BIOVALENTIA: BIOLOGICAL RESEARCH JOURNAL
e-ISSN: 2477-1392
Vol. 9 No. 1, May 2023

Comparison of Planting Shrub Pepper (*Piper nigrum* L) Floating and Dry Land with Magnesium Fertilizer Treatment (Mg)

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Peer review under responsibility of Biology Department Sriwijaya University

Abstract

The cultivation of pepper plants is usually carried out on dry land, but at this time there is a lot of conversion of pepper plantations to other plantations and even housing. This study aimed to investigate the growth ratio of floating agricultural pepper and dry land, study the best Mg dosage for the growth of pepper with float-ing and dry land systems, andinvestigate the planting system on soil moisture content, pH and Mg content of soil and plants. The research was carried out from September 2020 to January 2021 in the gardens of the Soil Department, Faculty of Agriculture, Sriwijaya University, Indralaya. This research was conducted using the Split Plot Design method with 2 factors. As the main plot is the farming system, namely: S1 = Floating. S2 = On dry land (conventional). Subplots were Mg fertilizer with doses per polybag: Mg0 = No Mg fertilizer, Mg1 = 4g plant-1 , Mg2 = 8 g plant-1 , Mg3 = 12 g plant-1 , Mg4 = 16 g plant-1 . Observations were made on the increase in plant height, number of leaves, elemental content mg, soil water content, soil pH. The results showed that the planting system had an effect on plant height, number of leaves in the 11th week and root length, Mg doses did not affect the growth of pepper and soil. The soil water content of the floating system is higher than the conventional system, whereas the pH is higher in the conventional system than the floating system.

Keywords : Shrub Pepper, Piper nigrum L, Floating, Magnesium (Mg) Fertilizer, swampland.

Received: May 4, 2023, Accepted: June 17, 2023

1. Introduction

Swamp land is sub-optimal land that can be used as agricultural land. South Sumatra's swamp lands cover an area of 2.5 million hectares [1]. Generally, swamp land is mostly used for agricultural cultivation activities only towards the end of the rainy season. This is due to the flooding of the swamps during the rainy season which results in low agricultural intensity in the swamps [2]. During the flood period, the swamp land was left inundated without any cultivation activities. So it is necessary to apply technology that can be applied to swamps during inundated periods.

The floating plant cultivation system is one of the cultivation systems that can be applied to flooded land. The floating plant cultivation in its cultivation system uses rafts made of bamboo so that the media and plants can float [3]. The planting medium or soil used in this system can be directly placed on a raft that has been coated so that it is like floating bed [4] or using *polybags*, such as chili cultivation carried out [5].

Floating cultivation systems have been widely applied, including chili [5], rice [4], and kale. The advantage of the floating system is that it maintains a natural balance in using swampland because it does not require irrigation [6] and does not need to be watered, because water is already available at the bottom of the growing media and will diffuse over the growing media [4] . This floating plant cultivation system can ensure that water will remain available on the ground so that plants that are suitable for planting in this medium are plants that are susceptible to drought, including pepper.

Pepper is a plant that has a high selling value, because it is one of Indonesia's export spices. Indonesian pepper production in 2017 was 87.9 thousand tons [7] . The cultivation of pepper plants is usually carried out on dry land, but at this time there is a lot of conversion of pepper plantations to other plantations and even housing. One way to increase pepper production is to increase the harvested area of pepper, namely in swamps. Therefore research is needed to compare the growth of pepper with a floating system with planting on dry land. In addition to expanding the land, the method that can be applied is the appropriate pepper fertilization. Where according to [8] the leaves of the pepper plant contain a low element of magnesium (Mg) to indicate a deficiency of the element Mg, so that it can be said that it is necessary to fertilize with the element Mg.
Magnesium in plants functions in plant physiological and biochemical processes, where it is an essential element for plant growth and development [9]. The results of a study [10] stated that the addition of 40 g of Mg and 4 g of Boron could increase the piperine content in pepper plants. Mg deficiency in pepper plants can result in decreased relative growth rate, Number of nodes, number of leaves, and stem diameter [11]. Mg plays a role in photosynthesis and cell energy balance [10]. Based on [8] the nutrient status of Mg in pepper in the Bangka Belitung Islands is low, namely around 0.10-0.46%, where the optimal content of pepper plants ranges from 0.40-0.69%.

