BIO COMPOST AND BIOFERTILIZER ON GERMINATION, GROWTH AND YIELD OF *ABELMOSCHUS ESCULENTUS* (L.) MOENCH. (OKRA)

Khin Lay Nandar Aung[1], Su Latt Win[2] and Ngwe Sandar[3]

Abstract

Experimental study was conducted to assess response of different types of bio composts and biofertilizers on germination, growth and yield of *Abelmoschus esculentus* (L.) moench. Five treatments: Bokarshi compost, *Spirulina* biofertilizer, Hatake biofertilizer, Vermicompost and control were comprising in germination and pot experiment. All of the experiments were done in Kyauk Tan Township, February to April in 2020 by using Randomized Completely Block Design (RCBD) with four replications in pot experiment under greenhouse condition. The results indicated that germination, growth and yield parameters treated with all types of bio compost and biofertilizer were found superior than control. Among the treatments, the results of Bokarshi compost were significantly affected than other treatment in cultuvaion of okra.

Keywords: Germination, pot, bio compost, biofertilizer.

Introduction

Abelmoschus esculentus (L.) moench. (okra) is a family of Malvaceae and important vegetable for human consumption which supplies many sectors for nutrition. Today, over-dose application of agro-chemicals increased to food productivity but also created to several environmental problems and consequently to serious negative effect to people. That habitat likely decreased in soil fertility, food nutritional quality, and polluted to various ecosystem.

Biofertilization has become a positive alternative to chemical fertilizer in last few decades. It is beneficial in nitrogen fixation, enhancing nutrients uptake, also secrete higher amounts of hormones, vitamins and antibiotics (Kannaiyan, 2002). Biofertilizers are environmentally friendly fertilizers that non only prevent damages to natural sources but, help in cleaning the nature (FAO, 2008).

Bokashi is a Japanese word that means “fermented organic matter.” Most Bokashi sites state that the inoculant (usually called EM or Effective Micro-organisms). This medium is inoculated with beneficial microbes that flourish in anaerobic, acidic environments, natural anaerobic conditions (www.planetnatural.com). *Spirulina plantensis* was a photosynthetic blue green micro alga. It can be used as a beneficial biofertilizer and has been largely studied in cultivation of various crops due to eco-agronomical importance.

Dominguez (2004) described that “Vermicompost is a nutrient rich, microbiologically-active organic amendment that results from the interaction between earthworms and microorganisms during the breakdown of organic matter”. Hatake biofertilizer is a product that contains pure *Bacillus Amyloliquefaciens* D 203 strain discovered from the microflora of marine environment in Japan. The strain showed excellent plant pathogen fighting ability and high organic matter degradation activities (http://hatake-global.com/product).

The application of bio composts and biofertilizers in crop cultivation was suitable for soil health, provided to good agricultural practice and adopted among the farmers in Myanmar. So, the effect of bio composts and biofertilizers were necessary to assess which kind will be effective in okra cultivation. This study was aimed to undertake a sustainable agricultural method of

[1] Dr, Lecturer, Department of Botany, East Yangon University
[2] Dr, Lecturer, Department of Botany, East Yangon University
[3] Dr, Lecturer, Department of Botany, East Yangon University

horticulture with the use of bio compost and biofertilizer in okra cultivation. The objectives of this research are to study germination of okra seeds with application of bio composts and biofertilizers, and to compare the impacts of growth and yield of okra treated with different types of bio compost and biofertilizers under greenhouse condition.

Materials and Methods

Preparation on Materials in Germination and Pot Experiment of Okra

Okra seeds, Bokarshi and Vermicompost were bought from Department of Vegetable and Fruit Research and Development Center, Ministry of Agriculture, Liver stock and Irrigation, Hlegu Township, Yangon Region. *Spirulina* biofertilizer was kindly provided by June Pharmaceutical CO. Ltd. Hatake biofertilizer was bought from Lawkanat Myanmar Group Co. Ltd. The basal cultured soil was collected from Kyauk Tan Township. The colorful baskets (21″×14″×6″) were used for germination experiment and the pots with 10″ height and 10″ width in diameter were used to grow okra plants.

