International Journal of Veterinary Science and Agriculture Research
Volume 7 Issue 3, July-August 2025
ISSN: 2582-4112, Available at www.ijvsar.com

Nutrient Availability, Growth and Production of Chinese Cabbage (*Brassica rapa* Var. Chinensis) in Planting Media from Different Aquatic Vegetation and Ameliorant in Floating Farming System

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Keywords: *substrate quality, mineralization, structure of chemical carbon, adsorption, decomposition.*

Abstract: *Floating farming systems, developed for crop cultivation in swampy areas during high water levels, typically utilize organic matter from aquatic vegetation as planting media. Therefore, selecting the appropriate materials for creating these media is crucial. This study aims to quantify the nutrient-providing capabilities of various aquatic vegetation, both with and without ameliorants, for plant growth and production in floating farming systems. Three types of aquatic vegetation—Eichhornia crassipes, Pistia stratiotes, and Mimosa pigra—were incubated on floating rafts for one week, with and without the addition of ameliorants (cow dung or chicken manure). After the incubation period, pH levels and available nitrogen (N) and phosphorus (P) were measured, and 3-week-old Chinese cabbage (Brassica rapa Var. Chinensis) seedlings were then transplanted into the planting media. The results showed that chicken manure improved NH_4^+ by 4-53%, NO_3^- by 22-123%, and available P by 98-672%, while cow manure increased NH_4^+ by 2-37%, NO_3^- by 5-43%, and available P by 9-94%. Plant height, number of leaves, stem diameter, and dried stem weight varied depending on the type of vegetation used as planting media. The effectiveness of these vegetation types in supporting plant growth and production increased in the order: E. crassipes < P. stratiotes < M. pigra. These findings underscore the importance of selecting appropriate vegetation types and ameliorants to enhance* *nutrient availability, thereby supporting sustainable floating farming in swampy areas.*

I. INTRODUCTION

Swamps are depressions situated far from the coast, inundated by river overflows and/or rainwater that stagnates periodically or continuously. The primary challenges in developing agriculture in swampy areas include unpredictable waterlogging and flooding, as well as drought during the dry season, limiting cultivation to once a year [1]. Additionally, soils in these areas typically exhibit high acidity and low fertility [2]. Farmers commence crop cultivation only after water levels in the swamps recede at the end of the rainy season. This highlights that farming in swampy areas necessitates specialized skills to overcome natural obstacles, particularly the extreme and fluctuating water conditions experienced annually.

Floating farming is an agricultural system designed to adapt to swamps that have been waterlogged and permanently inundated. In this system, crops are cultivated on platform floating on waterbody even as water levels rise. This technique has been implemented in Indonesian swamps, where various crops are grown simultaneously on bamboo rafts [3]. Floating farming systems are also employed for cultivating beets, pumpkins, tomatoes, chilies, and peppers in Bangladesh and Myanmar [4, 5]. The use of floating farming systems enables the year-round agricultural utilization of areas that have been long waterlogged and permanently inundated, such as swamps.

The floating farming system utilizes organic materials (OM) from vegetation around swamp areas as a growth medium instead of soils. These OM are processed and layered on the raft surface to create a planting medium. The decomposition of these OM is crucial for nutrient provision, thereby supporting plant growth [6]. It is well established that OM materials with varying chemical compositions decompose at different rates, affecting their nutrient supply capabilities [7, 8]. Commonly used OM in floating farming systems include water hyacinth, water lettuce, and other aquatic vegetation [9, 10]. Therefore, selecting the appropriate type of vegetation as a planting medium is essential for the success and sustainability of floating farming system management.

The application of ameliorants, such as manure, influences the decomposition rate of OM, ultimately enhancing nutrient availability for plants [11, 12]. Dion, Jeanne [13] demonstrated that adding manure to a peat-based organic growing medium alters bacterial communities, thereby increasing nitrogen availability. When OM from aquatic plants in swamps are combined with manure, they have the potential to serve as effective planting media and nutrient sources in floating farming system. Despite the abundance of various types of OM in swamp lands, information on using OM from aquatic vegetation as planting media for floating farming system remains limited. Moreover, comprehensive studies on additional treatments, such as incorporating manure to accelerate the decomposition of aquatic OM from swamp lands, are lacking. Therefore, this study aims to quantify nutrient availability (nitrogen and phosphorus) and plant growth in planting media derived from different vegetation, with and without the addition of livestock manure, in floating agriculture systems.

