Effect of Bokashi Leachate Application on Maize *(Zea mays L.)* Crops

Mohd Akmal Shafiq Buang
Politeknik Jeli
mohdakmalshafiq@gmail.com

Abstract
The objectives of the studies are to produce a Bokashi leachate from kitchen waste and to study the effect of Bokashi leachate application on maize *(Zea mays L.)* crops. Bokashi leachate is a by-product from Bokashi composting process which takes places in anaerobic condition for two weeks. Bokashi leachate is then applied on maize crops by using foliar technique. There are four treatments with five replications. Treatment 1 (T1) was control, Treatment 2 (T2) was treated with 10:1000ml Bokashi leachate, Treatment 3 (T3) was treated with 20:1000ml Bokashi leachate and Treatment 4 (T4) was treated with 30:1000ml Bokashi leachate. The treatments were applied on weekly basis. Five parameters were measured in this study; they are number of leaves, height of stem, diameters of stem, length of leaves, and width of leaves. The objectives of this study are achieved. Treatment 4 (T4) showed the best performance among all the other treatments in term of diameters of stem (9.2 cm), length of leaves (70.4 cm) and number of leaves (11.0 leave). Bokashi leachate is proven to have effect on maize plant. It shows the differences in enlargement on maize plant on every treatment with the use of Bokashi leachate except treatment 1, T1 (controlled). Application of Bokashi leachate is recommended to be applied on maize crop by using rate of 30:1000ml on weekly basis for optimum production.

Keywords: Bokashi leachate, kitchen waste

1.0 Introduction

Bokashi is a Japanese term, means 'fermented organic matter' (Boechat, 2013). It is used as a fermentation starter or as a microbe and nutrient-rich carrier for various purposes, as well as for providing organic content matter to the soil. It is not clear when Bokashi was first used by farmers. Some say Bokashi has been used by farmers since the 1940's while others say that it may have been around since during the early Edo period (mid 1600's) in Japan. The practice of making and using some form of fermented organic matter may have also been used in other cultures throughout the world in ancient to recent past (Matsukawa S., 2004).

Bokashi was made by farmers by collecting several different kinds of organic matter (in which were the main source of the microbes), mainly mountain soil, or soil and moss from pristine valleys and forests or wooded areas, and some say by placing rice balls under a layer of leaves in the mountain.

The farmers would then mix the collected materials with their post-harvest residue and other plant waste materials (cut grass, weeds and leaves), and keep them under a covering in order for the mix to ferment. From there, there may be various methods to manage the mix in terms of moisture and temperature. After the material has fermented, the farmers would then use it as a soil amendment to add nutrients and organic content matter to their farm. What they may not have known was that it also added beneficial microorganisms to their farm soil (Matsukawa S., 2004).

Effective Microorganisms (EM) is a combination of naturally existing microbes, mainly lactic acid bacteria, yeast and phototropic bacteria. The combination consists of naturally existing microbes, mainly lactic acid bacteria, yeast and phototrophic bacteria. The combination made it potent as a microbial inoculant for improving soil microbial health and as a fermentation starter (Matsukawa S., 2004).

2.0 Problem statement

Increasing population and tremendous urbanization growth and other factors influence directly the municipal solid waste (MSW) generation in Malaysia. The huge quantity of MSW generation, particularly in Peninsular Malaysia, has increased from 16,200 tonnes per day in 2001 to 19,100 tonnes per day in 2005 or an average of 0.8 kg/capita/day. The amount increases yearly and seems to grow in parallel with the urban areas in many Asian countries which are estimated to produce approximately 8 million tonnes per day (Zamali Tarmudi, A.O., 2009). Waste management required high cost to operate annually and current landfill area is limited to dump the wastes we made every day. Thus, by converting the wastes (in this case kitchen waste) into Bokashi leachate we can help government to solve the landfill problem by minimizing the waste that goes directly to the landfills. Bokashi leachate is a by-product from Bokashi composting that produced from fermentation process of kitchen waste. The main product is Bokashi compost. There are lots of academic studies on Bokashi compost and its positive impact on agriculture and environment. However there is insufficient study related to Bokashi leachate and its usage in Malaysia. Previous study in Sweden, Bokashi leachate was used in urban farming as a bio-fertilizer for pak choi (Lind Olle, 2014). This research wants to study the effect of Bokashi leachate on food crops farming. Does the Bokashi leachate have effect on plant growth or not. Maize was selected as a test crop to measure the effectiveness of Bokashi leachate.