Research on pepper fertilization in dry land has been carried out a lot. According to [12] application of 1.600 g of NPK 12-12-17 plant $^{-1}$ year $^{-1}$ gave the best growth and highest production of pepper plants. The application of fertilizer to 1.8 kg of tree $^{-1}$ is a sufficient dose of fertilization for a 6-year-old pepper [8] . [13] Dosing Urea 145 g plant $^{-1}$, TSP 130 g plant $^{-1}$, and KCl 120 g plant $^{-1}$ had the best effect on 1 year pepper in ex-tin mining land.

One of the obstacles to the development of floating pepper cultivation is the dose of fertilizer that should be applied. Where there is no recommended data on plant fertilization with a floating pepper farming system . This study aims to investigate the growth ratio of floating agricultural pepper and dry land , study the best Mg dosage for the growth of pepper with floating and dry land systems and investigate the planting system on soil moisture content, pH and Mg content of soil and plants.

2. Materials and Methods

This research was conducted using the Split Plot Design method with 2 factors. As the main plot is the farming system, namely: S_1 = Floating. S_2 = On dry land (conventional). Subplots are Mg fertilizer with the dose per *polybag*: Mg_0 = No fertilizer Mg, Mg_1 = 4 g plant $^{-1}$, Mg_2 = 8 g plant $^{-1}$, Mg_3 = 12 g plant $^{-1}$, Mg_4 = 16 g plant $^{-1}$. So that 10 treatment combinations were obtained where each treatment was repeated 3 times so that 30 experimental units were obtained. The soil used is swampland from the experimental field of the Faculty of Agriculture, Sriwijaya University, Indralaya. 5 kg of soil and 1 kg of mixed vermicompost are put into *polybags.* The conventional land planting system is carried out in a greenhouse while the floating system planting is carried out using a raft with the das of the polybag touching the water as high as 5cm. Mg fertilizer application is done after 2 weeks after planting. Observations of this study were the increase in height, number of leaves, Mg content, soil water content and soil pH. The data obtained were then analyzed statistically using the test of variance (ANOVA) at the 5% level to determine the effect of the treatment on the parameters tested.

3. Results and Discussion

The morphological observations of pepper plants were the increase in height, the increase in the number of leaves and the length of the roots of pepper. The growth results of pepper plants were obtained by measuring the height and adding pepper plant leaves. Measurements were taken when the plants were 2 weeks, 7 weeks and 11 weeks after planting. Pepper root length was measured at the end of the study.

The addition of garden height in Figure 1 shows that the growth of floating system pepper height is lower than the traditional system. The addition of the 3rd week of height in the traditional system shows a quadratic pattern, where B1 Mg3 shows the peak point of the increase in height. Meanwhile, the addition of height at week 7 and week 11 showed a decrease in height in the floating system. Plants continued to gain height in the traditional system from week 3 to week 11.

