Abstract

Nitrogen (N) is an essential plant nutrient required for the synthesis of proteins and DNA and is needed for photosynthesis. Plants assimilate N in the form of nitrate (NO_3^-) or ammonium (NH_4^+) by specific membrane-protein transporters. Synthetic fertilizers containing NO_3^-, are mainly produced by the Haber-Bosch process, which requires large amounts of energy and relies on greenhouse gasses. For this reason, new and sustainable technologies of producing nitrogen fertilizer are needed. Non-thermal plasmas (NTP) can use electricity to fix N_2 gas from ambient air into water in the form of NO_3^-. This plasma activated water (PAW) also contains varying concentrations of reactive oxygen species (ROS) which are relevant to plant health. PAW represents an untapped potential for new sustainable fertilizers for agriculture. Studies in this emerging field of plasma agriculture have shown that different chemistries of PAW can benefit plant growth, but there is no unified standard. Moreover, little is known about underlying plant molecular and physiological responses to PAW.

Our team is investigating the molecular pathways that are responsive to PAW treatment in the model plant *A. thaliana*. We have developed an effective protocol to treat plants with PAW in a controlled system. Continuous treatment of 3-day old seedlings with PAW results in increased primary root elongation. These results cannot solely be explained by the NO_3^- content of PAW as plants grown under similar levels of NO_3^- were significantly different. Our current studies are addressing what PAW chemistry is optimal for plant growth, as well as, investigating transcriptional and hormone responses to PAW and the potential role they play in the plant's response to PAW. Additionally, we are investigating the affect of PAW on plants grow in soil substrates and affects treatment has on the microbiome.