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Influence of copper-zinc mixture in different rates on pH and electrical conductivity as a potential for foliar spray fertilization

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Abstract

Electrical conductivity (EC) and pH of a nutrient solution influences the availability of nutrients, so it should be maintained in the optimum range. Nutrient solutions available to plants at low pH (between 5.0 and 6.0) and EC (between 1.6 and 2.4). Pineapple plants require copper and zinc micronutrients to produce high quality fruits. By applying different rates of copper-zinc chelated fertilizer with NPK fertilizer, it will help to increase the plant growth and nutrient uptake. 0.1,0.2,0.3,0.4,0.5 and 0.6 g of copper EDTA and zinc EDTA were added with 8.89 g nitrogen, 3.86 g phosphorus, and 2.18 g potassium. All the mixtures were diluted with 250 ml water. Electrical conductivity (EC) analysis was measured using the EC meter with calibrated conductivity meter while pH solution was measured using pH meter. Results from this study can be concluded that there was a significant difference between pH and EC reading. The optimum solution at 0.6 g rate of copper EDTA and zinc EDTA showed pH 5.74 and EC reading at 1.156 ms/m. The findings of this study showed that copper-zinc chelated fertilizer mixtures at different rates can affect the reading of pH and EC.

1. INTRODUCTION

Micronutrients such as copper (Cu) and zinc (Zn) are very important in the growth of plants. Micronutrient deficiencies are widespread in many Asian countries due to calcareous soil properties, low pH, salt stress, constant drought, high bicarbonate content in irrigation water, and unbalanced use of nitrogen (N), phosphate (P), potassium (K) fertilizers (Riaz et al., 2020). Some of the adverse effects of stress caused by micronutrient deficiencies on crops include low crop yield and quality, imperfect plant morphological structure (small xylem vessels), widespread infection of various diseases and pests, and low activation phyto siderophores, and lower efficiency of fertilizer use.

Cultivation of plants in mineral soil gives less satisfactory impact on farmers' income. Uneconomic farm size, poor crop management, low price of the fruits arising from low quality fruits and excess fertilization contributed to the low net income. Only if they are combined with adequate plant nutrition can improve quality and quantitative plant products. In addition, there are three macro elements of NPK, the main microelements are inevitable. Due to their involvement in enzyme activity, copper, and zinc in the nutrient supply of soil and plants should be prioritized for the basic microelements. Their deficiency greatly affects the quantity and quality of crop products (Narimani et al., 2010).

1.1. Problem statement

The study Copper and zinc are essential micronutrient, these micronutrients are the component of various protein particularly those involved in photosynthetic and respiration of plant. Elucidation of critical level of micronutrients delineating the deficiency, optimum and toxic range is very important with respect to fertilizers application.

Critical levels vary with the soil fertility states and the crop and the cultivator levels. Diagnosis and prevention of nutrient deficiency and toxicity requires a further knowledge of symptomology with critical values of any elements in plants too. According to (Jatav, 2019), the soil critical established for Zinc, Copper, Iron, Manganese, Boron, Molybdenum and Sulphur were 0.6, 0.2, 4.0, 2.0, 0.5, 0.2 and 10.0 mg per kg, respectively.

Copper and zinc deficiencies can cause light green, narrow leaves with wavy borders, a pronounced U-

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shape in cross-section and a small number of trichomes, short roots with reduced hairs and stunted plant (Arshad et al., 2011). In severe acute deficit, the following symptoms may appear such as dwarf growth and chlorosis (Sturikova et al., 2018). To increase the yield, micronutrient such as Cu and Zn should be added so that the plant can grow healthy and produce high quality fruits

1.2. Significant of study

It is important to highlight the effect of Cu-Zn chelate fertilizer on plants growth planted in mineral soil. In addition, the findings of the research could provide a better understanding about the effect of micronutrient on plants, which is Cu-Zn. Having this knowledge will help provide a better insight to academic curriculum and universities where the students especially in agriculture field have a little bit knowledge about Cu-Zn chelate fertilizer. In addition, this study is expected to help people in Malaysia who cultivate crops in mineral soils produce a good impact on the productivity.