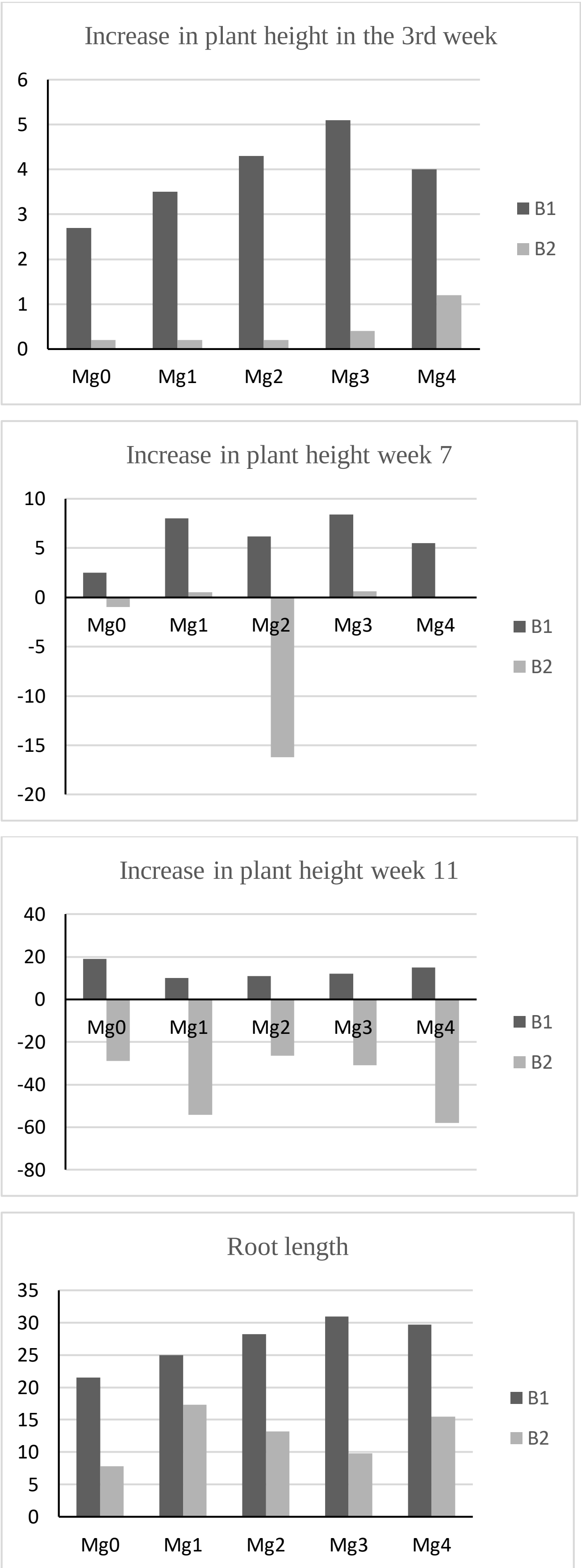

Figure 1. Diagram of increasing plant height in weeks 3, 7 and 11 and root length

The decrease in pepper height in the floating system was due to the death of the pepper plants, this indicates that pepper plants cannot be planted using a floating system.

This is because the water content of the growing media with the floating system is higher and the soil pores are filled with water, so according to [14] oxygen in the growing media of the floating system diffuses more slowly. As a result of soil that is too high in water content, the roots of pepper plants do not grow. According to [15] as a result of low oxygen in the soil resulting in low energy produced by roots, low energy roots resulting in inhibited root respiration and stunted root growth.

Plant canopy and plant roots have a close correlation. The plant canopy is largely determined by root development, roots that grow and develop properly will absorb water and nutrients to be translocated to other parts of the plant. According to [16] some salt and mineral absorption is controlled by the plant canopy, the canopy will stimulate roots to increase absorption by quickly using salt and minerals, added by[17] that there is a significant relationship between height, number of leaves and root biomass.

Table 1 shows that the planting system had a significant effect on plant height from week 2 to week 11. The increase in the number of leaves of the floating system treated plants had no significant effect on week 2 and week 7, while week 11 had a significant effect. Treatment of Mg fertilizer doses and treatment interactions had no effect on plant growth, both plant height and number of leaves in each observation, while root length was only influenced by the planting system.

The treatment of giving magnesium and its interaction did not have a significant effect on height, number of leaves and root length of plants, this was presumably because magnesium had no significant effect on the vegetative phase of plants. The nutrients that affect the vegetative phase include N, P and K, according to [18] the application of NPK fertilizer has a significant effect on the height, petiole and stem weight of moringa plants, oyong plants [19], and lettuce [20].

