MANIPULATING NITROGEN RELEASE FROM ORGANIC FERTILIZERS AS AFFECTED BY ORGANIC BIOLOGICAL WASTE IN SOIL

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ABSTRACT

The experiment was conducted at the Department of Soil Science Laboratory Room, College of Agriculture, Benguet State University, La Trinidad, Benguet from November 2006 to May 2007 to determine the effect of organic fertilizers as affected by organic biological waste in the release of nitrogen and some chemical properties of the soil.

The pH of the soil, organic matter content, available nitrogen content and nitrogen mineralized were all significantly affected by the different kinds and combinations of organic fertilizers and organic biological waste. The application of chicken manure with cabbage refuse or wild sunflower significantly resulted to the highest pH value, organic matter content, amount of available nitrogen and nitrogen mineralized during the six different incubation periods.

The pH, organic matter content and amount of available nitrogen in the soil was observed to exhibit an increase and then a decrease of values. The pH and organic matter content values continuously increase until the 5th, 7th, or 10th week and would then gradually decrease up to the end of the incubation period. Release of available nitrogen in the soil was significantly increasing until the end of the incubation period. The continuous increase suggests that applying different kinds of organic fertilizers supplemented with fresh organic biological wastes (OBW) is enough to satisfy the nitrogen requirement of crops for their growth and development. This is in particular with those that require large amount of nitrogen. Among those applied, chicken manure combined with cabbage refuse or wild sunflower are the best materials.

KEYWORDS: Nutrient release, organic fertilizer, organic biological waste

INTRODUCTION

Benguet province is predominantly an agriculture area. About 70 percent of its population depends on agriculture. Due to its conducive climate, various types of temperate vegetable crops are profitably grown and have become an important agricultural enterprise of most farmers in the province.

In an intensive tropical system involving vegetable production like that of the Benguet province, it is common for a number of crops to be grown each year on the same piece of land. This means that the nutrient supply of each crop is affected by the fertilizers which are applied to previous crops. Efficient use of fertilizers means matching the supply of nutrients with those required by crops, rather than managing the nutrients for separate successive crops. Vegetable production involves managing the nutrient supply and requirements of the total cropping system.

Intensive vegetable production is often characterized by an excessive use of N fertilizers, resulting in production of large volume of residues rich in mineral nitrogen at harvest. This will not only result to low crop quality but also ecological imbalance and higher losses of nitrogen in the environment. In view of this, vegetable production in Benguet presents a special fertilizer problem. Farmers use disproportionate amounts of fertilizers, much higher than what crops require.

Planning at farm level to maintain soil nutrient stocks, and avoiding either depletion or over fertilization and associated environmental damage is an important decision in maintaining farm level sustainability. At this level, alternative agricultural technologies, such as integrated nutrient management and various types of soil husbandry and other agricultural practices need to be assessed, and their impacts on the soil nutrient stocks and flows determined.

A possible alternative method to slow down mineral N concentration in soil is by manipulating N mineralization by simultaneously mixing organic fertilizers and off-farm organic biological waste (OBW) materials. The immobilized nitrogen can be made available through incorporating a new OBW material (herein referred to as remineralizer) to stimulate remineralization of nitrogen.

The aim of the study is to systematically screen the release of nitrogen from organic fertilizers as affected by different organic biological waste at a time when the crop N demand is low or to make it available when the crop demand for N is highly needed.

The prediction of the amount of mineralized N over time in soils assumes great importance relative to the following aspects: (1) allows the evalu-

ation of soil capacity to supply N to plants; (2) furnishes the basis for defining correctly the N rates for different crops; (3) developing appropriate fertilization strategies, which maintain or increase productivity while minimizing adverse N impacts on the environment.

The study was conducted to determine the potential organic biological waste (OBW) materials in stimulating nitrogen release from organic fertilizers and to determine the rate of available N release from organic fertilizers in the soil and some chemical properties in the soil.

MATERIALS AND METHODS

The different materials that were used in the study include soil, different organic materials (BSU compost, dried chicken manure, processed chicken manure (PCM), molasses, cabbage refuse and wild sunflower), PVC tubes (273 pieces), chemical reagents and other laboratory equipment required for soil analysis.

Media Preparation. The soil that was used in the incubation experiment was taken from the BSU Organic Farm. Soil samples were taken at the depth of 20 cm from different sites of the farm.

The soil samples were brought to the laboratory and were air dried to a moisture content of 15 percent. During sample preparation, all visible impurities (eg. Stones and roots) were removed. The soil was pulverized using the hand to maintain its natural aggregation and was not sieved.

Incubation of Soil. Soil samples were mixed thoroughly with different organic materials corresponding to the different treatments. The amount of chicken dung added was based from the farmers practice while the other organic materials were based from their respective recommended rate. The samples were placed in PVC tubes with a diameter of 5.08 cm and a length of 20.32 cm. Seven tubes were prepared for every replication of the treatment which corresponds with the number of sampling dates. Each of the tubes was filled with 400 grams of soil mixed with organic fertilizer plus the amount of organic biological wastes. After the tubes were filled up, distilled water was added to each tube to obtain a moisture content of 50 percent water filled pore space. The tubes were then covered with a single layer of cloth to minimize water loss. The tubes were incubated for 1, 3, 5, 7, 10 and 13 weeks at room temperature (200°C).

Destructive sampling was done for the analysis of released nitrogen. This was done by removing the tubes for each treatment at each sampling

date. Samples were taken at the start and at the 1st, 3rd, 5th, 7th, 10th and 13th weeks of incubation.