The Methods Applied in Germination and pot Experiment

The experiments were conducted in Kyauktan Township, during February and April, 2020. The baskets and pots were well perforated to allow excess water at the base and filled with 10 kg of soil in each. Five treatments comprising: T1 (control), T2 (100 g *Spirulina*), T3 (100 g Hatake), T4 (1 kg Vermicompost) and T5 (1 kg Bokarshi) per basket in germination experiment. Twelve seeds of okra were sown in each treatment and number of seed germinated were counted on 7th day. The germination percentage and vigor index were finally determined by the following formula of Harris (1996), and Abdul - Baki and Anderson (1973). The shoot and root length of okra seedlings were also measured.

$$\text{Germination percentage (\%)} = \frac{\text{No.of germinated seeds}}{\text{No.of total seeds in sowing}} \times 100$$

$$\text{Vigor index} = \text{Mean shoot length (cm)} + \text{Mean root length (cm)} \times \text{Percent of seedling germination (\%)}$$

Pot experiment consists of five treatments comprising: T1 (control), T2 (1 kg Bokarshi), T3 (100 g *Spirulina*), T4 (100 g Hatake) and T5 (1 kg Vermicompost) per pot. Okra seeds were pre-soaked in water for 12 hours to avoid the incidence of any plant disease. Three seeds were sown in each pot and out of three seedlings only one healthy plant was allowed to grow to maturity. Randomized Completely Blocked Design was used with four replications. Two liters of water per pot were poured to provide moisture for plants. The plant height, number of leaves, flowers and fruits per plant were recorded. All of collected data in pot experiment were subjected to the analysis of variance by using IRRISTAT software and mean values were separated by the least significant differences 5 % levels.

Results

Effect of Bio composts and Biofertilizers on Germination of Okra

In this experiment, the different types of bio composts and biofertilizers were used in germination test and their effect on germination and seedling growth of okra was described in Table (1). All of the biofertilizer treatments were higher in germination percentage than the control.

Among them, T5 treatment has the highest germination percentage and followed by T2, T4, and T3. The mean germination percentage of T5 were 91.67 % and the second highest germination percentage was found in T2 and T4 treatments, 83.33 %. The germination percentage of T3 was 75% while that of T1 was 58.33%.

Table 1 Effect of bio composts and biofertilizers on germination of okra.

Treatment	Mean Germi - nation (%)	Mean Shoot length(cm)	Mean root length (cm)	Vigor index
T1	58.33	13.57	3.81	3015.76
T2	83.33	23.25	7.07	13697.58
T3	75.00	21.42	7.36	11823.84
T4	83.33	23.38	6.88	13404.00
T5	91.67	25.54	8.01	18753.43

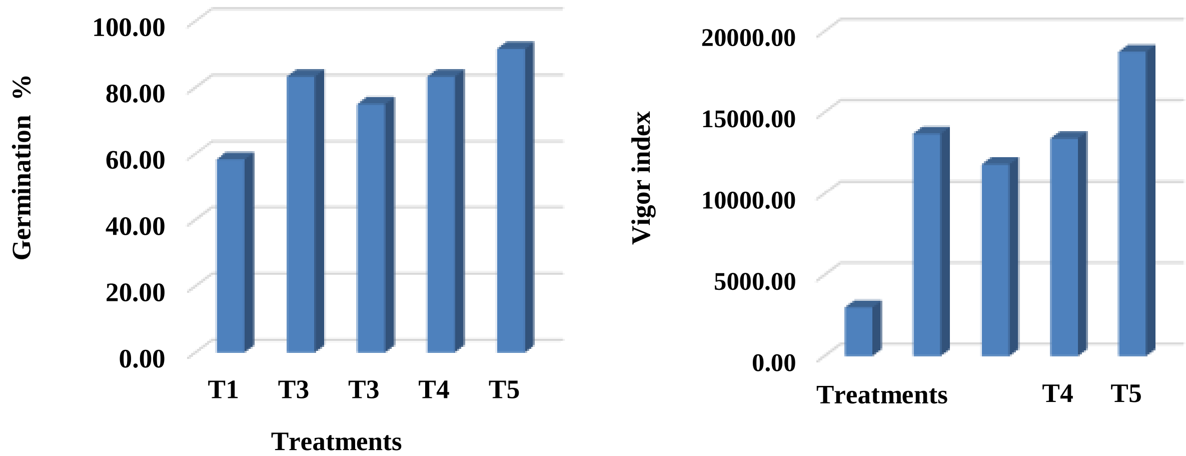

Figure 1 Germination percentage and vigor index of okra treated with bio composts and biofertilizers.

