

# Advanced oxidation to eliminate growth inhibition and to degrade plant protection products

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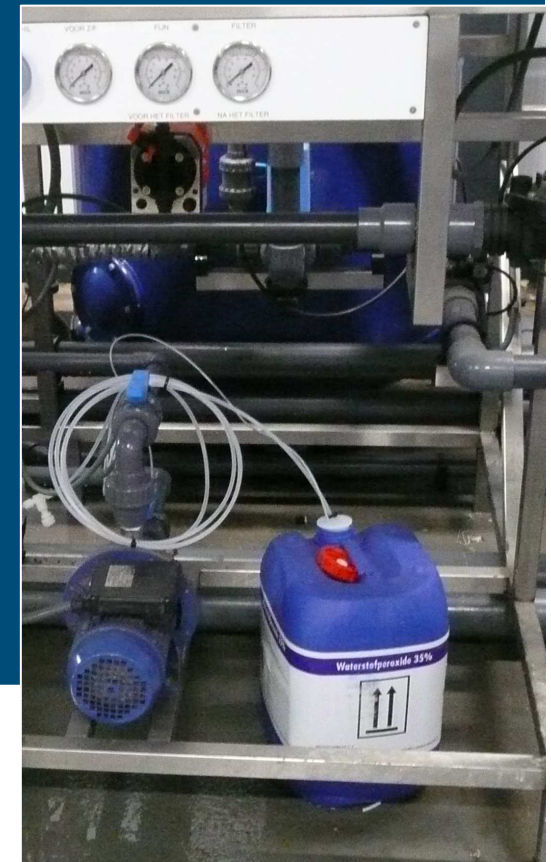
# Introduction

- EU Water Framework Directive (2000)
  - Sound surface and ground water by 2015
  - 2x 6-years phasing possible
- Dutch Greenhouse Industry
  - Almost zero emission by 2027
- Closed soilless systems
  - Vegetables: 5-20% discharge
  - Rose: 15-40% discharge



# Reasons for discharge

- Growth inhibition
  - Root exudates
  - Accumulation of Plant Protection Products (PPP)
  - Microbial reactions
- Sodium in supply water
- Unbalanced nutrient composition
- Technical failures of equipment
- Advanced oxidation ( $\text{H}_2\text{O}_2$  + UV-C)



# Aim of the research

- Prove of existence of growth inhibition
  - Prevention of growth inhibition
  - Degradation of PPPs
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- Longer recirculation of nutrient solution
  - No harm to surface water