The different treatments were arranged following the Completely Randomized Design (CRD) replicated three times. The treatments were as follows:

T1 = Control

T2 = 15 tons/ha chicken manure

T3 = 15 tons/ha chicken manure + 3 tons/ha molasses

T4 = 15 tons/ha chicken manure + 36 tons/ha cabbage refuse

T5 = 15 tons/ha chicken manure + 20 tons/ha wild sunflower

T6 = 20 tons/ha BSU compost (animal manure+plant residues)

T7 = 20 tons/ha BSU compost + 3 tons/ha molasses

T8 = 20 tons/ha BSU compost + 36 tons/ha cabbage refuse

T9 = 20 tons/ha BSU compost + 20 tons/ha wild sunflower

T10 = 3 tons/ha PCM

T11 = 3 tons/ha PCM + 3 tons/ha molasses

T12 = 3 tons/ha PCM + 36 tons/ha cabbage refuse

T13 = 3 tons/ha PCM + 20 tons/ha wild sunflower

The following data were gathered on the 1st, 3rd, 5th,7th, 10th, 13th week of the incubation period.

1. **pH.** The pH was determined using the electrometric method with the use of pH meter.

2. **Percent organic matter content.** OM content was determined using the Walkey and Black method, using the formula:

$$\%OM = \frac{6.9\,(B-S)}{S}$$

Where:

B- ml of ferrous solution required for the blank
S- ml of ferrous solution required for the sample

3. **Available nitrogen content (ppm).** Ammonium nitrogen content and nitrate content were determined using the Steam Distillation method.

4. **N mineralized (ppm).** N mineralization was computed using this formula:

$$\frac{\text{N mineralized}}{\text{Ha 20 cm deep}} = \frac{\text{(A kg OM)}}{\text{(100 kg soil)}} \quad \frac{\text{(B kg soil)}}{\text{(Ha 20 cm deep)}} \quad \frac{\text{(C kg N)}}{\text{(100 kg OM)}} \quad \frac{\text{(D kg OM)}}{\text{(100 kg Om)}}$$

Data gathered were statistically analyzed using Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSIONS

Soil pH as Affected by the Different Organic Fertilizers Plus OBW

Table 1 shows the effect of organic fertilizer and organic biological waste (OBW) on the pH of the soil after several weeks of incubation. The pH of the soil showed significant differences among the different treatments as affected by the kinds and combinations of organic fertilizers and OBW at different incubation periods. It was observed that majority of the treatments showed a continuous increase of pH from the start of the incubation until the 7th week. However, from the 7th or 10th week until the end of the incubation period (13th week) a decrease of pH was observed. The decrease of pH was not significantly different from the highest pH value. The increase of pH could be due to the capacity of the organic fertilizer to stabilize pH. Also, organic matter buffers soil pH by the release of basic ions from organic complexes from which which they are held with varying degrees in strength (Brady and Weil, 2002). The decrease in pH may be attributed to the release of organic acids during the decomposition (Guidi and Hall, 1984 as cited by Mustafa Kemal University, Undated). Also, accumulated organic matter tends to acidify the soil; it is a source of H+ ions because it contains numerous acid functional groups which these ions can dissociate leaving behind an increasing number of negatively charged sites on the molecule (Brady and Weil, 1996).

After a week of incubation, among soils applied with chicken manure, the addition of wild sunflower resulted to the highest pH value. Highest pH value was observed among the soils fertilized with BSU compost where cab-

bage refuse was applied. Among the soils applied with siglat, the addition of cabbage refuse and wild sunflower resulted to the highest pH value. Soils applied with chicken manure and wild sunflower had the highest pH value among all the treatments.

Table 1. Soil pH as affected by the different organic fertilizers plus OBW

TREATMENT	1ST	3RD	5TH	7TH	10TH	13TH
T_1	5.2^{f}	5.23^{f}	5.3^{d}	5.33^{d}	5.3^{c}	5.3^{f}
T_2	5.5^{ab}	5.47^{abc}	5.53^{b}	5.63^{bc}	5.67^{bc}	5.57^{cde}
T_3	5.47^{abc}	5.5^{ab}	5.6^{ab}	5.67^{bc}	5.63^{bcd}	5.6^{cd}
T_4	5.5^{ab}	5.57^{a}	5.7^{a}	5.87^{a}	5.83^{a}	5.77^{a}
T_5	5.53^{a}	5.53^{a}	5.67^{a}	5.87^{a}	5.83^{a}	5.73^{ab}
T_6	5.36^{cde}	5.37^{cde}	5.47^{bc}	5.6^{bc}	5.53^{d}	5.5^{de}
T_7	5.4^{bcd}	5.47^{abc}	5.5^{b}	5.57^{c}	5.57^{cd}	5.47^{e}
T_8	5.43^{abc}	5.5^{ab}	5.6^{ab}	5.73^{ab}	5.7^{b}	5.6^{cd}
T_9	5.4^{bcd}	5.4^{bcd}	5.53^{b}	5.7^{bc}	5.67^{bc}	5.63^{bc}
T_{10}	5.26^{ef}	5.27^{ef}	5.33^{d}	5.37^{d}	5.37^{e}	5.33^{f}
T_{11}	5.23^{f}	5.3^{def}	5.37^{cd}	5.37^{d}	5.33^{e}	5.33^{f}
T_{12}	5.3^{def}	5.33^{def}	5.33^{d}	5.63^{bc}	5.6^{bcd}	5.5^{de}
T_{13}	5.3^{def}	5.33^{def}	5.37^{cd}	5.6^{bc}	5.53^{d}	5.47^{e}

[1]Means within a column with the same letter are not significantly different at 5% level by DMRT

On the third week, soils fertilized with chicken manure and BSU compost added with cabbage refuse obtained the highest pH value. However, comparing all the treatments, it was observed that soils incorporated with chicken manure and cabbage refuse resulted to the highest pH value. On the 5th week, soils fertilized with chicken manure and BSU compost showed similar results as with the 3rd week of incubation. Among the soils applied with siglat, the addition of wild sunflower resulted to the highest pH value.

During the 7th week, the addition of cabbage refuse and wild sunflower both resulted to the highest pH value among the soils fertilized with chicken manure and the rest of the organic fertilizer treatments. Addition of cabbage refuse alone resulted to the highest pH value among the soils applied with BSU compost and PCM.

