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Zeolite Integrate with Natural Absorbance to Increase Crop Production

Muhammad Amirul Ashraff Rashidi[1], Syamsutajri Syamsol Bahri[1,2], Zawati Harun[1,2]*, Rosniza Hussin[1,2], Faiz Hafeez Azhar[1,2], Norsuhailizah Sazali[2], Siti Khadijah Hubadillah[3], Nur Hanis Hayati Hairom[4], Riduan Jamalludin[5], Ainun Rahmawati[1]

[1]Faculty of Mechanical Engineering,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, MALAYSIA

[2]Advanced Materials and Manufacturing Centre (AMMC), Faculty of Mechanical and Manufacturing Engineering,
Universiti Tun Hussein Onn Malaysia, 86400, Parit Raja Batu Pahat, Johor, MALAYSIA

[3]School of Technology Management and Logistics,
Universiti Utara Malaysia, Sintok, Kedah, 06010, MALAYSIA

[4]Faculty of Engineering Technology,
Universiti Tun Hussein Onn Malaysia, Hab Pendidikan Tinggi Pagoh, KM1, Jalan Panchor 86400, Muar, Johor, MALAYSIA

[5]Faculty of Mechanical Engineering Technology,
Universiti Malaysia Perlis, Kampus Tetap Pauh Putra, 026000 Arau, Perlis, MALAYSIA

*Corresponding Author

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Abstract: Mesoporous structure of Zeolites particles with higher micropores able to provide higher surface area that able to increase the efficiency of diffusion mechnism as well as cation exchange capacity (CEC). The uniquness and unreactive properties of zeolites enable to integrate this materials with other potential material to increase the zeolite absorption and CEC performance. Thus, the goal of this work is to study the effect of natural absorbents(chitosan and charcoal) when integrate with zeolite that function as a soil enhancer for the plants growth. Several experiments at different composition of soil, fertilizer, zeolite and absorbance compositions towards water spinach growth, pH and soil humidity were measured. The results of the plant growth show that both natural absorbance materials significantly assist the nutrient uptake either from the soil or fertilizer by showing higher plant growth, pH and humidity values as compared to soil mixed with fertilizer only. Integration of these absorbance with zeolite futher increase the capability of nutrient uptake by giving the highest value of plant growth, pH and humidity values. Detail observation also showed that water spinach grew faster in the sample that had fertilizer added to the zeolite with charcoal as compared to chitosan

Keywords: Zeolites, natural absorbance, charcoal, chitosan, pH, humidity, plant growth

1. Introduction

Zeolites are a class of microporous structure from the of aluminosilicate minerals [1]. It is believed that adding zeolite to the soil can improve both its physical and chemical properties for an extended period of time, due to its capability in holding the nutrients within its miropore structure. Many of the soil's physicochemical properties are thought to be improved by adding the zeolites. Zeolites can boost the soil's infiltration rate, saturated hydraulic conductivity, water holding capacity, aeration, and many other attributes, among many others. Zeolite enhances the cation exchange capacity of soil and increases water retention in the root zone [2-4]. Additionally, the higher absorption of its capability able to reduce the leaching of mineral components with at the same time capture a significant amount of heavy metals and organic pollutants in the polluted soils [4-5]. The use of zeolite, which is not acidic but rather slightly alkaline, in conjunction with fertilisers can help to buffer soil pH levels, thereby reducing the need for lime application.

Zeolite has ability in retaining the moisture is another positive aspect of using Zeolite as a soil amendment in agriculture. Zeolites also has a great property on aeration as they can hold up to 60% of their weight in water due to the existence of higher porosity within their crystalline structure. Due to this uniqueness geometry, therefore there are various possibility in enhancing the zeolites performance and capability to assist the plant growth. Thus in this work, zeolite was integrated with the absorbance such as charcoal, chitosan that will further assist in trapping and holding of nutrient and ions for the plant growth [6-7]. Therefore, the aim of of this present work is to study the effect of absorbance materials integrated with zeolite powder that acting as a soil enhancer in improving the humidity effect, pH, soil salinity of the plant growth as well as to determine the most suitable composition of mixture that able to increase the crop yield production.

2. Methodology

The following of Fig. (Fig.1) shows the overall flowchart that was conducted in this experiment. The first stage involves the preparation of soil compositions as shown in Table 1. Then followed up with the preparation of planting process. The performance tests were conducted base on the absorption ability and fertilizer test. Further measurement need to be conducted to measure the leaching which is not considering in this paper.