2. METHODOLOGY

2.1. Mixture NPK with Copper and Zinc

To determine the pH and EC, a study was conducted in the laboratory of UiTM Jasin, Melaka Campus. This experiment used 5 types of single fertilizer which are urea (N), phosphorus (P), potassium (K), copper (Cu) and zinc (Zn). The 3 main fertilizers which are NPK are constants while Cu and Zn will be added according to the treatment. In this study, 6 treatments were used which are 0.1,0.2,0.3,0.4,0.5 and 0.6 g of Cu EDTA and Zn EDTA. All these solutions will be prepared in a different beaker. Next, 8.89 g nitrogen, 3.86 g phosphorus, and 2.18 g potassium also will be prepared in different beaker. Then, mix each NPK with treatment and diluted with 250ml water. The mixed fertilizer will be stirred manually using glass rod.

Table 1: Summary of copper and zinc treatment.

Treatments	Details on treatment
T1	0.1 g Cu EDTA + 0.1 g Zn EDTA + NPK
T2	0.2 g Cu EDTA + 0.2 g Zn EDTA + NPK
T3	0.3 g Cu EDTA + 0.3 g Zn EDTA + NPK
T4	0.4 g Cu EDTA + 0.4 g Zn EDTA + NPK
T5	0.5 g Cu EDTA + 0.5 g Zn EDTA + NPK
T6	0.6 g Cu EDTA + 0.6 g Zn EDTA + NPK

2.2. Determination of pH and electrical conductivity of different rates of copper-zinc fertilizer

Next experiment is determination of pH and electrical conductivity of different rates of copper-zinc fertilizer. To obtain the pH of copper and zinc solutions, a pH meter was used while an EC meter was used to obtain the EC value. All of the mixtures will be replicated, the pH and EC reading will be taken separately. The data was analyzed for significance of different treatments of Cu and Zn. Pearson correlation test was conducted considering the Cu and Zn as a factor while pH and EC as variance.

Figure 1: Different rates of copper zinc chelate fertilizer.

3. RESULTS AND DISCUSSION

This study was conducted to determine the optimal amount of copper-zinc chelate fertilizer application for plants growth. The process to obtain the optimal Cu-Zn chelate fertilizer solution was carried out at the UiTM Jasin laboratory, Melaka.

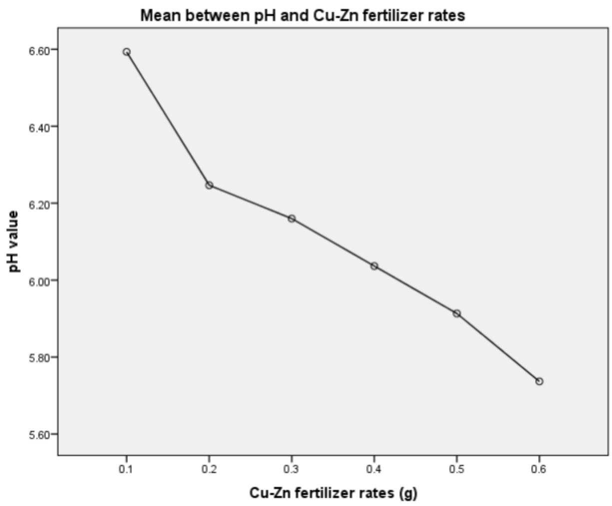

Figure 2: Mean between pH and Cu-Zn fertilizer.

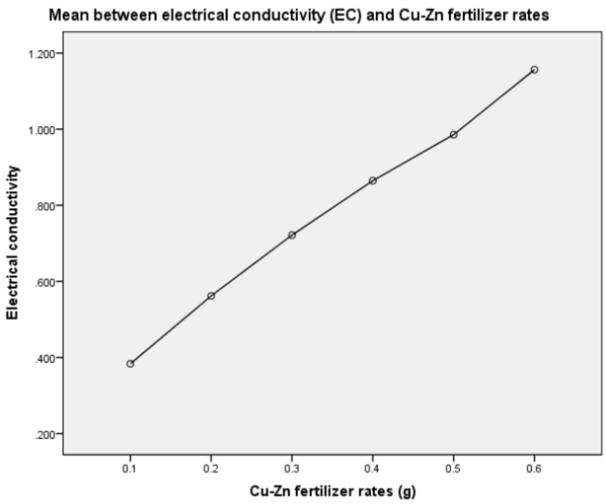

Figure 3: Mean between electrical conductivity (EC) and Cu-Zn fertilizer.