II. Materials and Methods

Study Site Description

This research was conducted in the lowland swamp area of Desa Sungai Limas, Haur Gading District, Hulu Sungai Utara Regency, Indonesia (2.383210° – 2.383201° S, 115.246945° – 115.246996° E). The region experiences an annual rainfall ranging from 801 to 3171 mm, with the lowest rainfall of 29 mm occurring in August and the highest of 419 mm in March. The dry season spans from May to October, while the rainy season extends from November to April. The average annual temperature is 26.7 °C, with the minimum average temperature of 23.8 °C and the maximum average temperature of 32.6 °C recorded in March and September, respectively.

The research area is a swamp that is flooded throughout the year, with water levels fluctuating between the rainy and dry seasons. During the dry season, the water level drops to approximately 30 cm, while in the rainy season it can rise to as high as 200 cm above the ground surface. Common aquatic vegetation found at the research area including mimosa (*Mimosa pigra*), water lettuce (*Pistia stratiotes*), dan water hyacinth (*Eichhornia crassipes*).

Preparation for Floating Rafts and Planting Media

The research activity began with the construction of a floating raft to serve as the cultivation platform for the floating farming system. The raft was constructed using a combination of bamboo and wood materials. Once assembled, a polyethylene (PE) net was placed on the raft surface, and drums were added to provide buoyancy. Each experimental plot utilized a raft measuring 2 meters by 2 meters, with nine plots arranged in a single row.

The experiment employed a completely randomized design with two factors: the type of vegetation (*Eichhornia crassipes*, *Pistia stratiotes*, and *Mimosa pigra*) and the type of ameliorant material (no amelioration, cow dung and chicken manure). This resulted in nine treatment combinations, each replicated three times, leading a total of 27 experimental units. For chemical characterization purposes, both the vegetation and ameliorant materials were oven-dried at 70°C for 72 hours and subsequently ground to achieve a particle size of less than 0.5 mm. The organic C content in the vegetation and ameliorant materials was determined using the Walkley-Black method [14]. Total N content was assessed using the Kjeldahl method [15], while total P was quantified through digestion with 60% $HClO_4$ and measured at 660 nm using a spectrophotometer [16]. The contents of lignin, cellulose, and hemicellulose in the vegetation were measured using the sodium hydroxide method [17], and carbohydrate content was quantified using the anthrone-sulfuric acid method [18].

Large planting media materials, such as *M. pigra* and *E. crassipes*, were cut into smaller pieces and evenly distributed on the surface of the floating raft according to the designated treatments to achieve a planting media thickness of 30 cm. Subsequently, either cow dung or chicken manure was added to the surface of the planting media for each experimental plot. The amount of organic material from vegetation used as planting media on the raft was 300 kg, with cow or chicken dung added to the planting medium was 5% of the organic material in the planting medium. The planting media were then incubated for one week to facilitate decomposition and mineralization. After the incubation period, a 200 g sample of the planting media was collected for the measurement of nutrient availability. These measurements included the pH of the planting media [19], ammonium content [20], nitrate content [21], and available phosphorous content [22].

Seeding and Planting Chinese Cabbage

The seeds of Chinese cabbage (*Brassica rapa* Var. Chinensis) were sown in a medium composed of a soil and manure mixture at a 2:1 ratio. The seeds were sown in the medium and then covered with a 1-2 cm layer of the soil and manure mixture. Chinese cabbage seeds characterized by their round shape, slightly shiny surface, hardness, and dark color, were selected for planting in the floating rafts.

Two 3-week-old Chinese cabbage seedlings from the nursery were transplanted into the planting medium on the floating raft, with a spacing of 20 x 20 cm per planting hole. The plants were then allowed to grow for 30 days, during which maintenance activities such as thinning, weeding, and watering were performed. Harvesting occurred when the plants reached 30 days of age. Observations during harvest included measurements of plant height, number of leaves, stem diameter, root length, and the dry weight of both roots and stems

Statistical Analysis

An analysis of variance (ANOVA) was conducted on the observation data to evaluate the effect of treatments on the nutrient availability and the growth and production of Chinese cabbage. Before performing the ANOVA, the Shapiro-Wilk and Bartlett tests were employed to verify that the data exhibited a normal distribution and homogeneous variance. If the ANOVA results demonstrated a significant treatment effect, a least significant difference (LSD) test at $p < 0.05$ was subsequently used to compare mean values. Correlation analyses were conducted to quantify relationship between the availability of nutrients and the parameters of the growth and yield of plants. All statistical analyses were carried out using GenStat 11th Edition.

