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Biogas slurry application on *Sesbania grandiflora*: A microbial transportation to improve plant quality

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Biogas slurry application on *Sesbania grandiflora*: A microbial transportation to improve plant quality

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Abstract. Slurry of biogas contains microorganisms that assist the preparation of nutrients for soil as well as for plant. This study aims to prove that the slurry biogas microbial can improve the quality of Turi plant sprout (*Sesbania grandiflora*). This research was conducted from April to May 2018 using Completely Randomized Design (CRD) with treatments which were slurry dosages; i.e T0: without slurry; T1: slurry dosage of 500 ml every 1 m³ plant media; T2: slurry dosage of 1000 ml slurry every 1 m³ plant media. There were 4 replications. Parameters were chemical composition of slurry, microbial population, plant height, total leaf, number of branch and stem diameter. The results showed that T0, T1 had no significant effect on every parameters while T2 improved total of leaf and number of branch ($P < 0.05$). There was a significant increasing of microbial population in line with the increasing of slurry dosage. T2 contained the highest population of bacteria or fungal ($P < 0.05$) compared to T0 or T1.

1. Introduction

Nursery in Indonesia, generally planting in the period of sprout without adding treatment such as fertilizer. This conventional planting is believed that fertilizer on sprout period will cause negative effect on sprout i.e. sprout become rotten. An example on cattle feed nursery, when they conduct sprouting of Turi (*Sesbania grandiflora*). The plants began to be given fertilizer during the growth period after the age of about 15 to 20 days.

The period of sprout is the period when plants begin to develop after the seeds are broken by damp conditions. Some understanding that in the period of sprout, the nutrients for the plants are aided by the nutrient reserves found in the seeds. Nevertheless, the development of sprout will be better if the sprout get a good environment such as sunlight, moisture and additional nutrients.

Slurry of biogas is a by-product of a biogas reactor. [1] [2] stated that farmers get various benefits by utilizing biogas slurry, among others, because the slurry of biogas is a ready to be used liquid fertilizer. [3] states that in European countries, slurry is not discarded, but is used for soil amendment or improved soil conditions. Slurry derived from livestock faeces contains many strains of microorganisms. Strains of microorganisms will naturally adjust to their environment. According to [4] strains that adapt to anaerobic and mesophilic conditions included *Methanobacterium omelianskii*, *Methanosarcine bacterium*, *Methanobacterium formicicum*, *Methanobacterium suboxydans* and *Methanobacterium sohngenii*. [5] proved that slurry microorganisms are able to adapt from anaerobic conditions to aerobes. Animal waste contains a very large population of microorganisms. Microbial populations in grazing cattle and low-fibre forages, such as buffaloes that consume field grass, reeds and agricultural waste



whose basic structure contains high lignocelluloses cause faeces contain a large variety of microbes than cows that consume less fibre. [6] stated that buffalo rumen fluid contains more colony of cellulolytic microbial *Ruminococcus* group that is as much as 7 colony than cow which only 4 colony. Cattle that consume a lot of crude fibre then between 20-70% of cellulose out with faeces and high levels of coarse fibres in the high stool and fermentation process is still going on which indicate there is a variety of microbes that help the occurrence of fermentation [7]. The objective of this research was to prove that soil on plant root that applied by biogas slurry still contain microbial which support plant quality.

2. Materials and methods

The research was conducted in Parlondut Village, measurement Sub district, Samosir Regency, North Sumatra Province. The study was conducted from April to May 2018. The materials used were *Sesbania grandiflora* sprout, slurry of buffalo faeces and water hyacinth. The experimental design used was Completely Randomized Design (CRD) with treatments which were slurry dosages; i.e. T₀: without slurry; T₁: slurry dosage of 500 ml every 1 m³ plant media; T₂: slurry dosage of 1000 ml slurry every 1 m³ plant growing media. There were 15 plants for each treatment placed on individual trays. Each tray was filled with stirred media with biogas slurry. Parameters were chemical composition of slurry, microorganism population, plant height, total leaf, stem diameter and number of branch. Microbial was identified and counted on Soil Microbiology Laboratory of Agriculture Faculty, Sumatera Utara University and used Plate Count Method. The unit of microbial was Colony Forming Unit/ml (CFU/ml).