According to the results, the vigor index of T5 treatment in okra seedlings were significantly higher than other treatments. The highest vigor index value, 18753.43 was produced by T5 treatment and followed by T2 and T4 treatments, 13697.58 and 13404.00. The vigor index value of T3 treatment were 11823.84. The lowest vigor index value, 3015.76 was obtained by T1 treatment.

It was found that T5 treatment produced the highest shoot length, 25.54 cm and followed by T2 and T4 treatments. The mean shoot length of T2 and T4 were not clearly different, 23.25 cm and 23.38 cm. The shoot length of T3 was 21.42 cm. Among these treatments, T1 treatment produced the lowest shoot length, 13.57 cm. The highest root length, 8.01 cm was possessed by T5 treatment. The root length of other treatment was presented as descending order: T3,7.36 cm; T2,7.07 cm and T4, 6.88 cm, respectively. Among these, T1 treatment had the lowest root length, 3.81 cm.

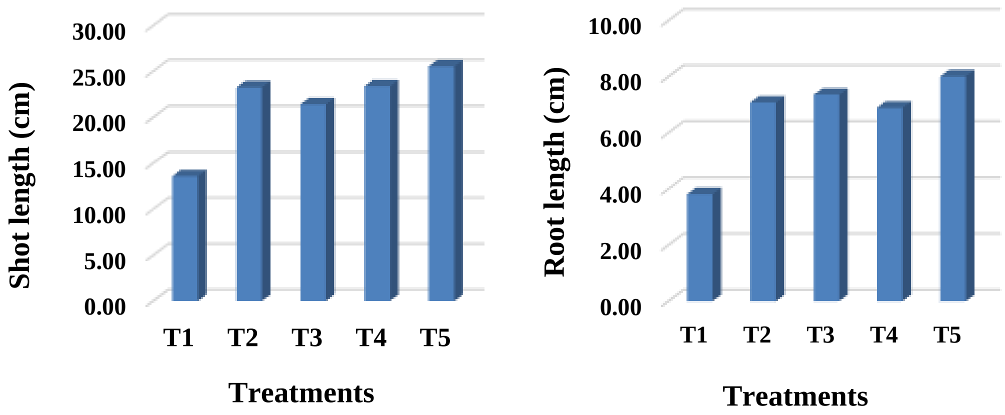

Figure 2 Shoot length and root length of okra treated with bio composts and biofertilizer.

Effect of Bio composts and Biofertilizers on Growth and Yield in Okra

Growth and yield parameters in all treatements were recorded to 6 WAS depending upon weather condition. It was found that the data were satistically significantly difference among treatments. T2 treatment produced the highest plant height, 33.50 cm while that of T1 treatment was recorded as the least plant height, 19.18 cm (Table 2 and Figure 3).

Table 2 Effect of bio composts and biofertilizers on plant height (cm) of okra.

Treatment	1WAS	2WAS	3WAS	4WAS	5WAS	6WAS
T1	3.30	7.18	11.13	15.80	18.25	19.18
T2	5.10	8.43	14.50	27.30	32.25	33.50
T3	4.68	7.98	14.13	25.50	29.50	30.50
T4	3.88	7.98	13.18	21.70	24.13	25.63
T5	4.78	7.58	13.68	23.05	25.15	28.13
F test	1.71	0.89	1.03	4.64	5.35	5.59
5 % LSD	ns	ns	ns	*	*	**
CV%	25.9	12.8	19.4	18.3	18.0	16.8

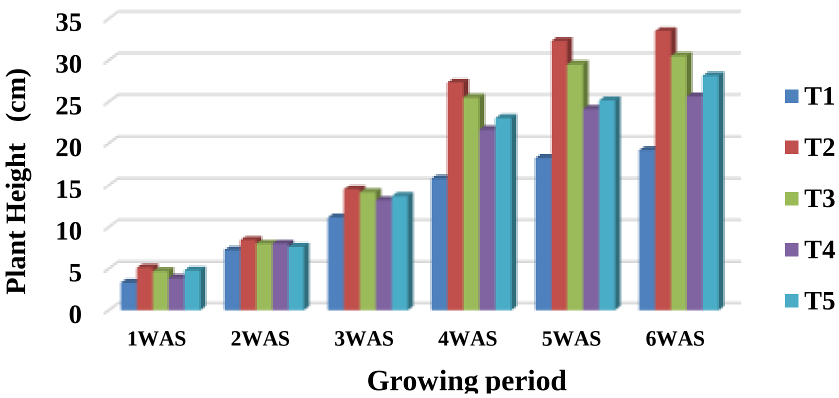

Figure 3 Plant height treated with bio composts and biofertilizers in okra.

