Research Journal of Agriculture and Forestry Sciences _____ISSN 2320– 6063
Vol. **12(3),** 15-20, July **(2024)** *Res. J. Agriculture and Forestry Sci.*

Comparative effect of bioslurry and chemical fertilizer application on growth and yield of groundnut (*Arachis hypogaea* L)

Nesaretnam Nemitha* and Thayamini H. Seran
Department of Crop Science, Faculty of Agriculture, Eastern University, Chenkalady, Sri Lanka
nemitha.nesaretnam@gmail.com

Available online at: www.isca.in, www.isca.me
Received 21st February 2024, revised 25th May 2024, accepted 28th June 2024

Abstract

Groundnut (Arachis hypogaea L.) is an annual important legume oil crop. Chemical and organic fertilizers are used to improve the crop growth and yield. Bioslurry is an organic liquid fertilizer. An experiment was carried out to find the comparative effect of chemical fertilizer and bioslurry application on growth and yield components of groundnut (Arachis hypogaea L.) during July to December 2022. The experiment was conducted with six treatments and eight replicates in a completely randomized design. The treatments were T1 – No fertilizer (control), T2 – 100% NPK chemical fertilizers, T3 – 75% PK chemical fertilizers and 25% bioslurry, T4 – 50% PK chemical fertilizers and 50% bioslurry, T5 – 25% PK chemical fertilizers and 75% bioslurry, T6 – 100% bioslurry. The results revealed that there were significant (P<0.0001) differences in plant height, number of branches per plant, number of flowers, leaf area, number of nodules, number of pods, pod weight per plant, seed weight per plant, 100 seed weight, shoot weight, root weight and seed yield of groundnut. Relatively higher seed yield (234.44 g/m^2) was obtained from the plants treated with 50% PK chemical fertilizers and 50% bioslurry (T4) whereas control treatment (T1) produced the lowest yield (48.96 g/m^2). Based on the results of this study, it could be stated that using a mixture of 50% PK chemical fertilizer and 50% bioslurry could give high seed yield of groundnut with an environmentally friendly manner.

Keywords: Bioslurry, Chemical fertilizer, Groundnut, Seed yield.

Introduction

Groundnut (*Arachis hypogaea* L.) is a major legume and oil crop in Sri Lanka that is cultivated for food and animal feed. It is used in the various food items preparation and also other production such as soaps lubricants, and cosmetics. Seeds contain 44–56% oil, 22–30% protein and a wealth of minerals, including phosphorus, calcium, magnesium and potassium[1]. Peanut oil has enough monounsaturated fatty acids, particularly oleic acid[2]. Groundnut has the ability to fix atmospheric nitrogen in the soil. It is grown mainly in dry and intermediate zones of Sri Lanka. In conventional agriculture, chemical fertilizers are mostly used by the farmers to enhance yield of ground nut[3] but the most of the them apply insufficient and unbalanced chemical fertilizers, which may reduce seed yield of groundnut particularly on sandy soil. Further, excessive usage of chemical fertilizers has imparted to polluted water and air and also caused other environmental and human problems[4,5] and also commercial chemical fertilizers are costly to poor farmers engaged in groundnut cultivation[4].

In contrast, organic fertilizers improve nutrient stock, cation exchange capacity and water retention ability while inorganic fertilizers provide the critical plant nutrients N, P and K[6]. Primary and secondary nutrients as well as micronutrients are available in organic fertilizers to enhance crop growth and productivity with less environmental impact[7]. Farmers use oil extracts from botanicals to control many of the diseases and to repel pests in organic farming which has become increasingly popular all over the world even in Sri Lanka[8]. Bioslurry is one of the organic liquid fertilizers and it is the byproduct produced during the anaerobic processing of waste to produce biogas. It can be applied on agricultural land as an organic fertilizer[9]. Biogas slurry can increase the biological and physical properties of soil in addition to providing crops with macro and micronutrients.

