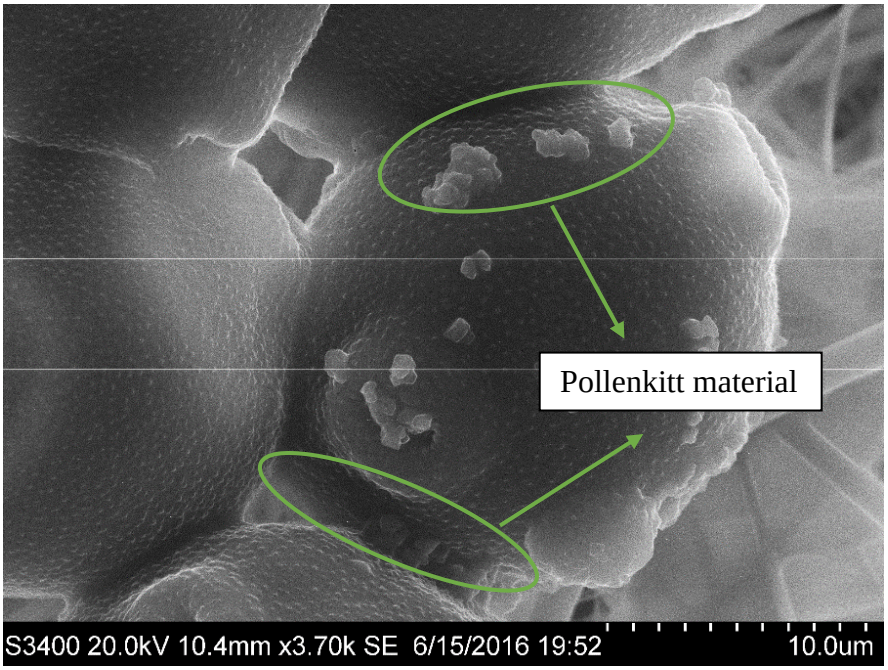

Fig. S1 SEM image of birch pollen grains. Pollenkitt compounds form a glue bridge between grains.

S2 Penetrated and captured pollen mass upon filtration

The mass of penetrated pollen species (total solid, TS) was determined as the difference between the initial pollen mass and the mass captured by the syringe filter. The average MR and standard deviation (SD) is the result of three measurements for each sample.

Table S1 Filtration protocol of the pollen aqueous solution. Three series of measurements performed for each type of pollen. *MR* is the ratio of the penetrated mass to the initial mass of pollen.

Pollen type	Initial pollen mass at 30 % RH	Blank filter mass at 30 % RH	Filter mass loading after 24h vacuum drying and exposure at 30 % RH	Filter captured pollen mass	Penetrated pollen mass	*MR*	
	mg	mg	mg	mg	mg		
	99.92	2548.01	2615.57	67.56	32.36		0.324
	100.09	2501.81	2569.22	67.37	32.72		0.324
Birch	100.16	2539.74	2607.22	67.48	32.68		0.326
						Average	**0.326**
						SD	**0.002**
	100.16	2505.80	2576.42	70.62	29.54		0.295
	100.06	2509.45	2579.97	70.52	29.54		0.295
Pine	100.17	2530.75	2602.77	72.02	28.15		0.282
						Average	**0.290**
						SD	**0.008**
	100.08	2498.13	2551.80	53.67	46.41		0.464
	100.05	2523.11	2576.15	53.04	47.01		0.470
Rapeseed	100.06	2507.88	2561.79	53.91	46.15		0.461
						Average	**0.465**
						SD	**0.004**

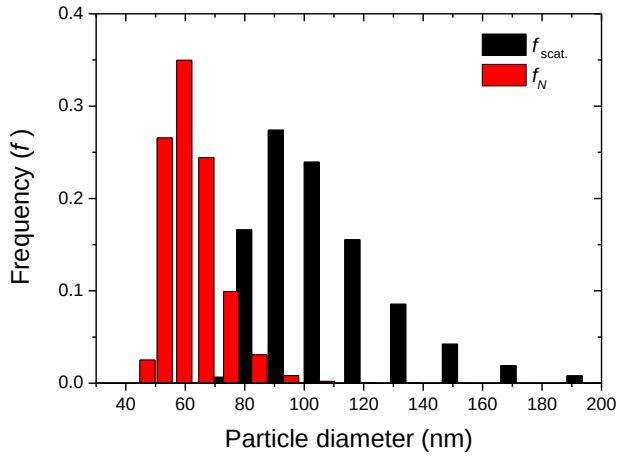

Fig. S2 Conversion of intensity-based size distribution ($f_{scat.}$) of birch pollen colloids to a number-weighted distribution (f_N).

S3 Size dependent SPP restructuring

The obtained in hydration and dehydration (H&D) HHTDMA experiments minimum mobility growth factors, $g_{b,H\&D,min} = D_{b,min}/D_{b.i}$ as a function of initial mobility diameter ($D_{b.i}$) (Fig. 5) were fitted by exponential curve (Eq.16). The best fit parameters are given in Table S 2.

