Algae extracts as a sustainable nitrogen-containing fertilizer

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Abstract

The enormous increase in the world population will provoke an escalation in our overall consumption and demand for food and animal feed, which will eventually drain our limited resources. Therefore, increasing agricultural production in order to respond to the growth of the population is necessary. However, it means an increase in the use of fertilizers as well. The widely applied Haber-Bosch method is a very important in nitrogen-containing fertilizers production. However, it is an energy-consuming process. Thus, the production of sustainable fertilizers is compulsory. Microalgae grow predominantly in nutrient-rich water (e.g. wastewater). They could be used to recover the nutrients and to avoid the leaching of nutrients (e.g. phosphorous and nitrogen) to the groundwater. Afterward, due to the high nitrogen content and to close the nitrogen cycle, microalgae or its extract could be used as nitrogen-containing fertilizers. Moreover, subcritical water extraction is a 'green' and efficient approach to recover protein from microalgae cells. In this project, the potential of using algae extracts as a nitrogen-containing fertilizer was investigated. Due to its high protein content, Spirulina platensis was chosen in this work. The extraction underwent in subcritical water condition (250°C, 40 bar) in a semi-continuous reactor. The obtained aqueous extracts were analyzed in aspects of total nitrogen, ammonium, and nitrate. The subsequent soil incubation tests with 5 treatments (control, urea, Horngriess, Spirulina and Spirulina extracts) were performed for 21 days. The nitrogen immobilization/mineralization in soil were evaluated in different time periods in comparison with conventional mineral fertilizer (urea) and organic fertilizer (Horngriess).
The primary results showed that the algae extract is a promising organic soil fertilizer in the aspect of nitrogen mineralization and nitrogen recovery. Moreover, after 21 days incubation the nitrate content in soil with the algal extract (56.76 ± 0.8) is comparable with that of conventional organic fertilizer (56.86 ± 5.86). On the other hand, subcritical water treatment of algal biomass did not contribute to nitrogen mineralization in soil.

Keywords: Microalgae, Nitrogen-containing fertilizers, Nitrogen recovery, Nitrogen cycle