Combined use of the inorganic and organic fertilizers was appropriate for increasing the seed yield of groundnuts[4]and for helping to create a sustainable agriculture model[10]. Comparing bioslurry fertilizer to composted agricultural waste, it has the advantage of having higher total nitrogen, ammonium and pH levels, while also having a lower C/N ratio that has decreased from 10.7 to 7, indicating that it is of good quality[11]. Therefore, this experiment was conducted to determine the comparative effect of combined usage of bioslurry and chemical fertilizers on growth and yield of groundnut.

Materials and Methods

Experimental site: A polybag experiment was done to determine the comparative effect of bioslurry and chemical fertilizers on growth and yield of groundnut. It was done at home garden in Eastern Province of Sri Lanka, from July 2022

to December 2022. This region is 10 meters above mean sea level and it is a part of the low country dry zone's Agro-Ecological Zone. The North-East monsoon causes the majority of the region's 1400 mm – 1680 mm annual rainfall, which peaks from October to February. The annual mean temperature ranges from 26.4 ^{o}C to 36.6 ^{o}C and the humidity ranged from 60% to 90%. The soil type of the experimental area is classified as sandy loam.

Experimental design: The experiment was laid out in a completely randomized design (CRD) with six treatments and eight replications. A number of 48 polybags were used in this experiment and each bag contained one plant. The treatments used in this experiment are as follows.

T1 - No fertilizer
T2 - 100% NPK chemical fertilizers
T3 - 75% PK chemical fertilizers + 25% bioslurry
T4 - 50% PK chemical fertilizers + 50% bioslurry
T5 - 25% PK chemical fertilizers + 75% bioslurry
T6 - 100% bioslurry

According to the treatments, 100%, 75%, 50% and 25% of recommended chemical fertilizers of groundnut were taken by using electronic balance. Bioslurry (3.6% N, 0.012% P2O5, 0.25% K_2O) was collected from Sethukuda area in Batticaloa district, Eastern Province of Sri Lanka. Then solution was prepared with bioslurry and water in 1:2 ratio by volume basis. After that, different rates (0, 25, 50, 75 and 100%) of solution were applied to the plants in weekly intervals for upto 7 weeks.

Agronomy practices : Groundnut variety "Tissa" was used in this study. For the experiment, black colour polybags (30 cm length and 30 cm width) were used. Three holes were made at the bottom of each bag to facilitate the drainage of water. The bags were filled with soil and a distance of 5 cm was left unfilled from the top of the soil to facilitate irrigation. All the bags were kept in the experiment area at the spacing of 45 cm between rows and 15 cm within rows. Each polybag was seeded with two seeds. At two weeks after seeding, one seedling was thinned out and one vigorous seedling was maintained in each polybag. In this experiment, fertilizers were applied according to the treatments. T2 treatment was treated with 35 kg/ha urea, 100 kg/ha triple super phosphate (TSP) plus 75 kg/ha muriate of potassium (MOP) [100% NPK chemical fertilizers] as basal and 30 kg/ha urea as top dressing application. The different rates of P and K were combined with different rates of bioslurry in T3, T4, and T5. Bioslurry (400 ml / polybag) was applied every week until 7 weeks. Irrigation was followed twice in a day in the morning and evening at early stage of plant growth after that it was reduced by once in a day during the experimental period. Hand weeding was done at one-week interval. The bags were maintained weed free until the final harvest. For the control of fungus disease, captan was applied at 10 weeks after planting.

Measurements: Growth parameters were taken at every two weeks interval. Plant height (cm) was measured in each plant in each replication of all treatments using measuring tape. The distance of plant between the upper boundary of the main photosynthetic tissues of the plant and the ground level was measured. Number of branches was counted 2 weeks after seeding up to the 10 weeks. Total number of flowers in each plant in each replication of all treatments was counted in the 5 weeks after planting to harvest. Plants were uprooted after the 14th week of sowing and the total leaf area (cm^2) was measured by using leaf area meter (LI-3100C, Germany). Leaf area was measured at harvesting after destructing the plant and the leaves were cut from base of the leaf petiole and measured the leaf area of each plant. Subsequently, the fresh weight of shoot and roots was measured by using an analytical balance. Harvesting was done at 14th week after planting in harvesting stage of groundnut. The total weight of pods, total weight of seeds (g) and weight of 100 seeds (g) were measured by an electronic balance after harvest. Finally, total average yield (g/m^2) was calculated.

