


For Teachers Growing hydroponic basil by using struvite

Module 1

The struvite recovered through the precipitation reaction of wastewater is a valuable mineral fertilizer. Thanks to this laboratory experience, pupils will be able to evaluate the fertilizing potential of struvite through the cultivation of basil plants in a hydroponic system realized recycling the plastic bottles of mineral water. At the end of this practical activity, pupils will be more responsible and interested for a variety of scientific disciplines: life and plant, ecology, sustainability, chemistry, nutrition, water and circular economy.

Necessities



Reagents	Formula		Quantity or Concentration
Mixture of salts to prepare Hoagland solution			7 g/L
Struvite	$\text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$		100 mg/L
Perlite	$\text{Al}_2\text{CaFe}_2\text{K}_2\text{MgNa}_2\text{O}_{12}\text{Si}$		

List of materials/tools

- NPK nutrients for hydroponics
- Struvite
- 48 basil plants (2 per bottle)
- 24 1/1,5 l PET bottles (polyethylene terephthalate) for beverage coming from recycling
- 48 plastic sieves
- distilled water
- perlite
- precision balance
- Distilled water

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Procedure

I. Preparation of basil plants

1. Clean the basil plants roots: the plants were first flared and then water washed until the soil was completely removed from the roots;
2. Acclimatize the basil plants with the Hoagland solution for a 24h period before the struvite treatment;
3. Cover the whole vases base with a thin layer of perlite;
4. Insert the plant into the vase and fill it with other perlite;
5. Repeat with other basil plants.

II. Experiment preparation

1. Perform 2 holes of the same dimensions of the vases on one side of each bottle;
2. Add in each bottle 7 g/L of Hoagland solution;
3. Prepare two struvite solutions of 10 mg/L and 100 mg/L dissolved in distilled water;
4. Fill three quarters of the plastic bottles, which will act as controls, with distilled water;
5. Fill the other bottles, 8 per each treatment, with one of the two struvite solutions;
6. Shake the bottles very slightly in order to make the nutrient solution homogeneous;
7. Insert the plastic vases, previously filled with basil plants and clay, into the appropriate bottle holes and label them;
8. After 3 or 4 days monitor the plants adaptation and eventual volume variations of each nutritional solution and, in case, bring back to the initial volume;
9. Wait three weeks until the basil plants have grown and observe the differences in the growth of the plants in different concentrations of struvite (Figure 1);
10. At the end of this period all plants are removed from their solutions and dried with paper absorbent (Figure 2). Determine the fresh weight of each plant and measure the development of the root apparatus (Table 1).
11. Dry up in the air the plants after about a week weight again in order to obtain the dry weight (Table 1).



Figure 1. Basil plants treated with struvite

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Figure 2. Basil plants are removed from their solutions and dried on paper absorbent

- Set up a table with fresh and dry weights of the plants
- Determinate the average of each plants group
- Plot the average values in the graph

Table 1. Fresh and dry weights of the basil plants untreated and treated with struvite

Control	Fresh weight (g)	Dry weight (g)	Struvite 10 mg/L	Fresh weight (g)	Dry weight (g)	Struvite 100 mg/L	Fresh weight (g)	Dry weight (g)
Plant n. 1			Plant n. 1			Plant n. 1		
Plant n. 2			Plant n. 2			Plant n. 2		
Plant n.			Plant n.			Plant n.		
Average			Average			Average		

Additional Notes

- Plastic vases used for fresh cheese, but also other plastic vases (eg. the yogurt ones) can be used (see the picture)
- The greenish coloration of the hydroponic solution could be caused by the growth of microalgae; this could be remedied by darkening the solution, for example by covering the bottles with aluminium foil.



Conclusions

- The effect of struvite dosage on plant growth;
- The difference between fresh and dry weight of the plant;
- The circular economy