EFFECT OF MONOSODIUM GLUTAMATE ON THE GROWTH OF *SOLANUM MELONGENA*

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Abstract

Solanum melongena is one of the vegetable crops broadly planted and has high demand, especially in Asia. Nowadays, chemical fertilizer was used to fulfill the demand as it function to speed up the plant's growth. However, prolonged use may create an imbalance of soil nutrients and discourage decomposition in soil microbes. Recently, monosodium glutamate (MSG) which is commonly known as food flavoring was reported to be used as alternative fertilizer due to the high content of nitrogen. However, the MSG used was from wastewater of MSG factory which may have the unknown component. Hence, the aim of this study is to determine the optimum concentration of pure MSG (Ajinomoto) towards the growth of *S. melongena* and how it affects the pH of the soil. The plants were treated by using 1.5g/L, 2.0g/L, 2.5g/L of MSG three times per week for seven weeks. The growth parameters were the plant's height, number of leaves and width of leaves. The result suggests that the height for all treatment were significantly higher compared to control. All treatment also shows a significantly higher number of leaves compared to the control group except for those with 1.5 g/L treatment. However, no significant difference in leaf width observed from all treatments compared to control. There are no significant changes in soil pH when MSG was used in this study. Hence, the study showed that MSG gives a significant positive effect on *S. melongena* and can be used as an alternative fertilizer to reduce the usage of chemical fertilizer.

Keyword: Ajinomoto, Fertilizer, Monosodium glutamate, *Solanum melongena*

Introduction

The population of the world has surpassed 7.63 billion individuals and this number is proceeding to increase each day. Therefore, the world is facing high food demand. In order to meet the demand, there was an increase in the use of chemical fertilizer to speed up food production (Metson et al. 2016). Even though chemical fertilizer may lead to a high rate of growth of the plant in a short period of time, it is expensive and has harmful effects on the environment, soil structure, soil properties and soil composition (Ranjan et al. 2018; Vinci et al. 2018). The continuous usage of high levels of chemical fertilizers may create the imbalance of soil nutrient, a decline in crop productivity and discourage decomposition in soil microbes (Mahanty et al. 2017). Therefore, the farmer is suggested to use alternative fertilizers to maintain the sustainability of food production. One of the alternative fertilizers that can be used nowadays is monosodium glutamate (MSG). MSG is one of the common kitchen needs (Meihuo, 2015) that is created by the fermentation of the starch, corn sugar or molasses from sugarcane or sugar beets (Zhang et al. 2012). Yang et al. (2005) described that MSG contains a high concentration of organic matter, ammonium, and sulfate which is needed for plant growth. The active component that reflects the quality of organic fertilizer is nitrogen (Krishna & Mohan 2017) and MSG has a high amount of nitrogen (Kraboun et al. 2013). MSG has been reported to give a positive effect on the growth of *Brassica rapa* and *Zea mays* (Singh et al. 2009; Singh et al. 2011). In addition, the same positive effects were reported on the growth of *Zea mays* using MSG purely from Ajinomoto. However, the MSG used in the study was from the wastewater of MSG factory which may have the unknown compound. *S.melongena* or commonly known as aubergine, brinjal or eggplant are classified as a berry fruit and often cultivated in a tropical and subtropical climate with a comparatively high price and beneficial for indigent consumers (Sujayanand et al. 2015). Most phenolics can be found in aubergine are known as life-saving plant bio-actives (Barreira et al. 2008; Gorinstein et al. 2009; Muller et al. 2011). Aubergine contain polyphenols which are bioactive molecules and act as free radical terminators in antioxidant activities of plant materials (Shahidi & Ambigaipalan 2015; Aleksic & Knezevic 2014). Aubergine has maximum antioxidant activity and can represent as an excellent source of natural antioxidant for human health (Sultana et al. 2013). Aubergine was known as the top ten of the world's healthiest food and the best species cultivated worldwide (Caguiat & Hautea 2014). Due to its various benefits and high demand in Asia, this study was carried out to find the alternative fertilizer for *S.melongena* that is safe to be used with minimum harmful effect. Hence, the aim of this study is to determine the optimum concentration of pure MSG (Ajinomoto) towards the growth of *S.melongena* and how it affects the pH of the soil.