Table 1. The results of the ANOVA analysis of the effect of the planting system and the dosage of Mg fertilizer and its interaction on the growth and root length of pepper.

Observational Variables	Treatment S	Mg	I
Plant height			
Week 2	9.08 *	0.12 ^{tn}	0.12 ^{tn}
Week 7	6.18 *	1.30 ^{mr}	0.79 ^{tn}
Week 11	58.52 *	1.01 ^{mr}	1.5 ^{mr}
Number of Leaves			
Week 2	0.11 ^{tn}	0.49 ^{tn}	1.43 ^{mr}
Week 7	2.06 ^{ms}	1.21 ^{tm}	0.11 ^{tn}
Week 11	11.22 *	0.19 ^{tn}	0.60 ^{tn}
Root Length	482.55*	0.31 ^{tn}	-117.24 ^{mr}

Information: *= significant effect, tn = no significant effect, S = cropping system, Mg = Mg fertilizer dose, I = interaction

Table 2. DMRT test results for planting system plant height number of leaves and root length

Planting System	Observational Variables				
	Week 2 plant height			11th week leaf count	root length
	2	7	11		
B1	3.266 ^{a}	5,1 ^{a}	10.83^{a}	11.166^{a}	162.5a –
B2	0.366^{b}	-2.7^{b}	-33.13^{b}	-2 ^{b}	58.75 ^{b}

Note: numbers followed by the same letter in the same column are not significantly different at the DMRT test level of 0.05.

Based on table 2, the results of the DMRT test for planting plant height, increasing the number of leaves in the 11th week and root length show that the conventional and floating planting systems are significantly different where the conventional planting system is better than the floating planting system.

Table 3 shows that the results of anova analysis of the lab treatment of the planting system, administration of various doses of Mg and their interactions did not have a significant effect on the observations of plant Ca, plant Mg, soil Ca and soil Mg. The planting system had an effect on soil pH and soil water content, while the treatment interactions only had an effect on soil pH.

Table 3. Results of ANOVA analysis of the effect of the planting system and dosage of Mg fertilizer and its interactions with Ca, Mg plants, Ca, Mg soil, pH and soil water content.

Observational Variables	Treatment S	Mg	I
Ca plant	0.042 ^{tn}	0.29 ^{tn}	1.01 ^{tn}
plant mg	0.495 ^{tn}	0.06 ^{tn}	0.370 ^{tn}
Ca soil	15,461 ^{tn}	0.57 ^{tn}	2.11 ^{tn}
Mg soil	-1,297 ^{tn}	0.03 ^{tn}	-0.174 ^{tn}
pH	9,285 *	1.7 ^{tn}	5.48 *
Water content	77,716 *	1.69 ^{tn}	0.27 ^{tn}

Information: *= significant effect, ^{tn} = no significant effect, S = cropping system, Mg = Mg fertilizer dose, I = interaction

Table 4. DMRT test results of the planting system on pH and soil water content

Planting system	Observational variable	
	soil pH	Water content
B1	12,983 ^{a}	168,101^{b}
B2	12,388^{b}	176,395 ^{a}

Note: numbers followed by the same letter in the same column are not significantly different at the DMRT test level of 0.05.

Table 4 shows that the soil pH of the conventional planting system is higher than that of the floating system. While the water content of the floating system is greater than the conventional system. This shows that soil pH is closely related to water content where when the water content is high, the soil pH will be lower and vice versa. The higher the soil water content, the greater the reaction of releasing H^+ so that the soil becomes acidic· [21] [22] bless and state that the more water in the soil, the more acidic the soil will be.

4. Conclusion

The conclusion of this study is that the growth of pepper is better in the conventional planting system, mg application does not affect the growth of both conventional and floating pepper and the soil water content of the floating system is higher than the conventional system, on the contrary, the ph is higher in the conventional system compared to the floating system. Floating.

5. Acknowledgement

The authors express their gratitude and appreciation to all parties who played a role in the research, both in support, licensing, consultants, and assisting in data collection.

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