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MONITORING OF A BOCASHI-TYPE FERTILIZER DURING THE PRODUCTION PROCESS

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Abstract: Bocashi is an organic fertilizer that increases microbial diversity and improves the physical and chemical properties of the soil. Quality control during production must guarantee adequate chemical and physical properties, as well as an adequate degree of stability and maturity. The objective of this work was to evaluate the variables of temperature, pH and electrical conductivity (EC) of bocashi during the production process. To fulfill this objective, bocashi was prepared according to the methodology proposed by Restrepo (2017) with some modifications and during the preparation period, the variables of pH, EC and temperature were measured. The results show that the final product (bocashi) had a pH of 7.0 ± 0.9, EC = 0.29 ± 0.2 ds/m, which are indicative of a mature bocashi that can be applied to the crop. Furthermore, regarding temperature, the maximum reached in the mixture was 63 ± 0.9 °C, a sufficient temperature for the elimination of pathogenic microorganisms. Finally, the bocashi reached a final temperature of 34 ± 0.3°C, indicating that the bocashi went from a thermophilic to a mesophilic phase. In the present work it is concluded that the bocashi type fertilizer was carried out in an adequate way, obtaining a quality fertilizer that can be incorporated into the soil and provide sufficient nutrients to the crop.

Keywords: Compost maturation, organic fertilizer, pH, electrical conductivity

INTRODUCTION

Bocashi is an organic fertilizer used by farmers as a soil improver, which increases microbial diversity, improves physical and chemical conditions, prevents soil diseases and provides nutrients for crop development (Ramos and Terry, 2014).

Some of the essential components for its formulation are: manure; ash; molasses; plant residues; lime and crushed or powdered charcoal (Ramos and Terry, 2014). This fertilizer can be made and used anywhere (Escobar, 2014), its chemical composition can vary according to its preparation, duration of the process, materials used and biological activity (Ramos and Terry, 2014). At the end of the process, a mature fertilizer is obtained which can be incorporated into the soil, providing nitrogen, phosphorus, potassium, calcium, iron and magnesium (Ramos and Terry, 2014).

Quality control during production must guarantee adequate chemical and physical properties, as well as an adequate degree of stability and maturity (Hemidat et al., 2018). In this sense, Sundberg and Jönsson (2008) comment that the variation in pH during composting is due to the formation of lactic acid and acetic acid that are present in high concentrations during the initial phase of composting (Sundberg et al., 2004) dependent on the oxygen level and temperature, such that at a higher oxygen concentration, a lower amount of these organic acids is produced, accompanied by an increase in pH (Sundberg and Jönsson, 2008). Regarding the temperature variable, it has been reported that the size of the pile, the ambient temperature, the initial C/N ratio of the mixture and the supply of oxygen affect the temperature of the mixture and therefore the decomposition rate. (Hemidat et al., 2018). Finally, electrical conductivity (EC) is related to crop yield (Carmo et al., 2016) since EC values greater than 4 ds/m in compost can cause a phytotoxic effect on crops (Francou et al, 2005). Due to the aforementioned, the objective of this work was to evaluate the variables of temperature, pH and electrical conductivity of bocashi during the production process.

MATERIALS AND METHODS

BOCASHI PREPARATION

The bocashi type fertilizer was prepared according to the methodology proposed by Restrepo (2017) with some modifications where the following inputs were used: 4 bags of manure, 3 bags of ground stubble, 1 bag of bran, 1 bag of ash, 2 kg of lime and 2 liters of molasses. The inputs were mixed until a homogeneous mixture was obtained, water was added until a humidity of between 50 - 60% was obtained, performing the fist test. Finally, it was stirred for a period of 15 days to control the temperature and to incorporate oxygen into the mixture.

MEASUREMENT OF VARIABLES

During the preparation period of the bocashi-type fertilizer, the variables of pH, temperature and electrical conductivity (EC) were measured at three points (center and ends) of the mixture. The pH was determined with a soil pH meter model PH05, the electrical conductivity with a HANNA soil electrical conductivity meter model HI98331, and the temperature using a thermometer. The data obtained were graphed using the Excel program and are presented as the mean ± standard deviation of the measurements recorded from the three points.

RESULTS AND DISCUSSION

During the preparation of the bocashi type fertilizer, monitoring of pH, EC and temperature was carried out because these variables can tell us if the fertilizer had a good fermentation process and if it can be considered a mature fertilizer, suitable for being applied to the soil.

Figure 1 shows the results corresponding to the pH during the bocashi preparation process. It can be seen that the pH value of the initial mixture was 6.50 ± 0.9 and this value decreased until day 5 (5.97 ± 0.5), subsequently, this value increased until reaching a value of 7.73 ± 0.8 on day 10 From day 11, a decrease in pH was observed until obtaining a final value of 7.0 ± 0.9.