Materials and Methods

S. melongena Growth Parameter

S. melongena were planted in a polybag filled with a fixed amount of nursery medium with the soil ratio of 2: 1: 1 (w/w/w) composed of 2 for cocoa peats, 1 for organic soil and 1 for river sand. Five seedlings of a month ages were used for each treatment. The seedlings chosen were equal in height and had the same number of true leaves. The plant's growth parameters were observed by measuring the number of leaves, the height of the plants and the width of the leaves for every week. The heights of plants were measured from the shoot to stem using a ruler and thread. The pH of soil was determined before the treatment and after seven weeks of treatments using pH meter.

Preparation of MSG Stock Solution

The solutions of MSG used in this study were prepared by diluting the pure crystal of commercialized MSG (Ajinomoto) with a fixed volume of water. MSG crystal was dissolved using 1.0 L of tap water into three different concentration of 3g/L, 4g/L and 5g/L. All the solutions were stored until further used.

Preparation of MSG Working Solution

1L of MSG stock solution were diluted with 1L of H_2O and used in the treatment. The concentration of the stock solution and working solution of MSG were listed in **Table 1**.

Table 1 Concentration of stock solution and working solution of MSG

Stock concentration	Working concentration
3g/L	1.5g/L
4g/L	2.0g/L
5g/L	2.5g/L

Treatment of *S. melongena* using MSG Solution

All the treatment in this study were done on *S. melongena* using five biological replicates and summarized in **Table 2**. Negative control plants were supplied with 300 mL of tap water (H_2O) while positive control plants were supplied with 300 mL AB fertilizer per application (according to manufacturer recommendation). Treatment A was supplied with a fixed volume (600 mL) of MSG (1.5g/L). Treatment B was supplied with a fixed volume (600 ml) of MSG (2.0g/L). Treatment C was supplied with a fixed volume (600 ml) of MSG (2.5g/L). All of the controls and treatments were done three times a week for total of seven weeks.

Table 2 Concentration of MSG solution used in the treatment of *S. melongena* plant

Type of treatment	Concentration	Amount
Tap water (Negative control)	-	300mL
AB fertilizer (Positive control)	-	300mL
Treatment A	1.5g/L	300mL
Treatment B	2.0g/L	300mL
Treatment C	2.5g/L	300mL

Statistical Analysis

All the characterizations on the growth parameter of *S. melongena* were conducted in five replicates. The data collected were presented as means ± standard deviation. The statistical analysis was performed using Minitab 18 software (Minitab, Inc., State College, Pennsylvania, USA). Statistical comparisons were made by one-way analysis of variance (ANOVA), followed by Tukey's multiple-comparison test. The significant difference was determined with 95% confidence interval ($P < 0.05$).

Results and Discussion

All the growth of *S. melongena* plant observed in this study were recorded in **Table 3** where all the growth parameter values are indicated as mean ± standard deviation values (n=5).

Table 3 The growth of treated *S. melongena* plant using MSG compared to the positive control and negative control

Treatment	Plant Height(cm)	Number of Leaves	Width of Leaves (cm)	Soil pH
Negative control	16.80 ± 1.89^{c}	5.40 ± 1.14^{c}	8.80 ± 0.76^{a}	6.10 ± 0.07^{b}
Positive control	24.30 ± 3.62^{ab}	8.60 ± 0.89^{ab}	10.70 ± 0.67^{a}	6.16 ± 0.19^{b}
Treatment A	22.40 ± 2.51^{b}	7.20 ± 0.84^{bc}	9.80 ± 1.10^{a}	6.94 ± 0.14^{a}
Treatment B	25.00 ± 2.92^{ab}	9.60 ± 1.14^{a}	10.80 ± 1.79^{a}	7.03 ± 0.11^{a}
Treatment C	28.00 ± 1.87^{a}	10.80 ± 1.92^{a}	10.60 ± 1.14^{a}	6.81 ± 0.48^{a}

a,b,c - Values with different letter are indicated as mean ± standard deviation which significantly different from each other ($P<0.05$).

Plant Height

All the plants' height is significantly higher compared to control (**Table 3**). The growth of plant in treatment C are significantly higher (28.00 cm) compared to the plants in treatment A (22.40

cm) but there was no significant difference with those in treatment B. The growth of plant in treatment B were also not significantly different compared to plants in treatment A (**Figure 1**) .

