Environmental impact reduction of greenhouse horticulture by removal of plant protection products from discharge water

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In greenhouse horticultural areas plant protection products (PPPs) are measured in concentrations exceeding the environmental standards in surface waters. The Dutch government intends to oblige growers that use PPPs to use purification technology for the removal of PPPs from the surplus nutrient solution (discharge water). Next to this generic measure, the Dutch PPP authorisation board recently included the use of purification technology in the legal instructions for a specific PPP (imidacloprid). These measures have led to efficacy tests of purification technology that is common in the water treatment industry. For comparability purposes, a Standardised Discharge Water recipe [1] is used that represents a realistic worst case composition of horticultural discharge water, containing macro- and micronutrients, PPPs and humic acids. Previous research [1] showed that inline treatment of this Standardised Water with ozone or hydrogen peroxide with either low pressure or middle pressure UV (AOP) showed an efficacy of 80% removal of PPPs. Current research focuses on increasing the cost-effectivity with other purification strategies, or new (combinations of) technology. In this paper we focus on oxidation technologies. Different purification strategies are batch-wise treatment or multiple treatment instead of single time inline treatment. This was tested for the combination of ozone and low pressure UV (batch-wise) and for hydrogen peroxide with low pressure UV (multiple treatment; 8x). Both strategies showed an increased efficacy of up to 98%. A new combination of technologies was tested with the combination of hydrogen peroxide, ozone and low pressure UV. This also showed an efficacy of 98%. However, multiple treatment with hydrogen peroxide with low pressure UV is less cost effective, even though the treatment time with ozone becomes longer. A concern when using (advanced) oxidation processes may be the incomplete mineralisation of the PPPs during the reaction time. Degradation products may remain which may be ecotoxic or phytotoxic and the treatment process may thus not be an improvement compared to the initial product. Ecotoxicity of the water treated with hydrogen peroxide and/or middle pressure UV was tested with bioassays with *Daphnia magna*. There is some indication that UV treatment of Standardised Water resulted in an increased ecotoxicity due to the formation of degradation products. This is subject of further study.

1. Van Ruijven, JPM, Van Os, EA, Van der Staaij, M, Beerling, EAM (2014). Evaluation of Technologies for Purification of Greenhouse Horticultural Discharge Water. Acta Hort. (ISHS) 1034, 133-140