VERMICOMPOSTING AND ITS APPLICATION ON GROWTH AND YIELD OF *Solanummelongena*L.

Thant Sin Nwe[1], Kay Khine Zaw[2], Myat Myat Moe[3]

Abstract

The processing of vermicomposting was conducted using earthworms and organic matter. The effect of vermicompost on the growth and yield of *Solanum melongena*L. (eggplant) was carried out in the field of Department of Botany, Dagon University Campus from November 2016 to March 2017. The mean composting maturity period of vermicompost was shown as 60 days. The temperature ranged from this organic compost was 27-30^{o}C and the C/N ratio was obtained 18.42/1. The resulted vermicompost was tested on the eggplant in field using three treatments such as T_1 (vermicompost), T_2 (NPK) and T_3 (Control) with 3 replications. Among treatments, the organic matter contents of vermicompost (T_1) were obviously higher than NPK (T_2) and Control (T_3). Thus, the growth and yields of eggplants were highest in the vermicompost treated plants followed by the plants treated with NPK fertilizer and control, respectively.

Key words: vermicompost, organic matter, eggplant

Introduction

Organic fertilizers have played an important role in agricultural for sustainability of soil quality and improving crop production.Earthworms are valued by farmers because, in addition to aerating the soil, they digest organic matter and produce castings that are a valuable source of humus. Vermicrmposting, or worm composting is simple technology that takes advantage of this to convert biodegradable waste into organic manure with the help of earthworms the red wigglers (*Eisenia foetida*) with no pile turning, no smell, and fast production of compost.They are finely-divided, peat-like materials, with high porosity, aeration, drainage, water-holding capacity and microbial activity which make them excellent soil conditioners (Edwards,1988).

Eggplant (Khayan-thee) a member of the Solanaceae, is one of the most common tropical vegetables grown in the world. The eggplants are erect, annual herb or spreading determinate growth habit.The leaves are large, lobed, ovate or ovate oblong, thick, smooth on upperside but hairy or prickly on the underside.The flowers are single, deeply lobed and toothed calyx and purplish pubescent corollas. Fruit is pendent and consists of a shiny, fleshy berry when mature may range in color from purple to deep purple. Eggplant contains low calorie and high nutrients. There are many eggplants varieties differ size and shape are grown throughout the world.In South East Asia eggplant is being used in curry and used to prepare different kind of dishes also has some medicinal properties. Eggplantis a warm-weather plant. The optimum temperature for germination is 24-29^{o}C and 22-30^{o}C for growth and fruit development. Soil pH in the range of 6.0 to 7.0 is desirable (Sat and Saimbhi, 2003).

1 Dr., Lecturer, Department of Botany, Dagon University
2 MSc, Student, Department of Botany, Dagon University
3 Dr., Professor and Head, Department of Botany, Dagon University

In this paper, the production of the small scaled composting production system for organic farming was conducted and its application on the growth and yield of eggplant were also studied.

Materials and Methods

Study I. Vermicomposting Process

Preparation for bedding:

The straw and banana stem, carbon-rich materials (carbonaceous) and the fresh manual cowdung, nitrogen-rich material (nitrogenous) were used for bedding in the 1:1 ratio to obtain the right C:N proportion about 30:1. The straw and banana stem were shredded into1cm pieces through degradation of organic materials and also enhancing the aeration of the bedding. The cement tank (76 x 75 x 37) cm was used in this process. Firstly, straw, banana stem and cowdung in the 6:6:12 ratios were spread inside the tank layer by layer orderly.And then, thirty earthworms, red wigglers, *Eisenia foetida* were also spread in the pile.Suitable amount of water sprayed to this pile. The size of bedding was at least 1 cubic meter is prepared to allow thermophilic heating.The bedding was turning up every 2 weeks to obtain through homogenization of composting materials.

Figure (1) Preparation of organic materials for obtaining in vermicomposting process

Volume Reduction

The reduction of volume was calculating by the following formula (Website 1).

$$\text{Reduced Volume \%} = \frac{\text{Reduced Volume}}{\text{Original Volume}} \times 100$$

$$= \frac{1 \times w \times h_r}{1 \times w \times h_o} \times 100$$

Where, l = length of tank

w = width of tank

h_r = reduced height of compost pile

h_o = original height of compost pile

Study 2 Utilization of Vermicompost and NPK for yield improvement of *Solanum melongena* L.

The seeds of eggplant were obtained from Vegetables and Fruit Research Development Centre (VFRDC), Vegetable Science Laboratory in Yemon, Hlegu Township, Yangon Region.

