
Growth Red Spinach (*Amaranthus amoena*) by Hydroponics Using Charcoal Media Husk

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ABSTRACT

KEYWORDS:

Ab mix
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Red Spinach
Hydroponics

Red spinach is a vegetable plant of the most common varieties of spinach. This plant has good content for the body such as vitamin A, vitamin C, protein and high polyphenols antioxidants content. Red spinach production in Indonesia is still very low. This can happen because the majority of our people are not very familiar with red spinach and cause its cultivation and marketing to be not very intense. Hydroponics is a farming method without using soil media, but with nutrient solutions or other materials that contain nutrients. The aim of the study was to find out the differences and yields of red spinach plants if the concentration of AB MIX fertilizer was different. The research used the research method used was experimental with an environmental design in the form of a Factorial Randomized Block Design (RBD), with 5 treatments. P0 = husk charcoal, P1 = husk charcoal + 1000 ppm, P2 = husk charcoal + 800 ppm, P3 = husk charcoal + 1200 ppm, P4 = husk charcoal + 600 ppm, and P5 = husk charcoal + 1400 ppm. Analysis using the Honest Significant difference Test (BNJ) with a level of 5% was carried out to determine whether there was an interactions of each treatments. The results showed that the best treatments was P1 with a plant heights of 1.5 cm, a leaf width of 0.7 cm, and a total of 6 leaves.

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1. INTRODUCTION

Red spinach is a vegetable plant that has a special characteristic, namely that the plant is red. Some can be found in Indonesia. These plants have concentrations that are good for the body, such as vitamin A, vitamin C, protein and high polyphenol antioxidant content (Pebrianti et al., 2015). Many uses of red spinach have been discovered in recent years, such as root dysentery and leaf asthma (Hidayanti and Kartika, 2019). Spinach contains nutrients that can improve blood circulation, lower cholesterol and high blood pressure. When growing red spinach, the soil is used the most to grow it. Good growth requires a substrate that is equipped with elements needed by plants (Mardhiana Et Al., 2017). In addition, along with the development of civilization, every year it is increasingly felt that it is difficult to obtain agricultural land.

Production of red spinach (*Amaranthus tricolor L*) is still relatively low and unstable. This can be seen from BPS data (Central Statistics Agency, 2017). Red spinach production in Indonesia continues to fluctuate: in 2016 red spinach production was 160,000 tons, in 2017 it fell to 148,000 tons and rose again to 162,000 tons in 2018, only to drop again to 157 thousand tons in 2019 and 2019 and became ., 2022). This can happen because most of our people are not familiar with red spinach. The lack of popularity of red spinach causes less intensive cultivation and marketing (Pebrianti et al., 2015).

Hydroponics is a step to overcome the problem where red spinach production is still very low and unstable. One of the advantages of the hydroponic system is that it can replace soil with

water and does not require too much land (Roidah, 2014) . Water is an essential element that plants need to grow, and hydroponics can solve this problem. The addition of nutrients to the aquatic environment combined with an irrigation system using a pump allows plants to grow well (Wibowo & Asriyanti, 2013) There are several types of hydroponics, including the Nutrient Film Technique (NFT), which involves growing plant roots in a nutrient solution to provide water and sufficient oxygen for plants (Mosa et al., 2016) .

Hydroponics can fold double the productivity of spinach plants compared to conventional planting. Hydroponics is a method of growing plants without soil and using a nutrient solution mixed with water as the nutrient source. One excellent hydroponic system for growing vegetables is the NFT (*Nutrient Film Technique*) hydroponic system. The NFT hydroponic system is a method of plant cultivation in which plant roots grow in a shallow, circulating layer of nutrients, allowing the plants to absorb water, nutrients, and oxygen (Chairani et al., 2017) . The working principle of this NFT hydroponic system is that water or nutrients flow through the grow tank. The planter is angled to allow nutrients to flow.

kindly traditional, when plant plant spinach, seeds only sown in the ground without notice distance between seeds. Too much spacing near will resulted competition nutrition, so happen even distribution growth spinach all over plant. because it, to achieve growth maximum spinach with the system hydroponics, spacing plant effective must guarded. On research This election distance plant aimed to get distance the most ideal planting that can be used moment plant spinach in a manner hydroponics.

