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Nitrate filtration by deep water culture

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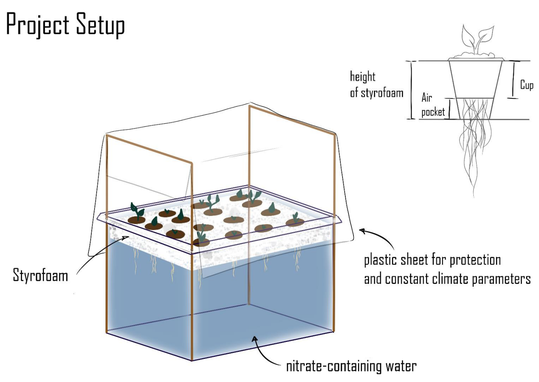
Introduction & Aim

- Sustainable water supply is crucial to meet the increasing demand for drinking water and water resources worldwide. A serious challenge in this context is the presence of high nitrate levels in water sources due to agricultural activities and human impact [1].
- Nitrate is a common anion found in water as a result of agricultural fertilization and other human activities. While nitrate itself is not harmful to health, it can cause health problems if it occurs at high concentrations in drinking water sources or industrial water reservoirs. The limit value in groundwater is 50 mg/L according to the European Union's Groundwater Directive 2006/118/EC, and counter-measures are to be initiated at a value of 37.5 mg/L. Most methods to reduce the nitrate level, however, are relatively expensive [2].
- One promising method for reducing nitrate levels in water could be the cultivation of plants in deep-water culture systems. In this approach, plant roots are placed in containers filled with water, whereby the plants are able to absorb nitrate from the water and use it for their own growth. In this way, an environmentally friendly alternative for the food supply by cultivating vegetable plants could be achieved in addition to the actual goal of processing groundwater and drinking water. The present experiment aims to test the effectiveness of deep water culture as a method for reducing high nitrate levels in water. Several series of tests were carried out with different nitrate concentrations and are presented in this poster, giving an overview of nitrite reduction possibilities and limits of the measurements [3].

Materials and Methods

Project stages:

1. Growing 25 lettuce seedlings in a seed tray; growing time: 4 weeks
2. Water used is tested for nitrate concentration (without fertilizer); test for setting the desired nitrate concentration; two different fertilizers with different nitrate concentrations are tested (NPK+Mg 24+6+12+2 und NPK 1:4:6 (5+20+30), aiming at 50 mg/L nitrate concentration
3. Inserting seedlings into the system, adjusting the fertilizer concentration (nitrate) using the VISOCOLOR ECO nitrate kit colorimetric test



4. Take 3x2 samples; fill both beakers with samples; drop NO_3-1 into beaker A and shake; mix with 1 measuring spoon of NO_3-2 and shake for 1 min; wait for 5 minutes and compare with color scale

Results

- **First experiment:** 1 g fertilizer (NPK+Mg 24+6+12+2) led to 120 mg/L nitrate, pH 7.06 (slightly growing up to 8)
  → No decrease of nitrate concentration measured, plants died

- **Second experiment:** nitrate concentration of 50 mg/L reached by NPK 1:4:6 (5+20+30)
  → Good plant growth
  → Reduction of nitrate to 0 mg/L within two weeks
  → Algal growth along the roots of the lettuce

- **Third experiment:** box painted gray to reduce light near the roots, nitrate concentration of 50 mg/L
  → Concentration reduced to 30 mg/L after 2 days; after 20 days reduction to 3 mg/L
  → Plants again grown very well

- General measurement problem: nitrate concentration measurement by color scale

Conclusion

- It is possible to effectively reduce the nitrate concentration through deep water culture
- The lettuces developed very well, both in leaves and roots, underlining the success of the experiment
- However, it is important to consider which by-products are present in the nitrate-containing water and whether these also need to be removed

Literature

[1] FAQs zu Nitrat im Grund- und Trinkwasser, https://www.umweltbundesamt.de/themen/wasser/grundwasser/nutzung-belastungen/faqs-zu-nitrat-im-grund-trinkwasser#was-ist-der-unterschied-zwischen-trinkwasser-rohwasser-und-grundwasser
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[3] Hamza, A.; Abdelraouf, R. E.; Helmy, Y. I; El-Sawy, S. M. M. Using deep water culture as one of the important hydroponic systems for saving water, mineral fertilizers and improving the productivity of lettuce crop. *International Journal of Health Sciences* **2022**, *6*, 2311-2331.

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