III. Results and Discussion

Characteristics of Vegetation for Construction of Planting Media

Three types of vegetation found around the research location—*E. crassipes*, *P. stratiotes*, and *M. pigra*—were used as planting media in a floating farming system. Laboratory analysis revealed that these plants had an organic carbon (C) content ranging from 128 to 326 g kg^{-1} and a total nitrogen (N) content between 3.7 and 8.6 g kg^{-1} (Table 1). The total phosphorus (P) content varied, with *M. pigra* having the lowest at 9.6 g kg^{-1} and *P. stratiotes* the highest at 14.7 g kg^{-1} (Table 1). All organic matter of *E. crassipes*, *P. stratiotes*, and *M. pigra* exhibited higher lignin content, which is a form of organic carbon that is relatively resistant to decomposition by soil microbes, compared to their carbohydrate content, which is more easily broken down by microbes (Table 1). This chemical composition of the aquatic plants used in the study aligns with findings from previous research [23, 24].

Table 1. Chemical characteristics of organic matter from vegetation and livestock manure used for construction of planting media. The values following ± symbol represent the standard deviation of the mean (n=3)

Characteristics	*Eichhornia crassipes*	*Pistia stratiotes*	*Mimosa pigra*	Chicken manure	Cow dung
Organic C (g kg^{-1})	177.45 ± 9.87	128.45 ± 8.45	325.67 ± 7.87	157.66 ± 9.21	95.42 ± 5.78
Total N (g kg^{-1})	4.56 ± 0.78	3.67 ± 0.27	8.56 ± 0.78	43.43 ± 1.12	19.86 ± 3.12
Total P (g kg^{-1})	12.56 ± 1.12	14.67 ± 0.98	9.56 ± 0.87	21.71 ± 1.03	15.83 ± 0.95
Lignin (g kg^{-1})	91.70 ± 7.45	178.80 ± 4.56	293.50 ± 7.67	-	-
Cellulose (g kg^{-1})	226.30 ± 8.54	212.20 ± 5.76	225.40 ± 6.50	-	-
Hemicellulose (g kg^{-1})	166.20 ± 6.40	4.80 ± 0.65	47.00 ± 1.25	-	-
Carbohydrate (mg kg^{-1})	398.56 ± 2.56	812.45 ± 8.56	476.45 ± 4.56	-	-

The ameliorants to be mixed with vegetation from the research location in the planting medium are chicken manure and cow dung. Chicken manure has a higher organic carbon (C-organic) and total nitrogen (N-total) content compared to cow manure (Table 1). This composition results in a relatively low C/N ratio for both ameliorants, with chicken manure at 6.7 and cow manure at 4.8. Additionally, the total phosphorus (P-total) content in chicken manure is higher than that in cow manure (Table 1).

Reaction (pH) and Available Nutrients of Planting Media

The ANOVA results indicated that the pH levels of the planting medium were significantly affected by the type of vegetation ($P < 0.001$) (Table 2). Among the different types of vegetation, the planting medium derived from *E. crassipes* exhibited the highest pH, whereas the medium from *P. stratiotes* showed the lowest pH (Figure 1A). The elevated pH in the *E. crassipes* medium might be attributed to its low nitrate contents compared to other vegetation (see Figure 2C). Except for the planting medium of *E. crassipes*, the nitrate contents in all other media were higher than the ammonium contents (Figure 2C). This suggests that the nitrification process in the planting medium of *E. crassipes* is slower compared to the other media. It is well established that the nitrification process in soil systems not only generates nitrate ions essential for plant growth but also produces H^+ ions, which contribute to soil acidification [25, 26]. Thus, the production of H^+ ions from nitrification results in a decrease in the pH of planting media of P. *stratiotes* and M. *pigra*.