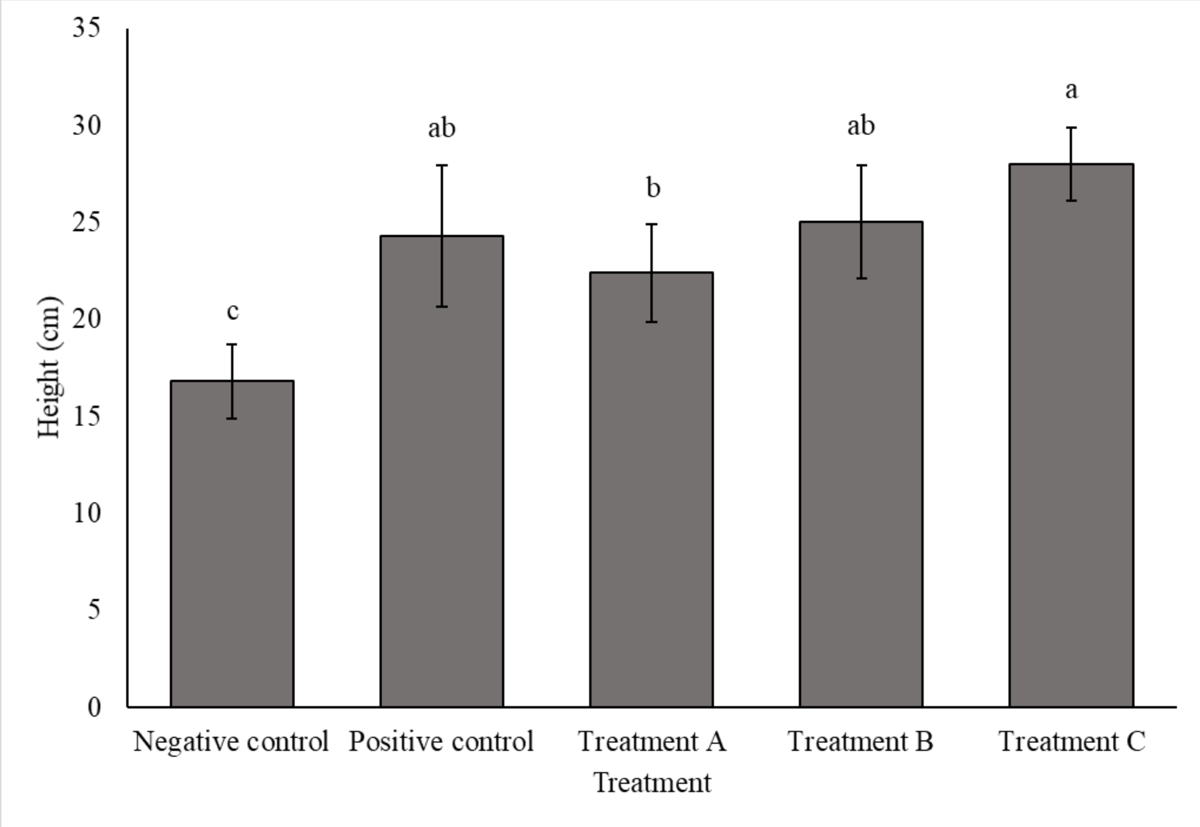

Figure 1 Height of *S. melongena* treated with different concentration of MSG solution compared to control. Different letter of a,b,c are indicated as mean which significantly different from each other (P<0.05)

The result showed that MSG can enhance the height of *Solanum melongena*. The height of *S.melongena* plants increased due to the high amount of nitrogen content in MSG. Previous studies have shown that the shoot morphology was positively affected by the supplementation of nitrogen (Jacquemoud et al. 2009; Gratani 2014). Nitrogen also plays an important role in photosynthesis as it can produce the supply of carbohydrates in the cell division process commonly in the shoots of plants and improved the root and shoot biomass production (Cormier et al. 2019).

Number of Leaves

All the treatments produce a significantly higher number of leaves compared to control except for the lowest concentration which is plant in treatment A (**Table 3**). The plants in treatment C are producing significantly higher number of leaves compared to the plants in treatment A despite showing no significant difference compared to those in treatment B (**Figure 2**).