.

Analysis of Data: Data were collected and tabulated. Data were checked for normality and homogeneity. An Analysis of variance (ANOVA) test was used to determine the significance level of the treatments. The analysis was carried out using the statistical analysis system (SAS) to determine significant difference among the treatments. Treatment means were compared using the Tukey's test at the P=0.05 (5%) probability level.

Results and Discussion

Plant height: Plant height was significantly varied (P<0.0001) from 2nd to 10th week after planting (WAP) (Table 1). At 2nd WAP, tallest plant was recorded in T4 (15.13 cm), followed by T2 (13.75 cm) while the lowest plant height was recorded in T1 (7.38 cm) and T2 and T3 were statically similar. At 10th WAP, the maximum plant height was observed in T4 (85.75 cm) which was treated with half of chemical fertilizer (P and K) and bioslurry, while shortest plant was observed in T1 (71.38 cm). This might be attributable to the enrichment of nutrient availability after addition of liquid bioslurry in the soil which may promote plant growth as stated by Ashenafi and Tewodros[12]. The application of bioslurry along with inorganic nitrogen fertilizer enhanced the plant height. In comparison to the other treatments, groundnut that received 50% chemical fertilizer (P, K) and 50% bioslurry performed better in terms of plant height (P<0.05). When compared to the control, the application of bioslurry without chemical fertilizer significantly increased plant height.

Number of branches: Number of branches per plant of groundnut at two weeks intervals is shown in Table 2. At the 2nd WAP, there were no significant differences (P>0.05) in number of branches between T2, T3 and T4 but they remarkably varied from T1 treatment. The highest number of branches was attained in T2 and T3 at the 4th WAP. At 6 WAP, T2 had the

most branches (4.1), followed by T3 (4). T1 Treatment had few number (1.3) and at the 8th and 10th WAPs also showed the same pattern. According to Sutresnawan and Trisnadewi[13], the application of liquid bioslurry fertilizer tends to increase the number of branches. This helps to absorb nutrients and, in turn, enhances crop growth and yield.

Table 1: Comparative effect of chemical fertilizer and bioslurry on plant height of groundnut at the different weeks after planting

Treatments	Plant height at the different weeks				
	2nd week	4th week	6th week	8th week	10thweek
T1	07.38± 0.15e	14.88± 0.21e	31.50± 0.39e	51.35± 0.13e	71.38± 0.31e
T2	13.75± 0.11b	27.13± 0.08b	43.38± 0.22b	63.38± 0.34b	84.88± 0.13a
T3	13.50± 0.10b	27.50± 0.12b	43.25± 0.21b	63.48± 0.35b	83.63± 0.21b
T4	15.13± 0.06a	29.63± 0.21a	48.00± 0.71a	65.38± 0.39a	85.75± 0.23a
T5	12.50± 0.12c	25.38± 0.12c	40.75± 0.21c	60.63± 0.22c	81.49± 0.15c
T6	11.63± 0.10d	22.59± 0.14d	37.63± 0.32d	59.39± 0.18d	77.93± 0.17d
P value	P<0.00 01	P<0.00 01	P<0.00 01	P<0.00 01	P<0.00 01

Value represents mean ± standard error of eight replicates. Means followed by the same letter in each column are not significantly different according to the Tukey's Test at 5% significant level.