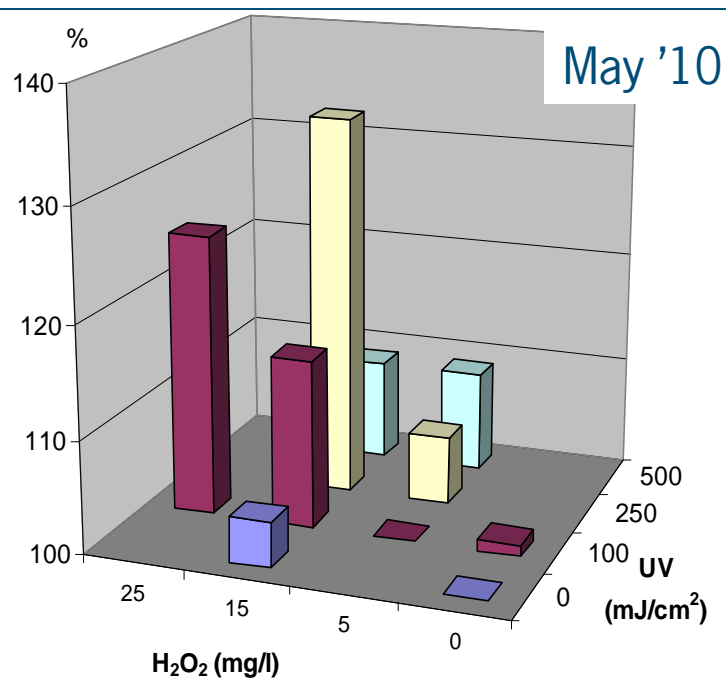
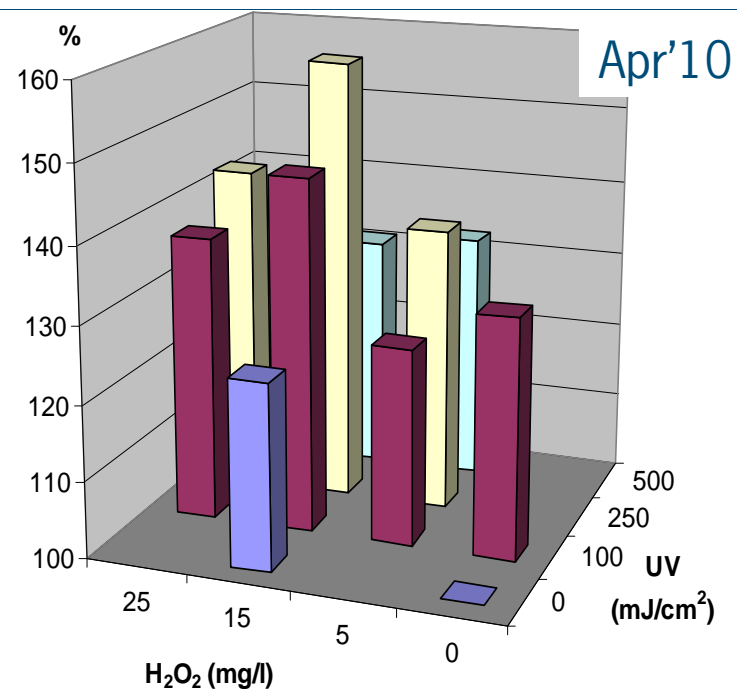
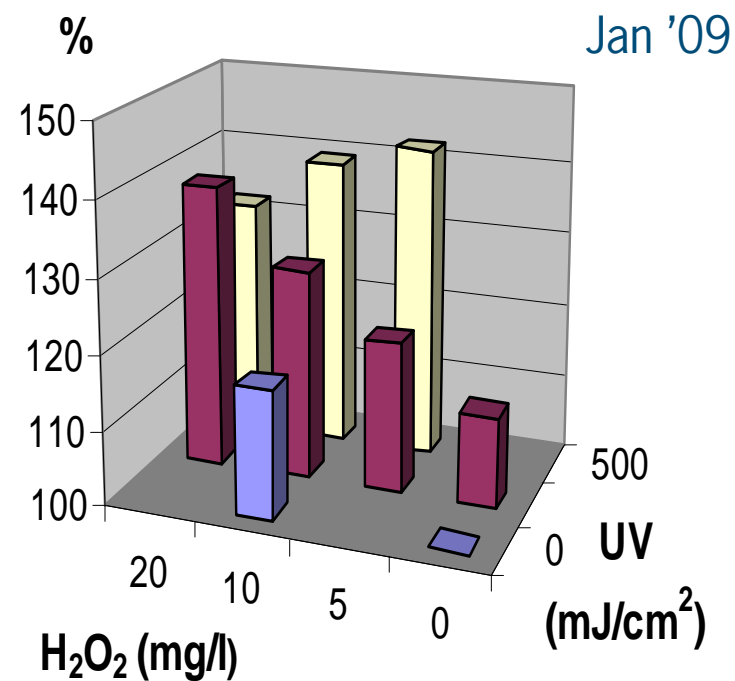
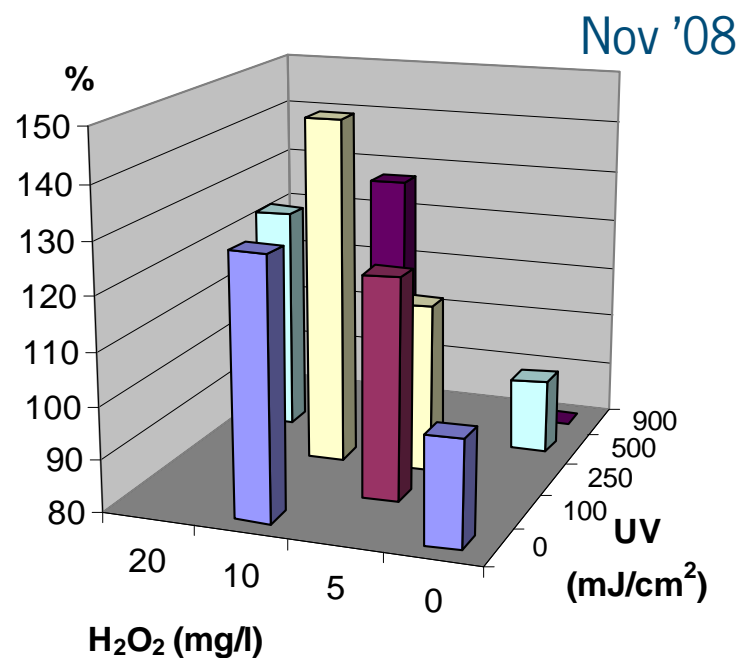