The mean number of leaves were not clearly different in initial growth (1WAS). The number of leaves were increased enentually at mature. T2 treatment obtained the highest leave number 10.25, followed by T3, T5 and T4 while T1 treatment recorded the least leave number (Table 3 and Figure 4).

Table 3 Effect of bio composts and biofertilizers on number of leaves of okra.

Treatments	1WAS	2WAS	3WAS	4WAS	5WAS	6WAS
T1	2.00	2.75	3.50	4.00	4.00	5.50
T2	2.00	5.25	5.75	8.00	8.50	10.25
T3	2.00	3.75	5.75	6.50	7.75	9.25
T4	2.00	3.00	4.50	5.25	5.75	7.75
T5	2.50	3.50	5.50	5.75	6.00	8.50
F test	3.00	3.14	3.97	4.75	3.55	4.58
5% LSD	ns	ns	*	*	ns	*
CV%	12.3	31.5	19.7	23.1	29.4	20.3

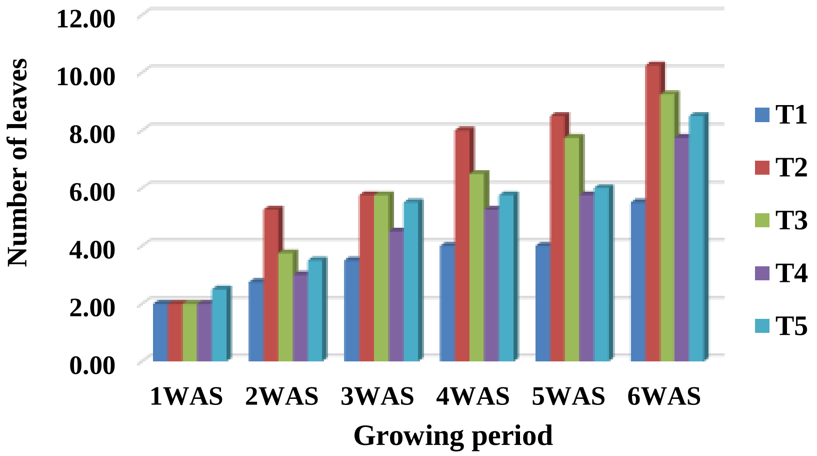

Figure 4 Number of Leaves treated with bio composts and biofertilizers in okra.

Flower formation was occurred in 2 WAS in all treatments. Among these, T2 treatment showed better results in flowering, followed by T3, T5 and T4. T1 treatments had the lowerst flower number than other treatments (Table 4 and Figure 5).

Table 4 Effect of bio composts and biofertilizers on number of flowers of okra.

Treatments	2WAS	3WAS	4WAS	5WAS	6WAS
T1	1.00	2.00	2.00	2.75	4.25
T2	3.00	3.50	4.25	5.75	7.50
T3	2.00	2.75	3.50	4.75	7.00
T4	2.00	2.50	3.25	3.75	5.50
T5	2.00	2.25	3.25	4.75	6.00
F test	15.00	7.35	32.43	14.22	10.08
5% LSD	**	**	**	**	**
CV%	18.3	23.7	11.8	14.1	13.3

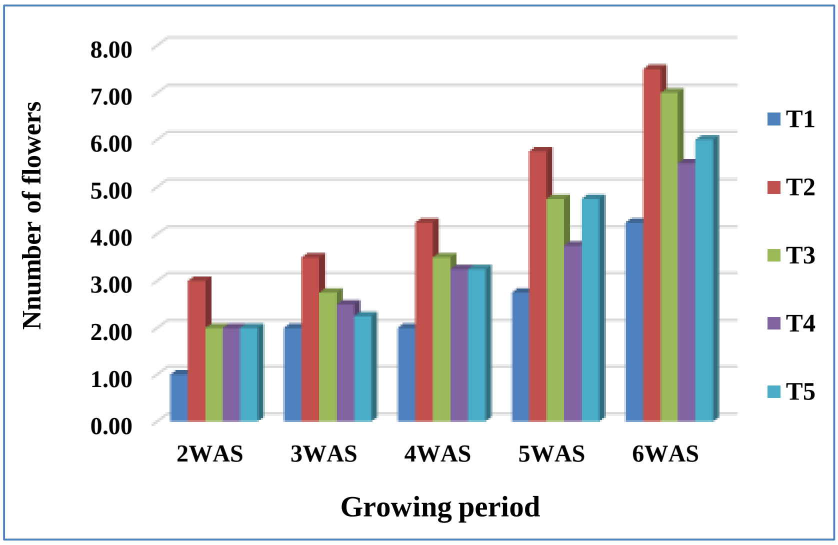

Figure 5 Number of flowers treated with bio composts and biofertilizers in okra.