At the end of the incubation period, among the soils applied with chicken manure the addition of cabbage refuse had the highest pH value. The same observation is also true for soils fertilized with PCM. The addition of sunflower resulted to the highest pH value among the soils fertilized with BSU compost.

Comparing all treatments, the combination of chicken manure and cabbage refuse obtained the highest pH value among all the treatments but was not significantly different from soils added with chicken manure and wild sunflower.

Soil pH as Affected by the Different Incubation Periods

Table 2 shows the soil pH as affected by the different incubation periods. Among the different treatments, adding cabbage refuse and sunflower to chicken manure resulted to the highest soil pH at the end of the incubation period. On the other hand, those that were applied with siglat alone or in combination with molasses had the lowest pH value of 5.33.

Soils applied with chicken manure and molasses showed that there was a continuous increase in soil pH until the 7th week, stabilized up to the 10th week and then decreased until the end of the incubation period. Greatest increase of pH value was observed between the 3rd and 5th week. On the other hand, the addition of cabbage refuse to chicken manure also increased the soil pH until the 7th week. Greatest increase was observed between the 5th and 7th week. Soils incorporated with chicken manure and sunflower showed no increase on the 1st and 3rd week of incubation and thereafter increased until the 7th week afterwhich decreased on the 13th week.

A continuous increase until the 7th week was observed on soils applied with BSU compost and molasses. The pH value did not change in the 7th until the 10th week, but at the end of the incubation period, the pH value eventually decreased. Soil pH from the BSU compost + cabbage refuse also increased until the 7th week then decreased until the 13th week. The greatest increase was observed between the 5th and 7th week. Similar results were observed among soils applied with BSU compost and sunflower, however, no increase was observed during the 1st up to the 3rd week.

Soils applied with siglat and sunflower also exhibited a continuous increase in pH until the 7th week then decreased until the end of the incubation, soils applied with PCM and cabbage refuse showed slight increase until the 3rd week, no increase was seen during the 3rd up to the 5th week, the pH value decreased after the after the 7th week.

Table 2. *Soil pH as affected by the different incubation periods*

INCUBATION DURATIONS	TREATMENTS												
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	T_{13}
1st week	5.20^{a}	5.50^{c}	5.47^{d}	5.50^{e}	5.53^{e}	5.37^{e}	5.40^{b}	5.43^{c}	5.40^{e}	5.27^{a}	5.23^{c}	5.30^{d}	5.30^{d}
3rd week	5.23^{a}	5.47^{c}	5.50^{d}	5.57^{de}	5.53^{e}	5.37^{e}	5.47^{ab}	5.50^{bc}	5.40^{e}	5.27^{a}	5.30^{ab}	5.33^{d}	5.33^{d}
5th week	5.30^{a}	5.53^{bc}	5.60^{abc}	5.70^{abcd}	5.67^{d}	5.47^{bcd}	5.50^{ab}	5.60^{ab}	5.53^{bcd}	5.33^{a}	5.37^{a}	5.33^{d}	5.37^{cd}
7th week	5.33^{a}	5.63^{ab}	5.67^{a}	5.87^{e}	5.87^{a}	5.60^{a}	5.57^{a}	5.73^{a}	5.70^{a}	5.37^{a}	5.37^{a}	5.63^{a}	5.60^{a}
10th week	5.30^{a}	5.67^{a}	5.63^{ab}	5.83^{ab}	5.83^{ab}	5.53^{ab}	5.57^{a}	5.70^{a}	5.67^{ab}	5.37^{a}	5.33^{ab}	5.60^{ab}	5.53^{ab}
13th week	5.30^{a}	5.57^{abc}	5.60^{abc}	5.77^{abc}	5.73^{bc}	5.50^{abc}	5.47^{ab}	5.60^{ab}	5.63^{abc}	5.33^{a}	5.33^{ab}	5.50^{abc}	5.47^{bc}

[1]Means within a column having the same letter are not significantly different at 5% DMRT

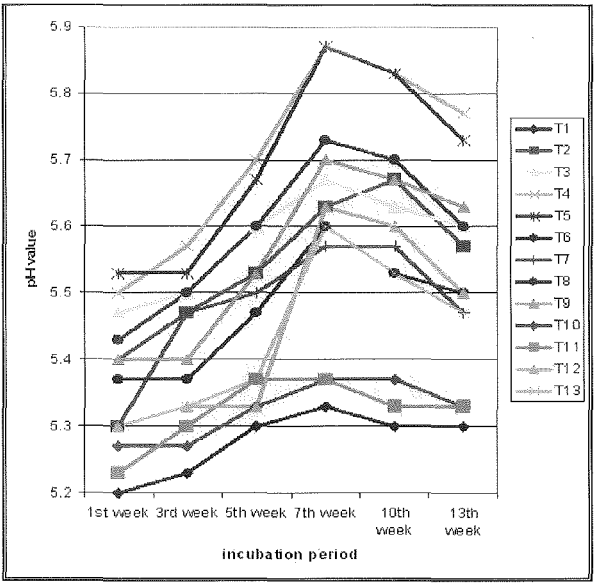

Figure1. *Soil pH as affected by the different incubation periods*

OM Content of the Soil as Affected by the Different Organic Fertilizers Plus OBW

Table 3 shows the organic matter content of the soil as affected by the different organic fertilizers and organic biological waste. Significant differences were observed on the organic matter content of the soil as affected by the different organic fertilizers and different organic biological waste. The result shows that there was a significant increase or decrease on the organic matter content of the soil after organic biological wastes were added on soils that were fertilized with organic fertilizer. this increase in organic matter corroborates Donahue and Follet (1981) who stated that heavy addition of manure or organic waste restore organic matter in the soil, while the decrease of OM is due to the mineralization of humus in the soil (Murakami, 1991).