3.0 Research objective

The objectives of the study are:

a. To produce a Bokashi leachate from kitchen waste.
b. To study the effect of Bokashi leachate application on maize *(Zea mays L.)* crops.

4.0 Methodology

4.1 Preparation of Lactic Acid Bacteria (LAB)

All the apparatus and materials were prepared such as plastic jar, spoon, rice, water, milk and brown sugar. Rice was washed with water. The rice-washed water was stored in a plastic jar for a week. The liquid turned into three distinct layers: top, middle (LAB culture) and bottom. The LAB culture was separated from the rest. The LAB culture was mixed with milk (1:10). The mixture was left for a week. The mixture turned into two layers: solid (curd) and liquid layer (whey). The whey was separated. The whey was mixed with molasses (1:1).

4.2 Preparation of Bokashi leachate

All the apparatus and materials were prepared such as knife, chopping board, glove, Bokashi bin, container, food/kitchen waste, LABs, molasses, tap water and milk. The bin were filled with food waste that already been chopped into small pieces. The food waste was put into the bin in layers alternating with molasses and *Lactobacillus* serum. The bin was closed with lid tightly. The food waste was fermented for two weeks. Any leachate accumulated in the bottom bin during fermentation was drained off. The leachate was collected twice a week. The leachate is ready to use as fertilizer when the collection of leachate was concluded.

4.3 Application of Bokashi eachate on maize *(Zea Mays L.)* Crops

All apparatus and materials were prepared such as spray bottle, maize seedlings, water and Bokashi leachate. Bokashi leachates were diluted in water in the following proportions: control (T1), 10:1000 ml for treatment two (T2), 20:1000 ml for treatment three (T3), 30:1000 ml for treatment four (T4). The Bokashi leachate is applied on weekly basis. Data was taken on week 8th.

4.4 Research design

Table 1: Treatments on maize crops *(Zea mays L.)*

Treatment Number	Treatment	Replication
Treatment 1	Control	5 maize seedlings
Treatment 2	Bokashi leachate 10:1000 ml	5 maize seedlings
Treatment 3	Bokashi leachate 20:1000 ml	5 maize seedlings
Treatment 4	Bokashi leachate 30:1000 ml	5 maize seedlings

4.5 Data collection & analysis

Four parameters were measured in this study: height of plant (cm), diameter of stem (cm), number of leaves (leave) and length of leaves (cm). Plant height of each plant was measured from the base of the plant to upper the top of plant shoot using the measuring tape. The diameter of maize stem was measured by using the measuring tape. The number of leaves per plant was counted manually. The results were analysed using descriptive analysis. The data taken are arranged and recorded and analysed by using Microsoft Excel and presented using table and bar chart.

5.0 Result & discussion

Table 2: showed the mean of height of plant, diameter of stem, number of leaves, and length of leaves for four treatments.

Treatment	Mean			
	Height of plant (cm)	**Diameter of stem (cm)**	**Number of leaves**	**Length of leaves (cm)**
T1	69.8	6.8	10.0	57.4
T2	129.6	8.4	10.0	64.0
T3	131.6	8.6	10.0	68.2
T4	128.6	9.2	11.0	70.4