Similarly, the number of fruits per plant was the highest in T2 treatment, 7.00 until harvest time (6WAS) and the second highest fruiting was observed in T3 treatment, 6.00. The result of T4 and T5 treatments were not significantly different, 4.75 and 5.25. Among these, T1 possessed lowest fruit number, 3.25 (Table 5 and Figure 6).

Table 5 Effect of bio composts and biofertilizers on number of fruits of okra.

Treatments	3WAS	4WAS	5WAS	6WAS
T1	1.50	2.75	2.50	3.25
T2	3.50	4.25	5.00	7.00
T3	3.25	4.00	4.75	6.00
T4	2.50	3.25	3.50	4.75
T5	3.00	3.75	4.25	5.25
F test	5.77	5.31	10.83	17.83
5% LSD	**	*	**	**
CV%	23.9	17.8	17.1	12.7

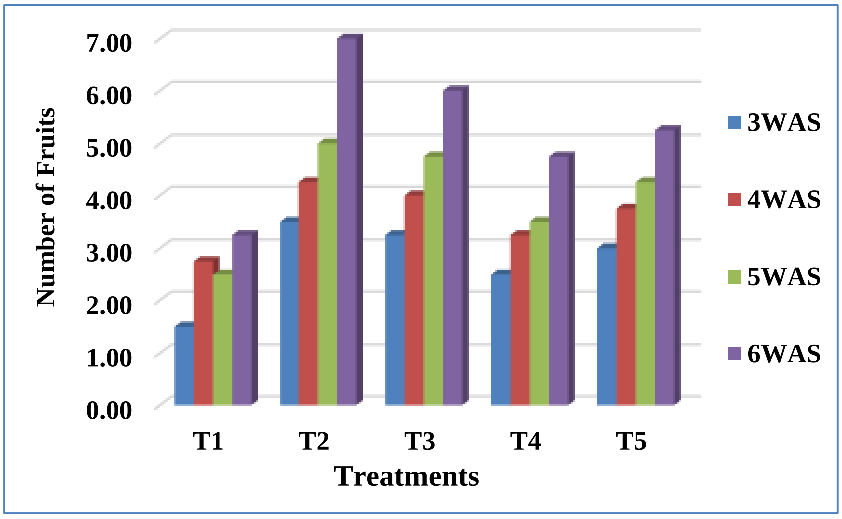

Figure 6 Number of fruits treated with bio composts and biofertilizers in okra.