Table S2. The best fit parameters of Eq. (16). R^2 is the coefficient determination of the fit.

Species	η	φ	τ	R^2
Birch SPP	0.852	0.179	149.3	0.998
Pine SPP	0.861	0.178	117.0	0.996
Rapeseed SPP	0.905	0.145	72.30	0.998

S4 Envelope shape of rapeseed SPP.

The irregular shape morphology of the rapeseed SPP (Fig. 5C) was approximated by a Ferret ellipsoid with maximal (a) and minimal (b) axis, respectively. The envelope shape factor, β was calculated by assuming that in both DMA the particles are oriented to its flow by maximal axis (prolate ellipsoid) (Fuchs, 1964):

$$\beta = \frac{\frac{4}{3}(\alpha^2 - 1)}{\frac{2\alpha^2 - 1}{\sqrt{\alpha^2 - 1}} ln\left(\alpha + \sqrt{\alpha^2 - 1}\right) - \alpha}, \quad \text{(S1)}$$

where $\alpha = a/b$ is the aspect ratio. The calculated values of β are listed in Table S.1.1.

Table S3. Envelope shape parameter (β) of rapeseed SPP as a function of size (b) and ellipsoid aspect ratio (α) estimated from SEM images using *ImageJ* processing software. Twenty images of each size range were used to calculate the average ± standard deviation aspect ratio.

b (nm)	a/b	β
60 ± 3	1.13 ± 0.11	1.03 ± 0.02
80 ± 4	1.16 ± 0.08	1.03 ± 0.02
100 ± 5	1.20 ± 0.11	1.04 ± 0.03
140 ± 7	1.32 ± 0.12	1.07 ± 0.03
180 ± 10	1.44 ± 0.10	1.09 ± 0.02

S5 Coagulation of hydrosols

Light scattering (red laser) by biopolymers colloid indicates that the Tyndall effect is not critical for 10 hours; however, it became essential after 20 hours. In the time scale of 20-50 h, the intensity of Reyleigh scattering (symmetrical phase function) progressively increasing. After 50 hours, large

particles are formed with a loss of aggregate stability, and the forward lobe of Mie scattering is dominant.

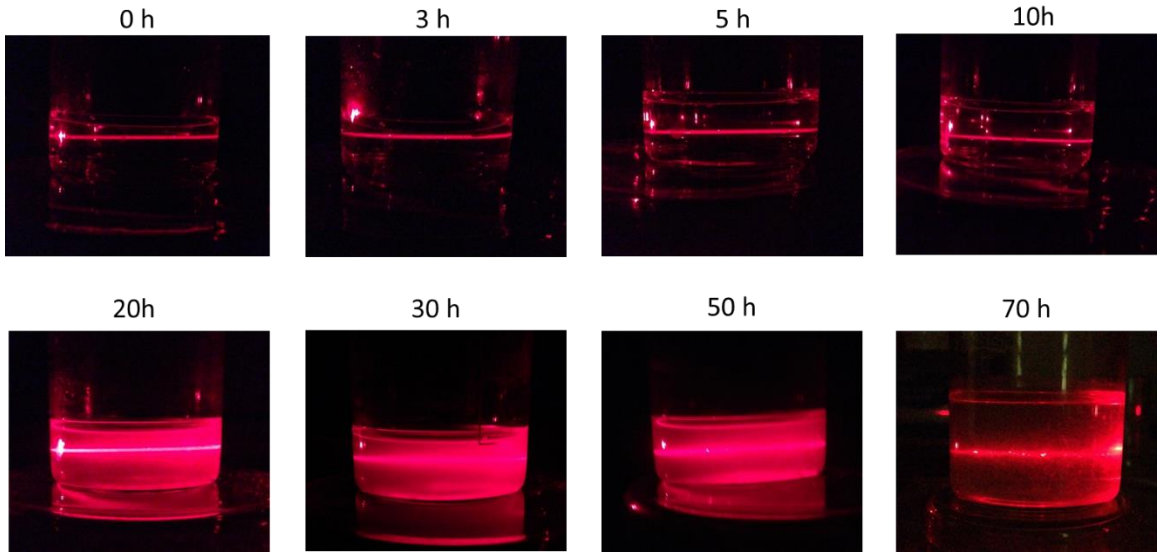

Fig. S3 Time-dependent light scattering of colloids in the birch pollen aqueous extract. The SPP concentration in the filtered solution was the same as used for HHTDMA and CCN measurements (Sect.2.1).

References

Chichiriccò, G., Pacini, E., and Lanza, B.: Pollenkitt of some monocotyledons: lipid composition and implications for pollen germination, Plant. Biol., 21, 920-926, https://doi.org/10.1111/plb.12998, 2019.

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