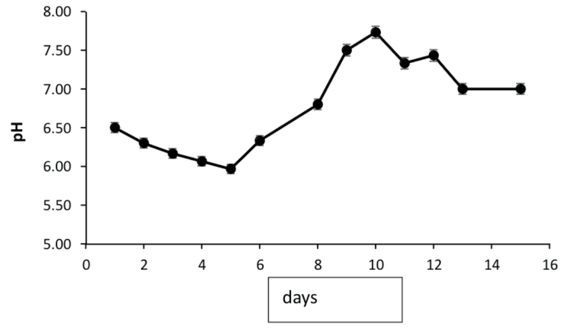

Figure 7. 1. Behavior of pH during the bocashi preparation period

The variation of the pH during the process depends mainly on the materials used and the phase or time in which the bocashi production process is located, however, Restrepo (1994) mention that the pH of the mixture must range between 7.8 to 8.8. On the other hand, Higa (2014) reports a pH value=8.5. Beck-Früis et al. (2001) reported a change in pH during the transition from the mesophilic phase (pH=4.5 – 5.5) to the thermophilic phase (pH= 8-9), this change in pH is due to the formation of organic acids such as acid acetic acid and lactic acid (Sundberg and Jönsson, 2008). In the present work, the final pH value obtained (7.0 ± 0.9) is an indication that good aeration was carried out in the mixture, thus favoring the proliferation of microorganisms, which participate in the decomposition of organic matter (Jordan and Pizarro, 2020).

In Figure 2, the EC results are presented where an increase can be observed on the second day from 1.42 ± 0.5 ds/m to 2.77 ± 0.3.ds/m. From the third day onwards, a decrease in EC is observed to a value of 0.29 ± 0.2 ds/m.

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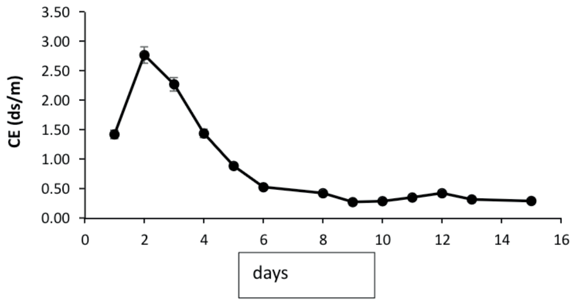

Figure 7. 2. Behavior of the EC during the bocashi preparation period.

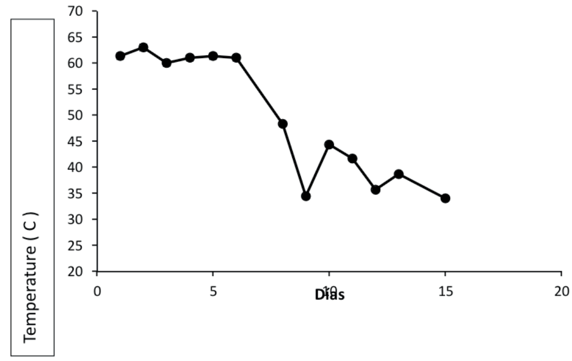

Figure 7. 3. Temperature behavior during the bocashi preparation period.

The classification of soils according to their EC value and according to Castellanos, 2000 is as follows: <1 Soils free of salts, 1-2 Soils very low in salts, 2-4 Moderately saline soils, 4-8 Saline soils, 8 -16 Highly saline soil and >16 Extremely saline soil. Ramos and Terry et al. (2014) found that high electrical conductivity was related to high potassium and sodium content, this was probably because this mixture contained potassium-rich organic matter. For their part, Campitelli et al. (2010) report an electrical conductivity of 3.3 dm/m. According to the results obtained and the final value obtained in the fertilizer, the bocashi prepared can be considered a fertilizer free of salts and with an EC adequate for the growth and development of the crop.

Figure 3 shows the temperature values over a period of 15 days. The results show that the temperature of the mixture remained stable from day one to six with an average value of 61.27°C. Subsequently, a decrease in temperature is observed to 34.43 ± 0.6°C on day nine, it increases to 44.33 ± 0.2°C on day 10 and finally decreases to a temperature of 34 ± 0.3°C

Rodríguez (1994) comments that fermentation begins during the first three days after preparation, reaching temperatures ranging from 45ºC to 55ºC until microbial activity is reduced as the humidity of the material decreases. According to the Ministry of Agriculture and Livestock (2011), the temperature can reach 70°C and 75°C. On the other hand, Restrepo (1994) mentions that the temperature of the mixture must not exceed 50°C for a good decomposition process to take place. In the present work, the maximum temperature reached was 63 ± 0.9 °C, which is lower than the value reported by the FAO and higher than that suggested by Restrepo in 1994.

Sundberg et al. (2004) report that the mesophilic phase where the degradation of organic matter occurs occurs at temperatures up to 40°C and that the thermophilic phase can take place at temperatures 45 – 70°C. According to the aforementioned, it is suggested that the thermophilic stage in bocashi occurred on days one to six, which ensures the destruction of pathogenic microorganisms and that from day 7 the mesophilic stage began (Miyatake and Iwabushi, 2005). Finally, it is concluded that the temperatures reached favored the fermentation process and the obtaining of a mature fertilizer.

CONCLUSION

The bocashi type fertilizer was made in an appropriate way since the pH, EC and temperature values indicate that during the process the fermentation process, proliferation of beneficial microorganisms and low salt content were favored, so it can be considered a free fertilizer. of salts and with an EC adequate for the growth and development of the crop.

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