Figure 7 Okra seeds, bio composts and biofertilizers

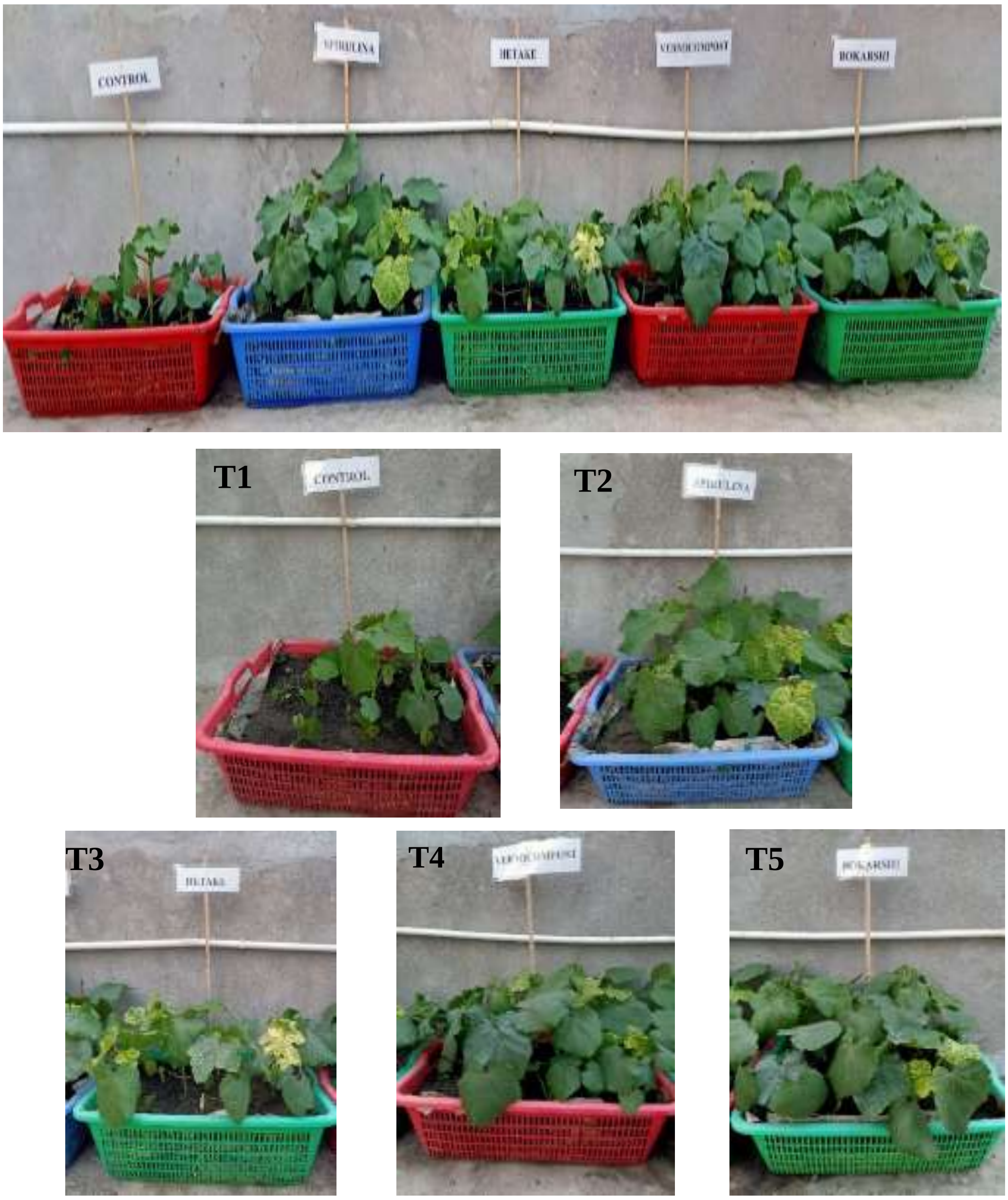

Figure 8 Germination experiment of okra

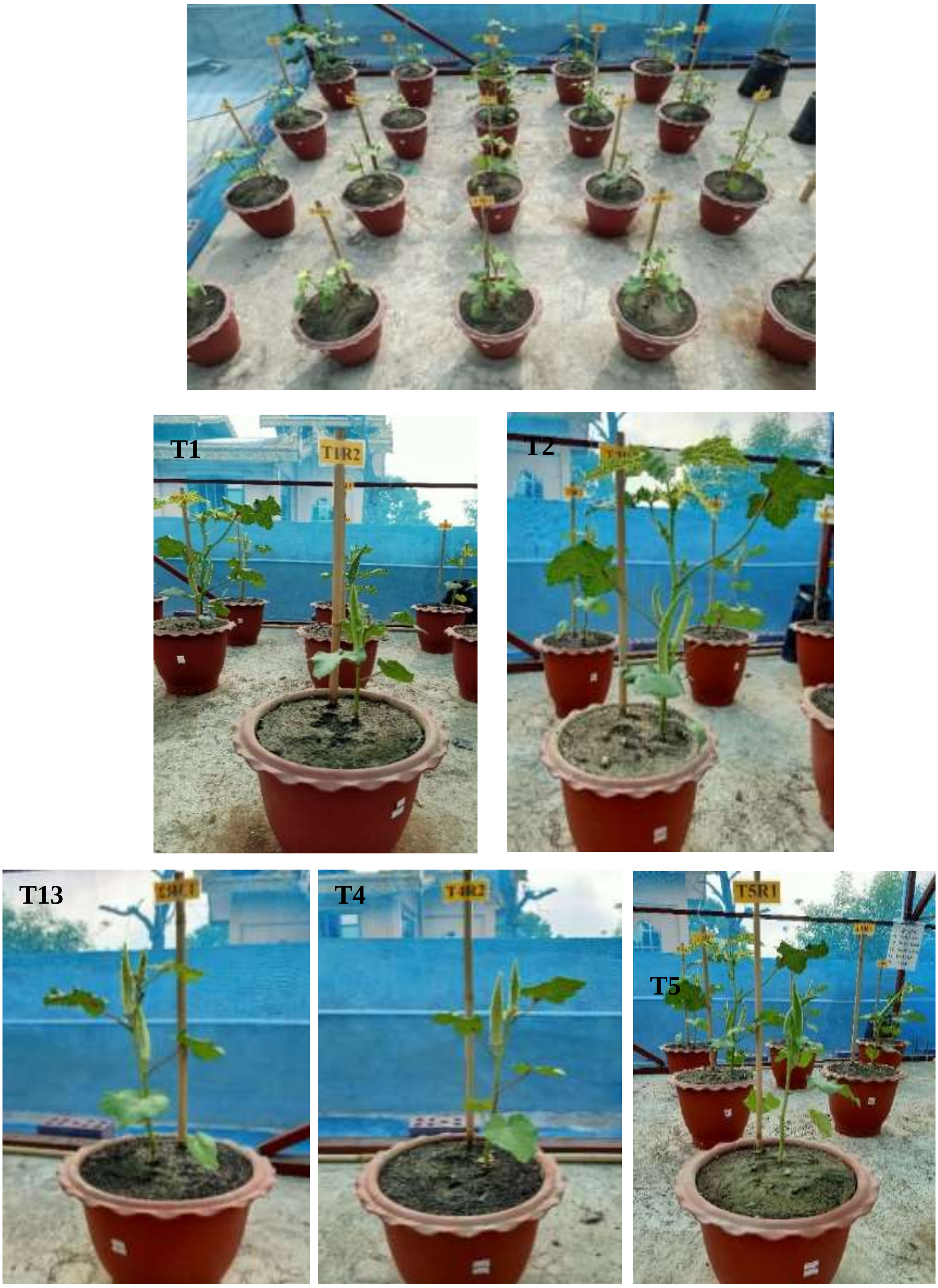

Figure 9 Okra plants treated with bio composts and biofertilizers in pot experiment.

Discussion and Conclusion

The effective utilization of bio composts and biofertilizers for crop production will not only to safe food production and but also provide avoidance to various health hazards of the people. Kannaiyan (2002) stated that "the beneficial effect of organic and biofertilization on enhancing soil fertility and the uptake of different nutrients surely reflected on stimulating growth characters and nutritional status of the trees in favour of producing more fruits".

This study has clearly described that the application of bio composts and biofertilizers make significant difference in germination, growth and yield of okra. Among these, germination percentage and all of measuring parameters were distinctly affected in T5 (Bokarshi) treatment. Ncube *et al*.,(2011) stated that "the application of Bokarshi appeared to promote early fruiting and root growth in tomato". Christel (2017) explained that "Bokarshi may be a feasible soil ferility amendment to be used as an alternative or supplement to compost". Naik *et al*., (2020) found that "foliar application of EM gave higher pod yields in okra compare to control".

Spirulina biofertilizer has a good response in okra cultivation and it has the second highest values in growh and yield parameters. Ahmed *et al*., (2011) presented that "Enriched organic fertilizers with biofertilizers especially *Spirulina platensis* algae was beneficial in improving yield quantitively and qualitatively rather than application of organic fertilizer alone". The plant height, number of leaves, flowers and fruits of Vermicompost treatment and *Spirulina* biofertilizer treatment were nearly difference.

According to the results, the germination percentage of okra treated with Vermicompost was 83.33 % and their height was 25.15 cm at 5 WAS. Tensingh and Muthulakshmi (2017) found that "the rate of seed germination was higher in okra plants treated with Vermicompost, 80 %. Agarwal and Sinha (2010) presented that "80 % of seed germination of okra was found to be numerically higher in pots with Vermicompost treatment in summer. They also stated that the plant height of okra in Vermicompost treatment was 24.13 cm after 45 days. Edwards *et al*., (2004) stated that "Vermicompost has a positive influence on vegetative growth, stimulating shoot growth and root development". In 2007, stimulated seed germination in green gram, tomato and petunia after imbedding vermicompost in soil has been documented by Zaller.