Table 2: Comparative effect of chemical fertilizer and bioslurry on number of branches of groundnut

Treatments	Number of branch per plant at the different weeks				
	2nd week	4th week	6th week	8th week	10th week
T1	1.1±0.1 b	1.3±0.2 c	1.3±0.2 c	1.4±0.3 c	1.4±0.3 c
T2	1.9±0.1 a	3.0±0.2 a	4.1±0.1 a	5.1±0.1 a	6.1±0.1 a
T3	1.9±0.1 a	3.0±0.2 a	4.0±0.2 a	5.0±0.2 a	5.9±0.2 ab
T4	1.9±0.1 a	2.9±0.1 ab	3.8±0.2 ab	4.8±0.2 ab	5.8±0.2 ab
T5	1.5±0.2 ab	2.5±0.2 ab	3.4±0.2 ab	4.4±0.2 ab	5.4±0.2 ab
T6	1.3±0.2 b	2.3±0.2 b	3.1±0.2 b	4.1±0.2 b	5.1±0.2 b
P value	P<0.00 01	P<0.00 01	P<0.00 01	P<0.00 01	P<0.00 01

Value represents mean ± standard error of eight replicates. Means followed by the same letter in each column are not significantly different according to the Tukey's Test at 5% significant level.

Number of flowers: The fertilizer treatments had considerable (P<0.05) effect on mean number of flowers of groundnut than an absolute control which gave lower values (Table 3). The maximum number of flowers obtained in T4 however there was no significant variation in number of flowers between T2 and T3. T1 had the minimum number of flowers. Ulla et al.[14] reported that application of both chemical and organic fertilizers at the same time enhances the number of flowers on brinjal plants. Imthiyas and Seran[15] stated that compost with expert™ fertilizer application increase reproductive growth of beans than NPK fertilizers alone. The availability of phosphorous and potassium organic manure may enhance the flower formation in plants. Generally, organic manures incorporated in the soil releases nutrients slowly but chemical fertilizers releases nutrients quickly. Therefore, the concurrent application of organic manures and chemical fertilizers may provide required for increasing flower production.

Table 3: Comparative effect of chemical fertilizer and bioslurry on number of flowers, leaf area and number of nodules per groundnut plant.

Treatments	Number of flowers	Leaf area (cm^2)	Number of nodules
T1	03.5±0.4d	1403.90±39.45d	35.0±1.7d
T2	25.3±0.6b	2091.14±44.95b	84.1±2.2b
T3	25.3±0.5b	2371.85±51.02a	87.0±2.1ab
T4	29.5±0.6a	2467.25±54.92a	93.5±2.0a
T5	19.8±0.4c	1990.89±36.19bc	75.8±1.5c
T6	18.5±0.4c	1808.19±39.65c	72.6±2.0c
F test	P<0.0001	P<0.0001	P<0.0001

Value represents mean ± standard error of eight replicates. Means followed by the same letter in each column are not significantly different according to the Tukey's Test at 5% significant level.

Leaf area: Table 3 shows the leaf area of groundnut at 14 week after planting (WAP). According to the findings, T4 and T3 are statistically similar to each other. Highest leaf area were recorded in T4 (2467.25 cm^2) followed by T3 (2371.85 cm^2) and lowest leaf area was recorded in T1 (1403.9 cm^2). This statement is supported by Ashenafi and Tewodros[12] who found that combined adding liquid bioslurry and chemical fertilizer significantly increased the amount of kale leaf area. The amount of leaf area gives a good measure of the plant's ability to photosynthesize.

Number of nodules: The result showed that changes in different level of chemical fertilizer and bioslurry significantly (P<0.05) influenced the number of root nodules (Table 3). The highest number of nodules was recorded in T4 (93.5) followed by T3 (87) and the lowest number of root nodules were recorded in T1 (35). This might be due to the application of organic manure boosted the symbiotic interaction with microorganisms in the soil which lead to increase the number of nodules in the

roots and these beneficial microorganisms operate as nitrogen (N) and phosphorus (P) solubilizers[16]. Madukwe et al.[17] declared that P and N encourage the development of nodules. Priyadarshani and Seran[18] reported that lack of potassium in legumes significantly slows down the rate of nitrogen fixation.

