THE EFFECTS OF MONOSODIUM GLUTAMATE AS AN ALTERNATIVE FERTILIZER TOWARDS THE GROWTH OF *Zea mays*.

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Abstract

Zea mays or commonly known as corn is one of the most important crops in the world. The large production of corn will be associated with the massive use of fertilizer that cost a lot of money. Nowadays, monosodium glutamate (MSG) was known to be used as alternative fertilizer. Despite its widespread use as food flavor, MSG was reported to show a positive effect on plant growth when used as fertilizer. However, the recent studies use MSG industrial wastewater as fertilizer which has an unknown chemical compound and changes the pH of the soil. This study focused on using commercial MSG (Ajinomoto) that is safer as the source of MSG. Hence, this study aims to determine the effects of commercial MSG towards the growth of corn plant. The plants were treated in this study using 1% w/v, 5% w/v and 10% w/v of commercial MSG. The MSG was supplied 3 times per week for 6 weeks. The result suggests that 10% w/v MSG gave the most rapid growth towards *Z. mays* plant. The plant's height, stem's diameter, number, and length of leaves increased 3.1 folds, 2.6 folds, 2.5 folds, and 2.7 folds respectively compared to control. Hence, this study was the first to report that Ajinomoto MSG has a positive effect on the corn plant and suitable to be used as a low-cost green practice fertilizer.

Keyword: Ajinomoto, Alternative Fertilizer, Corn, Monosodium Glutamate

Introduction

Zea mays or commonly known as corn is one of the most important and widely used crops in the world (Khan et al., 2008) including in Malaysia (Ashraf et al., 2017). Over the last five years, corn farmers experienced constant increases in annual revenues (Clarke, 2014). However, a large production of corn will lead to the massive use of fertilizer. Fertilizer can be divided into two types which are organic and chemical fertilizer. It is a substance that contains the elements that improve growth and productiveness of plants. According to Dittmar et al., (2009), fertilizers are manufactured mixtures of chemical products that contain nitrogen (N), phosphorus (P), potassium (K) and other necessary nutrients. Fertilizers may enhance or replace the natural fertility of the soil and the chemical component that is taken from the soil.

Nowadays, most fertilizer used was chemical fertilizer. It gives a huge impact on plant growth, but, extended use may create an imbalance of soil nutrients and reduce the decomposition of soil microbes (Zhao et al., 2016). Chemical fertilizers usually contain sulphuric acid and hydrochloric acid. The acids tend to increase the acidity of the soil and interfere with plant growth (Guo et al., 2010). Unlike chemical fertilizer, natural and organic fertilizer provides the plants with nutrients while naturally build the soil composition. The application of organic fertilizer also more flexible and can be applied in a larger amount (Xiao et al., 2017). There are several organic alternative fertilizers that can be used such as soy husk, animal waste and food waste (Wu et al., 2014).

Recently, there was a study conducted to determine the effect of MSG as an alternative

fertilizer. MSG was an odourless, soluble, white crystalline powder which considered as a cheap and reachable fertilizer as it was one of the common kitchen needs. Despite its widespread use as food flavour, MSG was reported to show a positive effect on plant growth when it was used as a fertilizer due to its high content of nitrogen (Kraboun et al., 2013). Similar to chicken manure, MSG contains a substance that promotes beneficial soil microbes to propagate (Lin, 2010). However, the recent studies use MSG-industrial wastewater as fertilizer which may have other unknown chemical compound and might change the pH of the soil. The changes in pH and concentration may occur when the MSG-wastewater resourced from the reservoir is exposed to rain and extreme weather (Walker, 2000). On the contrary, this study focused on using commercial MSG (Ajinomoto) that is safer as the source of MSG (Germain, 2017).

Hence, this study aims to determine the effects of commercial MSG (Ajinomoto) towards the corn plant physiological development and to determine the optimum concentration of commercial MSG required to grow corn plant efficiently. This study emphasizes alternative and sustainable practices for crop production by utilizing seasoning powder as fertilizer sources.

Materials and Methods

The study was conducted at WNR Enterprise nurseries, Bandar Tun Abdul Razak, Jengka, Pahang. The area was about 1/10 acre which equals to 404.686 square meters. Four sets of corn seeds were planted in linear form. Each line represents different concentration of MSG supplied which was 0% (control), 1%, 5% and 10% w/v.

Soils Preparation

Mixed soils were prepared at ratio 3:2:1 which consists of topsoil, compost (peat), and sand. Polybag with the size of 14x14 inches was used in this study.

Preparation of Seeds

Corn seeds with the brand of Ria Organik which contains at least 20 seeds per packed were used. The seeds were soaked in water overnight before the seed was planted. Only good and healthy seeds were chosen for this study.

Seed Planting

Only one seed was planted in each polybag. The seeds were planted at 2.0 cm depth from the soil surface. The seed was grown for two weeks with the daily watering schedule without MSG. There were four sets of 5 polybags consist of three treatments and one control done in this study. Including the set for the control, there were a total of at least 20 polybags used. Each of the polybags was labelled accordingly and placed in a distance of 35 inches apart from each other.