3. Results and discussion

Table 1. Chemical composition of slurry with buffalo faeces and water hyacinth input

No.	Parameter	Unit	Slurry
1	C-Organik	%	3.75
2	N total	%	0.24
3	C/N	-	15.63
4	P ₂ O ₅	%	0.46
5	K ₂ O	%	0.73
6	pH	-	7.1

Table 2. Total microbial, plant height, total leaf, number of branch and stem diameter due to application of different dosage of slurry on *Sesbania grandiflora* sprouts

Parameters	Treatments			Average
	T0	T1	T2	
Total Microbial (on soil)				
Total Bacterial 10 ⁷ (CFU ml ⁻¹)	1.97 ^a	3.50 ^a	7.65 ^b	4.37
Total Fungal 10 ⁵ (CFU ml ⁻¹)	1.80 ^a	1.92 ^a	7.00 ^b	3.57
Plant Height (cm)	4.33	4.98	5.35	4.89
Total leaf (piece)	4.06 ^a	5.85 ^a	9.03 ^b	6.30
Number of branch (piece)	0.27 ^a	0.40 ^a	0.60 ^b	0.42
Stem diameter (mm)	1.35	1.50	1.72	1.52

3.1. Chemical composition of slurry

Chemical composition in Table 1 showed that biogas slurry C / N ratio was 15.63 which was in the range of SNI standard [8] i.e. 11 to 20. Low C / N means that the slurry was good as fertilizer as degradation process of buffalo faeces and water hyacinth in bio digester was optimized. [9] argued that C / N around 12 was good as it enabled plants to metabolised nutrients. According to [10] fertilizer stability was indicated, among others, by a low C / N ratio. Biogas slurry contained of microbial. The more population of microbial especially local microbial would caused slurry getting matured faster and subsequently would support low C / N.

3.2. Total microbial

Table 2 shows that T2 contained the highest population of microbial bacteria or fungal ($P < 0.05$) compared to P0. According to [6] and [7] microbial were in ruminants faeces and [5] found that biodigester contained in with ruminants faeces would allow microbial to remain in biogas slurry. That microorganism was still actively proven slurry then could be used as decomposer in making compost.

In this study, biodigester was filled with faeces of buffalo and water hyacinth. The most common microorganisms found in this study were bacterial and fungal. Bacterial populations where larger than fungal. [11] found that majority of microbial on soil where livestock were grazed included bacterial and fungal. In addition [11] mentioned that soil respiration was related with microbial community and soil respiration was very much improved. 70% of plant respiration was supported through soil respiration. [12] found that soil nutrient was positively related with microbial community as microbial supplied soil with C and N thus improved soil quality. Microbial in self contain of C and N.

Biodigester which filled with ruminants faeces contained with many bacterial species such as *Ruminococcus albus* and *flavefasiens*, *Bacteroides succinogenes*, *Butyrivibrio fibrosolvens*. In addition, there were also *Clostridium lockheadi*, *Eubacterium ruminantium*, *Bacteroides ruminicola*, *Streptococcus bovis*, *Bacteroides amylophylus* and *ruminicola* [4]. [13] mentioned, there were also fungal such as *Neocallimastic frontalis* and *Sphaeromonas communis* which assisted the bacterial work in digestion process. [13] also stated that in work, microorganisms produce enzymes containing elements of N.

The various enzymes produced are useful when slurry is used to remediate the soil or to cultivate plants. Examples of microbial applications to improve soil fertility have been demonstrated by farmers on Samosir Island since hundreds of years ago till now. Soil type, i.e. Inception which has a low nutrient content on Samosir Island [14] continuously gets additional manure of buffalo and goat to produce good crop production. [15] Indeed, various microbial bacterial soil and fungal are helpful in nutrient preparation on the soil. In addition [15] stated that fungal present in the soil as spores or hyphae free or symbiotic with plant roots in the form of hyphae, vesicles or arbuscular, contributing to increasing plant capacity in absorbing nutrients and water.

