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Effects of Coconut Oil Cakes on the Growth Performance of Gima Kalmi (*Ipomoea aquatica*)

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

A pot experiment was conducted to investigate the effect of coconut oil cakes on the growth performance of gima kalmi (*Ipomoea aquatica*). The experiment was laid to fit a completely randomized design (CRD) with three treatments (5, 10, 20 tonha^{-1}) of coconut oil cake treatment along with control (no oil cake) each having three replications for this experiment. After plant harvesting, the laboratory investigation was carried out in the Soil, Water and Environment Discipline, Khulna University, Khulna, Bangladesh. Yield contributing characters like plant height and leaf number were significantly (P <0.05) influenced by different treatments. Among the three treatments applied 20 tonha^{-1} treatment has shown highest response to plant growth due to nutrient availability of the soil. The sequence of response was in the order 20 tonha^{-1}>10 tonha^{-1}>5 tonha^{-1} significantly (P <0.05) difference in plant growth from the control (0 tonha^{-1}). But the application of organic manure as coconut oil cake, decrease in soil pH was probably due to the production of organic acids during organic manure decomposition or by nitrification and EC value of soil was increased with different treatments. In addition, increased the organic carbon of the soil. Organic carbon increased due to the application of organic manure but insignificantly.

Keywords: Effects; coconut oil cake; growth performance; organic carbon; Ipomoea aquatic.

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1. INTRODUCTION

In the present day, heavy doses of chemical fertilizers and pesticides have been aggressively used by the farmers to get a better yield of various field crops. Imbalanced fertilization has led to mining out scarce native soil nutrients to support plant growth and production, the dominant soil ecological processes that severely affected the fertility status and production capacity of the major soil in Bangladesh. Excessive use of inorganic fertilizers creates environment related problems, and the situation can be improved through the use of bio-fertilizers [1]. Due to the adverse effect of chemical fertilizers interest has been stimulated for the use of organic fertilizer. In organic agriculture it is generally believed that a soil treated for years with massive doses of chemical fertilizers and pesticides can be restored in three years with compost and a return to traditional practices. In comparison with mineral fertilizers, compost produces significantly greater increases in soil organic carbon and some plant nutrients [2,3].

In today's era, the growth of the world population is increasing day by day and for this reason the higher pressure of food production appears. It has resulted in a greater demand for fertilizer. The continuous use of inorganic fertilizer will be caused damage to physical, chemical and biological properties of soil, so that the soil fertility will be more decreased [4]. Chemical fertilizers often have low use efficiency, meaning that only a portion of the applied nutrients are taken up by plants [5]. The rampant use of chemical fertilizers contributes largely deterioration of the environment, loss of soil fertility less agricultural productivity and soil degradation [6]. The hazardous environmental consequences and the high cost of inorganic fertilizers make them not only undesirable but also uneconomical and out of reach of the poor farmers [7]. Although chemical fertilizer increases soil fertility, it is doing more harm than good in that the soil itself is being degraded in one hand and the environment is being polluted on the other hand [8]. Although organic and synthetic fertilizers add the same nutrients to the soil, organic fertilizers work in a different way. Organic fertilizers work double duty by providing required nutrients to growing plants while also feeding the soil. A balanced blend of organic fertilizer provides nutrient sources for important microorganisms and growth is difficult to sustain. Therefore, scientists and planners of both developed and developing countries are interested in searching the alternate technology to reduce the dependence on the chemical fertilizer. The answer to this, is organic fertilizer.

Organic fertilizers provide all nutrients in readily available forms and also enhance the uptake of nutrients by plants and play a major role in improving growth and yield of different field crops. Among them coconut oil cake acts as an organic fertilizer. Oil cakes have a high nutritional value. When we apply oil cake with soil, then it plays a beneficial role in the growth response of water spinach (*Ipomoea aquatic)*. It is evident that the application of organic manures enhances the soil physical, chemical and biological properties, as well as plant growth and yield. Organic manures can also help in reducing environmental pollution and increasing the use of organic fertilizers in soil. The application of manures to soil provides potential benefits including improving the fertility, structure, water holding capacity the of soil, increasing soil organic matter and reducing the amount of synthetic fertilizer needed for crop production [9]. They provide organic acids that help dissolve soil nutrients and make them available for the plants [10]. The soil scientists pay more attention to making use of organic materials (both organic manures as well as organic wastes) for improving the physical properties of soils that allow profitable crop production. Due to the changing pattern of soil fertility management of cultivable land with emphasis on organic matter replenishment, the organic fertilizers could play a vital role in restoring fertility as well as organic matter status of the soil [11]. Organic matter in soil considered to be the life blood of soil. The present research was the application of organic fertilizer as coconut oil cake to observe the effect of oil cake on the growth response of gima kalmi (*Ipomoea aquatic*). The main objectives of this study were to evaluate the influence of coconut oil cake on the growth response of gima kalmi (*Ipomoea aquatic*) and test the organic carbon status of post-harvest soil due to the application of coconut oil cake.

