# The application of biogas sludge as organic fertilizer on the grwoth of spinach plant (*Amaranthus tricolor)*

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**Abstract.** As North Sumatera Province has focused on agriculture in its development, a lot of agriculture researchs need to be conducted. A research of biogas sludge ( from cattle dung) application on spinach plants was done on February until April 2012. The research's objective were to determine chemical quality of biogas sludge as organic fertilizer, the growth response of spinach plants and the economic benefits of biogas sludge. The research was used Completely Randomized Design (CRD) with seven replications and five treatments. The results showed that chemical quality of biogas sludge were as follows: N, P, K, C and pH 1.25% , 0.065, 0.097%, 27.26%, 9.02. C/N ration was 21.80. These chemical quality indicated biogas sludge can be used as good organic fertilizer. Data on average plant height, leaf number, canopy biomass and root biomass indicated that 250 ml per day biogas sludge could be an alternative of 2.5 g NPK as early fertilizer. The highest yield of five treatments was application of 250 ml biogas sludge with 2.5 g NPK at the beginning of spinach planting to the parameters plant height, canopy biomass and root biomass. Biogas sludge application on spinach plants in this research gave economic benefits as much as Rp. 205,554; which was obtained every 30 HST and R/C ratio was 2.93 means that every Rp. 1 costs in spinach planted wil get Rp. 2.93 revenue
**Keywords**: biogas sludge, organic fertilizer, spinach plants (*Amaranthus tricolor L.*)

## Introduction

As a province with significant development on agriculture, North Sumatera faces problem such as on fertilizer. Now adays, farmers find that fertilizer is not available all the time and expensive. In oder to overcome fertilizer problem, a research to find other source of fertilizer is worthed. Biogas sludge is an organic material that after finished its HRT (Hydraulic Retention Time) in biodigester become a by product of the system (FAO, 1979). In biogas sludge, organic compounds become simple, so that plant root could absorb any nutrient left in it. For example, natural cow dung contains C/N ratio about 40 but after process by microorganims in biodigester, C/N ratio decreased around 20 and sometimes below 20 (Ginting, 2010).

According to Lazcano *et al*.,(2008) biogas sludge could be used as fertilizer however application of biogas sludge amongs farmer is less since in developing countries biogas is a rather new technology so only few farmers are aware on biogas sludge. As biogas sludge usually is used cow dung, its quality is less or more like cow dung such as its contain of micro and macro nutrients. Simamora *et al*., (2008) from their research mentioned that organic fertilizer could improve soil texture and in addition improve biology, chemical condition of soil. Also, organic fertilizer provide nutrients for soil. In conclusion, organic fertilizer is a soil amendment (Rauf, 2010). Up till now in North Sumatera Province, farmers use more chemical fertilizer than organic fertilizer. Application of chemical fertilizer for along time ( say 25 years since Pelita I) create a compact condition on soil and this cause a decreased on agriculture production. To overcome this problem, at least 5 ton organic material such as organic fertilizer either liquid or solid should be added every year (Dinas Pertanian Sumatera Utara, 2010).

### Materials and Methods

Research was conducted in the village of Tebing Tinggi as there is a biodigester unit in this vilage. The research last from February until April 2012. Instead of biogas sludge, materials used in this research were spinach plants (*Amaranthus tricolor* L) and other tools for agriculture activity. The methods of this research used Completly Rendomized Design with five treatments and seven replications. The treatments of this research were as follows:

1. S0 : NPK 2,5 g applied in the beginning of treatment
2. S1 : 250 ml biogas sludge every day
3. S2 : 250 ml biogas sludge every week
4. S3 : 250 ml biogas sludge + 2,5 g NPK
5. S4 : 250 ml biogas sludge every week + 2,5 g NPK

All treatments were applied on Spinach Plants/vege that were planted in plastic bags/polybags. Parameters which were observed such as : plant production (number of leaves, height of plant, biomass production), soil quality ( N, P, K, pH, Organic Compounds and C/N ratio). Sonce there were five treatments and seven replication s, so there were 35 samples. All data was analysed by F test which then proceeded by Honestly Significant Difference/HSD) on 5% and 1%. Research Procedure were as follows:

1. Plant media preperation : 35 polybags filled by 5 kg soil and treated with NPK and biogas sludge ( 5 treatments)
2. Plant plantation
3. Growing preparation
4. Cultivation

## Results and Discussions

### Chemical Quality of Biogas Sludge

Table 1 show that sludge biogas contains better chemical compounds than standard by SNI (Indonesia National Standard). Although the pH and C/N ratio a little bit higher than SNI, plant root could adapted and used to the condition.

