Organic nitrogen in hydroponics, the proven way

Nitrogen is a critical nutrient for plants. In hydroponics, we can choose to provide it in three ways, as nitrate, as ammonium or as organic nitrogen. This last choice is the most complex one. It contains all possible nitrogen-containing organic molecules produced by organisms, such as proteins and nucleic acids. Since nitrate and ammonium are simple molecules, we know how plants react to them, but given that organic nitrogen can be more complicated, its interactions and effects on plants can be substantially harder to understand. In this post, we will take an evidence-based look at organic nitrogen, how it interacts in a hydroponic crop and how there is a proven way to use organic nitrogen to obtain great results in our hydroponic setups.

An organic nitrogen source, product of corn fermentation, rich in protein and humic acids

Nitrogen uptake by plants

The main issue with organic nitrogen is its complexity. Plants will mainly uptake nitrogen as nitrate (NO_3^-) and will also readily uptake nitrogen as ammonium (NH_4^+) to supplement some of their nitrogen intake. However, organic nitrogen is made up of larger, more complex molecules, reason why its uptake is more complicated. Various studies have looked into whether plants can actually uptake organic nitrogen directly at all (1, 2). They have found that while some uptake is possible, it is unlikely to be the main contributor to a plant's nitrogen uptake. While plants might be able to uptake this organic nitrogen to some extent, especially if it is comprised of smaller molecules (3, 6), it is unlikely that this nitrogen will be able to replace the main absorption pathway for nitrogen in plants, which is inorganic nitrate.

Effects of organic nitrogen in hydroponics

Many researchers have tried to figure out what the effect of organic nitrogen is in hydroponics. This study (4), looked at the effect of various organic nitrogen sources in the cultivation of lettuce. The study tried to measure how these fertilizers compared against a complete Hoagland solution. The results show that the organic nitrogen sources were unable to successfully compete with the standard mineral nutrition. The best result was obtained with blood meal, with less than half of the yield obtained from the Hoagland solution. It is clear that this study is not fair, as using organic nitrogen sources as the sole source of nutrition means more deficiencies than simply nitrogen might be present, but it does highlight some of the challenges of using organic nitrogen in hydroponics.

Another study (5), performed a more direct comparison of

various different nitrogen sources, changing only the nitrogen source between nitrate, ammonium, and organic nitrogen in the cultivation of tomatoes. Organic nitrogen performed the worst across most measurements in the study. This showed that organic nitrogen is, by itself, not a suitable form of nitrogen for plant absorption and is unable to replace the nutrition provided by a synthetic inorganic nitrate source. This is especially the case when the organic nitrogen comes from more complex sources.

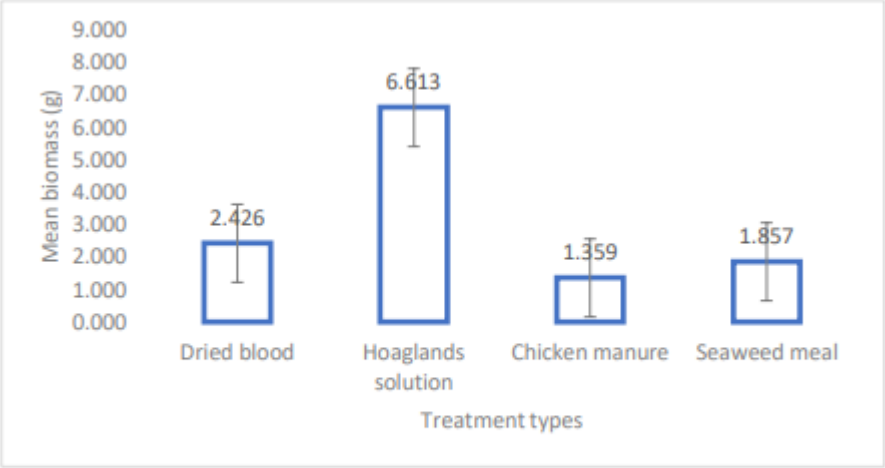

Figure 10: Compares the mean values for dried lettuce biomass of the four different treatment types.

Taken from this thesis.

How to solve these issues

As we've seen, the main problem with organic nitrogen is that plants cannot uptake it efficiently. However, the nitrogen cycle provides us with mechanisms to convert organic nitrogen into mineral nitrate which plants can readily metabolize. The best way to achieve this is to prepare compost teas using the organic nitrogen source to create a nutrient solution that is better suited for plants. The use of nitrifying organisms provides the best path to do this. These organisms are present in a variety of potting soils and composts, but can also be bought and used directly.

This study (7) showed how using goat manure coupled with

nitrifying bacteria was a viable path to generate a nutrient solution suitable for plant growth. Another study (8), also using manure, confirms that viable nutrient solutions can be created and used to grow crops successfully when compared to hydroponic controls. Manure, as an animal waste product, contains a lot of the macro and micronutrients necessary for plant growth, providing an ideal feedstock for the creation of a full replacement for a nutrient solution.

Another interesting study (9) uses vegetable sources in order to study the creation of such solutions. I recently used this study to create a detailed post about how to create a nitrate-rich compost tea for use in hydroponics starting from corn steep liquor and bark compost as inputs.

In conclusion

Organic nitrogen sources, by themselves, are not suitable as the main source of nitrogen for plant growth. This is especially true of very complex nitrogen sources, such as those contained in blood meal, corn steep liquor and fish emulsions. However, we can take advantage of nitrifying bacteria and use these inputs to create nitrate-rich solutions that can be used to effectively grow plants. *This is a proven solution that has been tried and tested in multiple studies and in nature for hundreds of thousands of years*. Instead of attempting to use organic nitrogen sources either directly in the hydroponic solution or as media amendments, create compost teas with them that contain readily available mineral nitrate instead.

Do you use organic nitrogen in hydroponics? What is your experience?