ALGAE COMPOSTING AND THE USE OF COMPOST OBTAINED AS FERTILIZER FOR ORGANIC FARMING

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ABSTRACT

Composting is a cheap and efficient management approach for recycling organic waste, but also an alternative to landfills. Recycling algae into composts has also proven to be an ecological alternative for reducing beach pollution and water eutrophication.

There is a growing interest in the use of algae-based fertilizers as they maintain organic farming and contribute to a significant increase in agricultural productivity.

This paper presents the particularities of algae as a raw material for composting, the types of composting methods, as well as the advantages and disadvantages of algae-based fertilizers in terms of agricultural cultivation.

INTRODUCTION:

Seaweeds are macroscopic macroalgae, being an integrated part of the world's coastal ecosystems, providing essential benefits to the coastal marine environment. There are about 10,000 species of macroalgae, and based on their pigmentation, they are classified as follows: Chlorophyta ("green" algae), Rhodophyta ("red" algae) and Ochrophyta ("brown" algae).

Most macroalgae grow naturally attached to hard substrates, however, a limited number of selected species (semi-domesticated) are grown in open water or in terrestrial installations for commercial applications (food and extracts). (Jatinder Singh Sangha, 2014)

Seaweed contains nutrients, trace elements, alginic acid, vitamins, gibberellins, auxins, antibiotics and hormones, beneficial for both animals and plants.

Melatonin is found in large amounts in most species of algae, and brown algae are the only non-animal sources of thyroid hormones.

The mineral macronutrients in algae are: magnesium, sodium, chlorine, calcium sulfur, potassium nitrogen and phosphorus, and the micronutrients are: fluoride, iron, zinc, selenium, fluoride, manganese, boron, iodine, copper, nickel, molybdenum and cobalt, all these elements being beneficial to agricultural crops. (Siddhartha Pati et al., 2017)

In recent decades, the unusual growth of algal biomass has led to the eutrophication of coastal ecosystems. Recently, the interest in the use of algae in agriculture in the form of compost has increased, thus solving to some extent this problem of eutrophication.

Currently there is a growing interest in the use of organic methods in agriculture, and the declining number of synthetic chemical fertilizers allowed, favors the search for new environmentally friendly solutions. Also, the harmful effect of synthetic chemical fertilizers on the soil and the environment led researchers to examine new alternatives, called biofertilizers. (Christos Chatzissavvidis et al., 2014)

MATERIAL AND METHOD:

Composting methods

Windrow composting - The method of composting in rows and piles is the most common form of composting, it

does not use machinery during composting. The piles are turned by hand with shovels, thus being naturally aerated.

According to Nor Habsah (2008), this method of composting is simple, and organic waste is formed in large and elongated piles. A static pile can be made in the shape of a triangle, to reach 2 meters high with a width between 2.5 meters and 3 meters. (Nur Fatin Mat Saad et al., 2014)

Vermicomposting

Vermicomposting is a decomposition process that involves the joint action of worms and microorganisms. Although microorganisms are responsible for the biochemical degradation of organic matter, worms are determinants of the process.

Vermicompost is the final product obtained by the vermicomposting method and is a finely divided peat-shaped product with a large specific surface area and a good water retention capacity, which contains nutrients in forms that can be easily taken up by plants. This compost obtained with the help of worms is rich in organic matter and has a high rate of mineralization, which implies an increased availability of nutrients, especially ammonium and nitrates, for plants. (Jorge Dominguez et al., 2004)

Aerated static pile with perforated pipes

Aerated static piles are piles with a system perforated pipes that are mechanically aerated by blowers, and they draw (negative ventilation) or push (positive aeration) clean air through the material. This method allows better odor control than manual aeration, especially if the air is directed through an odor filter.

The blowers used for aeration serve not only to supply oxygen but also to ensure cooling. The blowers can be run continuously or at intervals. When operated at intervals, the blowers are activated either at set intervals or based on the temperature of the compost. This method is spatially efficient, and increased aeration shortens the time required for composting. (Robert E. Graves, et. Al., 2010)

In vessel composting

This composting method is a closed system in a container or tank. There is an outlet for the removal of harmful gases, which filters them through biofilters mounted on the exhaust unit. Aeration is ensured either by rotating the container or by aeration pumps to maintain a constant air flow. Because the entire system is closed, moisture is preserved in itself, thus reducing water dependence. (Vivek Manyapu et. Al., 2017)

Algae composting

Composting is a simple and practical method of managing algae biomass waste and will be widely applied in the future, with compost being suitable as a natural fertilizer. (Wei Han et al., 2014) Large-scale composting of algae is rarely performed. Few researchers have dedicated themselves to this field of seaweed composting, believing that different composting technologies can be used to stabilize algae, such as composting in piles, which can have dimensions of 6 x 2 x 1.5 m .