After a week of incubation, among soils applied with chicken manure

in combination with cabbage refuse had the highest increase among the other treatments. Soils added with molasses had the highest increase in soil organic matter among the other soils fertilized with BSU compost, which also showed an increase in OM except for the soils added with wild sunflower which showed a decrease in OM content. Only the soils applied with pure siglat showed an increase in OM. the soils added with cabbage refuse did not show any increase, while those added with molasses and wild sunflower showed a decrease of OM. comparing all the treatments, application of chicken manure and cabbage refuse but did not significantly differ from other soils fertilized with chicken manure.

Table 3. *OM content of the soil as affected by the different organic fertilizers plus OBW (%)*

TREATMENT	1ST	3RD	5TH	7TH	10TH	13TH
T_1	2.34^{d}	2.37^{d}	2.39^{e}	2.47^{f}	2.33^{f}	2.37^{h}
T_2	2.92^{a}	2.93^{b}	2.92^{bcd}	2.96^{d}	2.93^{d}	2.93^{abc}
T_3	2.89^{ab}	2.90^{b}	2.67^{de}	3.01^{cd}	2.91^{dc}	2.83^{bcd}
T_4	2.97^{a}	3.10^{a}	3.32^{a}	3.22^{a}	3.08^{a}	3.04^{a}
T_5	2.83^{abc}	3.00^{ab}	3.22^{ab}	3.19^{ab}	3.00^{ab}	2.97^{ab}
T_6	2.73^{c}	2.76^{c}	2.76^{cd}	2.79^{e}	2.85^{e}	2.80^{bcde}
T_7	2.77^{bc}	2.73^{c}	2.79^{cd}	2.79^{e}	2.75^{e}	2.77^{cde}
T_8	2.74^{c}	2.95^{b}	3.14^{ab}	3.13^{abc}	2.89^{abc}	2.89^{abcd}
T_9	2.71^{c}	2.76^{c}	3.04^{abc}	3.08^{bcd}	2.79^{bcd}	2.74^{def}
T_{10}	2.48^{d}	2.47^{d}	2.44^{e}	2.51^{f}	2.52^{f}	2.53^{g}
T_{11}	2.39^{d}	2.44^{d}	2.44^{e}	2.42^{f}	2.48^{f}	2.57^{g}
T_{12}	2.46^{d}	2.64^{c}	2.77^{cd}	2.76^{e}	2.64^{e}	2.65^{efg}
T_{13}	2.41^{d}	2.67^{c}	2.67^{de}	2.74^{e}	2.65^{e}	2.59^{fg}

[1]Means within a column with the same letter are not significantly different at 5% level by DMRT

On the third week of incubation, soils added with cabbage refuse still had the highest OM content and soils added with molasses the lowest among the treatments applied with chicken manure. However, the additon of cabbage refuse did not significantly differ from soils added with wild sunflower. Among the soils fertilized with BSU compost, the addition of cabbage refuse significantly resulted to the highest OM content while soils added with molasses the lowest. Soils added with wild sunflower had the highest OM among the soils fertilized with PCM but was not significantly different from soils added with cabbage refuse. Among all the treatments, soils fertilized with chicken manure + cabbage refuse still had the highest OM content.

Among the soils applied with chicken manure, adding cabbage refuse resulted to the highest soil OM content after five weeks of incubation, but was not significantly different from soils added with wild sunflower. This is also true for the soils fertilized with BSU compost. On the other hand, among the treatments fertilized with siglat, the soils added with wild sunflower had highest OM content but was not significantly different from soils added with cabbage refuse. Among all the treatments soils fertilized with chicken manure and cabbage refuse still had the highest OM content.

During the 7th week of incubation, results of treatments fertilized with chicken manure and BSU compost were similar from the results on the 5th week of incubation. On the other hand, among the treatments applied with siglat, soils added with cabbage refuse had the highest OM content but was not significantly different from those added with wild sunflower. Comparing all the treatments, the combination of chicken manure and cabbage refuse had the highest OM content.

On the 10th week of incubation, among the treatments applied with chicken manure, soils added with cabbage refuse had the highest OM content but significantly different from soils added with wild sunflower. This is also true for the treatments applied with BSU compost and PCM. Chicken manure combined with cabbage refuse had the highest OM content among all the other treatments.

Similar results were observed at the end of the incubation period (13th week). Results show that, among all the treatments, organic matter has the highest value when cabbage refuse was added to soil applied with chicken manure. This corroborates with Inoko (1984) who stated that farm manures tend to enrich soil organic matter content.

OM Content of the Soil as Affected by the Different Incubation Periods

Table 4 shows the effect of the incubation periods on the organic matter content of the soil. Among the soils fertilized with chicken manure, BSU compost and PCM, only two of each were significant, that is, the application of chicken manure and cabbage refuse had shown a continuous increase in organic matter content from the start of the incubation period until the 5th week then the value decreased until the end of the incubation period. The greatest increase in organic matter content was observed between the 3rd and 5th week. OM content of soils during the different incubation period was significantly different. The pattern of increase and decrease of organic matter content is also the same for soils applied with chicken manure and wild sunflower.

Table 4. *OM content of the soil as affected by the different incubation periods (%)*

INCUBATION DURATIONS	TREATMENTS												
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	T_{13}
1st week	2.34^{a}	2.92^{a}	2.89^{a}	2.97^{cde}	2.83^{c}	2.73^{a}	2.77^{a}	2.74^{e}	2.71^{c}	2.48^{a}	2.39^{b}	2.46^{e}	2.41^{e}
3rd week	2.37^{a}	2.93^{a}	2.90^{a}	3.10^{bc}	3.00^{c}	2.73^{a}	2.73^{a}	2.95^{cd}	2.76^{c}	2.47^{a}	2.44^{b}	2.64^{abcd}	2.67^{ab}
5th week	2.39^{a}	2.92^{a}	2.67^{a}	3.32^{a}	3.22^{a}	2.79^{a}	2.79^{a}	3.14^{a}	3.04^{ab}	2.44^{a}	2.44^{b}	2.77^{a}	2.67^{ab}
7th week	2.41^{a}	2.96^{a}	3.01^{a}	3.22^{ab}	3.19^{ab}	2.79^{a}	2.79^{a}	3.13^{ab}	3.08^{a}	2.51^{a}	2.42^{b}	2.76^{ab}	2.74^{a}
10th week	2.33^{a}	2.93^{a}	3.01^{a}	3.08^{abc}	3.00^{c}	2.75^{a}	2.75^{a}	3.04^{abc}	2.79^{c}	2.52^{a}	2.78^{ab}	2.64^{abcd}	2.65^{bc}
13th week	2.37^{a}	2.93^{a}	2.83^{a}	2.89^{e}	3.19^{ab}	2.77^{a}	2.77^{a}	2.89^{cde}	2.74^{c}	2.53^{a}	2.57^{a}	2.65^{abc}	2.59^{bcd}