Among the treatments, Hatake biofertilizer showed better results in root length. Hatake biofertilizer improved the growth rate of plants, enhancing the microbial activities of soil, may be improved to root biomass and increasing plant uptake on soil nutrients. It is 100 % organic and will not contaminate the soil, water streams or environment and even safe for human ingestion (http://hatake-global.com/product).

Therefore, the results of this study were agreed with findings of previous researchers. The results showed that application with Bokarshi, Vermicompost, *Spirulina* biofertilizer and Hatake biofertilizer have been shown to have several agronomic positive impacts on germination, growth and yield of okra under greenhouse condition. Thus, these bio composts and biofertilizers were determined as promising beneficial fertilizers in organic agriculture and can be used as an alternative to inorganic fertilizers.

Acknowledgements

We would like to express gratitude to Dr. Kyaw Kyaw Khaung, Rector, Est Yangon University, for his suggestions to carry out the research works. We wish to express my sincere thanks to Dr Min Min Yee, Pro-rector, East Yangon University, for her encouragement to do this research. We were greatly thanked to Dr. Daw San Khaing (Professor and Head), and Dr Thida Htoo (Professor), Department of Botany, for their constant encouragement to do the research. We would like to acknowledge to my colleges for their essential providing.

References

Abdul-Baki, A. and Anderson, J.D. (1973) Vigor Determination of soybean seed by Multiple Criteria. Crop Science 3, 630-633.

Agarwal, S., R.K. Sinha and Sharma, J. (2010) Vermiculture for Sustainable Horticulture Agronomic Impact Studies of Earthworms, Cow dung Compost and Vermicompost vis-à-vis Chemical Fertililzers on Growth and Yield of Lady's finger (*Abelmoschus esculentus*). International Journal Global Environmental Issues, *Vol*.10. *Nos*.3/4,2010.

Ahmed, F.F., A. Ibrahem-Asmaa, A.E.M. Mansour, E.A. Shaaban and M.S. EI-Shamma (2011) Response of Thompson Seedless Grapevines to Application of Some Amino Acids Enriched with Nutrients as well as Organic and Biofertilization. Res. J. of Agric. And Biological Sci., 7(2):282-286

Christel, D.M. (2017) The Use of Bokarshi As A Soil Fertility Amendment in Organic Spinach Cultivation. Graduate College Dissertations and These. University of Vermont.

Dominguez, J. (2004) State the art and new perspectives on vermicomposting research: In: C.A. Edwards (Ed.) Earthworm Ecology (2nd Edition.) CRC Press LLC.Pp,401-424

Edwards, C.A., J. Dominguez, and Arancon, N.Q. (2004) The Influence of Vermicompost on Plant Growth and Pest Incidence In: Soil Zoology for Sustainable Development in the 21st Century. Cairo, pp.397-420

FAO, Food and Agricultural Organization (2008) Guide to Laboratory Establishment for Plant Nutrients Analysis. Rome.

Harris, D. (1996) The Effect of Manure, Genotype, Seed Priming, Depth and Date of Sowing on the Emergence and Early Growth of Sorgnum bicolor (L.). Moench in Semi-arid. Botswans. Soil and Tillage Research, 40: 3-88.

Kannaiyan, S. (2002) Biotechnology of Biofertilizers. Alpha. Sci. Inter. Ltd, P.O. Box 4067 Pang Bourne R.68, U. K. pp:1-275

Naik, K., S. Mishra, H. Srichandan, P.K. Singh and A. Choudhary. (2020) Microbial Formulation and Growth of Cereals, Pulses, Oilseeds and Vegetables Crops. Sustainable Environment Research. Biogas Development and Training Centre, Kalinga Institute of Industrial Technology, Bhubaneswar, India.

Ncube, L., P.S.N. Minkeni and O. Brutsch. (2011) Agronomic Suitability of Effective Microorganisms, Composts and Mineral Fertilizer on Greenhouse-grown Tomato. African Journal of Plant Science, 6.120-124.

Tensingh, B.N. and Puthulakshmi, P. (2017) Effect of Microbially Enriched Vermicompost on the Growth and Biochemical Characteristics of Okra (*Abelmoschus esculentus* (L.) moench). Advanced Plants Agriculture Research. 2017 :6(5): 147-152

Zaller, J.G. (2007) Vermicompost as a Substitute for Peat in Potting media: Effects on Germination, biomass Allocation, Yields and Fruits Quality of Three Tomato Varieties. *Scientia Horticulture*, 112;191-199.

http//www.planetnatural.com

http://hatake-global.com/product