5.1 Height of plant (cm)

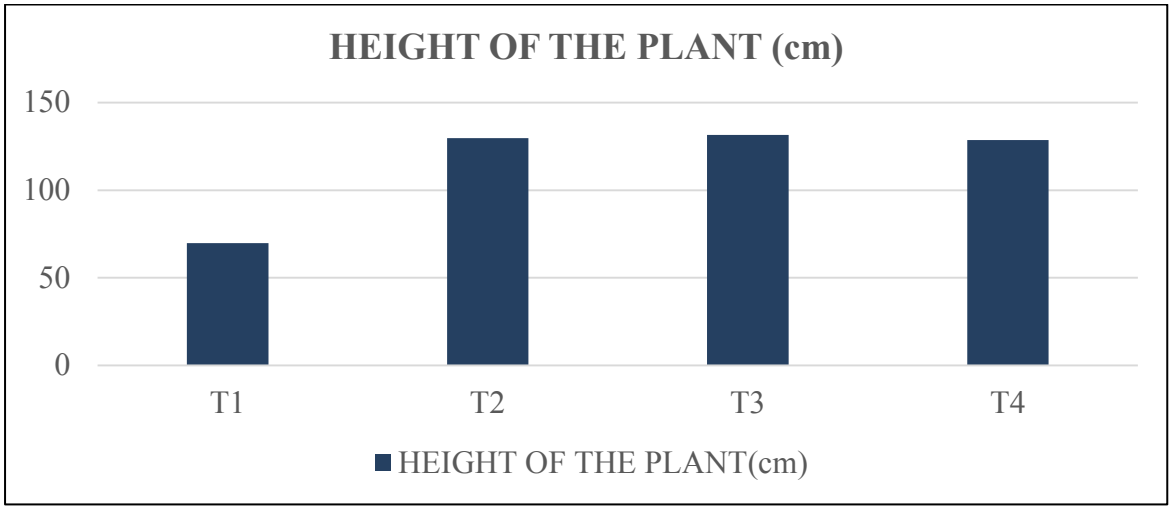

Figure 1: shows the height of the plant (cm)

Treatment 3 (T3) showed the highest height than the other 3 treatments. The mean height of maize *(Zea mays L.) i*n T3 is 131.6 cm. Even though the difference in the mean value is not large, it is proven that T3 (20:1000ml) is the most essential ration to optimize the growth height of maize *(Zea mays L.)* The controlled treatment showed the poorest growth in height which is the mean height is 69.8 cm. This shows that Bokashi leachate foliar application technique is very efficient for encouraging plant to grow vertically by promoting cell elongation in stem.

5.2 Diameter of stem (cm)

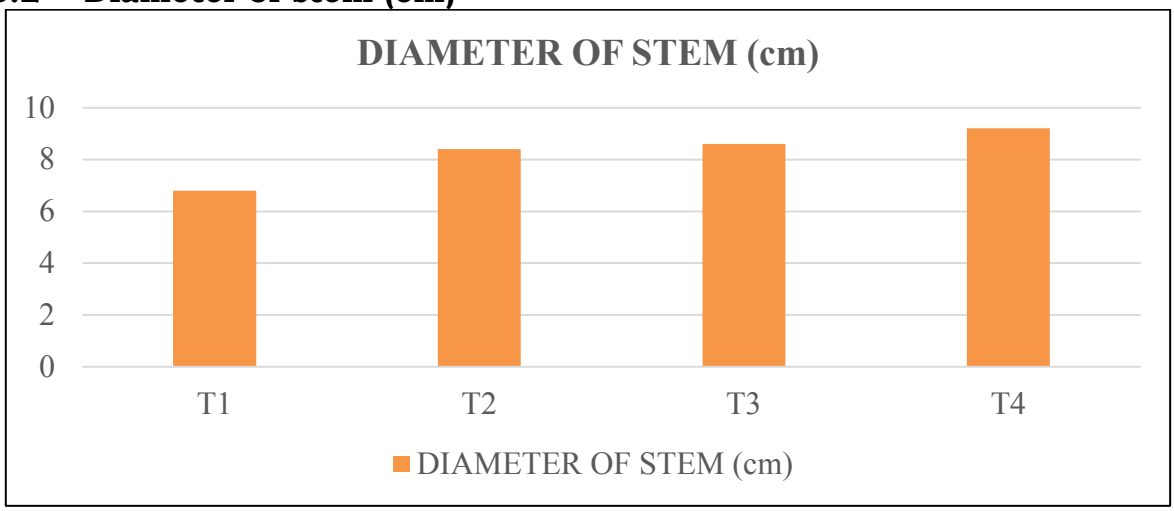

Figure 2: shows the diameter of stem (cm)

Treatment 4 (T4) showed the best performance among the other 3 treatments. The mean for diameter of the stem in T4 is 9.2cm which is the highest. The controlled treatment (T1) showed the worst performance where the mean is only 6.8cm. This proves that concentration in (T4) is most suitable for the rapid cell elongation on maize *(Zea mays L.)* stem. The difference in the value of mean measurement in T2 and T3 is very small which only 0.2 cm. In this case T4 is more suitable for the improvement of the stem diameter. Thicker stems help the keep the plant steady during strong wind and also for linear growth of plant. The presence of beneficial microbes and elements promotes the thickness of the stem of maize stem.

