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Farmers' and academia's views"

Experimental development of a hydroponic nutrient solution based on organic residues

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Abstract

Bioponics have a great potential to replace mineral fertilisers and offer a strategy for reutilising nutrient-rich organic residues. This study aimed at developing a balanced organic nutrient solution for lettuce, based on different organic waste materials with known N, P, K contents with minimal technical effort. Two different recipes were prepared: (1) containing animal bone meal and goat manure (R1), and (2) based on R1, augmented with potato- and banana peel (R^2). To extract the nutrients ingredients were mixed with water according to recipe and digested over 25 days. The experiment comprised aerated (aerobic) and non-aerated (anaerobic) digestion either pH uncontrolled or pH manually kept at pH 6.5, with three replicates.

Samples of the digestate were taken every third day, and NH_4^+, NO_3, K+, and PO43- concentrations were analyzed. For the pH-controlled samples, pH was adjusted at the same interval.

Mineralisation rates differed strongly between digestion method, pH treatment, and the minerals N, P, and K.

Anaerobic treatment showed a higher N mineralisation. The mineralisation was promoted by the lower pH in anaerobic conditions since NH_4^+ mineralisation negatively correlated to the pH with correlation factors r = - 0,6 (R^2) respectively - 0,79 (R1). Although highest N mineralisation was observed for R1 under anaerobic, pH-controlled digestion, only 11 % of the N contained in the organic substrates was converted into NH_4^+.

P was mineralised slowly over the entire time of observation. Again, a negative correlation to the pH was observed. Mineralisation was highest for the anaerobic and the pH-controlled aerobic treatments. The highest conversion of the organically bound P into PO43- with 23 % was measured for R1, anaerobic, pH-controlled digestion at day 22.

Almost all K was mineralised within a short time for both recipes and treatments. The pH value did not influence K mineralisation.

Neither recipes nor digestion treatments resulted in well-balanced nutrient solutions for hydroponics.

This study provides, however, relevant information on the mobilisation of main plant nutrients, the role of the pH, and digestion treatments. The findings serve as the basis for subsequent research to increase mineralisation rates and optimise the nutrient ratios of the mixtures.

Keywords: Bioponics, hydroponics, nutrient mineralisation, plant nutrition, reutilisation

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