[1]Means within a column having the same letter are not significantly different at 5% DMRT

The combination of BSU compost and cabbage refuse significantly increased OM content of the soil until the 5th week then decreased until the end of the incubation period. The highest increase was observed from the 1st week up to the 3rd week. Using wild sunflower instead of cabbage refuse as the an organic biological waste, organic matter content continuously increased until the 7th week then decreased, the greatest increase in OM value occurred during the 3rd week until the 5th week.

Soils applied with PCM+cabbage refuse did not increase in soil organic matter content until after a week of incubation while increase in organic matter content stopped on the 5th week then decreased. Based on the initial data of the soils fertilized with PCM, a decrease in organic matter content was observed after a week of incubation on the soils applied with siglat and wild sunflower. The OM content however increased on the 3rd week and maintained it until the 5th week. It continued to increase until the 7th week then decreased until the end of the incubation period. Both treatments applied with PCM had the greatest increase in organic matter value during the 1st up to the 3rd week.

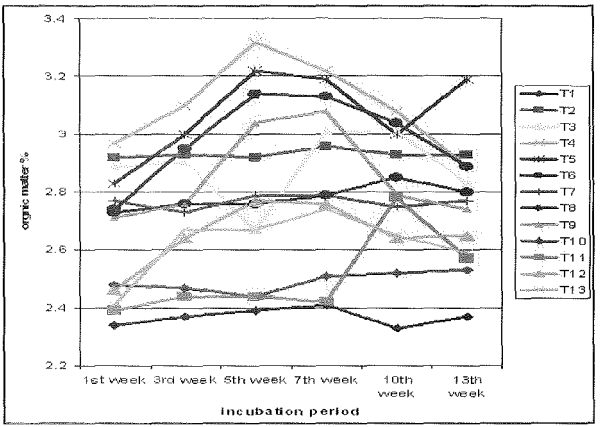

Figure 2. *Organic matter content of the soil as affected by incubation period*

The results show that among all treatments, highest organic matter as influenced by the addition of organic biological wastes in organic fertilizers were observed from the 5th to 10th week of incubation. This coincides with the vegetative growth of plants where nutrient demand is at highest.

Available Nitrogen Content of the Soil as Affected by the Different Organic Fertilizers Plus OBW

Data show that there are significant differences among the soils applied with different organic fertilizers and organic biological waste (Table 5). After a week of incubation, among the soils applied with chicken manure, the addition of wild sunflower had the highest amount of available nitrogen. However it was not significantly different from soils incorporated with the other organic biological wastes except for soils fertilized with pure chicken manure. Comparing the soils applied with BSU compost, soils added with wild sunflower had the highest amount of available nitrogen but did not significantly differ from other soils applied with BSU compost also. Among the soils applied with PCM, the addition of wild sunflower resulted to the highest amount of available nitrogen. It was not significantly different from soils added with other organic biological waste except for soils applied with pure PCM. Comparing all the soils with different treatments, result shows that soils applied with chicken manure combined with wild sunflower obtained the highest amount of available N.

Table 5. *Available N content of the soil as affected by the different organic fertilizers plus OBW (ppm)*

TREATMENT	1ST	3RD	5TH	7TH	10TH	13TH
T_1	66.46^{f}	72.62^{d}	79.76^{g}	84.52^{f}	80.95^{e}	76.19^{e}
T_2	86.9^{bcde}	122.62^{bc}	143.71^{cd}	145.24^{cd}	197.62^{bc}	217.86^{c}
T_3	105.94^{a}	126.19^{b}	146.43^{bcd}	158.34^{c}	204.76^{b}	219.05^{c}
T_4	108.33^{a}	138.09^{ab}	182.14^{a}	230.95^{a}	253.57^{a}	310.71^{a}
T_5	110.72^{a}	148.81^{a}	183.33^{a}	225^{a}	225.95^{a}	307.14^{a}
T_6	94.05^{abcd}	109.52^{c}	111.90^{ef}	124.99^{c}	179.76^{c}	208.33^{c}
T_7	97.62^{abc}	108.33^{c}	127.38^{de}	132.14^{de}	182.14^{c}	203.57^{c}
T_8	96.43^{abc}	138.09^{ab}	169.05^{ab}	217.87^{a}	251.19^{a}	296.43^{a}
T_9	100^{ab}	133.33^{ab}	153.57^{bc}	217.86^{a}	247.48^{a}	291.66^{a}
T_{10}	76.19^{ef}	82.14^{d}	86.91^{g}	94.05^{f}	140.47^{d}	170.24^{d}
T_{11}	77.38^{def}	75^{d}	94.06^{fg}	98.81^{f}	139.28^{d}	170.24^{d}
T_{12}	77.38^{def}	110.71^{c}	127.38^{de}	190.47^{b}	208.33^{b}	263.1^{b}
T_{13}	80.95^{def}	109.52^{c}	128.57^{de}	194.15^{b}	198.81^{bc}	252.38^{b}

[1]Means within a column with the same letter are not significantly different at 5% level by DMRT

On the 3rd week of incubation, among soils applied with chicken manure, addition of wild sunflower had the highest available nitrogen but was not significantly different from soils added with cabbage refuse. Among the

soils applied with BSU compost, the addition of cabbage refuse obtained the highest amount of available nitrogen but not significantly different from soils applied with wild sunflower. Similar results were observed on soils applied with siglat. Comparing all the different treatments, soils applied with chicken manure combined with wild sunflower obtained the highest amount of available nitrogen.