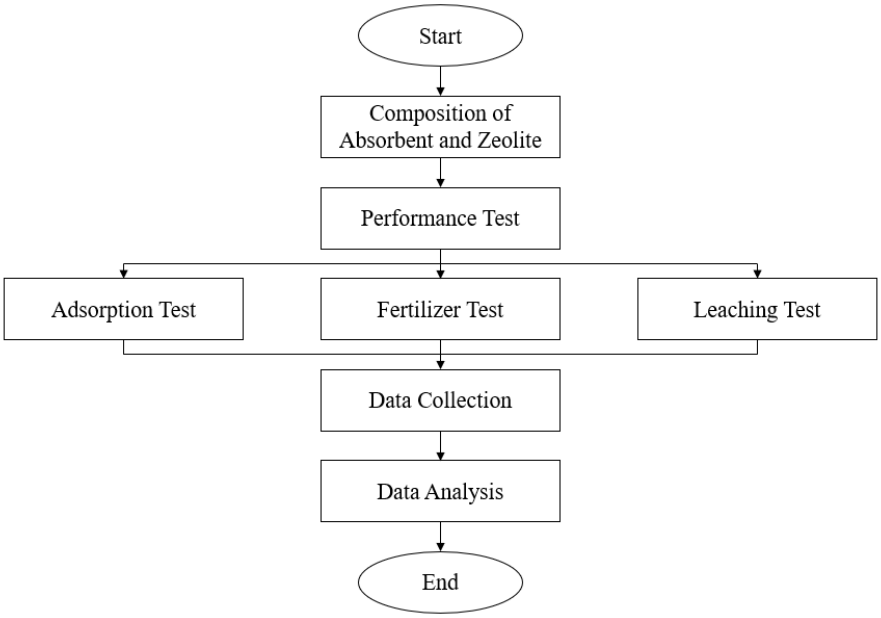
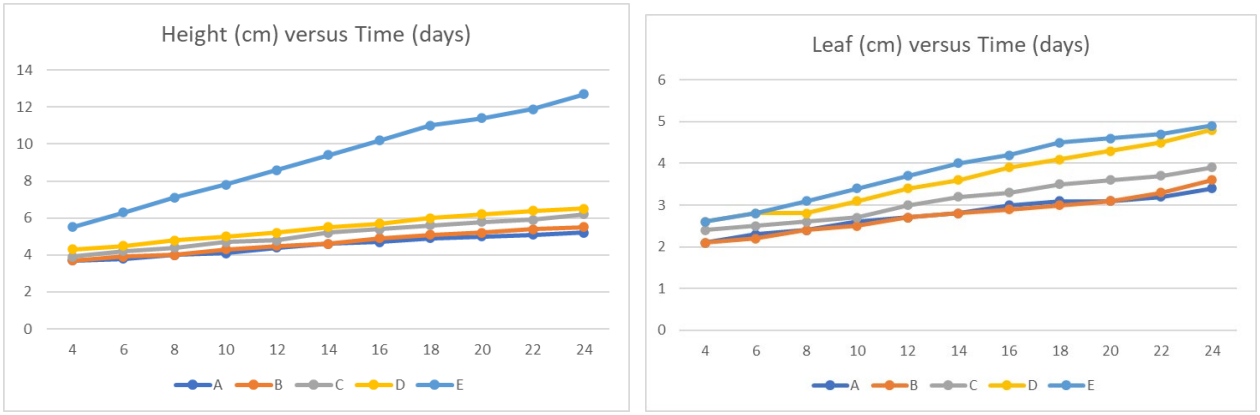


Fig. 1 - Overall flowchart of the experiment

Table 1 - Soil compositions for planting purpose

Sample	Composition
Soil + fertilizer	400gram: 100gram
Soil + fertilizer + chitosan	400gram: 100gram: 25gram
Soil + fertilizer + charcoal	400gram: 100gram: 25gram
Soil + fertilizer + chitosan + zeolite	400gram: 100gram: 25gram: 25gram

Soil + fertilizer + charcoal + zeolite	400gram: 100gram:25 gram: 25gram



(a) (b)

Fig. 2 - Plant growth for the water spinach with height (a) and leaf; (b) measurement at different mixture of fertilizer and absorbance composition

Analysis from the Fig. also revealed that both natural absorbance from charcoal and chitosan have better absorption ability and holding the fertilizer nutrient with longer period of time [7]. The performance of charcoal absorbance shows better plant growth as compared to chitosan absorbance. This may be due the absorption capability of charcoal is much higher as compared to chitosan. Further observation of both absorbance integrates with zeolite also proven that mixture zeolite with charcoal has high potential in producing a high yield as compared to the chitosan with zeolite [8-9]. Thus sample E show better plant growth with bigger leaf size and higher plant height.

