Table S1: Specifications of the used plasma device and seed type

Plasma Reactor Characteristics and Treated Samples	
Discharge configuration	Volume DBD in parallel plane geometry, symmetric electrodes
Electrode materials	Alumina dielectric plates Ø = 25.4 mm, d = 0.5 mm Embedded silver powered/grounded electrodes Ø = 21 mm, d = 0.05 mm
Discharge gap	5 mm
Discharge power	Periodic AC (5 kHz) bursts at 500 Hz repetition frequency, HV amplitude 21 kV (peak-to-peak)
Working gas	Synthetic air (5.0), 1 slm at 20 °C and 760 Torr
Treated samples	Spring barley (*Hordeum vulgare* L., cv. Malz, country of origin: Czech Republic), 3 seeds freely placed on the grounded side
Sample preparation	No soaking or sterilization (base moist content 11.5%)
Treatment approach	Direct (filamentary micro-discharges directly impacting seeds)
Treatment time	t_{tr} = 0, 5, 10, 20, 40, 180, and 300 s seconds at a discharge duty cycle of 0.4
Discharge and Treatment Characteristics	
Average discharge power	1.2 ± 0.1 W
Exposure energy per seed	Min: 2 (t_{tr} = 5 s), max: 120 (t_{tr} = 300 s) [J/seed]
Exposure energy per surface	Min: 0.025 (t_{tr} = 5 s), max: 1.5 (t_{tr} = 300 s) [J/mm^2]
Exposure to temperature	356 ± 5 K (time-averaged rotational temperature of $N_2(C^3\Pi_u)$ state)
Exposure to UV	≤1%* (UV-C); 19% (UV-B); 80% (UV-A)
Post-treatment testing	
Contact angle	≈120° (no treatment), ≈55°(t_{tr} ≥ 10 s), (droplet of distilled water right after treatment)
Imbibition	14 kernels in glass beakers (14 mL of DI water), weight measured every 15 minutes
Germinability	<48 kernels in Petri dishes (2 layers of filter paper + 20 ml DI water) – 4 repetitions Incubation in the dark at 20°C for 3 days
Root system growth	10 kernels in Petri dishes (2 layers of filter paper + 20 ml DI water) – 4 repetitions Incubation in the dark at 20°C for 3 days

*UV-C detection is limited to approximately 225 nm by the photocathode of the ICCD and the efficiency of the dispersion grating used to detect spectra.

Table S2: Reference values of surface energy components of used liquids[72].

Liquid	γ^d_L **(mJ/m²)**	γ^p_L **(mJ/m²)**	γ^t_L **(mJ/m²)**
Deionized water	21.8	51.0	72.8
Methylene iodide	50.8	≈0	50.8

Note: γ^d_L, dispersive component of surface energy; γ^p_L, polar component of surface energy; γ^t_L, total surface energy of liquid.

Table S3: Elemental composition determined from high-resolution XPS peaks for all tested treatment times of barley seeds. Graphical representation is in Figure 9.

Treatment time, s	Atomic concentration of chemical elements, at.%					
	O	C	N	Si	K	Ca
0	9.2 ± 1.4	88.8 ± 1.7	0.9 ± 0.1	0.4 ± 0.2	0.3 ± 0.1	0.4 ± 0.2
10	21.8 ± 2.0	74.4 ± 3.2	1.1 ± 0.2	0.8 ± 0.6	1.6 ± 0.4	0.3 ± 0.3
40	35.1 ± 0.6	53.7 ± 0.7	1.5 ± 0.8	7.0 ± 2.8	2.2 ± 0.9	0.5 ± 0.1
180	52.4 ± 3.8	25.5 ± 7.6	2.4 ± 0.1	15.1 ± 4.4	3.9 ± 0.5	0.7 ± 0.5
300	57.9 ± 1.9	16.6 ± 1.8	2.4 ± 1.4	18.7 ± 3.3	3.5 ± 2.0	0.9 ± 0.9