Number of pods : The statistical analysis revealed that different combination of chemical fertilizer and bioslurry significantly influenced to the mean number of pods per plant of groundnut (Table 4). Maximum number of pods per plant at 14 WAP were recorded in T4 (25.6) followed by T2 (24.0) and T3 (22.9) but the minimum number of pods were recorded in T1 (4.1). The Treatment T4, the plant treated with 50% chemical fertilizer (P, K) and 50% bioslurry, number of pods was increased than the control treatment (T1). It may be because of chemical fertilizer releases the essential nutrients at the beginning quickly and organic manures supply both macro and micronutrients for crop growth and subsequent development. The increase in soybean pod number after the application of chemical fertilizer and organic fertilizer in combination may be due to the rate of nutrient release and the proportion of nitrogen in the liquid bioslurry affects growth and increases the number of pods and the number of seeds produced per hectare[19].

Pod weight per plant : Combined application of chemical fertilizer and bioslurry influenced the pod weight per plant of groundnut were shown in Table 4. The maximum pod weight was recorded in T4 (24.65 g), the plant treated with 50% chemical fertilizers (P, K) and 50% bioslurry and the minimum pod weight was recorded in T1 (5.11 g). Kamble et al.[20] found that combining chemical fertilizer with organic manure has resulted more vegetative growth. In comparison to the other treatments, groundnut that received 50% chemical fertilizer (P, K) and 50% bioslurry performed better in terms of pod weight.

Seed weight per plant : Table 4 represents the different rate of chemical fertilizers and biosurry influenced on average seed weight per plant. The mean values of seed weight per pod ranged from 3.31 g to 15.83 g. Among these values, T4 showed the highest seed weight per pod (15.83 g) and T1 (control) showed the lowest seed weight per pod (3.31 g). The treatment T4, the plant treated with 50% chemical fertilizer (P, K) with 50% bioslurry and seed weight per pod was increased compared to the T1. Based on the results of this experiment, it was determined that a high growth rate and a large number of leaves increased the plant's photosynthetic activity in T4. Zhao et al.[21] who stated that increased photoassimilation occurred when the plant received enough potassium and that increased photosynthetic activity directly increased the weight of seeds, supported these findings.

100 seed weight : The data presented in Table 4 clearly indicate there was significant effect on 100 seed weight. The highest 100 seed weight was recorded in T4 (42.05 g) followed by T2 (37.42 g) and T3 (36.61 g) and the lowest yield was recorded in T1 (25.00 g). It can be a result of the micronutrients in the bioslurry which are advantageous to plant growth and development. According to Haque et al.[22], rice grain weights significantly increased when chemical fertilizer and bioslurry were applied together. The rate of absorption affects seed formation, which establishes the weight of 100 seeds. By producing more carbohydrates, which were subsequently transformed into sugar and delivered to the seed tissue, greater absorption ultimately increased seed weight[23].

Table 4: Comparative effect of chemical fertilizer and bioslurry in groundnut pod parameters at harvest

Treatments	Number of pods	Pod weight (g) per plant	Seed weight (g) per plant	100 seed weight (g)
T1	04.1±0.4c	05.11±0.27e	03.31±0.16e	25.00±1.25d
T2	24.0±0.7a	21.41±0.63b	14.14±0.40b	37.42±0.19b
T3	22.9±0.8a	21.05±0.46bc	13.69±0.31bc	36.61±0.10b
T4	25.6±1.0a	24.65±0.56a	15.83±0.28a	42.05±0.47a
T5	18.6±0.6b	19.3±0.58cd	12.83±0.38cd	32.49± 0.07c
T6	17.5±0.5b	18.78±0.33d	11.70±0.26d	31.41±0.04c
F teat	P<0.0001	P<0.0001	P<0.0001	P<0.0001

Value represents mean ± standard error of eight replicates. Means followed by the same letter in each column are not significantly different according to the Tukey's Test at 5% significant level.

Shoot weight : The mean fresh weight of shoot was significantly affected by the fertilizer's treatments (P <0.05) compared to an absolute control, which produced lower values. T4 (80.08 g) recorded the maximum fresh weight of the shoot, while T1 (32.73 g) recorded the minimum fresh weight of the shoot (Table 5). Increase in the number of leaves and leaf area may contribute for increasing shoot weight. Ashenafi and Tewodros[12] stated that the application of a liquid bioslurry with different levels of inorganic nitrogen sources determines the fresh weight of leaves. The availability of the nutrients in bioslurry may lead to increase in fresh weight of shoot.