Similar results were observed among soils applied with chicken manure and BSU compost on the 5th week. Among soils applied with PCM, addition of wild sunflower resulted to the highest amount of available nitrogen but was not significantly different from soils added with cabbage refuse. Comparing all the treatments, soils fertilized with chicken manure added with wild sunflower obtained the highest available N content.

On the 7th week, comparing all the soils incorporated with chicken manure, soils added with cabbage refuse had the highest amount of available nitrogen. Results are also true for soils fertilized with BSU compost. Among the soils applied with PCM, addition of wild sunflower resulted to the highest amount of available N which was not significantly different from soils added with cabbage refuse. Comparing all the treatments soils fertilized with chicken manure and cabbage refuse obtained the highest available N content.

During the 10th week, soils fertilized with chicken manure, BSU compost and siglat all showed that the addition of cabbage refuse resulted to the highest available N content but was not significantly different from soils added with wild sunflower. Among all the treatments, chicken manure combined with cabbage refuse obtained the highest amount. Results are also true for soils incubated until the end of the incubation period.

Soils fertilized with chicken manure and BSU compost alone showed higher amounts of available N than soils fertilized with PCM. This corroborates with the report of Brady (1990) that animal manure is a good source of nitrogen and is the best material for maintaining the nitrogen content of the soil. Cox and Jackson (1960) also found out that manure hasten the decomposition process in soil because it contains many organism. Americana Corporation (1973) stated that chicken manure when fully decomposed supply high amounts of N. Addition of wild sunflower and cabbage refuse enhanced the release of nitrogen because of its chemical components. High amounts of available N on soils treated with cabbage refuse could be due to its high water content that may have a beneficial effect on the soil decomposers.

The findings further indicates that among the OBW that were added cabbage or sunflower were found to enhance the release of nitrogen from the organic fertilizers that were applied.

Available Nitrogen Content of the Soil as Affected by the Different Incubation Periods

Table 6 shows how available N is affected by time resulting to a significant increase of available N in the soil. Pranes (1986) claimed that OM is the principal source of nitrogen. Increase in N could be due to the decomposition of OM and the eventual release of N.

Soils applied with pure chicken manure showed a continuous increase in N content until the end of the incubation period. Greatest increase in N was observed between the 7th and 10th week. This is also true for the soils applied with chicken manure+ molasses however, no increase in N was observed between the 3rd and 5th week and that there was a decrease in N between the 10th and 13th week. The greatest increase in available N was observed during the 10th until the 13th week. Among soils applied with chicken manure and cabbage refuse. Similar increase during 10th until the 13th week was observed on the soils applied with chicken manure and wild sunflower.

Greatest N increase was observed during 7th and 10th week on soils applied with pure BSU compost. This is also true for soils applied with BSU compost and molasses. Soils applied with BSU compost and cabbage refuse showed the greatest increase between the 5th and 7th week, which is also true for soils applied with BSU compost and wild sunflower.

Greatest increase in N was observed between the 7th and 10th week among soils applied with pure siglat. This is also true for soils applied with siglat and molasses, however, a decrease was observed between the 1st and 3rd week. Soils applied with siglat combined with cabbage refuse and wild sunflower both resulted to having the highest increase between the 5th and 7th week.

The results show that there was gradual release of N from organic fertilizer as influenced by adding OBW from the 1st week until the 13th week. This means that plants are continually supplied with N through out its growth and reproductive stages. It was observed further that the highest amounts of N were obtained during the 13th week, which already coincides with the maturity of most annual crops. This means that there will be high residual N after cropping, which could either be utilized for the next crop, or could be lost through leaching, if soil conditions favor nitrification of NH4 – nitrogen.

Table 6. *Available nitrogen content of the soil as affected by the different incubation periods (ppm)*

INCUBATION DURATIONS	TREATMENTS												
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	T_{13}
1st week	66.46^{a}	86.90^{e}	105.94^{d}	108.33^{f}	110.72^{f}	94.05^{e}	97.62^{d}	96.43^{f}	100.00^{f}	76.19^{d}	77.38^{c}	77.38^{d}	80.95^{d}
3rd week	72.62^{a}	122.62^{cde}	126.19^{c}	138.09^{e}	148.81^{e}	109.52^{d}	108.33^{d}	138.09^{e}	133.33^{e}	82.14^{cd}	75^{c}	110.71^{c}	109.52^{c}
5th week	72.62^{a}	143.71^{bcd}	146.43^{c}	182.14^{d}	183.33^{d}	111.90^{de}	127.38^{c}	169.05^{d}	153.57^{d}	86.91^{cd}	94.06^{c}	127.38^{c}	128.57^{c}
7th week	84.52^{a}	145.24^{bc}	158.34^{b}	230.95^{c}	225^{c}	124.99^{c}	132.14^{c}	217.87^{c}	217.86^{c}	94.05^{c}	98.81^{c}	190.47^{b}	194.05^{b}
10th week	80.95^{a}	197.62^{ab}	204.76^{a}	253.57^{b}	225.95^{b}	79.76^{b}	182.14^{b}	251.19^{b}	247.48^{b}	140.47^{b}	139.28^{b}	208.33^{b}	198.81^{b}
13th week	76.19^{a}	217.86^{a}	219.05^{a}	310.71^{a}	307.14^{a}	208.33^{a}	203.57^{a}	296.43^{a}	291.66^{a}	170.24^{a}	170.24^{a}	263.1	252.83^{a}

[1]Means within a column having the same letter are not significantly different at 5% DMRT