Table 2. Analysis of variance (anova) of treatment effect on the characteristics of planting media and plant growth

Characteristics of Planting Media and Plant Growth	F (*P* Value)		
	Vegetation	Livestock manure	Ameliorant * Vegetation
pH of media	99.61 (<0.001)	7.19 (<0.005)	1.20 (0.410)
Concentration of NH_4^+	585.08 (<0.001)	21.09 (<0.001)	9.81 (<0.001)
Concentration of NO_3^-	520.48 (<0.001)	15.93 (<0.001)	3.64 (0.024)
Available P	1200.26 (<0.001)	90.57 (<0.001)	14.43 (<0.001)
Plant height	426.68 (<0.001)	2.27 (0.132)	1.58 (0.224)
Leaf number	355.39 (<0.001)	1.74 (0.087)	1.01 (0.426)
Shoot diameter	47.31 (<0.001)	0.64 (0.540)	1.38 (0.279)
Root length	362.94 (<0.001)	5.63 (0.013)	8.64 (<0.001)
Dried weight of root	153.43 (<0.001)	1.04 (0.373)	2.96 (0.049)
Dried weight of shoot	360.62 (<0.001)	1.45 (0.261)	1.67 (0.200)

The ANOVA results demonstrated that the application of livestock manure significantly influenced the pH of the planting medium ($P < 0.005$). The addition of chicken manure and cow dung led to a reduction in the pH levels of the planting medium (Figure 1B). Specifically, cow dung application reduced the pH from 6.60 to 6.19, while chicken manure further decreased it to 5.94 (Figure 1B). This decline in pH is attributed to the production of H^+ ions during the nitrification process [27, 28]. The presence of a nitrification reaction in this study was evidenced by the increased nitrate contents in the planting media treated with cow dung and chicken manure compared to those without these amendments (Figure 2B). These findings suggest that using ameliorant materials like cow dung and chicken manure can effectively enhance nitrogen availability in the planting medium, although it also results in increased soil acidity. This insight is vital for improved soil management, especially within sustainable agricultural systems.

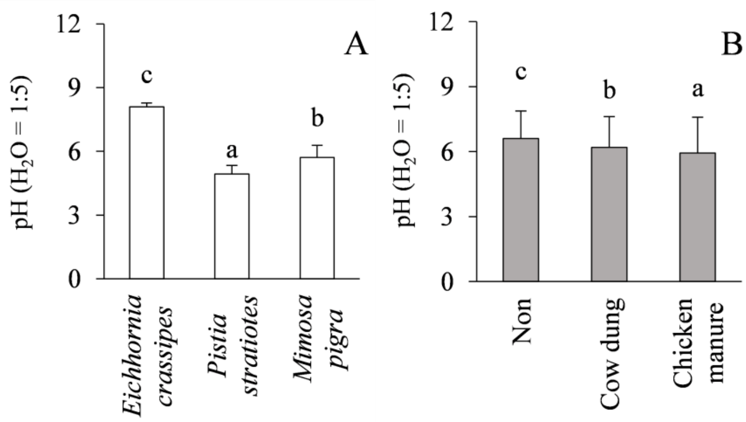

Figure 1. pH of medium as influenced by vegetation (A) and livestock manure (B) in the floating farming system. The line above each bar represents the standard deviation (n=9), and the letters above the line indicate the effects of treatments that are not significantly different based on the least significant difference (LSD) test at $p < 0.05$

The availability of nitrogen (NH_4^+ and NO_3^-) in all planting media was influenced by the interaction between the type of vegetation and livestock manure application (P <0.001) (Table 2). The application of chicken manure resulted in a higher increase in NH_4^+ + NO_3^- compared to cow dung (Figure 2A and 2B). Specifically, the application of cow dung and chicken manure increased the availability of NH_4^+ from 22.7 mg kg^{-1} to 31.2 mg kg^{-1} and 34.6 mg kg^{-1}, respectively, in the planting media of *E. crassipes* (Figure 2A). In the planting media of *P. stratiotes*, NH_4^+ levels rose from 6.4 mg kg^{-1} to 6.65 mg kg^{-1} with cow dung and to 7.6 mg kg^{-1} with chicken manure (Figure 2A). For *M. pigra*, NH_4^+ levels increased from 146.3 mg kg^{-1} to 148.7 mg kg^{-1} with cow dung and to 156.5 mg kg^{-1} with chicken manure (Figure 2A). A similar pattern was observed for nitrate (NO_3^-). In the growing media of *E. crassipes*, nitrate concentration increased by 43.6–123.8% with the application of cow dung and chicken manure (Figure 2B). In the growing media of *P. stratiotes*, nitrate levels rose by 10.6–22.4%, and in the growing media of *M. pigra*, nitrate concentration increased by 4.6–63.9% (Figure 2B).