Plant plant by method hydroponics more efficient Because can arranged such shape so that No need long distance like match plant. With technology hydroponics, nutrients needed _ plant can distributed in a way dissolve these nutrients to in the water that became the planting medium, so direct absorbed by the roots plant. When using hydroponics, time plant it more short, so plant Can more fast harvested. because that, when match plant method hydroponics, cost production become more cheap when soil, water and nutrients are used in a manner efficient as well as production and yield increase (Zamriyetti et al., 2019) .

Success cultivation spinach hydroponics determined by the nutrients it contains element macro and micro, as well addition substance regulator supportive and stimulating growth growth plant . Giving nutrition AB mixture with a concentration of 5mL/L and the addition of 2mL ZPT as nutrition addition is the optimal combination to increase growth hydroponics plant spinach red on the substrate based sand (Hidayanti & Kartika, 2019) .

Sufficient nutrients must be given to plants so that the right amount of nutrients is available and plants can easily absorb them (Fitriansyah et al., 2019). AB Mix Nutrients contain macro and micronutrients needed to support plant growth and performance. These nutrients are composed of several chemical elements needed for plant growth (Hidayanti & Kartika, 2019) . In addition to nutrients, growth regulators (ZPT) are also needed to support plant growth, which must be applied externally. The addition of ZPT at the right concentration has a positive effect on plant growth (Darwis, 2021).

Charcoal husks or roasted husks used as plant material are obtained from the combustion process with imperfect combustion techniques. Charcoal shell contains high carbon and is often used as a planting medium. Charcoal husk is widely used by farmers as soil conditioner, planting medium, planting substrate and compost material. The mixed composition consisted of 2 parts of soil, 1 part of compost and 1 part of shell coal (2:1:1). Mix well. Prepare a pot or polybag and pour the mixture into it. The growing media is ready to use. Chaff charcoal is made by incomplete (partial) burning of rice husks. Harvesting carbon waste from rice husks can increase productivity

and protect the environment (Rahmiati et al., 2019). Increased productivity can be seen in the response of plants to rice husk carbon. Charcoal responds better to plant growth (Gustia, 2013) ; (IRAWAN, 2015) .

The use of different media (rockwool, coconut coir, and shell charcoal) with core types (flannel, coconut coir, and banana stem fibers) affects the hydroponic growth of red spinach. The use of charcoal growing media with flannel leaf axils was the best treatment, because it produced the highest root volume of 4.67 cm³ and produced 5.56 leaves, plant fresh weight of 17.40 g and plant dry weight of 1.24 g, the highest in spinach plants. and brown rice. cultivated hydroponically (Vanesaputri et al., 2022) As a planting medium, charcoal has the advantages of (1) keeping the soil loose because of its high porosity and light weight, (2) encouraging the growth of microorganisms in plants, (3) regulating soil pH under certain conditions, (4) maintain moisture, (5) fertilize soil and plants, (6) increase crop production, (7) act as an absorbent to reduce the number of pathogenic microbes, and (8) increase absorption and bind soil to water.

One form of agricultural waste is husk. In general, the waste generated from the processing of agricultural products contains high levels of nutrients and starch to produce compounds that can stimulate plant growth (Irianto, 2015) . Husk is bran produced from the rice milling process which separates the rice from the chaff. Rice husks are usually stacked and only become a waste material at the Rice Mill. Utilization of rice yields is not matched by waste utilization. In general, rice husks can be used as a growth substrate, charcoal husk briquettes, animal feed mats, or destroyed by indiscriminate and uncontrolled burning which pollutes the environment. According to several studies, agricultural waste such as rice can be used as animal feed and the use of chemical fertilizers can be saved (Agustono et al., 2018) ; (Karyaningsih, 2012)

According to research (Muhammad Fuad Syah et al., 2021) , it is known that in this study the concentrations of AB Mix 1000, 1200, 1400, 1600 and 1800 ppm had no significant effect on all parameters observed. , i.e. plant height, number. leaves, leaf area, root volume, fresh plant weight and consumption weight. The AB Mix concentration of 1000ppm is the best among several concentrations because it is more effective, economical and saves the use of nutrient solutions.

