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Water treated by transient spark discharge for stimulating plant growth

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Low-temperature plasma (LTP) has become more and more involved in agriculture applications [1]. LTP generated by electrical discharges in atmospheric pressure air is a source of various reactive species, free radicals and charged particles. When plasma is in the contact with water the reactive particles originated in the gas phase (O_3 , NO , NO_2 , HNO_3) diffuse into the liquid phase and produce reactive species ($^{\bullet}OH$, H_2O_2 , NO_3^- , NO_2^- , $ONOO^-$). These species can stimulate seeds germination or plant growth, mostly NO_3^- as a source of nitrogen and H_2O_2 as a signal molecule in plants [2, 3]. We used self-pulsing transient spark discharge (TS) generated in a system with tap water repetitively flowing through the discharge zone to produce plasma activated water (PAW) [3]. We monitored the concentrations of H_2O_2 , NO_2^- and NO_3^- in PAW by colorimetric methods. We cultivated seeds on filter papers in Petri dishes for 6 days and grown plants in soil for 4 weeks. Several plant species (lettuce, radish, tomato, wheat) were tested and their growth parameters, photosynthetic pigments and net photosynthesis were measured. The characteristic concentrations of H_2O_2 , NO_2^- and NO_3^- in 1 mL of PAW treated for 1 min were approximately 0.42 mM, 0.38 mM and 0.85 mM, respectively. We found differences in post-treatment concentrations of reactive species in water with and without seeds (figure). The most pronounced effect was observed for lettuce watered by PAW compared to lettuce watered by tap water, unlike e.g. radish where no difference was found. More experiments need to be done in order to optimize the treatment time and identify the role of reactive species.

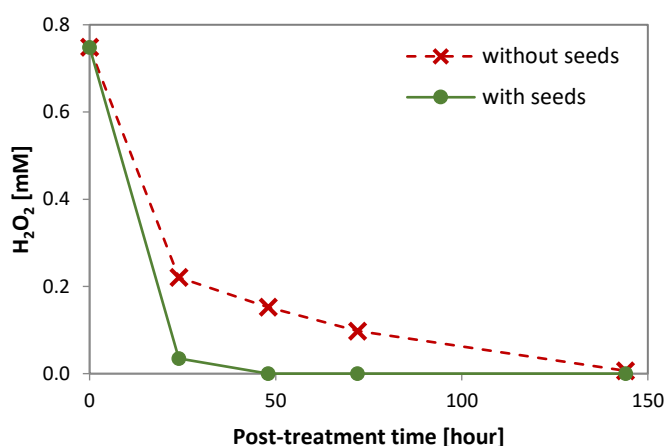


Figure: Concentration of H_2O_2 in PAW after treatment with and without presence of wheat seeds.

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References

- [1] N.N. Misra, O. Schluter, P.J. Cullen, *Cold Plasma in Food and Agriculture: Fundamentals and Applications*, Academic Press Elsevier, 2016
- [2] S. Sivachandiran, A. Khacef, *RSC Advanced*, 7, 1822-1832, 2017
- [3] D.P. Park, K. Davis, S. Gilani et al., *Current Applied Physics* 13, S19 – S29, 2013
- [4] K. Hensel, K. Kučerová, B. Tarabová et al., *Biointerphases* 10, 029515, 2015