Analysis of soil, raw materials and composts

The soil, raw materials for composting such as straw, banana stem, cowdung, bran, rice husk and the composts were analyzed in the soil laboratory, Land Use Division, Myanmar Agriculture Service, Yangon Region.

Soil preparation

Soil mixture for growing eggplant was prepared by mixing thoroughly with rice husk, burnt rice husk and compost were prepared and the seeds were sown in polyethylene bag.The seeds were soaked in water at about 6 hours for acceleration of seed germination.After thirty-five days the germinated seedling was transplanted into the field.Total of 30 plants were grown in this experiment and the compost was applied 5:1 ratio.The plant spacing and row spacing were 33 cm and 45 cm and total plot area was 17 m^2. There were three treatments each with three replicates was assigned in three rows.

Treatment

T_1 – eggplant treated with vermicompost
T_2 – eggplant treated with NPK and
T_3 – control.

Data collection

Plant height, number of leaves, length and width of leaves, number of flower per plant, and fruit per plant were collected 5 days interval from each treatment.The data were analyzed using the IRRISTAT software version 4, developed by international Rice Research Institute (IRRI), the Philippines.

Method

- Leave area (LA)
  Leaf area (LA) = (L x W) K
  L = Length
  W = Width
  K = Adjustment factor, K = 0.64 for eggplant (Rivera, 2007)

Results and Discussion

In the initial stage of vermicomposting, 30 numbers of Red wigglers were inoculated in the compost tank. At 15-30 days, no multiplied number was observed. However, at 45 days, it was multiplicated into 327 numbers and at 60 days, 458 numbers of Red wigglers were obtained.During this period, the temperature inside the tank was 27° - 30° C (Table:2).

Aspects of the biology for *Eisenia fetida*

Color	- Brown and buff bands
Size of adult earthworms	- 15-20 cm
Mean weight of adults	- 28-30
Time to maturity (days)	- 28-30
Incubation time (days)	- 18-26
Life cycle (days)	- 45-51
Temperature	- 25° C (0° C – 35°C)
Moisture	- 70 – 90 %

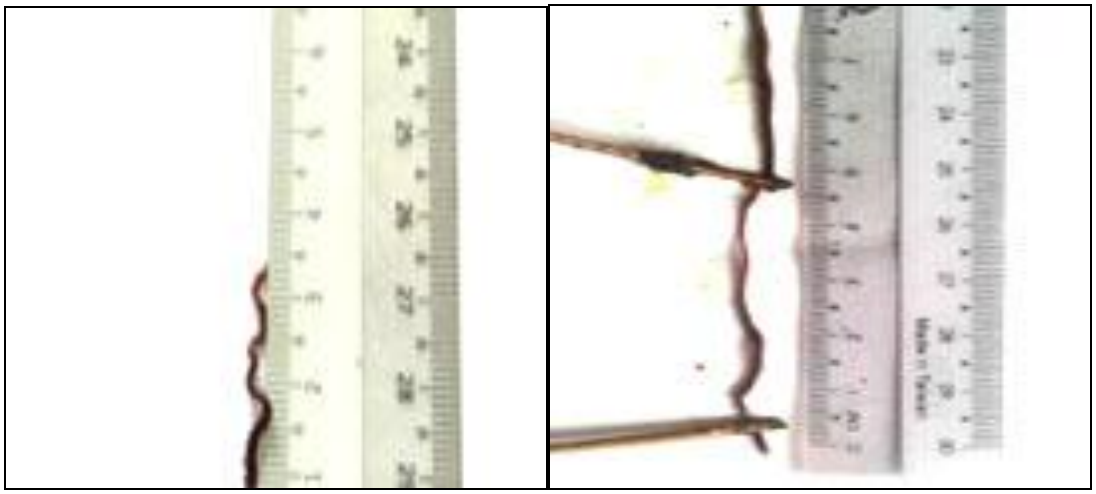

Figure (2) The size of earthworm before and after compost

Table (1) Results of analyzed soil from cultivation area

Texture	Sand (%)	Silt (%)	Clay (%)	Organic carbon (%)	Total N_2	Exchangeable Cations		Available Nutrients
						K	P	K_2O
Slightly clay	1.00	68.80	28.70	low	low	Medium	low	Medium
Moisture (%)	pH	Organic carbon (%)	Humus	Total N_2 (%)		Exchangeable CationsMeq/ 100g		Available Nutrients
						K	P ppm	K_2O mg/100g
1.50	5.36	1.127	1.94	0.144		0.19	1.68	9.13