2. MATERIALS AND METHODS

In this research, a pot experiment was carried out to assess the effect of coconut oil cake on the growth performance of water spinach.

2.1 Soil and Pot Preparation

Soil sample was collected from the field of Khulna University, Bangladesh by composite soil

sampling method [12]. The bulk soil was air-dried at room temperature and all the plant debris was removed manually. Then the massive aggregates were broken by gentle crushing with a wooden hammer and passed through a 0.5 mm sieve. Twelve plastic pots were used in this experiment. The pot experiment was conducted in the field laboratory of Soil, Water and Environment Discipline, Khulna University.

2.2 Collection of Coconut Oil Cake

Coconut oil cake was purchased from local market of Fulbarigate, Khulna. It was dried and kept in a sack for 3 months before using. This helps the particle to decompose more rapidly before use. After taking in the laboratory, it was sieved with 0.5 mm sieve for chemical analysis such as determination of pH, EC and organic carbon.

2.3 Experimental Layout

Twelve plastic pots (250gm) were collected for this experiment. 200gm soil was poured into each pot. There were three rates (5, 10, and 20 ton/ha) of coconut oil cake treatment along with control (no oil cake) and 3 replications for each treatment.

2.4 Sowing of the Seed

Only the healthy, plump and large sized seeds were selected for sowing. Seeds of water spinach were sown by spreading them over the surface of the soil. The seeds were covered by a thin layer of soil. The pots were allowed to germinate. After seed sowing, due care was taken to ensure that there was no infestation of pests and damages by birds and to raise healthy and strong seedling.

2.5 Harvesting

The experimental plants were harvested 44 days after sowing date. The harvested plants were tagged separately, weighed and different growth parameters were measured and recorded.

2.6 Methods for Soil Analysis

Soil samples were analyzed in the laboratory to determine the physical and chemical properties of soil. The methods used for the determination are presented in the following sections. Soil pH was determined electrochemically with the help of glass electrode pH meter suggested by Jackson [13]. Electrical conductivity (EC) of soil samples was measured by EC meter, [12]. Organic carbon of soil samples was determined by Walkley and Black's wet oxidation method as outlined by Jackson [14]. Organic matter was calculated by multiplying the percent value of organic carbon with the conventional Van-Bemmelene's factor of 1.724 [15].

2.7 Data Collection of Different Attributes of the Test Crop

The following parameters were recorded and their mean values were calculated from the sample plant after the harvest. The number of plants of each pot was counted. The number of leaves of plants of each pot was counted and the average value was considered. Plant height was measured using a meter scale from ground level to the tip of the plant. Harvest of plants from each pot, fresh weight was weighed by an electrical balance and their mean value was calculated as plant fresh weight was expressed in gm.

2.8 Statistical Analysis

Analysis of variance (ANOVA) was performed to investigate the influence of coconut oil cake on the growth response of gima kalmi (*Ipomoea aquatic*) and test the organic carbon status of post-harvest soil due to the application of coconut oil cake. The ANOVA and Duncan Multiple Test were done in completely randomized design by using the SAS 6.12 software package [16].

3. RESULTS AND DISCUSSION

The major findings obtained from the present study regarding the effect of coconut oil cake on the growth of gima kalmi have been presented with the significant and relevant discussion in this chapter. The chapter starts with mentioning the results on the influence of coconut oil cake on different growth parameters of gima kalmi.