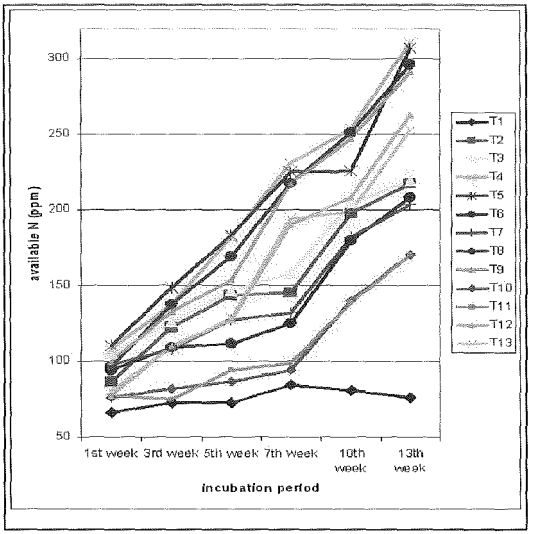

Figure 3. *Available nitrogen content of the soil as affected by the different incubation periods*

Mineralized Nitrogen in the Soil as Affected by the Different Organic Fertilizers Plus OBW

After a week of incubation, among soils applied with chicken manure, addition of cabbage refuse resulted to the highest amount of nitrogen mineralized (Table 7). However, it was not significantly different from the other treatments applied with chicken manure except soils added with wild sunflower. Among soils fertilized with BSU compost, addition of molasses obtained the highest N mineralized but was not significantly different from other soils. Soils that were applied with pure siglat obtained the highest amount of nitrogen mineralized.

On the 3rd week, the addition of cabbage refuse on soils fertilized with chicken manure and BSU compost obtained the highest amount of mineralized nitrogen. On the other hand, soils added with wild sunflower resulted to

the highest mineralized N among the soils incorporated with PCM.

Table 7. *Mineralized nitrogen in the soil as affected by the different organic fertilizers plus OBW (ppm)*

TREATMENT	1ST	3RD	5TH	7TH	10TH	13TH
T_1	129.37^{e}	131.03^{f}	131.77^{e}	132.87^{g}	128.82^{g}	130.66^{e}
T_2	250.72^{ab}	241.83^{bc}	251.00^{b}	253.16^{b}	251.54^{b}	251.83^{ab}
T_3	248.14^{ab}	248.68^{ab}	228.93^{bc}	258.41^{b}	249.82^{b}	242.95^{b}
T_4	254.69^{a}	266.13^{a}	285.02a	276.72^{a}	264.13^{a}	261.27^{a}
T_5	243.27^{b}	229.79^{bc}	276.72^{a}	247.14^{a}	257.55^{ab}	254.69^{ab}
T_6	203.46^{c}	205.70^{d}	205.95^{c}	208.18^{d}	212.16^{cd}	208.88^{c}
T_7	206.45^{c}	203.22^{d}	207.93^{c}	207.94^{d}	204.95^{d}	206.45^{c}
T_8	204.21^{c}	219.61^{cd}	234.27^{b}	236.19^{c}	215.39^{c}	215.39^{c}
T_9	201.97^{c}	205.45^{d}	226.82^{bc}	229.30^{c}	207.94^{cd}	204.27^{c}
T_{10}	150.08^{d}	149.48^{ef}	147.46^{de}	151.70^{f}	152.30^{ef}	152.91^{d}
T_{11}	144.84^{d}	147.46^{ef}	147.66^{de}	146.65^{f}	149.88^{f}	155.53^{d}
T_{12}	148.87^{d}	159.76^{e}	167.63^{d}	167.23^{e}	159.76^{e}	160.37^{d}
T_{13}	146.05^{d}	161.58^{e}	161.58^{d}	165.81^{e}	160.37^{e}	156.74^{d}

[1]*Means within a column with the same letter are not significantly different at 5% level by DMRT.*

The addition of cabbage refuse on soils fertilized with Chicken manure, BSU compost and PCM resulted to the highest amount of mineralized nitrogen during the 5th week. Same results were observed on the 7th, 10th and 13th week. However, on the 10th week, it was observed that the addition of wild sunflower among soils incorporated with siglat obtained the highest amount of mineralized N.

Comparing all the treatments, the addition of cabbage refuse and wild sunflower in chicken manure, BSU compost and PCM enhanced the amount of mineralized nitrogen. The result of the study suggests that in order for organic fertilizers to provide crops the needed nitrogen during its critical growth stage, cabbage refuse and wild sunflower could be added when organic fertilizers will be applied before planting.

Mineralized Nitrogen in the Soil as Affected by the Different Incubation Periods

Table 8 shows the amount of mineralized nitrogen on the soil as affected by the different incubation period. Soils incorporated with cabbage refuse and wild sunflower combined with the different organic fertilizers were

Table 8. Nitrogen mineralized in the soil as affected by the different incubation periods (ppm)

INCUBATION DURATIONS	TREATMENTS												
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	T_{13}
1st week	129.37^{a}	250.72^{a}	248.14^{a}	254.69^{c}	243.87^{ab}	203.46^{a}	206.45^{a}	204.21^{c}	201.97^{b}	150.08^{a}	144.84^{b}	148.87^{b}	146.05^{c}
3rd week	131.03^{A}	241.83^{a}	248.68^{a}	266.13^{bc}	229.79^{b}	205.70^{A}	203.22^{a}	219.61^{b}	205.45^{b}	149.48^{a}	147.46^{b}	159.76^{a}	161.58^{ab}
5th week	131.77^{a}	251^{a}	228.93^{a}	285.02^{a}	276.72^{a}	205.95^{a}	207.93^{a}	234.27^{a}	226.82^{a}	147.46^{a}	147.66^{b}	167.63^{a}	161.58^{ab}
7th week	132.87^{a}	253.16^{a}	258.41^{a}	276.72^{ab}	274.14^{A}	208.18^{a}	207.94^{a}	236.19^{a}	229.30^{a}	151.70^{A}	146.65^{b}	167.23^{a}	165.81^{a}
10th week	128.82^{a}	251.54^{a}	249.82^{a}	264.13^{bc}	257.55^{ab}	212.16^{a}	204.95^{A}	215.39^{bc}	207.94^{b}	152.30^{a}	149.88^{ab}	159.76^{a}	160.37^{ab}
13th week	130.66^{a}	251.83^{a}	242.95^{a}	261.27^{c}	254.69^{ab}	208.88^{a}	206.45^{a}	215.39^{bc}	204.21^{b}	152.91^{a}	155.53^{a}	160.37^{a}	156.74^{b}

[1]Means within ta column having the same letter are not significantly different at 5% DMRT.

the only treatments found to be significant.