Haq et al., 2011, conducted a study in which the composition of algal compost was composed of two parts algal biomass and one part manure, all being covered with straw for insolation. (Haq, T et al., 2011)

Another method for obtaining algae compost is composting algae in a vessel system, for example in thermos bottles, reactors or plastic containers whose volumes range from 500 mL to 300 L. (Izabela Michalak, et.al. , 2016)

Han et al., 2014, point out that pilot composting has been successfully used for the management of algal waste removed from eutrophic environments, but clear aspects for large-scale composting of algae have not yet been established. (HAN W. et al., 2014)

RESULTS AND DISCUSSIONS:

Peculiarities of algae

Algal biomass usually has a low C / N ratio and a high moisture content. The effects of such peculiarities on the composting of this raw material have been addressed by some researchers. NO2 emission is a potential problem in algae composting, compared to normal organic waste, due to the low C / N and AFP commonly associated with algae; Consequently, algae biomass can be mixed with other organic waste to make a more suitable mixture for composting. All aerobic stabilization technologies have a substantial carbon footprint, which is exacerbated when CO2 emissions are accompanied by NO emissions. (Wei Han et al., 2014)

Chang and Hsu, 2008 reported that the C / N ratio of organic material to be composted is a determining factor as it affects the microbial community and product quality in terms of stabilization and final nutrients available. Cumulative CO2 production and composting time proved to be linearly dependent on the initial C / N ratio (James I.ChangTin-En.Hsu, et.al., 2008)

Cuomo et al., 1995 investigated an efficient way to adjust the C / N ratio of algae-based raw material. This method involves mixing with a co-composting material (straw, manure) that has a high C / N ratio. (Cuomo V., et al., 1995)

Ahn et al., 2008 analyzed the moisture content of the material to be composted and concluded that this is a critical parameter.

The moisture content affects the microbial activity as well as the physical structure of the compost material. Therefore, it has a significant influence on the biodegradation of organic materials. (Ahn H.K. et. Al., 2008)

Rodriguez et al., 1995 reported that microbial activity is inhibited when the moisture content drops below 25%, and aeration may be restricted when the moisture content is greater than 70%. (Rodriguez, M.E., et al., 1995)

Temperature is an important variable during the composting process. For the elimination of pathogens, which do not form spores (Salmonella and E.coli), a temperature higher than 55 C is recommended during composting for a longer period. (Droffner, M.L., et al., 1995)

Vallini et al. 1993, indicated that algal biomass reaches a temperature of up to 50° C during the thermophilic phase of composting, this temperature favors microbial growth. (Vallini, G et al., 1993)

Algae as biofertilizer in agriculture

Seaweed is used on agricultural land as fertilizer, examples include brown and red algae used as organic fertilizer; they are richer in potassium, but poorer in nitrogen and phosphorus (Waaland, 1981). The algal compost is applied directly, both as a solid and as a concentrated extract of algae, this extract is distinguished by a high content of trace elements and growth regulators (especially cytokinins). (Neveen Abdel-Raouf et al., 2012)

Algae compost applied to crops of flowers, vegetables, fruits and other grains, had higher productivity yields, higher resistance to diseases and other pests, improved vigor, increased absorption, increased immunity against abiotic stresses and improved seed germination.

Algae extracts have been shown to contain several types of plant growth regulators, such as cytokinins, auxins and betaines, but even so there is no clear evidence that they are solely responsible for the observed improvements. (Christos Chatzissavvidis et.al, 2014)

Natural algae biofertilizers have demonstrated multiple benefits in the field of green agriculture. These fertilizers increase soil fertility, fix nitrogen in the soil and provide the effect of PGPR to crops. Teaching technologies to obtain algal biofertilizers for farmers can develop

the production of small-scale biofertilizers.

One of the advantages of algal fertilizers is the development of organic farming without the need for a large area for the production and efficient exploitation of marginal lands.

In other words, applications of algae biofertilizers will meet the needs of developing sustainable agriculture that has three important objectives: socio-economic equity, a healthy environment and economic profitability. (Theint Theint Win, 2018)

Based on this review in the literature, it could be concluded that the use of natural fertilizers only from algae or in combination with chemical fertilizers will contribute to improving the physicochemical properties of the soil and the efficient use of fertilizers applied to improve seed yield. The use of this renewable resource for agricultural and horticultural purposes could also benefit the whole community, as it could help reduce the use of chemical fertilizers and pesticides that can be hazardous to human health. (Izabela Michalak et al., 2013)

CONCLUSIONS:

In conclusion, algae composting is an appropriate and inexpensive method for handling and processing seaweed accumulated on the coast, thus preventing water eutrophication and environmental pollution.

Compared to chemical fertilizers, natural fertilizers obtained from seaweed do not pollute the soil or the environment. Chemical fertilizers often lead to the accumulation of a lot of phosphate and nitrogen in the soil, and this excess drains into the groundwater and surface water and affects water quality and causes the death of aquatic life.

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