According to study (Wijaya et al., 2020) , treatment with values highest for this parameter is L2M3 (mix AB 4 mL/L + charcoal skin), L3M3 (mixture AB 6 ml/L + charcoal shell) L2M1(AB) 4 ml/l mixture + rockwool) and L2M3 (AB 4 ml/l mixture + shell coal). The best planting medium to support growth plant is originating _ from charcoal husk rice. L2M3 treatment (4 ml/l AB mixture + charcoal shell) has mark highest fresh weight that is 21.65 grams Because content nutrition the AB mixture used as needed plant. Besides that is, content growing media chemistry form coal shell in form SiO₂ reaches 31% at 52 °C. Content chemistry in amount small in the form of Fe₂O₃ also contains MnO, Cu, CaO, MgO and K₂O. So that, we examined growth hydroponics spinach red with addition charcoal husk, because production spinach red in Indonesia is still very little and no stable.

The growth and development of hydroponic plants is largely determined by the availability of nutrients in metabolic processes. The availability of nutrients plays an important role in the formation of proteins, enzymes and hormones due to cell division in plant tissues which affects the formation of flora. Buds, leaves and roots multiply. Nutrients are obtained by dissolving a mixture of dissolved nutrients in water. These nutrients are obtained from a mixture of mineral salts with a certain composition, a certain amount can be adjusted according to the needs of the flora. Even though they look the same, each plant requires different nutrients and nutrients. In addition to nutrition, the population must also be considered when planting, because stock management is directly related to the level of plant density, which can affect the quality and

quantity of plants. To maintain a complete population for optimal growth, cropping intervals must be considered to allow for effective nutrient protection.

Mix nutrients are nutrients used in aquaculture. The three must not be mixed in a concentrated state so as not to cause precipitation because when the sulfate anion (SO_4^{2-}) in Mixture B mixes with the calcium cation (Ca) in Mixture A, calcium sulfate (CaSO_4) is formed. Precipitate so that the roots cannot take Ca and S elements, and when the calcium cation (Ca) from Mixture A meets the phosphate anion (PO_4^{3-}) from Mixture B, calcium phosphate ($\text{Ca}_3(\text{PO}_4)_2$) precipitates. formed so that Ca and P cannot be absorbed by the roots. (Sastro, 2016) .

Hydroponics involves growing plants using water without soil as a growing medium. When growing plants in a hydroponic system, the emphasis is on meeting the nutritional needs of growth. Nutritional needs are very important for the growth and development of hydroponic plants. When nutritional needs are not met, plant growth and development slows down. Research (Izzuddin, 2016) shows that hydroponics is a method of farming that does not use soil but rather a nutrient solution or other nutrient-rich materials such as coconut, mineral fiber, sand, brick chips, sawdust, etc. Several factors affect hydroponic results including temperature, nutrients and water pH.

Rice husk charcoal has more fragile characteristics compared to other plant materials. This feature is thought to facilitate the penetration of the roots of the Cempaka Wasian seedlings tested into the environment, as well as a larger root extension area and can accelerate root development. Based on the difference in the percentage of growth, it is also seen that the dry weight of the roots has a higher growth value compared to the growth of the dry weight of the shoots. This could indicate that the addition of shell charcoal had a greater effect on the root development of Cempaka Wasian seedlings compared to the addition of shoots which also had a positive effect on shoot growth. Root dry weight.

Using organic matter such as sawdust and rice husk charcoal as a substrate is also considered better than humus. This is because organic matter can provide nutrients for plants. This results in good air circulation, high water absorption and lower seed weight compared to terrestrial media , making it easier to transport. This is probably because husk charcoal has many pores which can increase ventilation and high porosity. Therefore, rice husk charcoal is weaker than other antioxidants. Conversely, if the seeds are planted in a medium that is too dense with low aeration and porosity, it will be difficult for the media to penetrate the roots and the root elongation zone will be shorter. (Aksa et al., 2018) .

Therefore, from the explanation above, research was conducted on the growth of red spinach hydroponically which aims to find out the differences and yields of red spinach plants if the concentration of AB MIX fertilizer is different.

2. MATERIALS AND METHODS

2.1. Material

As for the tools and materials to be used for research This namely, basins, trays, polybags, glasses measure, shovel, glass, cloth flannel and bottle used. As for the materials used namely, seeds spinach red, charcoal husk, soil, water, AB Mix.

