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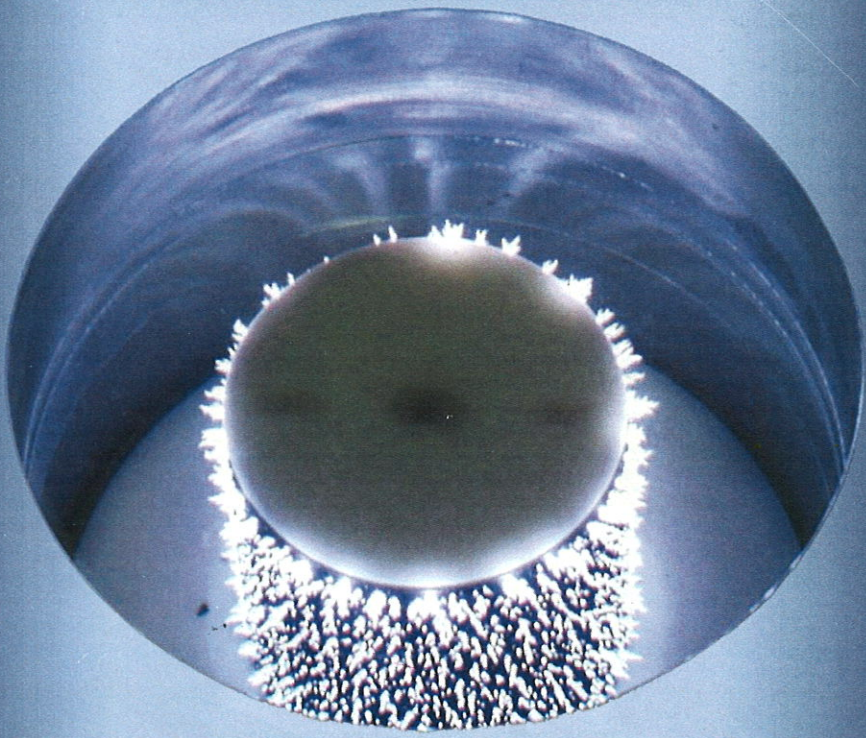

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Stimulation of germination and growth of wheat by plasma activated water

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Nitrogen is an essential component of many cellular constituents, such as proteins, nucleic acids or photosynthetic pigments. It is also an essential nutrient and often the limiting factor for plant growth, development, reproduction and biomass production in all environments with suitable climate and water conditions. Despite there is nearly 79% of nitrogen in the atmosphere, it is unavailable for use by most of the organisms. In order for nitrogen to be used for growth it needs to be fixed in the form of ammonium NH_4^- or nitrate NO_3^- ions. Besides common biological and industrial methods of nitrogen fixation, the low temperature plasma (LTP) technology is an also effective source of NO_3^-. Moreover, the LTP generated in atmospheric air in contact with water can also produce other reactive species in water ($^{\bullet}OH$, NO_2^-, H_2O_2), which can act like signal molecules in plants [1] and also have bactericidal effect [2].

We used positive DC driven self-pulsing transient spark (TS) discharge generated in atmospheric air above the circulating deionized water to produce plasma activated water (PAW). We investigated the effect of PAW on winter wheat (*Triticumaestivum*L.) cv. Isgordius, i.e. seed germination and early seedlings growth. The seeds were imbibed in PAW and then either cultivated *in vitro* on filter-paper disc in Petri dishes in dark at 21°C for 6 days or *in vivo* in two types of soils (loam or clay) during 3 weeks. The germination, the fresh and dry weight of plants, shoot and root length, and the seedling vigor index were evaluated with respect to the PAW treatment time. In addition to germination and growth parameters we also measured the concentrations of H_2O_2, NO_2^- and NO_3^- in freshly prepared PAW and also in the PAW during the seedlings growth.

We observed the increase by 10% in germination of wheat seeds and small increase in the dry weight of seedlings cultivated *in vitro*. The efficiency of PAW *in vivo* experiments depended on the type of soil. The chemical composition of PAW is important, as it may induce various biochemical pathways inside the seeds and seedlings that result in accelerated germination and seedling growth. NO_3^- ions are known to stimulate germination of most seeds [3].Our TS discharge produces approximately 0.75 mM NO_3^- and 0.75 mM H_2O_2 in 1 mL of water treated for 1 minute. Higher concentrations can be achieved, if the treatment time is adequately prolonged. The optimal effect on the growth parameters was found for the treatment time in the range 0.4 – 0.6 min/mL, when the concentrations of H_2O_2 and NO_3^- were 0.3 – 0.4 mM and 0.4 - 0.5 mM, respectively. Despite relatively high concentrations of reactive species in PAW produced by the TS discharge, we have observed only small difference in growth parameters between seeds watered by PAW and reference seeds watered by deionized water. More experiments have to be done in order to optimize the treatment time and identify the role of chemical species in stimulation of seed germination and plant growth hand with respect to a seed/plant type that have different requirements for living environment.

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