Randomized Complete Block Design (RCBD)

RCBD method was used in this study as the study was done on open fields. The RCBD method was done to randomized the possible input of environmental factor such as rain and sunlight on each polybag and reduce bias. The plots were divided by 5 blocks where each block contains 4 plants (**Figure 1**). Each of the plant from every treatment was randomly assigned in every single block using excel randomization function (**Figure 2**).

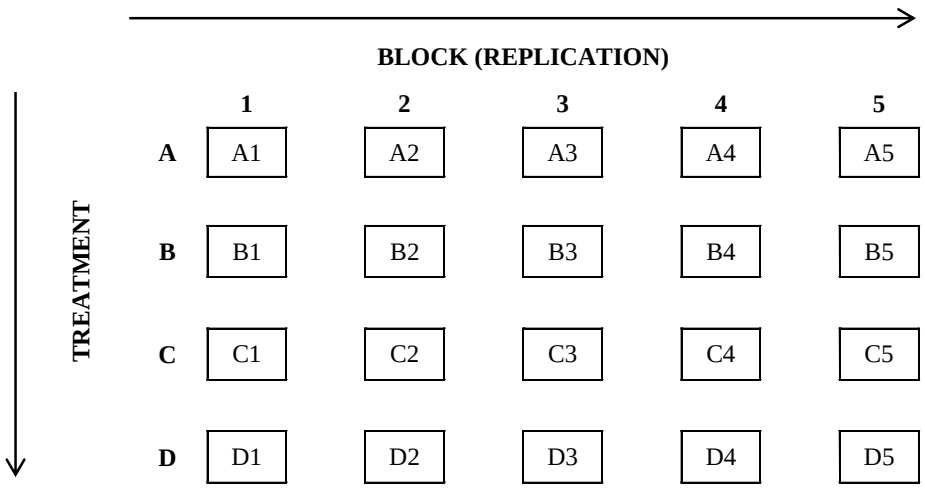

Figure 1 Planting plot of corn plant before randomization

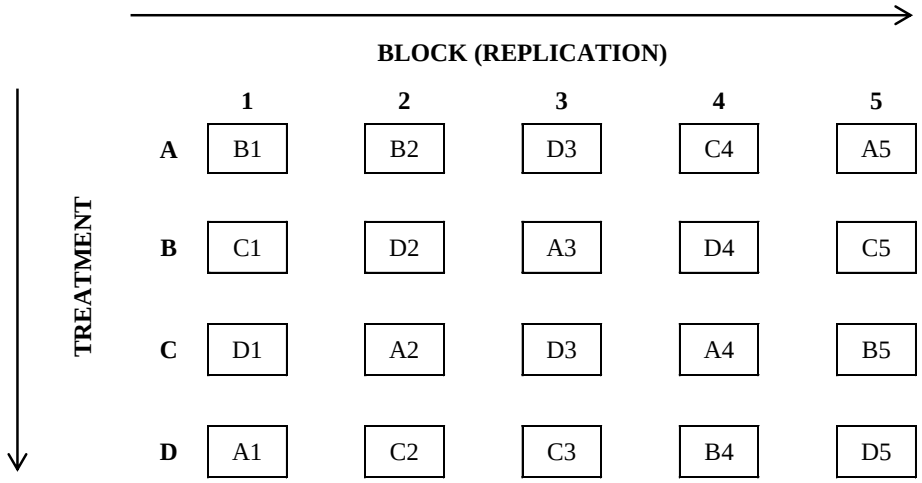

Figure 2 Planting plot of corn plant after randomization

Stock Preparation and Treatments

Pure MSG of Ajinomoto brands was used in this study. Three different concentration of MSG stock (1% w/v, 5% w/v and 10% w/v) were prepared using the unit of weight/volume. Each of the concentration was prepared in a total of 1.5 L. 1% w/v MSG was prepared by adding 1% (15 mg) of MSG from total volume (1.5 L) prepared. 5% w/v MSG was prepared by adding 5% (75 mg) of MSG from total volume (1.5 L) prepared and 10% w/v MSG was prepared by adding 10% (150 mg) of MSG from total volume (1.5 L) prepared. The treatment with MSG started when the *Zea mays* plants were grown approximately 12 cm in height (2 weeks after seed were planted). The treatments were applied (100 mL per application) three times a week for 6 weeks using the stock prepared.

Growth Parameter

All parameters were observed to make sure the plants were in the same condition before treatment. The growth parameters recorded in this study were the height of the plant, the diameter of the stem, number of leaves and length of leaves. The growth parameters were measured and the data were recorded weekly and tabulated in a table.