3.1 Plant Number

The average number of plants showed that the applied treatments (5, 10, 20) tonha^{-1} and control 0 tonha^{-1} value were 3, 1.33, 2.67 and 2.33 respectively. The maximum plant number was found for 5 tonha^{-1} and the minimum for 10 tonha^{-1}. Here the number of plants decreased in the order of (5>20>0>10) tonha^{-1} which shown in Fig. 1. But there found an insignificant change in treatments. This is a short-term effect of coconut

oil cake but in case of long-term effect, coconut oil cake will provide a positive result. The decrease in plant number was probably due to the production of organic acids during organic manure decomposition or by nitrification [4,9]. There found insignificant change where p value was 0.427.

3.2 Plant Height

The height of plants showed that the applied treatments (5, 10, 20) tonha^{-1} and control 0 tonha^{-1} value were 10.5 cm, 7.78 cm, 12 cm and 19.22 cm respectively. The maximum height was observed in 0 tonha^{-1} and the minimum height was observed in 10 tonha^{-1}. Here the plant height decreased in the order of (0>20>5>10) tonha^{-1} which shown in Fig. 2. Here found a significant change in treatments. The decrease in plant height in the 10 tonha^{-1} was probably due to the production of organic acids during organic manure decomposition or by nitrification [6, 9]. There found a significant change in treatment 0 tonha^{-1} to 10 tonha^{-1} but insignificant between treatment 5 tonha^{-1} and 20 tonha^{-1}. Here the height of plants decreased significantly where the p value was 0.017.

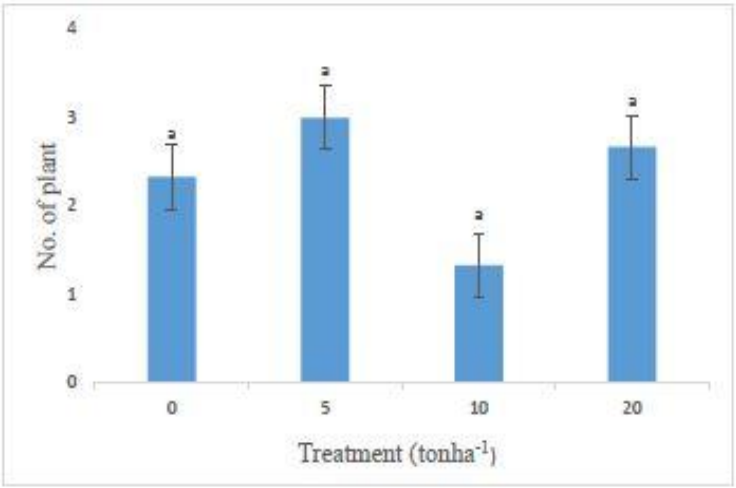

Fig. 1. Number of plants (gima kalmi) treated with different rates of coconut oil cake application

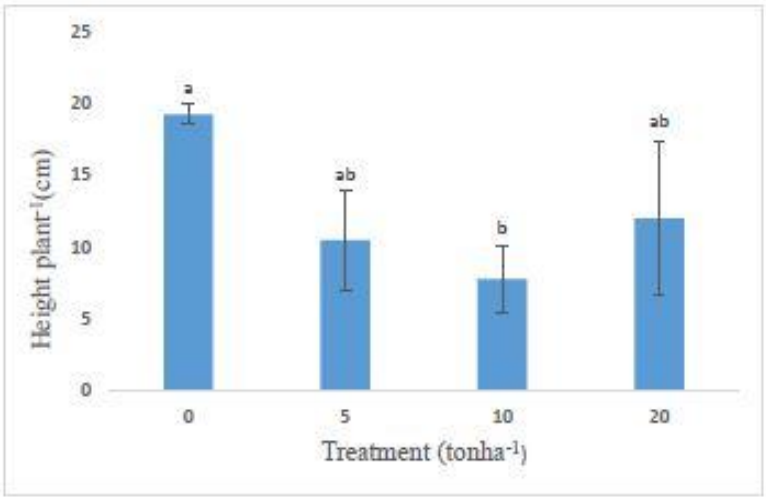

Fig. 2. Changes in the height of gima kalmi under no treatment and under 5, 10, and 20 tonha^{-1} level of coconut oil cake application

3.3 Leaf Number

The number of leaves is an important parameter. Leaf number showed significant variations by the application of organic manure treatments. The average number of leaves showed that the applied treatments (5, 10, 20) tonha^{-1} and control 0 tonha^{-1} value were 8.19, 4.67, 11.43 and 7.75 respectively. The maximum plant number was observed in 20 tonha^{-1} and the minimum plant number was observed in 10 tonha^{-1}. Here the leaf number decreased in the order of (20>5>0>10) tonha^{-1} which shown in Fig. 3. By the application of coconut oil cake, the growth performance of leaves in other treatments was shown a better result than the control. Here the number of leaves increased significantly where p value was 0.012.