As shown in Table 5, the maximum dry weight of shoot biomass was recorded in T4 (32.05 g) and the minimum in T1 (12.73 g). There was no significant (P<0.05) difference between T2 and T4. Application of 50% chemical fertilizer (N, P) and 50% bioslurry significantly (P<0.05) increase the dry weight of shoots over control plants. Islam et al.[24] reported that applying bioslurry has a significant effect on the dry matter content and enhance the production of biomass and nutrient content in maize fodder. Combined application of 50% chemical fertilizer (P, K) and 50% bioslurry gave maximum shoot fresh and dry weight than other treatments.

Root weight: Effect of different combination of chemical fertilizer and bioslurry on fresh root weight of groundnut is shown in Table 5. Among all the treatment the maximum fresh root weight was observed in T4 (4.78 g) and it was statistically similar with T2. The lowest fresh root weight was found from

T1 among all the treatments which was 2.24 g. Application of 50% chemical fertilizer and 50% bioslurry significantly (P<0.05) increased the fresh weight of roots over the control plants. The reasons of increase root weight may be due to improvement of the soil properties which facilitates the better growth and development of the roots. Devakumar et al.[25] reported organic liquid fertilizer may have increased soil biomass and supported the uptake of both applied and native soil nutrients, leading to improved crop growth and yield.

As shown in Table 5, the maximum dry weight of root was recorded in T4 (1.71 g) followed by T2 (1.59 g) and T3 (1.25 g) while T1 (0.77 g) showed minimum dry weight of root. Application of 50% chemical fertilizer (P, K) and 50% bioslurry significantly (P<0.05) increased the dry weight of root than control plants. Higher plant height, more branches and more leaves led to this rise in dry weight. According to Dhananjaya[26], improved performance may be the consequence of faster decomposition of organic manure, which enhance the availability of nutrients which helps in protein synthesis and ultimately results in greater dry matter production. In this experiment, combinations of 50% of chemical fertilizer (P, K) and 50% bioslurry application in T4 gave the maximum weight of fresh and oven dry weight of root in groundnut.

Table 5: Comparative effect of chemical fertilizer and bioslurry on fresh and dry weight of shoot and root of groundnut plant

Treatments	Fresh weight of shoot (g)	Dry weight of shoot (g)	Fresh weight of root (g)	Dry weight of root (g)
T1	32.73±0.65e	12.73±0.33e	2.24±0.05e	0.77±0.02e
T2	77.61±1.30a	30.59±0.36ab	4.54±0.04b	1.59±0.04b
T3	73.13±1.08b	29.65±0.59b	4.28±0.03c	1.25±0.14c
T4	80.08±0.51a	32.05±0.23a	4.78±0.05a	1.71±0.02a
T5	66.46±1.52c	24.88±0.62c	3.24±0.03d	1.19±0.03c
T6	60.74±0.93d	22.83±0.33d	3.19±0.03d	1.08±0.02d
F test	P<0.0001	P<0.0001	P<0.0001	P<0.0001

Value represents mean ± standard error of eight replicates. Means followed by the same letter in each column are not significantly different according to the Tukey's Test at 5% significant level.

Seed yield: The data on the total seed yield per m^2 of groundnut as influenced by chemical fertilizer and bioslurry are presented in Figure 1. The total seed yield per m^2 showed significant variation due to the different combination of chemical fertilizers and bioslurry doses. Among all the treatment the highest total seed yield per m^2 (234.44 g) was recorded in T4 and the minimum yield was recorded in T1 (48.96 g). In T4 treatment, most of the parameters such as plant height, leaf number, pod number, pod weight and number of nodules have increased. As a result, yield has been increased. The application of liquid organic fertilizer known as Amuthakaraisal improves yield and its components of groundnut[27]. Zheng[28] reported a similar effect was found in rice that a 10 % yield increase occurred with chemical fertilizer and bioslurry combination that contained 50 % chemical fertilizer and 50% bioslurry. Combining 50% chemical fertilizer (P, K) and bioslurry (T4) application had the potential to increase seed yield in groundnut than other treatments.