5.3 Number of leaves

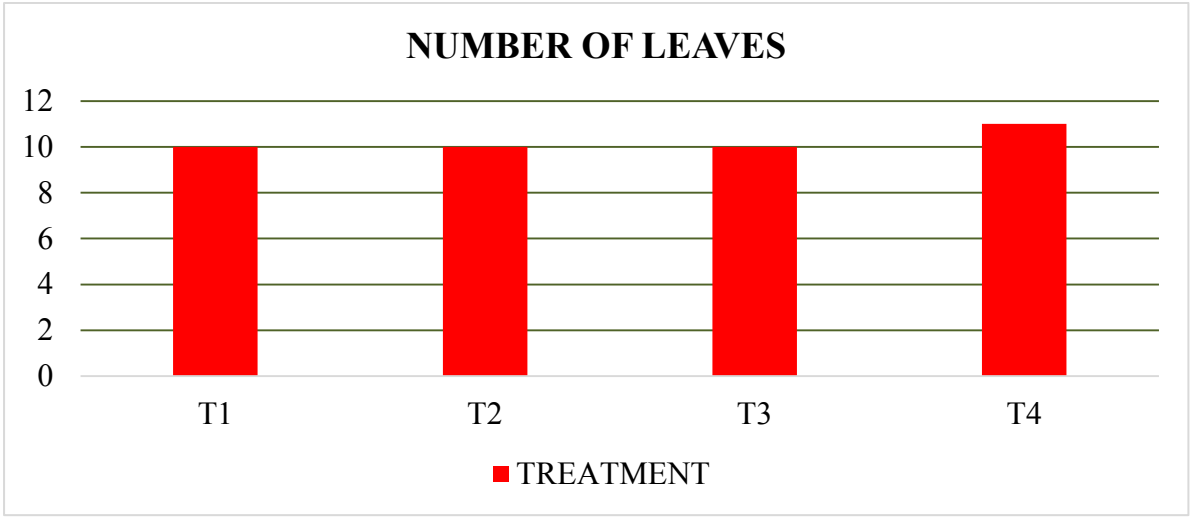

Figure 3: The bar graph mean of number of leaves.

Treatment 4, T4 (30:1000ml) showed the highest performance number of leaves (11.0 leaves). Treatment 1, 2 and 3 were totally same (10.0 leaves). Application of Bokashi juice is proven increasing the growth of leaves of *Zea*

mays L. Presence of nitrogen content in Bokashi juice helps to fasten the process of leaves formation. Plants require nitrogen in the largest amounts to make new cell and tissue. Nitrogen promotes rapid growth, increase leaf size and quality. Leaves photosynthetic capacity is strongly positively correlated with leaves nitrogen content. (Evans, 1989 and Wright et al. 2004).

