



# Plasma Activated Water in USDA-organic fertilization

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In nature, around 10% of fixed nitrogen is produced by lightning flashes. VitalFluid has taken this natural process to a reactor, for disinfection of water and fixation of nitrogen, so called Plasma Activated Water. A lightning flash is produced with electricity, creating a plasma from air (78% N<sub>2</sub>, 21% O<sub>2</sub>). In this plasma, nitrogen and oxygen are turned into reactive components and led through water. The reactive components disinfect the water (within 15 minutes the reactivity is gone), with nitric acid (HNO<sub>3</sub>) as the main reaction product. The nitric acid can be used for fertigation of greenhouse crops.

## Project goal

In USDA-organic cultivation, there is no nitrogen fertilizer allowed in a form directly available for take-up by the crop. Normally nitrogen is applied in an organic form, which needs to be processed by microorganisms before it becomes available to the crop. This means that it is really difficult to control the amount of available nitrogen fertilizer to the crop on a day-to-day basis. The nitrogen fertilizer produced by VitalFluid in the Plasma Activated Water (PAW) process is readily available for take-up by the crop, which is a clear advantage over organic fertilizers. The goal for this project is to create a USDA-organic nutrient solution with the Plasma Activated Water, with recirculation of drain water and test it in a pilot scale production system.

## Experimental setup

A greenhouse experiment (120 m<sup>2</sup> cultivation area) will be conducted with a tomato crop on a peat substrate hydroponic cultivation system, according to USDA principles for

organic cultivation. Half of the greenhouse compartment will be the control treatment according to the USDA principles. For the other half of the greenhouse compartment the nitrogen fertilizer will be provided by VitalFluid from their PAW process. The experiment will be conducted with recirculation of drain water (30-40% drain), without disinfection of recirculated water. Part of the supplement water (25-100%) is treated with the plasma activated water process for addition of nitrate, the other part is used to add the other elements to the nutrient solution. Weekly analyses of the nutrient and drain solutions ensure the right amount of nutrients for the crop. Discharge of the nutrient solution will only be done if sodium concentrations increase to threshold levels for decreased crop productivity. Cultivation period is from July – December 2021, with the use of additional lighting from September onwards.

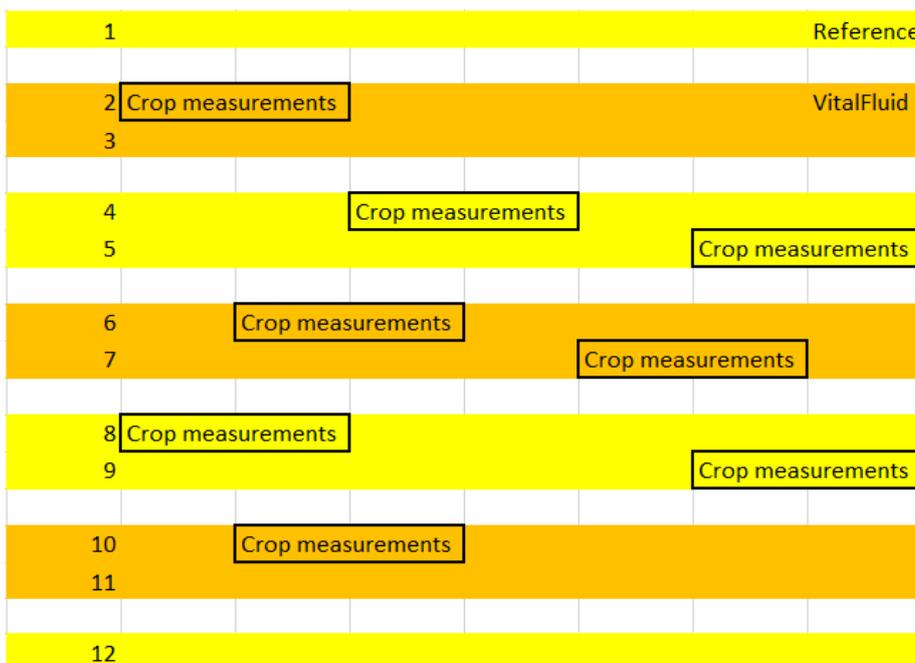


Figure 1. Partitioning of treatments through the greenhouse compartment; Reference (yellow gutters) and VitalFluid (orange gutters)

## Start of cultivation

Cultivation in the experimental greenhouse started halfway July. Three hundred equally treated plants were delivered by the propagator. The plants were placed next to the plant holes on the substrate slabs (see Figure 2), because the micro organisms in the substrate required some more time for the conversion of organic nitrogen to nitrate in the control treatment. At the start of August, the plants were placed in the plant hole, the first harvest is expected early September.



*Figure 2. Left: plants at the propagator; Right: plants in the experimental greenhouse, before placement in plant holes (July 27).*

Currently (17-8) we see slight a difference in the crop, as the control treatment is a bit lighter green and less vegetative compared to the VitalFluid treatment (Figure 3). The cause of this difference is under investigation.



*Figure 3. Left: VitalFluid treatment; Right: Control treatment USDA-organic (August 17).*