Table 1. Chemical Quality of Biogas Sludge

| No. | Chemical Quality Unit | Total | |
|---|---|---|---|
| | | Sludge | Liquid Fertilizer Standard ( SNI ) |
| 1. | N-total (%) | 1,25 | - |
| 2. | P2O5 | 0,065 | >0,05 |
| 3. | K2O | 0,097 | >0,05 |
| 4. | C-organic (%) | 27,26 | 4,5 |
| 5. | pH H2O | 9,02 | 4 – 8 |
| 6. | C/N | 21,80 | - |

Source:Central Laboratory, Agriculture Faculty, North Sumatera University 2012

### Height of Spinach Plant

S3 treatment showed the best result which means application of 250 ml biogas sludge every day plus 2,5 g NPK in the beginning of plantation process produced spinach with the highest plant. From S0 and S1 where plant highest almost the same, means that biogas sludge has the same effect as NPK ( 250 ml biogas sludge has the same effect as 2,5 g NPK).

Table 3. Height of Spinach Plant.

| | Treatments | Average |
|---|---|---|
| S0 | NPK 2,5 g applied in the beginning of treatment/control | 21,57 C |
| S1 | 250 ml biogas sludge every day | 22,47 C |
| S2 | 250 ml biogas sludge every week | 25,34 C |
| S3 | 250 ml biogas sludge every day + 2,5 g NPK | 35,50 A |
| S4 | 250 ml biogas sludge every week + 2,5 g NPK | 30,78 B |

### Number of spinach leaves

From S0 and S1 since the number of leaves is not different and notation is the same , i,e A means that the effect of biogas sludge and NPK is the same (250 ml biogas sludge has the same effect as 2,5 gNPK). The best result is from S4 which means that application of 250 ml biogas sludge every week plus 2,5 g NPK in the beginning of planting produced the more spinach leaves.

Table 4. Number of leaves

| | Treatments | Average |
|---|---|---|
| S0 | NPK 2,5 g applied in the beginning of treatment/control | 5,89A |
| S1 | 250 ml biogas sludge every day | 5,99 A |
| S2 | 250 ml biogas sludge every week | 4,97 A |
| S3 | 250 ml biogas sludge every day + 2,5 g NPK | 5,79 A |
| S4 | 250 ml biogas sludge every week + 2,5 g NPK | 6,21 B |

**Canopy Biomass Production of Spinach Plant**

From S0 and S1 since canopy biomass production is not different and notation is the same , i,e A means that the effect of biogas sludge and NPK is the same (250 ml biogas sludge has the same effect as 2,5 gNPK). The best result is from S4 which means that application of 250 ml biogas sludge every week plus 2,5 g NPK in the beginning of planting produced the more canopy biomass production.

Table 5. Canopy Biomass Production

| | Treatments | Average |
|---|---|---|
| S0 | NPK 2,5 g applied in the beginning of treatment/control | 7,07A |
| S1 | 250 ml biogas sludge every day | 6,71 A |
| S2 | 250 ml biogas sludge every week | 5,67 A |
| S3 | 250 ml biogas sludge every day + 2,5 g NPK | 9,46 AB |
| S4 | 250 ml biogas sludge every week + 2,5 g NPK | 7,19 B |

**Root Biomass Production of Spinach**

From S0 and S1 since root biomass production is not different and notation is the same , i,e A means that the effect of biogas sludge and NPK is the same (250 ml biogas sludge has the same effect as 2,5 gNPK). The best result is from S4 which means that application of 250 ml biogas sludge every week plus 2,5 g NPK in the beginning of planting produced the more root biomass production.

Table 6. Root Biomass Production

| | Treatments | Average |
|---|---|---|
| S0 | NPK 2,5 g applied in the beginning of treatment/control | 6,99B |
| S1 | 250 ml biogas sludge every day | 6,77 B |
| S2 | 250 ml biogas sludge every week | 6,60 B |
| S3 | 250 ml biogas sludge every day + 2,5 g NPK | 12,32 A |
| S4 | 250 ml biogas sludge every week + 2,5 g NPK | 14,41B |

## Conclusions

The conclusion of this research that the best result was by using 250 ml biogas sludge every day plus 2,5 g NPK ( NPK used at the beginning of spinah planting) to achieve the best production of spinach plant : parameters plant height, canopy biomass and root biomass. In addition that 250 ml biogas sludge could substitute 2,5 g NPK. Biogas sludge application on spinach plants in this research gave economic benefits as much as Rp. 205.554 ; which was obtained every 30 HST and R/C ratio was 2,93 means that every Rp. 1,- costs in spinach planted wil get Rp. 2,93,- revenue

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