2.2. Method

Study growth spinach red with the addition of AB Mix is done at the green house of the Faculty of Education, University of Muhammadiyah Surakarta to find out rate growth plant spinach red. Method used in study This is Draft Random Complete (RAL) one composed factors of five treatments :

- P0 : Treat without AB Mix
 P1 : Treatment charcoal husk + 1000 ppm of AB Mix nutrition
 P2 : Treatment charcoal husk + 800 ppm of AB Mix nutrition
 P3 : Treatment charcoal husk + 1200 ppm of AB Mix nutrition
 P4 : Treatment charcoal husk + 600 ppm of AB Mix nutrition
 P5 : Treatment charcoal husk + 1400 ppm of AB Mix nutrition

Analysis variance by Design Random Factorial group (RBD). used for data analysis. If F count more big from F table so Duncan Multiple Range Test (DMRT) was performed at 5% level.

3. RESULT AND DISCUSSION

3.1. Results

On results study this P1 has results growth best at the moment tall plant 1.5 cm, wide leaves 0.7 cm and the number leaves 6 strands. And growth worst occurs at P0 moment tall 1 cm plant. 0.3cm leaf width and number 6 leaves. While P3 and P5 were obtained same result that is tall plant 1.2cm, wide 0.5cm leaves and amount 6 leave. And for P2 and P4, height plant 1 cm, wide leaves 0.3 cm, and the number leaves 6 strands. this shown in Table 1.

Table 1. Average growth plant spinach red (*Amaranthus amoena*)

<i>Treatment</i>	<i>Plant Height (cm)</i>	<i>Leaf Width (cm)</i>	<i>Amount Leaf (strand)</i>
P0	1	0.3	6
P1	1.5	0.7	6
P2	1	0.3	6
P3	1.2	0.5	6
P4	1	0.3	6
P5	1.2	0.5	6

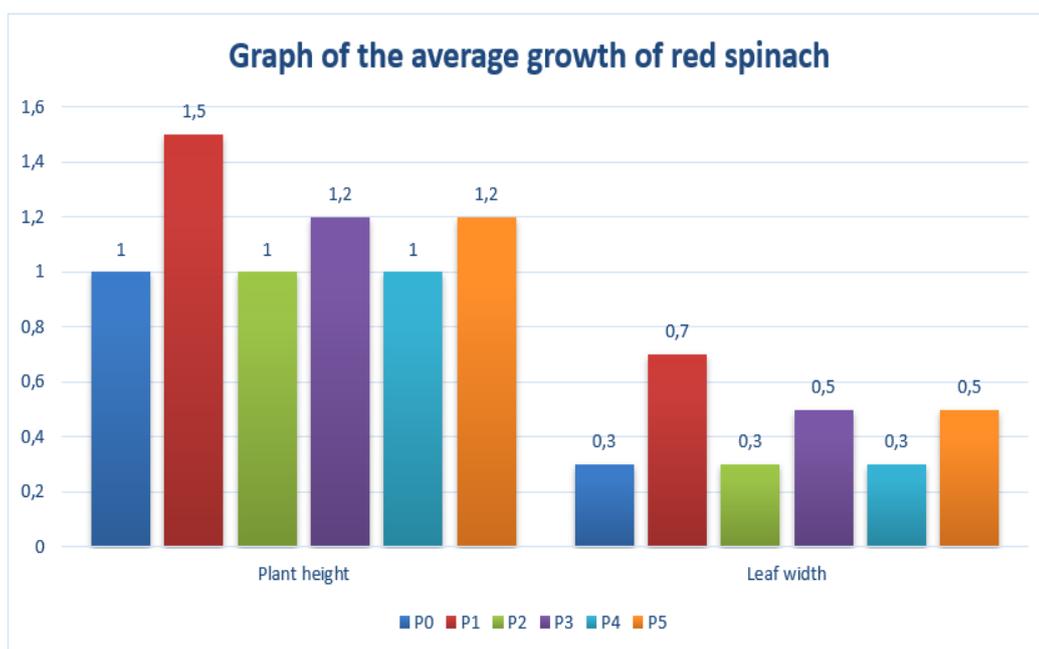


Figure 1. Graph average growth

Giving coal in processing it also offers Lots profit. Charcoal can repair porosity and aeration land, as well tie nutrients that are not absorbed plant. this useful for plant when rare nutrient, because plant can absorb it from carbon skin released wood in a manner slowly. Charcoal also delivers more influence Good to tall plant spinach compared to husks, because charcoal husk paddy own more abilities Good in increase porosity ground, so land become more loose and ability absorb water increases. Besides that's skin wood No contains harmful salt for plant or pathogen dangerous, because generated from the combustion process.