Statistical Analysis

Mean and standard deviation values of the data were calculated from 3 replicates. One-way analysis of variance (ANOVA) was carried out to evaluate the significant differences between the treatments Tukey's HSD post hoc test was used for all multiple comparisons using software package Minitab. Differences were declared significant at P value < 0.05 unless specified.

Result and Discussion

Height of the Plant

The plant height treated with 10% w/v MSG were higher than the rest of the treatment and significantly higher (3.1 folds) when it was compared to control. However, the other two treatments, 1% w/v and 5% w/v MSG show no significant difference compared to each other and also towards control (**Table 1**). The lowest value of plant height was observed with 1% MSG with the mean of 50.63cm that is 2.3 folds compared to control.

Diameter of the Stem

The diameter of the stem for corn plant treated with 10% w/v MSG was higher compared to the rest of the treatment. It shows means diameter of 12.67 mm which is 2.6 folds bigger compared to control. All the treated plants (1%, 5% and 10% MSG) were significantly different from the control. The lowest diameter was observed from the corn plant treated with 1% MSG which shows 1.9 folds compared to control.

Number of the Leaves

The maximum numbers of leaves were recorded with the corn plant treated with 10% MSG which reach 2.5 folds higher compared to control. All of the MSG-treated plant shows significantly superior number of leaves over the control. However, there is no significant difference between 1% and 5% MSG treatment where the number of leaves from 1% MSG were on par with 5% MSG-treated plant.

Length of the Leaves

Significant increments of plant growth in terms of the length of leaves also recorded on corn plant treated with MSG. The mean length of leaves on plant treated with 10% MSG was recorded to be the longest (62.55 mm) which shows 2.7 folds longer leaves than control. The other two treatments (1% and 5% MSG) also shows significantly longer leaves compare to control but shorter than leaves from corn plant treated with 10% MSG.

Table 1 The growth of corn plant for each of the treatment using MSG compared to the control (0% MSG)

Treatment (w/v)	Growth parameter			
	Height of the plant (cm)	Diameter of the stem (mm)	Number of the leaves	Length of the leaves (mm)
0%	21.62^{a}	4.83^{a}	4^{a}	23.34^{a}
1%	50.63^{ab}	9.17^{b}	8^{b}	46.52^{b}
5%	53.31^{ab}	10.73^{b}	8^{b}	55.86^{b}
10%	67.52^{b}	12.67^{b}	10^{b}	62.55^{b}

All the growth parameter values are indicated as mean values (n=3).

^{a,b} Means with different letter are significantly different from each other (P<0.05).

The results suggest that 10% w/v MSG was the best amount of MSG supplied to the corn plant in this study. All the growth parameter recorded were highly significant towards plant treated with 10% MSG compared to other treatment and control. The growth of corn plant and lettuce were also reported to increase significantly when MSG wastewater used as fertilizer (Singh et al., 2009; Singh et al., 2011; Haghighi et al., 2015). The results also supported by the study on a peanut legume which shows the highest yields when treated with MSG compared to the peanut treated with pig manure, chicken manure or cattle manure (Lin et al., 2010). Kraboun et al., (2013) stated that MSG contains a high amount of nitrogen. Nitrogen is one of the important elements that are needed by the plant to grow and it will reflect the quality of most organic fertilizer (Omari et al., 2016). Referring to the nitrogen content in an organic fertilizer, the similar results were observed toward the growth of tomato plant by Omari et al., (2016) which uses various plant materials as the source of nitrogen to the plant. According to El Gendy et al., 2015, the amounts of chlorophyll molecule were increase when nitrogen increases. The nitrogen directly participating in the structure of the chlorophyll itself and stimulates the cell division for plant growth. Nitrogen also has been reported to positively affect the nutrient uptake and promotes the increasing in shoot growth (Chrysargyris et al., 2016).

The result where the corn plant treated with 10% MSG gave the highest growth was also suggested being related to the content of beneficial microbes in the soil that responded to the MSG used. The same result was recorded by the corn plant treated with MSG wastewater where a significant increase of the plant growth and soil microbial content was observed with an increased application rate of MSG wastewater (Singh et al., 2011). Yeoh et al., (2016) stated that maximum plant growth and crop yields can be achieved when the balance between nitrogen in the fertilizer applied and soil microbial communities are met.

Conclusion

Hence, this study report for the first time that the pure MSG (Ajinomoto) shows a positive effect on corn plant and can be used for growing corn as a green practice. However, this study only limits the treatment to 10% MSG which gave the best result. Thus, the study should be further researched using a higher amount of MSG in order to determine the limit of pure MSG can be supplied to corn plant.

Acknowledgement

We wish to thank, Dr. Hj. Muzamil Mustaffa, Hajah Sarina Hashim and Wan Luqman Hakim Wan Nasaruddin for guidance and technical assistance. We would like to acknowledge Universiti Teknologi MARA (UiTM) Pahang and WNR Enterprise nursery for equipped with the place or land, tools and accommodation to conduct the study.

Conflict of interests

Author declares no conflict of interest.

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