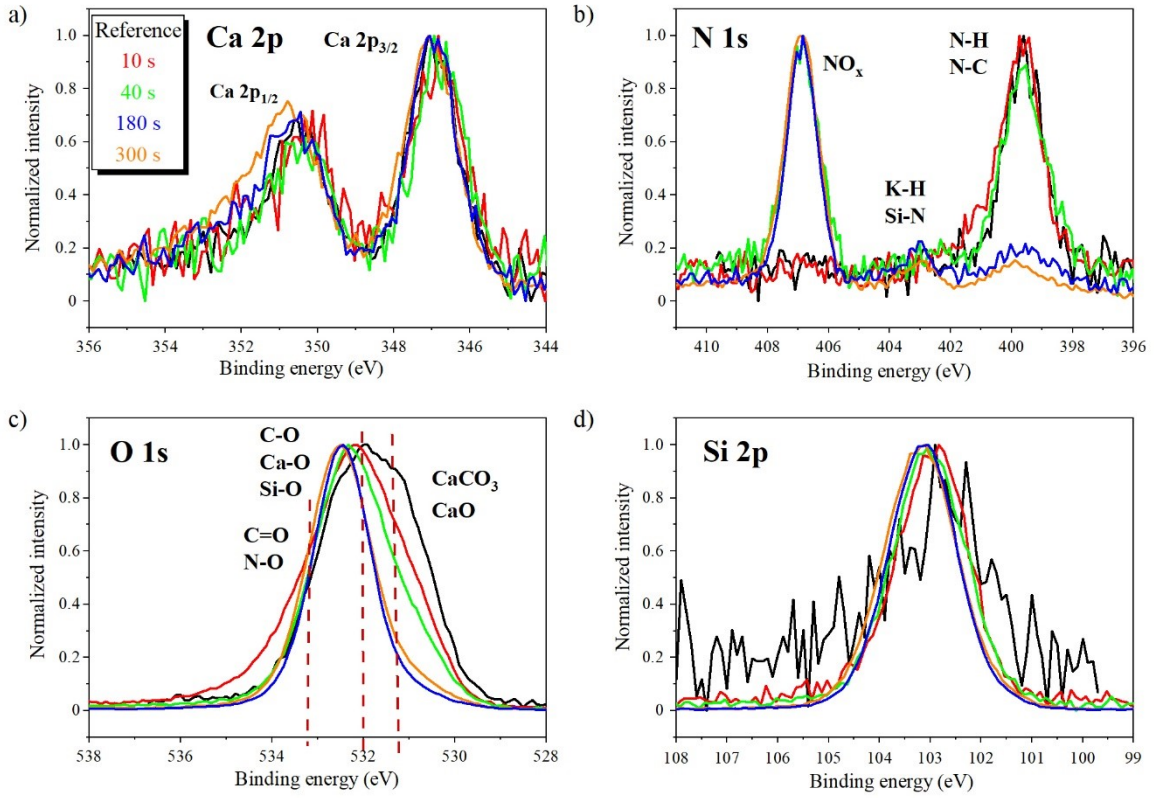

Figure S1: The effect of plasma treatment (0-300 s) on of Ca 2p, N 1s, O 1s, and Si 2p high-resolution XPS peaks of barley seeds.

Table S4: Evaluated parameters of seedling in biotesting. Data are presented as the average values (± standard errors), and the significance of the differences in average values between untreated seeds (reference) and treated seeds was evaluated by means of one-way analysis of variance (ANOVA) and Tukey's test. A P-value of less than 0.05 was considered statistically significant.

	Parameters							
Treatment time [s]	Germination [%]			Germination speed [%]	Germination index	Average root length [1 cm]		
	1st day	2nd day	3rd day			1st day	2nd day	3rd day
Reference	76 ± 4.32 a	83 ± 3.79 a	83 ± 3.79 a	91.49 ± 2.29 a	6.05 ± 0.30 a	0.15 ± 0.01 a	3.52 ± 0.34 a	11.78 ± 1.20 a
10	76 ± 2.31 a	79 ± 3 a	82 ± 2.58 a	92.72 ± 1.33 a	5.95 ± 0.19 a	0.15 ± 0.01 a	4.14 ± 0.16 a	10.44 ± 0.56 a
40	78 ± 3.46 a	80 ± 1.63 a	81 ± 1 a	96.25 ± 3.75 a	6.04 ± 0.19 a	0.04 ± 0.02 b	3.50 ± 0.64 a	11.53 ± 0.92 a
180	77.19 ± 5.11 a	86.92 ± 5.64 a	86.92 ± 5.64 a	89.7a ± 6.95 a	6.23 ± 0.32 a	0.13 ± 0.01 a	3.21 ± 0.56 a	10.45 ± 1.70 a
300	77.08 ± 3.99 a	81.25 ± 2.08 a	81.25 ± 2.08 a	94.72 ± 3.06 a	6.03 ± 0.23 a	0.21 ± 0.01 c	4.85 ± 0.25 a	8.60 ± 0.15 a

Figure S2: Barley kernels after three days of germination – comparison of root system length of untreated (ref.) and plasma-treated samples. White lines represent 1 cm.