Producing High Nitrogen Liquid Fertilizer for Fertigation Purposes

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Introduction

Figure (1): Meat and bone meal by products (Tankage). High nitrogen content (9.5%). Also good source of other nutrients.

Over 85% of our food in the pacific islands is imported, with stores having less than a 7-day supply at any given time (Leung and Loke, 2008). Improving food security includes ensuring a cost effective, stable source of agricultural inputs. Cost of imported N fertilizers increased from \$300 to \$1000 per ton between 2006 and 2008, and is expected to increase further (The Fertilizer Institute, 2010). The rising cost of imports increases the demand for locally produced organic fertilizers. Organic amendments release nutrients over a relatively long time compared to synthetic fertilizers. This slow release of nutrients protects the environment by reducing N leaching into ground water and builds soil fertility over longtime application (Ahmad et al., 2009). One drawback to solid organic amendments is that they may not meet the crops demand for nutrient at high demand stages (vegetative growth, flowering, and fruiting), due to the time needs to convert nutrients from organic to inorganic form (Hue and Liu, 1995; Gaskin, et al., 2011). Due to climate change and water scarcity on a worldwide scale, today it is more important than ever to use water resources wisely and to irrigate intelligently (United Nation, 2006). Fertigation is a highly recommended technique to apply both water and nutrient into crops at the same time and reduce water and nutrient losses (Bres, 2009). Producing soluble fertilizers benefits plants, soil, humans, and the environment, by improving soil fertility and crop growth, while reducing nutrient leaching into the groundwater (Lupin et al., 1996). Fertigation allows for uniform and proper application of nutrients within the wetted areas at the right time of crop need, in available form close to plants root (Imas, 1999). It's known that nutrient release from organic fertilizers are mainly due to biological and environmental factors (Shaviv and Mikkelsen, 1993). In addition, aerated (brewed) compost tea is proven to have higher nutrient availability and content (Ingham, 2005). Since maturity of different organic fertilizers varies with source and production condition (Hue and Liu, 1995). The goal of this study was to elucidate the processes (biology and chemistry) and other factors (covering, time, and temperature) on nitrogen release from tankage (meat and bone meal- by products).

Materials and Methods

Figure (2): The lab experiment setup. Showing 125 ml flask (covered and uncovered) contain 1 gram tankage and 50 ml deionized water. Each treatment was replicated 3 times.

Lab experiments were conducted to produce aqueous solutions from tankage (rendered meat (9.5% N), Island Commodities, Inc.). One gram of tankage was added to 50 ml of deionized water. The treatments were arranged in Complete Randomized Design (CRD) with 3 replicates (flasks). Different materials (treatments) were used to enhance NO_3-N and NH_4-N release, such as: baking soda, sugar, soil, and vermicompost. All materials were tested at room and oven temperature (75 and 95^o F, respectively). NO_3-N and NH_4-N concentration were measured at different time intervals (0, 4, 8, 24, and 48 hours). In the covering treatment, we used parafilm sheets to cover the sample containers. Samples were filtered using Fisher filter papers (size 2). Nitrate concentration was measured using a Vernier electrode (Vernier company). A calibration curve was established before reading the experiment samples.

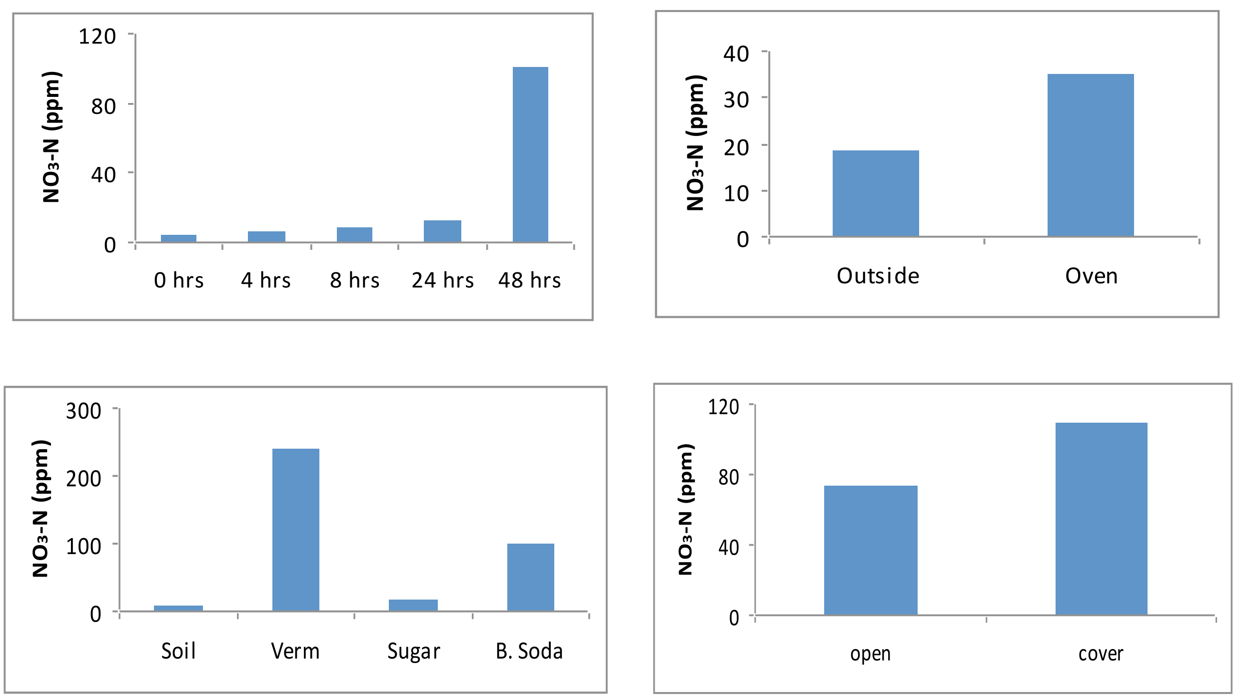

Figure 3: Nitrate release (ppm) from tankage under the effect of: A) Time; B) Lab and oven temperature; C) Different materials; and D) Open or covered conditions.

NOTE: Cover = Parafilm was used to cover each sample through out the test; Verm = Vermicompost; B.Soda = Baking Soda.

Results and Discussion

The statistical analysis of the results (ANOVA tables are not presented) showed that there was significant effects of time, temperature, covering, and the addition of vermicompost on NO3-N release from tankage. The results suggested that both biological and non-biological factors played significant roles in the N release from tankage. There was a significant increase in NO3-N concentration in the liquid fertilizer after 48 hours of initial mixing time (Fig. 3-A). Keeping the mix temperature around 950F increased significantly the NO3-N concentration in the solution (Fig. 3-B). Adding small amount of vermicompost (10% of the total tankage amount) increased significantly the NO3-N concentration in the soluble fertilizer (Fig. 3-C). That might be due to vermicompost enhancing the biological activities in the solutions and/or that vermicompost is rich with NO3-N as well. However, leaving the containers open (no covering) reduced the NO3-N concentration in the solution (Fig. 3-D).

Future Steps

Our goal is to evaluate the quality of the produced aqueous solutions on long-term and vegetable crops growth and yield, and soil fertility, especially under drip and mulching conditions for different Hawaiian soils.

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