3.4 Fresh Weight

Fresh weight showed significant variations by the application of coconut oil cake as organic manure. The fresh weight of plants showed that the applied treatments (5, 10, 20) tonha^{-1} and control 0 tonha^{-1} value were 1.1 gm, 0.25 gm, 1.45 gm and 0.72 gm respectively. The maximum weight was found for 20 tonha^{-1} and minimum weight for 10 tonha^{-1} which shown in Fig. 4. Fresh weight decreased in the order of (20>5>0>10) tonha^{-1}. There found a significant change in 10 tonha^{-1} and 20 tonha^{-1} but there found an insignificant change in treatment 0 tonha^{-1} and 5 tonha^{-1}. The decrease in fresh weight was probably due to the production of organic acids during organic manure decomposition or by nitrification [9]. Here the p value was 0.021.

3.5 The pH of Post-Harvest Soil

The pH of this study showed that the applied treatments (5, 10, 20) tonha^{-1} and control 0 tonha^{-1} soil value were 8.08, 7.98, 8.03 and 8.05 respectively. The highest value 8.08 was found for 5 tonha^{-1} and lowest value 7.98 was found for in 10 tonha^{-1} which shown in Fig. 5. So, most of the applied treatments reduced the pH of the studied soil. The decrease in soil pH was probably due to the production of organic acids during organic manure decomposition or by nitrification [6]. Here found insignificant change in pH values to the applied treatments.

3.6 EC of Post-Harvest Soil

The EC of this study showed that the applied treatments (5, 10, 20) tonha^{-1} and control 0 tonha^{-1} soil value were 0.016 dSm^{-1}, 0.017 dSm^{-1}, 0.018 dSm^{-1} and 0.014 dSm^{-1} respectively. The maximum value of EC was found for treatment 20 tonha^{-1} and the minimum value was found for control (0 tonha^{-1}) which is shown in Fig. 6. Here a positive correlation was found in different treatments. EC value of control was low compared to other treatments. But the application of organic manure as coconut oil cake, EC value of soil was increased with different treatments. This might be caused by the effect of coconut oil cake. EC of the other three treatments was increased insignificantly compared to the control.

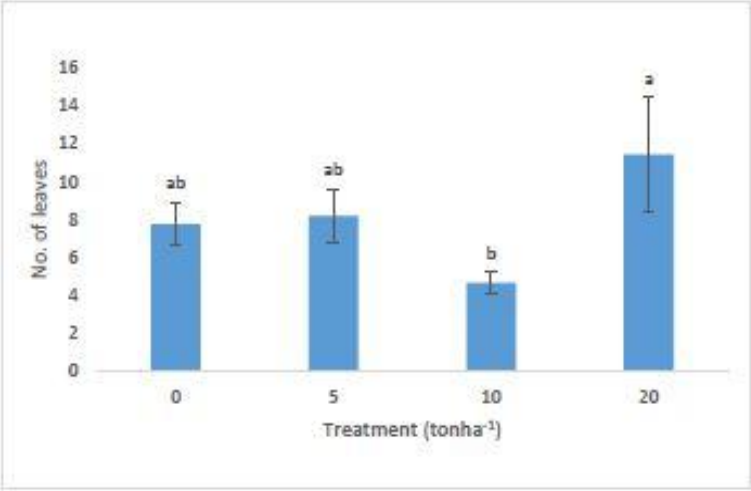

Fig. 3. Number of leaves of gima kalmi treated with different rates of coconut oil cake application