# Method

- Commercial grower with UV disinfection equipment
  - Additional  $\text{H}_2\text{O}_2$  dosing applied to get advanced oxidation
- Tests on growth inhibition (phytotoxkit), degradation of PPP, pathogens, nutrients, pH, EC
  - Nov 2008, Nov 2009, April 2010, May 2010
  - $\text{H}_2\text{O}_2$ : 0-25 mg/l
  - UV-C (200-280nm): 0-1000 mJ/cm<sup>2</sup>



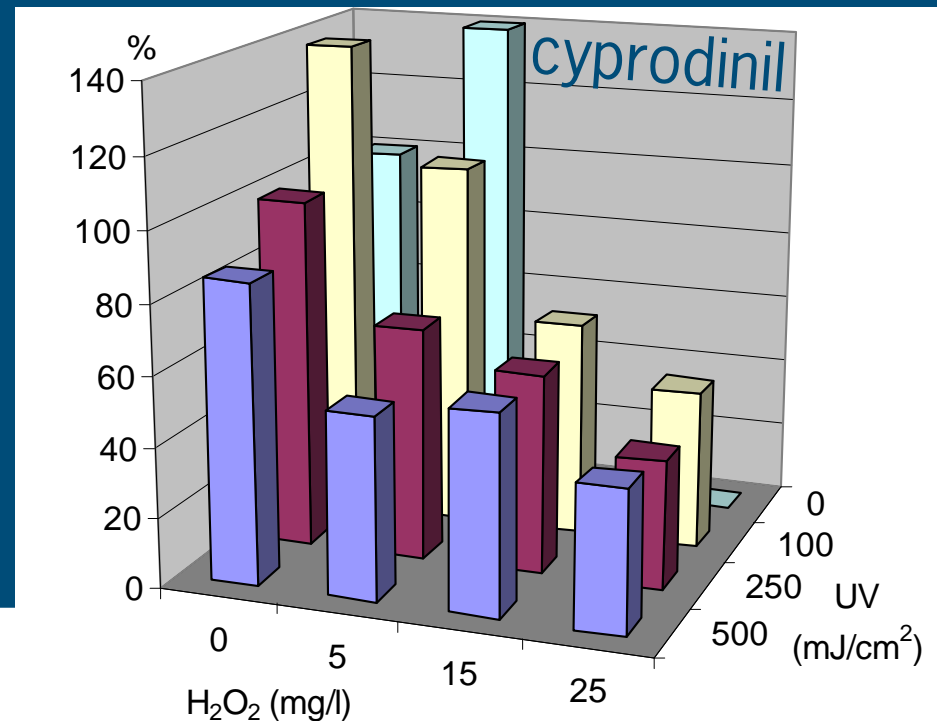
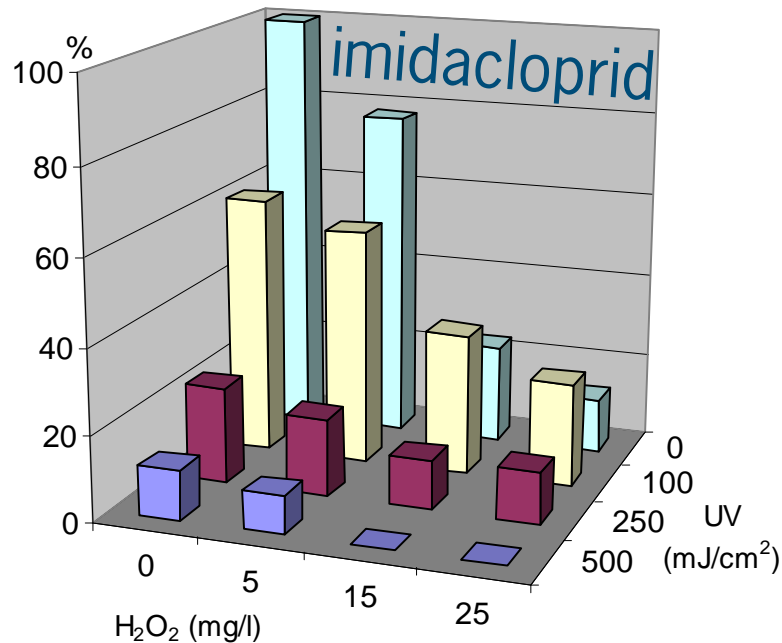
# Results (Growth inhibition)