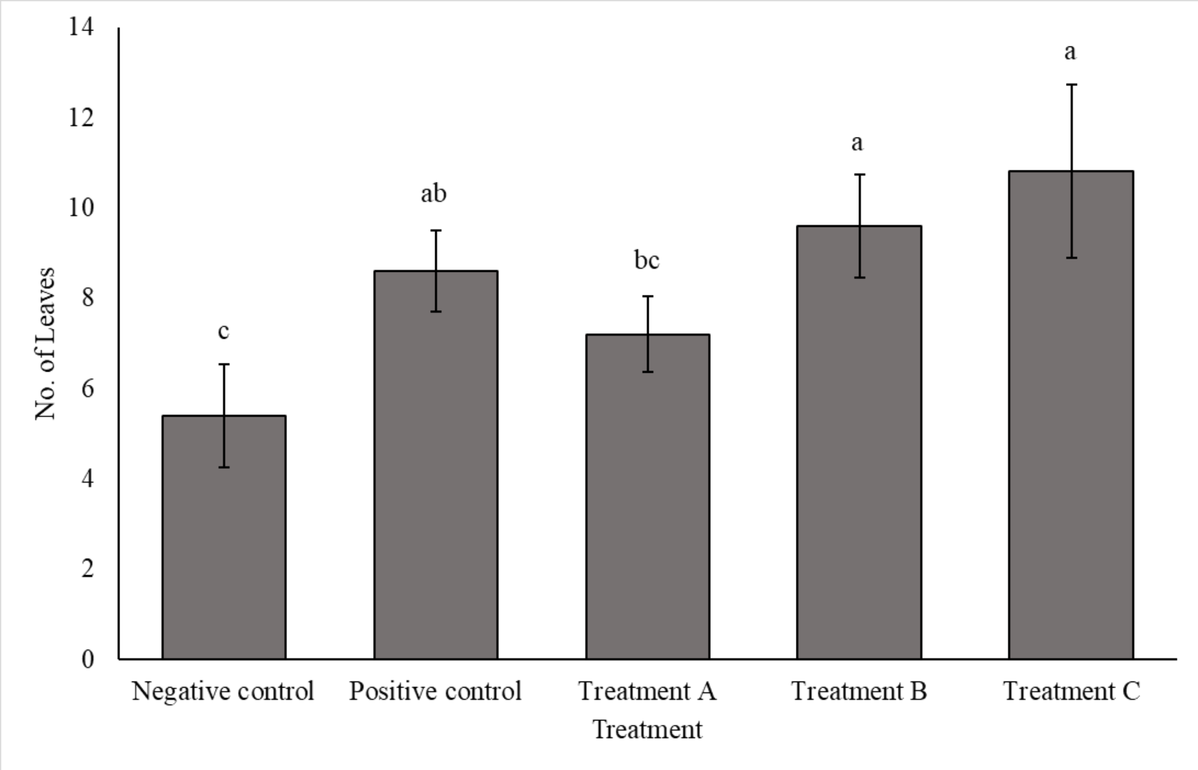

Figure 2 Number of leaves of *S. melongena* treated with different concentration of MSG solution compared to control. Different letter of a,b,c are indicated as mean which significantly different from each other (P<0.05)

The number of leaves for *S.melongena* plants in treatment C were highly significant compared to the negative control. The result suggested that it was due to the nitrogen content in MSG. According to Erisman et al. (2015), nitrogen is one vital nutrient to help the plant increase the number of leaves. Carocho et al. (2014), also agreed that the treatments which have high nitrogen content give a positive influence in the growth of new leaves. Hence, it was suggested that MSG can contribute to the growth of leaves.

Width of Leaves

The width of leaves of *S.melongena* plants that treated with MSG were not significantly different between negative control and treated plants (**Table 3**). The treatment with MSG does not affect the width of *S.melongena* plants. Supposedly, nitrogen in MSG may show its effect in increasing leaf area (Maluki, 2016). The result suggests that the width of the leaves was not affected due to the presence of pest which is whitefly (*Bemisia tabaci*) in which it can respond negatively toward the width of the leaf (Khalil, 2017).

Conclusion

The study reported that pure MSG from Ajinomoto has a significant positive effect on *S. melongena* and can be used as an alternative fertilizer to reduce the usage of chemical fertilizer. In the study, the pH of the soil of plant treated with MSG was slightly higher but *S. melongena* can still grow up as nitrogen is the vital element for the growth of a plant.

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Conflict of interests

Author declares no conflict of interest.

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