Table (2) Characteristics of raw materials for vermicompost

No.	Sample	Moisture %	Total N%	Organic Matter %	C:N
1.	Straw	9.086	0.69	84.73	71.22:1
2.	Banana stem	9.560	1.161	85.35	42.63:1
3.	Cowdung	12.422	1.159	19.23	9.87:1

Table (3) Number of earthworms during composting

Days	Temperature	Number of earthworms
0	27°C	30
15	27°C	30
30	28°C	30
45	29°C	327
60	30°C	458

Table (4) Comparative Results of Vermicompost from Recent Research and Product of VFRDC

Sample	VRFDC	Recent Research
Moisture %	70.53	64.99
Total N %	1.048	1.875
Total C %	9.65	9.15
Total P2O5 %	1.083	1.052
Total K2O %	0.607	2.72
pH (1:5)	6.8	8.19

* Vegetable and Fruit Research Development Centre

Table (5) Physical and chemical characteristics of the vermicompost

Physical and chemical characteristics	Condition for stability* (FFTC)	Recent Research
Color	Dark-Brown	Dark-Brown
Odor	Earthy	Earthy
Temperature	Stable	30°C
pH	Alkali	8.49
C/N	< 20	18.24
Total carbon (%)	> 5	9.15
Moisture (%)	< 35	64.99
Total organic Matter (%)	40	62.65

* Food and Fertilizer Technology Center (2005)

Table (6) Effect of fertilizers on eggplants at 90 DAS

Treatments	Plant height (cm)	No. of leaf	Leaf Area (cm^2)	Fruit number (pt^{-1})	Fruit Yield ($kgha^{-1}$)
T_1	42.63	14.45	200.66	9.33	535.05
T_2	37.37	13.33	180.16	7.33	466.53
T_3	26.40	11.43	141.33	5.00	312.82
F-test	**	**	**	**	**
5%LSD	14.21	0.18	3.44	1.29	10.72
CV(%)	21.50	11.81	9.68	9.2	3.12

* Each value represents the mean from 3 replications. Mean differences in each column was determined by LSD.
* = 5 % level of significance, ** = 1 % level of significance;

Table (7) Effect of fertilizers on growth and yield of eggplants at 90 DAS

Parameters	PH (cm)	NL	LA (cm^2pt^{-1})	FN(pt^{-1})	FY ($kgha^{-1}$)
PH	1				
NL	0.314ns	1			
LA	0.357ns	0.205ns	1		
FN	0.802**	0.120ns	0.707**	1	
FY	0.861**	0.475*	0.865**	0.831**	1

* Each value represents the r value of correlation relationship, * = 5 % level of significance,
** = 1 % level of significance; pH = plant height (cm). NL = number of leaf, LA = leaf area (cm^2 pt^{-1}), FN = fruit number pt^{-1}, FY = fruit yield (kg ha^{-1}).

The production of compost was carried out and studied its effects on eggplant. In this experiment, vermicompost was prepared by adding four-layers such as straw, banana stem and cowdung.In the present study, the number of earthworms increased greatly in number, size and length within 60 days. The number of earthworm population increased from thirty to four hundred and fifty-eight after composting process (Table: 3).The more increased in number of earthworms the more they degraded the substrate and the more fine quality compost was left.Watenabe and Tsutomoto (1997) reported that the growth of *Eisenia fetida* has ability to degrade in organic matter substrates with different moisture contents and temperatures had been studied by various authors.

Edwards (1988) observed that optimum growth of *Eisenia fetida* in different animals manure and wastes occurred at 25-30°C and a moisture content range of 75-85%, but these factors could vary in different substrates. This observation was also approved by Gunadi*et al.*, (2003).In the vermecomposting process temperature was range from 27-30°C and the pH value was 8.49.Atyyeh (2001) stated that earthworm it difficult to survive if the pH falls below 6 and thus they migrate or are killed. Most epigamic earthworms are relatively tolerant of 5-9.The applied vermicompost was compost of 62.65 % organic matter, 1.875 % total nitrogen, 1.052 % of total phosphorous and 2.72 % total potash, 9.15 % total carbon and pH of the compost was 8.19 (Table: 4,5). These results are approximately agreed with the report from

Vegetable and Fruit Research Development Centre in Yemon, Hlegu Township, Yangon Region, 1996 (Table: 4).The results were also agreed FFTC (2005), dark-brown color of earthy-odor, pH value and CN ratio. But in recent result the compost moisture 64.99 % and total organic matter 62.65 % were higher than FFTC value of compost moisture 35 % and 40 % respectively (Table: 5).