# Results (degradation of PPPs)

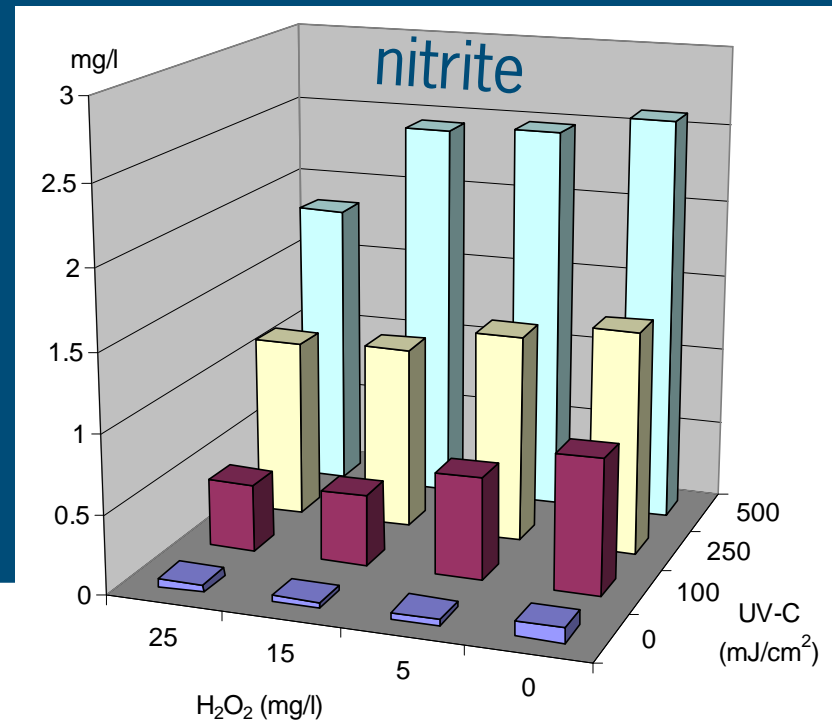
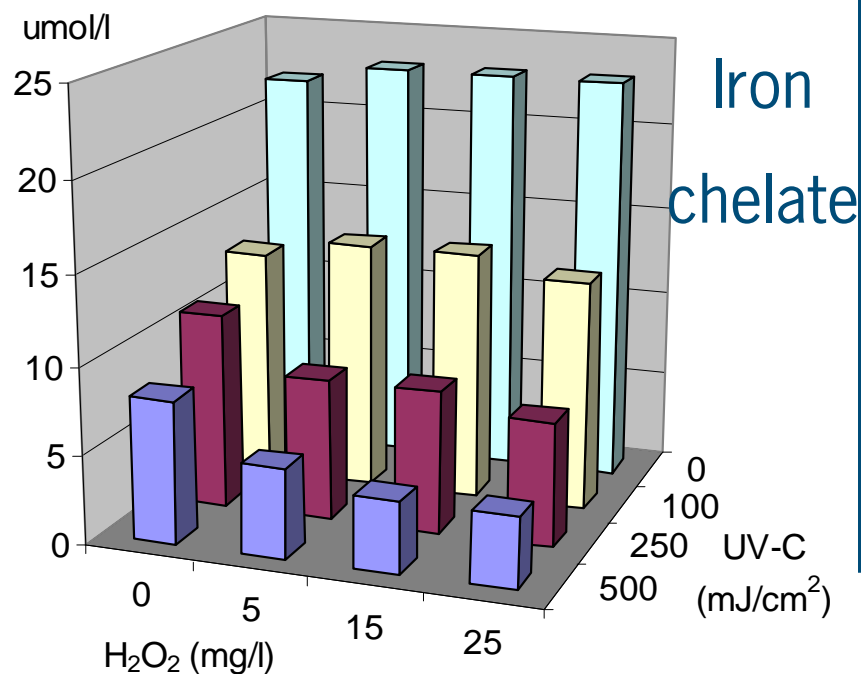
## ■ Drainwater compared with treatments