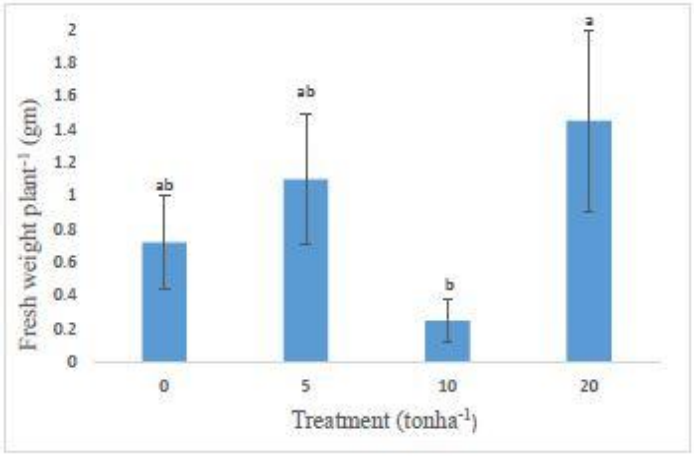

Fig. 4. Changes in fresh weight of gima kalmi under no treatment and under 5, 10, and 20 tonha^{-1}level of coconut oil cake application

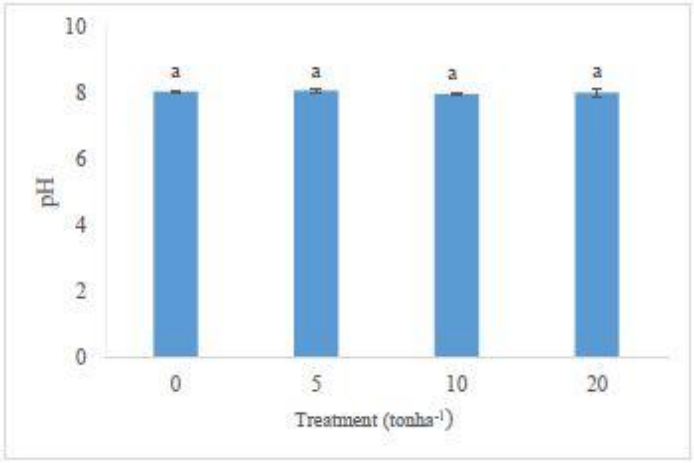

Fig. 5. Response of pH of post-harvest soil with different rates of coconut oil cake application

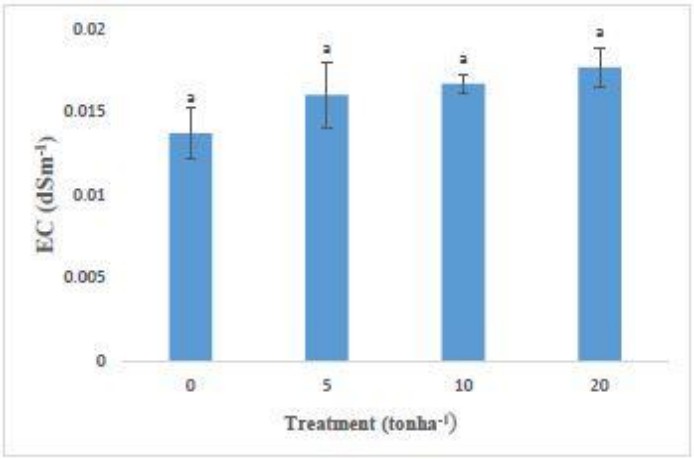

Fig. 6. Response of EC of post-harvest soil with different rates of coconut oil cake application

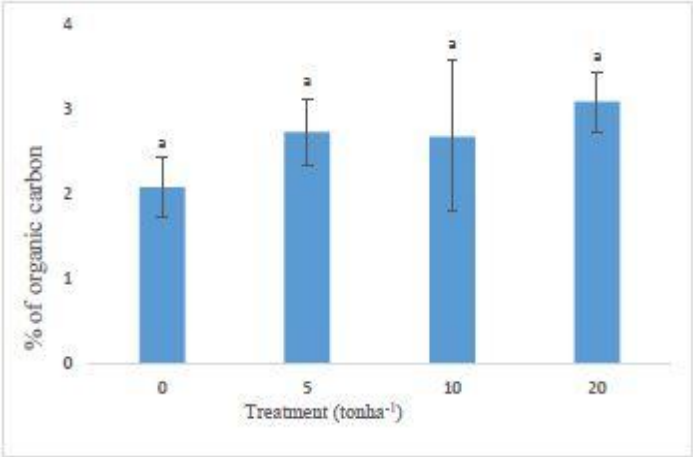

Fig. 7. Response of organic carbon of post-harvest soil with different rates of coconut oil cake application