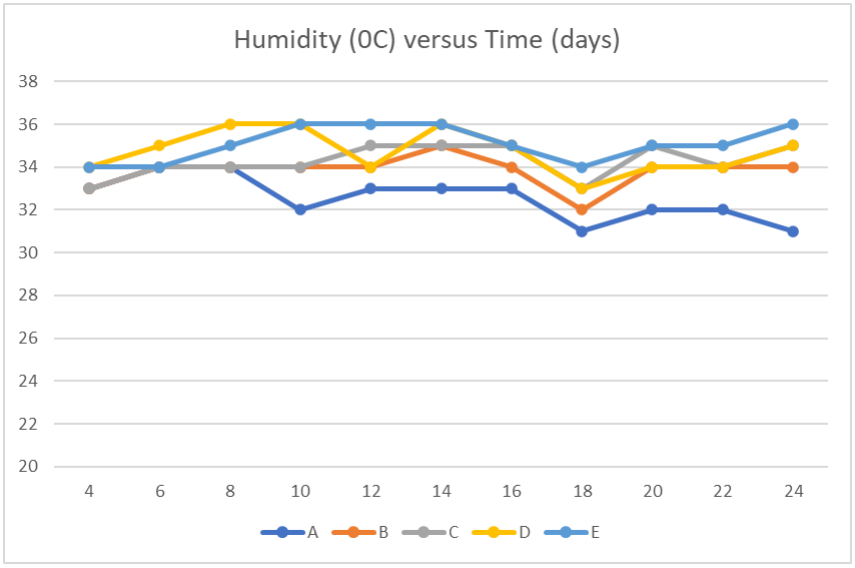


Fig. 3 - Soil humidity

2.1 Humidity

Fig. below shows that the soil moisture is almost the same in all samples, but there are some small differences that show how well zeolite, chitosan and charcoal can absorb water. When the samples were compared, they were found to be slightly different, which shows that zeolite added with charcoal can hold water better than zeolite added with chitosan because charcoal generally has a higher water-holding capacity.

2.2 pH

The addition of zeolite to the soil resulted in a rise in pH, as seen in Sample D and E. This may be because the zeolite structure can "hold" or "trap" the fertilizer ion within its mesoporous, thereby increasing the soil pH and decreasing its acidity but Sample E has slightly higher pH because it contains charcoal which can neutralize soil acidity to some extend due to its alkaline nature[10]. In addition, charcoal can help to boost the soil pH towards a neutral range as it absorbs acidic compounds. This can also be seen in sample B and C with mixture Chitosan and Charcoal, comparison between both sample show that sample C has the higher pH compared to sample B.

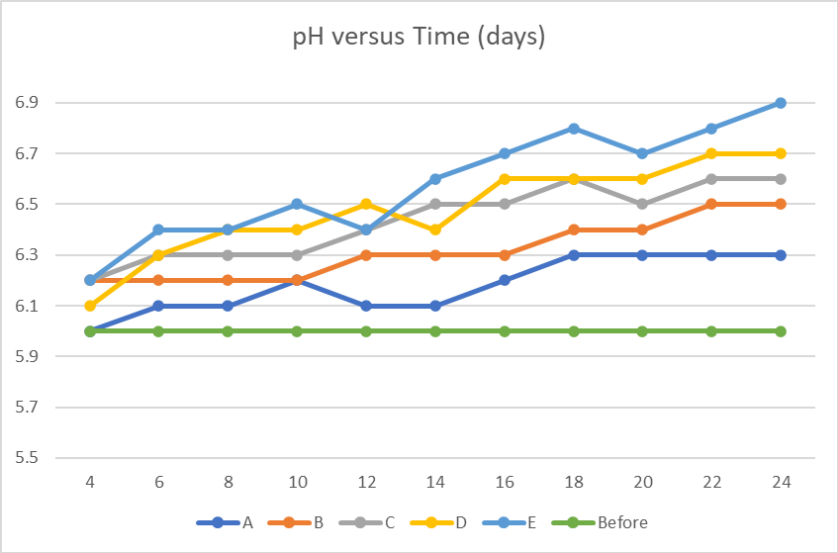


Fig. 4 - PH of soil

3. Conclusion

Zeolite integrate with absorbent as a modifier for soil enhancement show able to deliver sufficient nutrients and maintain better soil condition, which had a significant impact on maintaining high yield and crop growth. As compared to the standard sample that contained solely NPK fertilisers, the modified fertiliser containing zeolite and charcoal displaye a quicker growth rate of water spinach plant. It helps and enhance the plants growth that able encouraging the development of their root systems, holding sufficient water in the root zone, and preventing nutrients from being leached out of their plants' roots. All of these factors contribute to the plants' overall health and growth. In the current investigation, the use of zeolite-charcoal fertilisers was met with success, which was to be anticipated. However, it is recommended that the experiment or study to be repeated using long term plants or plants that take long time to grow to determine the overall impact on plant growth and to use higher ratio of zeolite and absorbent application in a future research study.

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