Soils applied with chicken manure+cabbage refuse showed an increase of the amount of nitrogen mineralized until the 5th week then decreased. Greatest increase was observed between the 3rd and 5th week. The combination of chicken manure and wild sunflower only showed an increase during the 3rd and 5th week, the rest of incubation periods displayed a decrease on the amount of mineralized nitrogen.

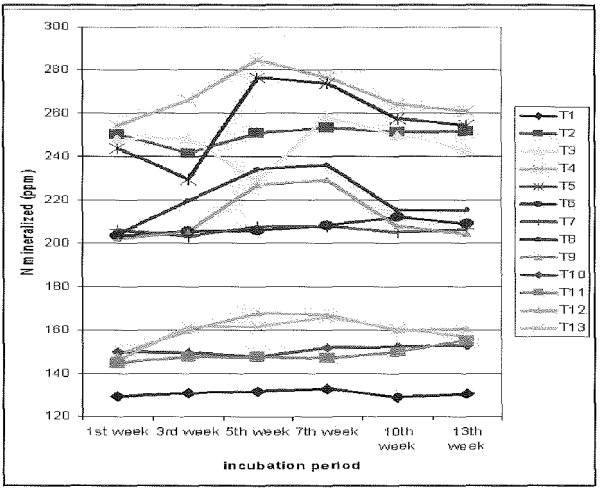

Figure 4. *Nitrogen mineralized in the soil as affected by different incubation periods*

The increase of mineralized nitrogen was greatest between the 1st week and 3rd week among soils applied with BSU compost+cabbage refuse. It was observed that between the 7th and 10th week, there was a decrease on the amount of mineralized nitrogen while in between the 10th week and 13th week, that there was no change in the amount of N mineralized. Treatments with BSU compost combined with wild sunflower showed an increase in the amount of mineralized N until the 7th week then a decrease was observed from the 7th week until the end of the incubation period. Greatest increase was observed between the period of 3rd and 5th week.

The greatest increase was observed between the 1st and 3rd week among the soils applied with siglat combined with cabbage refuse and wild sunflower. Addition of cabbage refuse showed a decrease on the amount of mineralized on the 5th week until the 10th week. As for the addition of wild sunflower, no increase on the amount of N mineralized was observed during the 3rd until the 5th week and the decrease on the amount was seen during the 7th week until the end of the incubation period.

Among all treatments, it was noted that the highest amount of mineralized nitrogen were observed on the 5th up to the 10th week of incubation. The result mean that adding organic biological wastes to organic fertilizers will hasten the release of nitrogen in time when the crop needs it most for its growth and development.

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

Manipulating nitrogen release from organic fertilizer as affected by organic biological waste in soil was conducted at the Soil Science Laboratory Room, College of Agriculture, Benguet State University, La Trinidad Benguet from October 2006 to May 2007. This study was conducted to: 1) determine the potential of organic biological waste (OBW) materials in stimulating nitrogen release from organic fertilizers, 2) determine the rate of available nitrogen release from organic fertilizers in the soil.

Adding organic biological waste (molasses, cabbage refuse and wild sunflower) on organic fertilizers showed significant increase on the pH value, organic matter content and available nitrogen content. The amount of mineralized nitrogen was only significantly increased by cabbage refuse and wild sunflower during the 5th, 7th and 10th week. It was observed that among the OBW's, cabbage refuse and wild sunflower resulted to the highest pH value, OM content, available nitrogen content and mineralized nitrogen.

Soil was highest during the 7th week while the organic matter content was highest during the 5th week of the incubation period. The available nitrogen content of all the soils applied with organic fertilizers continuously increased until the end of the incubation period. The amount of mineralized nitrogen was observed to have reached the highest level during the 5th and 7th week. After the highest level was attained the values either stabilized until the next incubation period or significantly decreased until the end of the incubation period.

Conclusion

The results show that the organic biological wastes applied significantly affected the release of nitrogen from the organic fertilizers. Among the different kinds of organic biological waste, cabbage refuse and wild sunflower are more likely to stimulate nitrogen release from organic fertilizers as compared to molasses. It was observed that the addition of cabbage refuse and wild sunflower on the organic fertilizers resulted to a higher pH, organic matter content, and available nitrogen on different incubation periods. The amount of mineralized nitrogen was also observed to be higher among the soils added with cabbage refuse followed by wild sunflower. Among the organic fertilizers, applying chicken manure significantly resulted to the highest amount of available nitrogen, soil pH, organic matter content and nitrogen mineralized followed by BSU compost and PCM, respectively. Based on the data gathered combining chicken manure with cabbage refuse or wild sunflower is the best material to increase soil pH, organic matter content and the amount of available nitrogen in the soil.

During the different incubation periods the pH value, organic matter content, and amount of nitrogen mineralized were observed to have reached their highest level during the 5th and 7th week. It was also noted that after the values reached the highest level the values significantly decreased until the end of the incubation period. Decrease of the pH value and organic matter content could be attributed to the decomposition of the organic matter and the release of organic acids. The amount of available nitrogen continuously increased until the end of the incubation period. This implies that applying the different kinds and combinations of organic fertilizers and organic biological waste can satisfy the nitrogen needed by the crops.

Recommendation

Based on the results, it is recommended that applying organic fertilizers+organic biological waste is needed to increase soil pH, organic matter content and amount of available nitrogen in the soil. Applying a combination chicken dung and cabbage refuse or wild sunflower is recommended to increase nitrogen content of the soil. A follow-up study using varying organic fertilizers and organic biological waste should be made.

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