Conclusion

The results revealed that application of chemical fertilizer and bioslurry had significant difference on all the measured parameters. The application of 50% of chemical fertilizer (P, K) with 50% of bioslurry increased the plant height, number of branches per plant, number of flowers, leaf area, number of nodules, number of pods, pod weight per plant, seed weight per plant, 100 seed weight, shoot weight, root weight and seed yield of groundnut. All these parameters measured in 50% P, K chemical fertilizers with 50% bioslurry treatment (T4) were statistically par with T2. However, the application of bioslurry without chemical fertilizer showed positive effect on most of the measured parameter. According to the seed yield per m^2, the highest value of seed yield was obtained in T4 (234.44 g/m^2) followed by T2 (209.44 g/m^2) and T3 (202.78 g/m^2) while, lowest value was gained in T1 (48.96 g/m^2). Combined application of chemical fertilizer and bioslurry increased growth and yield of groundnut in sandy regosol compared to the control treatments. Therefore, the 50% of P, K chemical fertilizers and 50% bioslurry could be used for the cultivation of groundnut in order to increase the growth and yield in sandy regosol.

References

1. Savage, G.P. and Keenan, J.I. (1994). The composition and nutritive value of groundnut kernels. In: J. Smartt (Ed), The Groundnut Crop. Springer, Dordrecht. pp. 173-213.

2. Mekdad, A. A. A. (2017). Response of peanut to nitrogen fertilizer levels and foliar zinc spraying rates in newly reclaimed sandy soils. *Journal of Plant Production*, 8(2), 153-159.

3. Seran, T. H. (2016). Yield and yield components of Arachis hypogaea L. as influenced by NPK chemical fertilizers, farm yard manure and gypsum. *Bangladesh Journal of Scientific and Industrial Research*, 51(4), 285-290.

4. Seran, T. H. (2018). Effects of inorganic and organic nutrients combindly used on yield and quality of groundnut (Arachis hypogaea L.). *Bangladesh J Sci Ind Res*, 53(4), 289-296.

5. Pahalvi, H. N., Rafiya, L., Rashid, S., Nisar, B., & Kamili, A. N. (2021). Chemical fertilizers and their impact on soil health. *Microbiota and Biofertilizers, Vol 2: Ecofriendly*

tools for reclamation of degraded soil environs, 1-20.

6. Iren, O. B., Akpan, J. F., Ediene, V. F., & Asanga, E. E. (2015). Influence of cassava peels and poultry manure-based compost on soil properties, growth and yield of waterleaf (Talinum triangulare Jacq) in an ultisol of south-eastern Nigeria. *Journal of Soil Science and Environmental Management*, 6(7), 187-194.

7. Fernando, W. M. B. F., & Seran, T. (2023). A Effect of compost with banana peel and Moringa leaf powders on crop residue and seed yield of green gram (Vigna radiata L. Wilczek). *Journal of Agricultural Sciences (Belgrade)*, 68(2).

8. Yashanthini, S., & Seran, T. (2009). Weed and pest management practices adapeted by organic farmers at Kaluwanchikudy Village in the Batticaloa District.

9. Rachmah, M. A., Darwanto, D. H., & Mulyo, J. H. (2020). Farmers' Willingness to Pay for Bio-slurry Fertilizer in Central Java. *Agro Ekonomi*, 31(2), 121-134.

10. Wu, W., & Ma, B. (2015). Integrated nutrient management (INM) for sustaining crop productivity and reducing environmental impact: A review. *Science of the Total Environment*, 512, 415-427.

11. Insam, H., Gómez-Brandón, M., & Ascher, J. (2015). Manure-based biogas fermentation residues–friend or foe of soil fertility?. *Soil Biology and Biochemistry*, 84, 1-14.

12. Haile, A., & Ayalew, T. (2018). Comparative study on the effect of bio-slurry and inorganic N-fertilizer on growth and yield of kale (Brassica oleracea L.). *African Journal of Plant Science*, 12(4), 81-87.