3.3. Plant height

In this study there was no difference in plant height by all treatments although there was a trend of T₂ higher than other treatments. This was suspected because the effect of indirect treatment correlates with plant height and was due to data collection during the sprout period of only 15 days. [16] states that organic fertilizers contain macro elements N, P, K. Increased vegetative values such as plant height are caused by the role of the nitrogen element. Organic fertilizers help improve the physical, chemical and biological properties of the soil and can make nutrients from unavailable forms into more available forms for plant height growth. The addition of organic matter also contribute various other micro nutrient nutrients, plant growth hormone, increase water holding capacity, and increase soil organism activity in all soil types.

3.4. Total leaf

The total leaf increased markedly in line with the increasing dose of slurry application P2 which was significantly different than P0 ($P < 0.05$). The leaves are part of the plant that is highly responsive to

fertilizer treatment. [15] stated that the role of N elements in the most important crops in the formation of chlorophyll and in the process of photosynthesis, accelerate the growth of plants which in this case increase the height of plants and increase the size of the leaves. Organic fertilizers can increase the availability of food (nutrients) for plants that can be absorbed from the soil. In addition, organic fertilizers have a positive effect on soil physical and chemical properties, encouraging the development of microorganisms. In other words manure has the ability to change various factors in the soil, so as to better grow the plants [17].

3.5. Number of branch

The results showed that in the first week of data retrieval, no branching appeared, but on the second week of data collection, there was already branching. Branching was most abundant in T₂ treatment that was significantly different from T₀ or T₁. Branching is part of the plant that develops after the leaves. According to [18] primary branch number included major factors that affect the plant bodies thus plant productivity. The nutrient content of T₂ is always higher than the control including the N elements highly correlated with the development of leaves and branches.

3.6. Stem diameter

[19] stated that fertilizers contain N, P, K which trigger the growth of stem diameter. Increased vegetative values such as stem diameter are caused by the role of nitrogen elements, the main role of nitrogen for plants is to stimulate overall growth, including stems. Plants require nutrients that suit their needs in the process of growth and development.

In young plants for increased stem diameter growth is aided by the availability of element P. This is in accordance with the assertion [15] which stated that P levels are found in the growth centres. If the plants lack P then the plant becomes dwarfed, the leaves form abnormally and when it is severe then the leaves, fruit, and stems will die.

The diameter stem was not significantly different among the treatments, possibly this was because data was collected after 15 days while stem was grew longer than other part of plant. However there was a tendency that the stem diameter of T₂ had a higher growth rate compared with other treatments especially T₀. It proved that slurry had a better quality of organic fertilizer and slurry can increase the productivity of the plant. This was due to the process of fermentation in biogas anaerobic reshuffle of organic matter into bioactive and acetic acid, butyric acid and lactic acid. Increased organic acid will increase the concentrations of elements of N, P and K. With these conditions, the slurry of biogas has become a liquid organic fertilizer.

The results showed that slurry could fulfilment of nutrients on the soil so that it changes the physical properties of the soil, especially the soil structure. It also increases the availability of water that is essential to the growth of vegetative plants. Increased values of vegetative character such as plant height and stem diameter are due to the role of the nitrogen element. The main role of nitrogen for plants is to stimulate overall growth, especially the stems, branches and leaves [19].

4. Conclusions

The results showed that soil microbial consisted of bacterial and fungal. There was a significant increasing of microbial population in line with the increasing of slurry dosage. The best *Sesbania grandiflora* sprout quality was from application of 1000 ml slurry every 1 m³ soil which significantly caused a higher total of leaf and number of branch. This research proven that *Sesbania grandiflora* sprout grew better with the application of biogas slurry.

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