3.2 Discussion

3.2.1. Plant Height

Research results showing high average value plants on each treatment. This is caused difference ppm level. The treatment which showed the ideal plant height was obtained from P1 (charcoal husk + 1000 ppm AB Mix). Condition This due to charcoal husk and nutrition AB Mix has balanced content. However If use AB Mix nutrition too Lots or too A little so nutrients needed by plants will excessive or less. And on charcoal husk has good aeration so that air circulation goes well. This shown in the picture following.

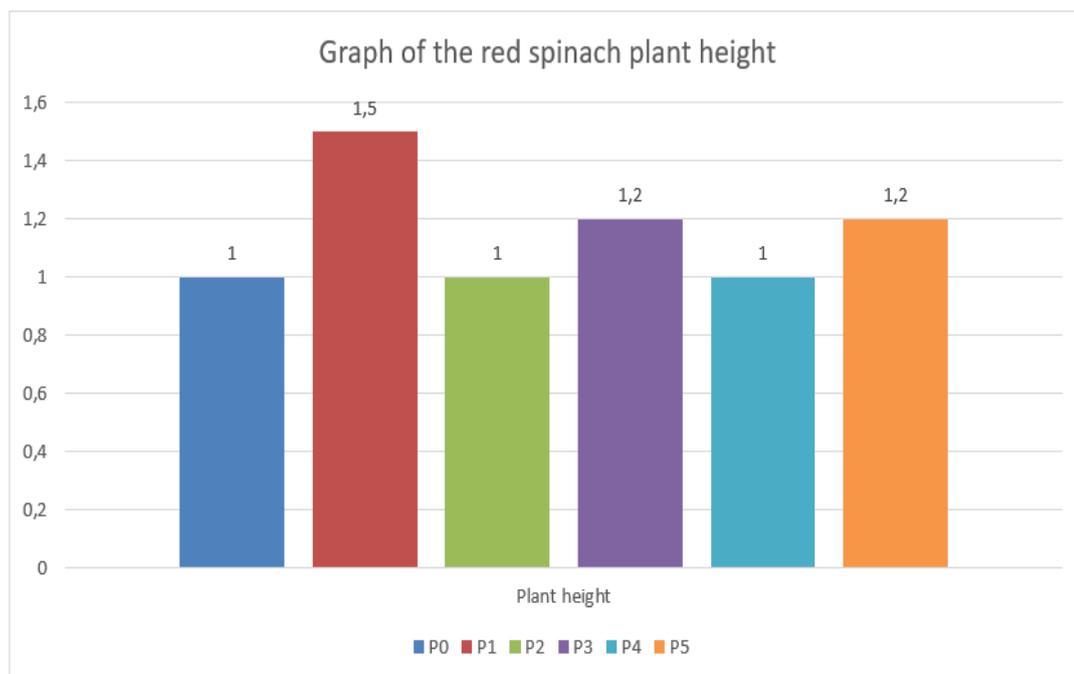


Figure 2. Chart high average value plant spinach red

3.2.2. Leaf number

Research results of 5 treatments show same result that is relatively lots of 6 leaves. this caused content nutrition a mixture of AB and charcoal husk. Besides good mix, they got too give retention more roots well and flow good air to absorb nutrition from root plant. The more Lots leaves, increasingly wide leaves (no each other shade), allows more Lots energy the sun is captured for the process of photosynthesis, so assimilation more high, and plants that experience drought during growth vegetative own more leaves narrow than plant. who get enough water. this shown in the picture following

