

Direct and indirect atmospheric pressure plasma jet treatments for agriculture: evaluation of plasma component effects and RONS production

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Biological applications of Low Temperature Non Thermal Plasmas (LTNTP) have underwent a very rapid development over the recent years and have, even more recently, attracted a lot of attention in the field of agriculture and related domains. Their ability to fight harmful microorganisms and to promote decontamination makes them particularly attractive in that they do not generate chemical residues that must be reprocessed. They are also very attractive to generate interesting reactive species in liquid media that can then be sprayed or used for watering or for soil fertilization.

The quality of seeds not only includes their capacity of rapid germination and fruitful growth, but also their protection against, at least, major well know diseases that can threaten their development (for example diseases provoked by *Tilletia caries* or *Ustilago tritici* (smut) in the case of wheat). Taking into account the fact that, in the coming years, the new regulations will lead to the impossibility to use the up to now frequently used chemicals, seed producers will have to find new physical treatments if they don't want to face problems when putting their production on the market. They are then facing another problem: physical treatment must cure seed from pathogens, but, at the same time, they must be totally safe for seed germination and grow. Also, the longer term effects on plants and potential gene modifications should be considered. Due to seed characteristics, especially design to survive in aggressive environments during the latency period, this represents a huge challenge not easy to overcome. LTNTP appear as a very interesting potential treatment in that domain, especially for very high added value seeds and slip, and can open new routes in agriculture processing.

On one hand, due the complex nature of plasmas produced at atmospheric pressure in air, experiments must be conducted to allow determination of plasma components (at least RONS and specific species like CO, UV and Electric field) main action trends. On another hand, due to the increasing use of plasma treated water, it is suitable to find new ways of producing different cocktails of usable reactive species of agricultural interest. Experiments, dedicated to that, have been conducted on various seeds and discharge systems (including jet, multijets, volumic plasmas, low pressure plasmas, bubbling plasma treated water) and will be presented.