13. Sutresnawan, K. and Trisnadewi (2015). The growth and production of telang flower (clitoria ternatea) which is given various kind and dosage of organic fertilizer. *Tropical Animal Husbandary*, 3(3), 586-596.

14. Ullah, M.S., Islam, M.S., Islam, M.A., and Haque, T. (2008). Effects of organic manures and chemical fertilizers on the yield of brinjal and soil properties. *Journal of the Bangladesh Agricultural University*, 6(2), 271-276.

15. Imthiyas, M. S., & Seran, T. H. (2016). Effect of compost and EXPERT TM fertilizer on the vegetative parameters of bush beans (Phaseolus vulgaris L.).

16. Rajkhowa, D.J., Saikia, M., and Rajkhowa, K.M. (2003). Effect of vermicompost and levels of fertilizer on green gram. *Legume Research-An International Journal*, 26(1), 63-65.

17. Madukwe, D. K., Christo, I. E. C., & Onuh, M. O. (2008). Effects of organic manure and cowpea (Vigna unguiculata (l.) Walp) varieties on the chemical properties of the soil and root nodulation. *Science World Journal*, 3(1).

18. Priyadharshini J. and Seran T.H. (2009). Paddy husk ash as a source of potassium for growth and yield of cowpea (*Vigna unguiculata* L.). *Journal of Agricultural Sciences* 4(2), 67-76.

19. Falodun, E.J., Ehigiator, J.O. and Ogedegbe, S.A. (2015). Growth and yield response of Soyabean (*Glycine max* Merr.) to organic and inorganic fertilizer in Edo rainforest of Nigeria. *American Journal of Plant Sciences*, 6(19), 3293.

20. Kamble, M. Y., Kalalbandi, B. M., Kadam, A. R., & Rohidas, S. B. (2016). Effect of organic and inorganic fertilizers on growth, green pod yield and economics of french bean (Phaseolus vulgaris L.) cv. HPR-35. *Legume Research-An International Journal*, 39(1), 110-113.

21. Zhao, D., Oosterhuis, D. M., & Bednarz, C. W. (2001). Influence of potassium deficiency on photosynthesis, chlorophyll content, and chloroplast ultrastructure of cotton plants. *Photosynthetica*, 39, 103-109.

22. Haque, M. A., Jahiruddin, M., Islam, M. S., Rahman, M. M., & Saleque, M. A. (2018). Effect of bioslurry on the yield of wheat and rice in the wheat–rice cropping system. *Agricultural Research*, 7, 432-442.

23. Harjadi, S., & Tahitoe, D. (1991). The Effects of Plastic Film Bags At Low Temperature Storage On Prolonging The Shelf-Life Of Rambutan (Nephelium Lappacem) Cv Lebak Bulus. *Frontier in Tropical Fruit Research*, 321, 778-785.

24. Islam, M.R., Rahman, S.M.E., Rahman, M.M., Oh, D. H., and Ra, C.S. (2010). The effects of biogas slurry on the production and quality of maize fodder. *Turkish Journal of Agriculture and Forestry*, 34(1), 91-99.

25. Devakumar, N., Rao, G. G. E., Shubha, S., Imrankhan, N., & Gowda, S. B. (2008). Activities of organic farming research centre. *Navile, Shimoga, University of Agriculture Sciences Bangalore*, 12.

26. Dhananjaya, J. (2007). Organic studies in radish (Raphanus sativus L.) varieties. *Department of Horticulture Collage of Agriculture, Dharwad University of Agriculture Science, Dharwad*, 580(5), 12-13.

27. Hassaan, M. A., & Seran, T. H. (2015). A note on split application of liquid organic fertilizer as top dressing on yield of groundnut (Arachis hypogaea L.). *seeds*, 5(30), 45.

28. Zheng, X., Fan, J., Cui, J., Wang, Y., Zhou, J., Ye, M., & Sun, M. (2016). Effects of biogas slurry application on peanut yield, soil nutrients, carbon storage, and microbial activity in an Ultisol soil in southern China. *Journal of soils and sediments*, 16, 449-460.