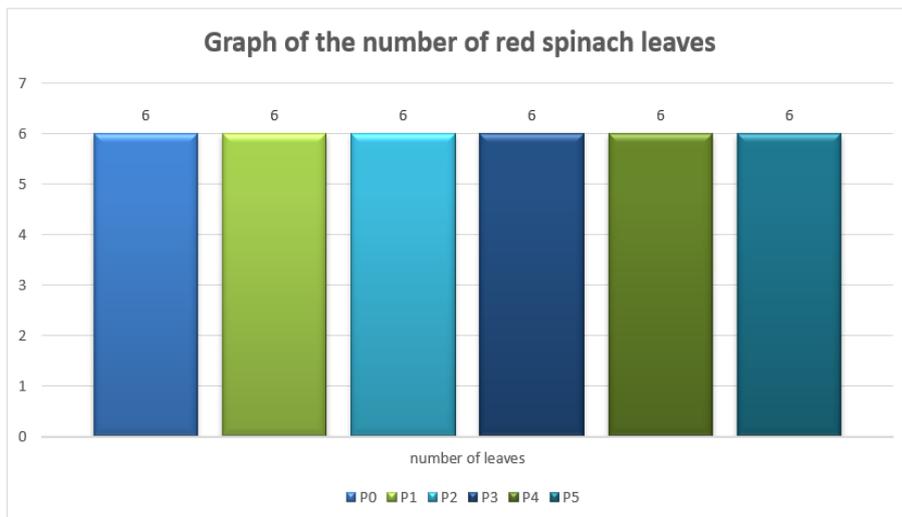


Figure 3 . Graph of the average value of the number of leaves of the red spinach plant

3.2.2. Leaf Width

In vegetable plants, especially red spinach, leaf area is an important factor in the rate of plant photosynthesis. The main function of the leaf is where photosynthesis takes place for plant development. Leaf area can also be used to determine the chlorophyll content of plants. The wider the leaf surface, the more chlorophyll there is. The best leaf width research results were P1 with a width of 0.7 cm. For P0, P2 and P4 the results were not good, the leaf width was 0.3 cm. whereas in P3 and P5 the results are the same, namely 0.5 cm. Because the carbon environment in the bark is able to bind water optimally, so that the roots bind firmly, absorb nutrients properly and growth develops properly. this shown in the picture following.

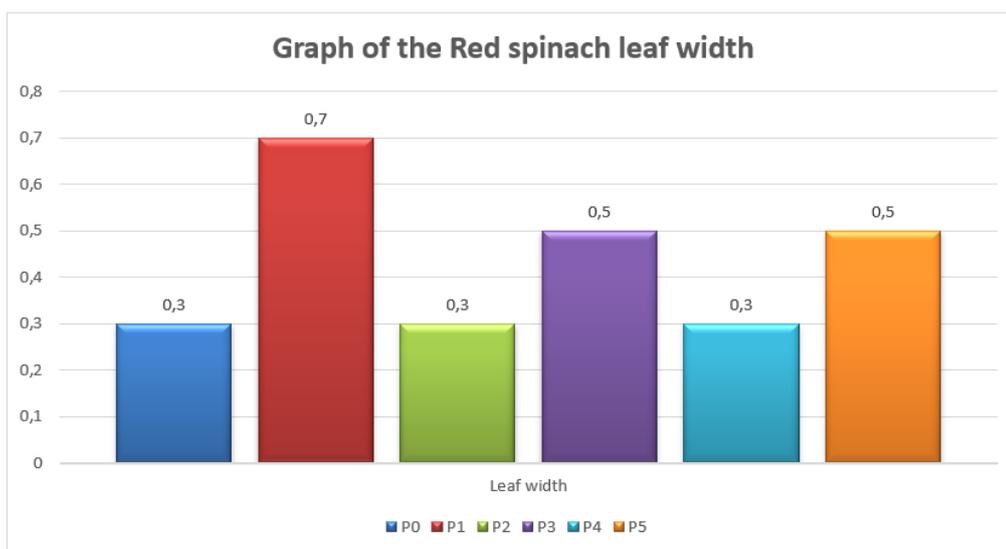


Figure 4. Chart width average value leaf plant spinach red

4. CONCLUSION

On research This can concluded that treatment best is on the mix charcoal shell P1 + AB nutrient 1200 ppm with high plant 1.5 cm, wide leaves 0.7 cm and 6 leaves. And treatment worst is P0 with height plant 1 cm, wide leaves 0.3 cm and the number leaves 6. In the treatment P2, P3, P4 and P5 the results balanced meaning. No results best and worst. this is caused by several factors, namely light, environment, temperature and seeds which cause growth in red spinach to have the same value even though the concentration of AB Mix fertilizer is different.

5. SUGGESTION

This useful for plant when rare nutrient, because plant can absorb it from carbon skin released wood in a manner slowly. Charcoal also delivers more influence Good to tall plant spinach compared to husks, because charcoal husk paddy own more abilities Good in increase porosity ground, so land become more loose and ability absorb water increases.

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