Figure 2 and 3 shows the mean between pH and copper-zinc chelate fertilizer. The results in this study showed that the use of the least fertilizer that is 0.1 g will produce a less acidic solution, which is pH 6.59. When the rates of fertilizer increase, the solution will become more acidic with a maximum pH value of 5.74. According to (Orie et al., 2019), the pH that is suitable for plant uptake through the leaves and other part of plants is between 5.0-6.0 where this solution is slightly alkaline.

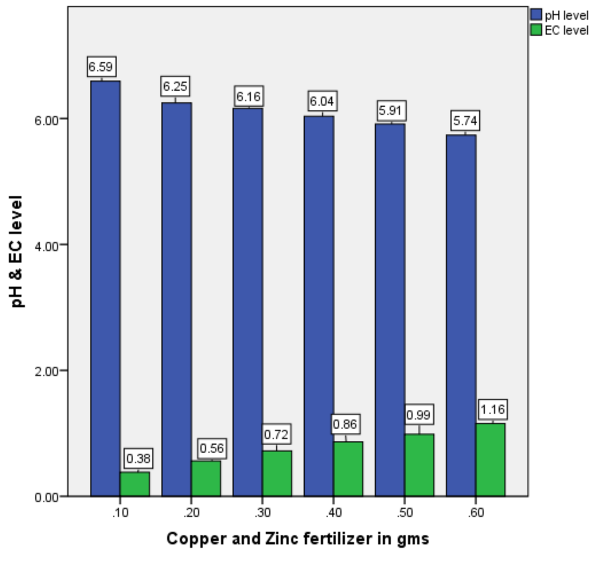

Figure 4: Mean between electrical conductivity (EC) and Cu-Zn fertilizer.

Figure 4 shows the mean between electrical conductivity (EC) and copper-zinc chelate fertilizer. The results in this study showed minimum rates of fertilizer which is 0.1 g copper and zinc chelate fertilizer will produce a less electrical conductivity, which is 0.383 ms/m. When the rates of fertilizer increase, the electrical conductivity will increase with a maximum EC value of 1.157 ms/m. The optimum electrical conductivity for plant uptake is 1.8-2.4 ms/m (Ding et al., 2018).

Table 2: Pearson correlation.

Control	Variable		pH	EC
Cu + Zn	pH	30.9	1.000	-.692
		7.31	-	.002
		0.901	0	15
	EC	312	-.692	1.000
		236.1	.002	-
		3	15	0

The Pearson correlation test proved that Cu and Zn treatments had the significant effect on pH and EC. The table shows there is negative correlation, meaning that when the fertilizer rates increase, the pH will decrease while EC will increase. Since the significance value is 0.002, it can be concluded there is statistically significant correlation between the pH and EC value.

This study shows that the use of 0.6 g copper zinc chelate fertilizer is the best choice. It will produce a pH of 5.74 and an EC of 1.157. However, the optimum value for pH is 5.0-6.0 while for EC it is 1.8-2.4 ms/m. Studies show the higher the rates of fertilizer, the pH will be the more acidic and the EC will be the higher. Therefore, to produce the optimum EC value in line with the pH value, then the rates of fertilizer need to be increased.

4. CONCLUSION

This paper focuses mainly on providing insights on the use of copper-zinc chelated fertilizer specifically to assist farmers in increasing their agricultural yields in Malaysia. This paper discusses how the use of copper-zinc chelated fertilizer can influence the growth of plants which in turn will produce healthy and fertile trees. This research aims to investigate the influence of copper-zinc mixture in different rates on pH and electrical conductivity as a potential for foliar spray fertilization. This requires various strategies such as the use of chelate fertilizers to strengthen the value chain especially on agronomic practices using minerals soil to ensure the sustainability of production (Zubir et al., 2020). Based on the findings above, it can be concluded copper-zinc chelated fertilizer mixtures at different rates will affect pH and electrical conductivity (EC). The rising cost of fertilizer will burden farmers in Malaysia. Therefore, the use of copper-zinc chelated fertilizer should be used to increase the yield of farmers and in turn can improve the living standards of farmers in Malaysia.

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