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Study the Potential Use of Waste Water Grown Microalgae Biomass as Biofertilizer

Probir Das, Mehmoud Ibrahim Thaher, Hareb Mohammed S.J. Aljabri, Talaat Abdelfattah Ahm Youssef

Qatar University, QA

Email: probir.das@qu.edu.qa

Liquid wastewater streams that contain nitrogen must be treated before being discharged into the environment to prevent eutrophication. Already there are several existing conventional treatment technologies that can remove the nitrogen from the wastewater in combination of multiple processes. Depending on the processes involved, a fraction of nitrogen will be released to the atmosphere. On the contrary, there are several types of microalgae have the voracious demand of nitrogen and can assimilate waste bound nitrogen in a single step mostly as intrinsic proteins. Once the microalgae are separated from the water the minerals inside the microalgae cells remain available for plants and it can be used as fertilizer for the plants. Furthermore, removal of microalgal biomass from the wastewater at the end of the process may completely, or at least partially, treat the waste water minimizing the processes and cost of conventional treatment processes. Qatar's climate and non-arable land are ideal combinations for cultivating microalgae. The harvested microalgae can be dried and stored for future growth of fodder plants. On theory, every kg of microalgae biomass will require 1.73 kg of CO_2. Some of the microalgae can also utilize specific organic carbon sources that are available in wastewater. However, the concentration of available organic carbon in the wastewater is not sufficient to support complete removal of nitrogen by microalgae. Hence, carbon dioxide must be supplied for complete and faster treatment. As the minerals will be utilized by the fodder plants, a fraction of the organic carbon associated with the microalgae biomass will be locked in the soil and thus increasing the soil's organic content. Therefore, successful application of wastewater grown microalgae biomass as biofertilizer can provide (1) a cost and energy effective wastewater treatment process, (2) nutrients (N, P and other minerals) recycling, (3) sustainable and environmental friendly agricultural application, and (4) carbon sequestration. Algal technology group of Qatar University is growing microalgae biomass in large scale open ponds. Mineral composition of a marine microalgae, Chlorocystis sp., biomass was characterized as 3.45% N, 0.22% P, 2.78% Ca, 0.39% Fe, 0.01% Cu and 0.02% Zn. Currently, this biomass is used to study its application as biofertilizer for the growth of sorghum plants.

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Soil was mixed with microalgae biomass and 5 kg of the soil mix was added in each pot. Three different microalgal biomass concentrations were applied in peat soil: 1.5 g/l, 3 g/l and 4.5 g/l. In another pot 3 g/kg NPK fertilizer was added while in another pot there was no inclusion of any fertilizer. Currently, each pot is irrigated with freshwater twice a week and the experiment will continue for two months. In parallel, Scenedesmous sp., a local fast growing freshwater microalgae, is currently being grown in wastewater collected from a small wastewater treatment plant, with an aim to be used as biofertilizer. The mineral composition of wastewater-grown Scenedesmous sp. will be determined and used as appropriate ratio for growing sorghum plants. Results obtained for different fertilizers (i.e., 1. NPK, 2. marine microalgae biomass, and 3. Wastewater grown microalgae biomass) will be compared in terms of plant growth, residual minerals in the soil.