This resulted compost and NPK were conducted to eggplant to evaluate the effect of compost and NPK on the eggplant.Among the treatments, T_1 treated with vermicopost obtained the maximum value in plant height, number of leaf area, fruit number (pt^{-1}) and fruit yield (kgh^{-1}) were 42.63 $cmpt^{-1}$, 14.45, 200.66 cm^2pt^{-1}, 9.33 pt^{-1} and 535.05 $kgha^{-1}$ respectively (Table: 6).

According to the soil analysis, the soil pH 5.9 was suitable to grow eggplant (Table: 1). Nitrogen is considered as the essential macronutrients required by the plants for their growth development and yield. But excess uses of chemical fertilizer damage the soil's health. Sharma (2003) stated that one of the main causes of reduction in soil's health is the decreasing fertility of soil and organic matters in the soil.The use of inorganic fertilizer in long-term has reduced physical, chemical and biological traits, as well as organic matters in the soil and of course, they will affected efficiency of nutrients absorption.Excessive application of inorganic fertilizers would contaminate environment and the food yield that may human health Watanabe (1976).

Therefore, some efforts are required to fulfill a part of nutrients and improve the physical, chemical and biological traits of the soil through the application of organic fertilizers.

Sat and Saimbhi (2003) observed that increasing the nitrogen significantly delayed flowering of eggplant and increased the number of days taken to fruit setting of eggplant. Two to three weeks after planting extra N should be side dressed. But many advertisements caused to use of chemical fertilizers and farmers forgot its effect on bioenvironmental pollution.

Conclusion

The result compost was showed compost maturity with compost's odor, suitable moisture and organic matters as in marketable composts.Timely and appropriate application of fertilizer can make a significant difference in the quality and quantity of fruit and can promote earlier harvest.According to the study, the application of vermicompost significantly influenced on the vegetative growth and yield improvement of eggplant. The findings of this study will provide useful information for the growers of the horticultural crops and encouraged them the way to the organic farming systems.

Acknowledgements

I would like to express my sincere gratitude to Dr. Myat Myat Moe, Professor and Head, Department of Botany, Dagon University, for the permission to use various department facilities during the study period.I also acknowledge to Dr. Khin Lat Lat Mon, Professor, Department of Botany, Dagon University, for her interesting advices and suggestions on this study.I am thankful to Department of Botany, Dagon University and Chonbuk National University, the Republic of Korea for active participation me to present my research paper in "2nd Myanmar-Korea Conference".

References

Atiyeh, R.M., Arancon, N. Q., Edwards, C. A., Metzger, J.D. Lee, S., Arancon,N.Q. (2001). The influence of humid acids derived from earthworm-processed organic wastes on plant growth. Bioresource Technology 84, 7-14.

Edwards, 1988.Breakdown of animal, vegetable and industrial organic wastes by earthworms.In Earthworms in Waste and Environment Management. 21-31.SPB, the Hague, the Netherlands.

Food and Fertilizer Technology Centre. 2005. Compost Production: a Manual for Asia Farmers, Taipei, Taiwan: FFTC for the Asian and Pacific Region.

Gunadi, Bintora, C.A. Edwards and C. Blount IV.2003.The influence of different moisture level on the growth, fecundity and survival of *Eiseniafetida*(savigny) in cattle and pig manure solids.Soil Biology. 39: 19-24.

Rivera, C.M., Rouphael, Y., Cardarelli, M., Colla, G. (2007) A simple and accurate equation for estimating individual leaf area eggplant from linear measurements. European J. Hort. Sci. 70:228-230.

Sat, P, and M.S. Saimbhi, 2003.Effect of varying levels of nitrogen and phosphorus levels on growth and yield of brinjal hybrids.J.Res. Crops., 4(2): 217-222.

Sharma, S., 2003.Biofertilizers for substainable Agriculture.Agribios (India). Gaarg, V.K., S. Chand and A. Chillar. 2005. Growth and production of *Eiseniafetida* in various animal wastes during Vermicomposting. Applied Ecology and Environmental Research 2: 51-9.

Watanabe, 11., and J. Tsutomoto, 1976. Seasonal change in size, class and stage structure of lumbricid*Eiseniafetida*population in afield compost and its practical application as the decomposer of organic waste matter. Rev. Ecol. Biol. Sol 13,141-146.

Website 1 http://www.basic-mathematics.com/volume-of.