5.4 Length of leaves (cm)

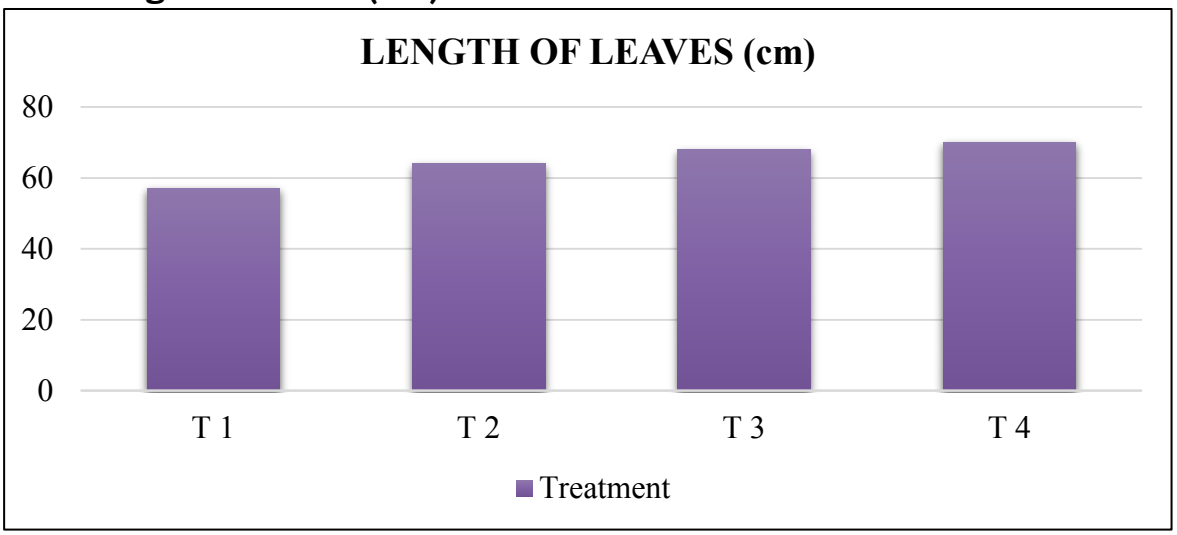

Figure 4: The bar graph mean of length of leaves.

Treatment 4, T4 (30:1000ml) showed the highest performance in term of length of leaves (70.4 cm) when compared with treatment 3, T3 (68.2 cm), treatment 2, T2 (64.0 cm) and treatment 1, T1 (57.4 cm). In this case the rate of concentration of Bokashi leachate does influence the length of leaves. Application of the Bokashi leachate is proven can promote the length of leaves of maize crops (*Zea mays L.*). This is because Bokashi is an organic fertilizer, which is made by fermenting organic matter. Bokashi contains a lot of nutrients and it serves as a rapid working fertilizer (Frimpong, K.A., 2016).

6.0 Conclusion

The objectives of this study are achieved. Treatment 4, T4 (30:1000ml) showed the best performance of maize *(Zea mays L.*) crops with largest diameter of stem (9.2 cm), highest number of leaves (11.0 leave) and highest length of leaves (70.4 cm). These parameters help plant to growth better, able to withstand strong wind and conduct photosynthesis efficiently. Overall, Bokashi leachate is proven to have effect on maize plant. It shows the differences in enlargement on maize plant on every treatment with the use of Bokashi leachate except treatment 1, T1 (controlled). Bokashi leachate contains nutrients from the kitchen waste and full with the beneficial microorganisms such as lactic acid bacteria that can promote the growth of maize crops. Last but not least, application of Bokashi leachate is recommended to be applied on maize crop by using rate of 30:1000ml on weekly basis for optimum production.

References

Boechat, C. L., Santos, J. A. G., & Accioly, A. M. D. A. (2013). Netmineralization nitrogen and soil chemical changes with application of organic wastes with fermented Bokashi compost. *Acta Scientiarum. Agronomy, 35(2*), 257-264. Retrieved from www.recyclefoodwaste.org

Evans, J.R. (1989). *Photosynthetic and nitrogen relationships in leaves of C. plants*. Occologia, 78:9-19. Retrieved from www.eprints.uthm.edu.my Evans,

J.R (1989). *Partitioning of nitrogen between and within leaves grown under different irradiance*. Aust. J. Plant Physiol., 16:533-548.

Frimpong, K. A., & Osei, B. A. (2016). Growth, yield and leaf nutrient composition of lettuce grown in a silty loam soil amended with compost at different rates. *Journal of Organic Agriculture and Environment, 4(1)*, 4-16. Retrieved from www.aob.oxfordjournals.org

Lind, O. (2014). *Evaluation of Bokashi fermentation leachate as a biofertilizer in urban horticulture: inorganic plant nutrient content in Bokashi leachate and its effect as a fertilizer on pak choi*. Second cycle, A2E. Alnarp: SLU, Department of Plant Breeding (from 130101). Retrieved from: https://stud.epsilon.slu.se/7353/

Matsukawa, S. (2004). *Making Bokashi. Bokashi fermentation starter for recycling food waste,* 5. Retrieved from www.recyclefoodwaste.org

Zamali Tarmudi, A. O. (2009). An overview of municipal solid wastes generation in Malaysia. *Jurnal Teknologi, 1-2*.