- 9-14 PPPs found in drainwater
- 40% of originally found PPPs disappeared
- Others decreased by 60-100%
- Few: no effect



# Nutrients and micro-organisms

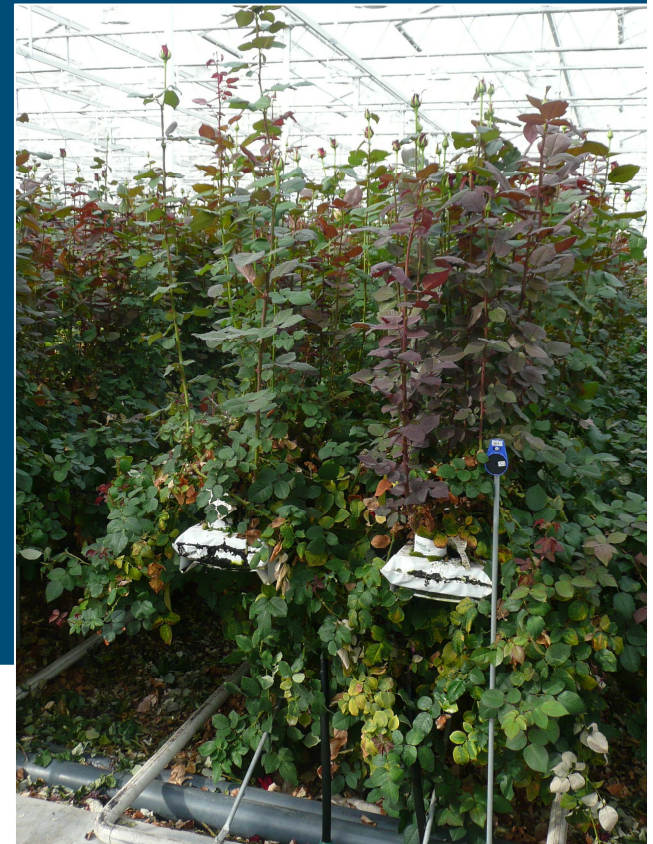
- No differences, except for iron chelate
- Additional nitrite ( $\text{NO}_2$ ) build up
- EC, pH, oxygen: stable
- Turbidity decreased; transmission increased
- Micro-organisms all eliminated





# Conclusions

- Phytotoxkit proves existence of growth inhibition and indicates correlation between test results and rose cultivation
- Advanced oxidation
  - decreases growth inhibition,
  - degrades PPPs
- No additional effects on nutrients, except iron
- Micro-organisms are eliminated



# Wageningen UR Greenhouse Horticulture

## Innovations for and with the greenhouse industry

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