3.7 Organic Carbon of Post-Harvest Soil

The OC of this study showed that the applied treatments (5, 10, 20) tonha^{-1} and control 0 tonha^{-1} soil value were 2.73%, 2.68%, 3.09% and 2.08%. The organic carbon of the post-harvest soil was influenced by different treatments and highly positive correlation was found. The maximum organic carbon (3.09%) was obtained in 20 tonha^{-1}. The minimum organic carbon was recorded in 0 tonha^{-1} and the value was 2.08% which shown in Fig. 7. According to the results, all treatments of organic carbon showed a positive effect. The difference of OC among treatments was statistically insignificant. By the application of organic manure as coconut oil cake substantially increased the organic carbon of the soil. Here a positive response of organic carbon was shown in Fig. 7. Organic carbon increased due to the application of organic manure but insignificantly.

4. CONCLUSION

The study was undertaken to assess the effect of coconut oil cake on the growth response of gima kalmi and some chemical properties of soil. The target of application of organic fertilizers was twofold- first to obtain reasonable growth and second to increase soil fertility to optimum levels. Manures have a very long-term effect on the soil because nutrients are released very slowly. After harvesting of the plants, the soil OC was found to be increased due to the application of coconut oil cake but insignificantly. The reason might be due to the production of organic acids during organic manure decomposition at its initial stage and due to the short-term effect of coconut oil cake. But different parameters of the plant such as leaf number, fresh weight of plants increased significantly.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Saadatnia H, Riahi H. Cyanobacteria from paddy fields in Iran as a biofertilizer in rice plants. Plant, Soil and Environment. 2009;55:207-212.
2. Moradi H, Fahramand M, Sobhkhizi A, Adibian M, Noori M, Abdollahi S, Rigi K. Effect of vermicompost on plant growth and its relationship with soil properties. International Journal of Farming and Allied Sciences. 2014;3(3):333-338.
3. Nardi S, Morari F, Berti A, Tosoni M, Giardini L. Soil organic matter properties after 40 years of different use of organic and mineral fertilizers. European Journal of Agronomy. 2004;21:357-367.
4. Altuhaish A, Hamim N, Tjahjoleksono A. Biofertilizer effects in combination with different drying system and storage period on growth and production of tomato plant under field conditions. Emirates Journal of Food and Agriculture. 2014;26(8):716-722.
5. Adesemoye AO, Torbert HA, Kloepper JW. Plant Growth-Promoting Rhizobacteria Allow Reduced Application Rates of Chemical Fertilizers. Microbial Ecology. 2009;58:921-929.

6. Inbar Y, Hadar Y, Chen Y. Recycling of cattle manure: the composting process and characterization of maturity. Journal of Environmental Quality. 1993;22:857-863.
7. Oyedeji S, Animasaun DA, Bello AA, Agboola OO. Effect of NPK and poultry manure on growth, yield, and proximate composition of three amaranths. In: Ashraf MY (ed.). Journal of Botany. 2014;1-6.
8. Higa T. Effective microorganisms: A biotechnology for mankind. Presented in the 2nd international conference on Kyusei nature farming at the university of Soa Paul, College of Agriculture; 1991.
9. Blay ET, Danquah EY, Ofosu-Anim J, Ntumy JK. Effect of poultry manure on the yield of shallot. Advanced Horticulture Science. 2002;16:13-16.
10. Husson O. Redox potential (Eh) and pH as drivers of soil/plant/microorganism systems: A trans disciplinary overview pointing to integrative opportunities for agronomy. 2013;362:389-417.
11. Islam MS. Use of bioslurry as organic fertilizer in Bangladesh agriculture. Prepared for the presentation at the International Workshop on the Use of Bioslurry Domestic Biogas Programme. Bangkok, Thailand; 2006.
12. USDA (United states Department of Agriculture). Soil survey laboratory manual. Soil survey investigation report no. 42, version 4.0, USDA-NRCS, Nebraska, USA; 2004.
13. Jackson ML. Soil Chemical Analysis. Prentice Hall of India, Private Limited, New Delhi. 1973;495-498.
14. Jackson ML. Soil Chemical Analysis. Prentice Hall, In: Englewood Cliffs, New Jersey, USA; 1962.
15. Piper CS. Soil and plant analysis. Adelaide University Press Australia; 1950.
16. SAS. SAS/STAT User's Guide, No. 1, ANOVA, Version 6. 4th Edition. Statistical Analysis System Institute, Cary, NC; 1988.

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