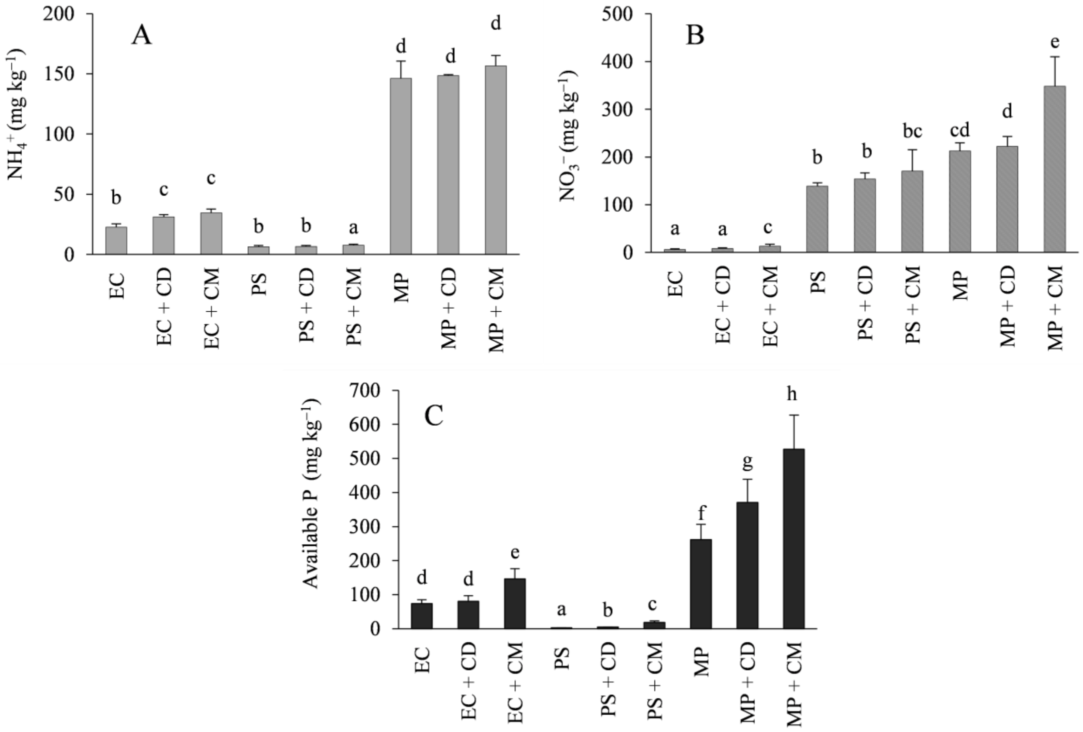

Figure 2. The concentration of ammonium (A), the concentration of nitrate (B), and the amount of available phosphorus (C) in planting media with different vegetation and ameliorant materials in the floating farming system. The line above each bar represents the standard deviation (n=3), and the letters above the line indicate the effects of treatments that are not significantly different based on the least significant difference (LSD) test at p <0.05

The increase in NH_4^+ and NO_3^- availability in the planting medium with the addition of livestock manure is attributed to the mineralization of organic nitrogen from cow dung and chicken manure. As shown in Table 1, the total nitrogen content in cow dung and chicken manure is 2-5 and 5-12 times higher, respectively, than in the organic matter used as a planting medium. Additionally, cow dung and chicken manure have C/N ratios of 4.8 and 3.6, respectively (Table 1), which promote nitrogen mineralization processes mediated by microorganisms, releasing NH_4^+ and NO_3^- essential for plant growth [29, 30]. Previous research by Lazicki, Geisseler [31] identified a C/N ratio of 16 to 19 as the limit of nitrogen mineralization. In another study using manures and compost as sources of organic nitrogen, Gale, Sullivan [32] suggests a C/N ratio of 15 as a threshold value for nitrogen mineralization.

In addition to the mineralization of organic nitrogen from added manure, the increased availability of NH_4^+ and NO_3^- may also result from the mineralization of organic nitrogen present in the planting media itself. The introduction of fresh organic matter enhances microbial activity, leading to the breakdown of organic nitrogen in the planting media—a process known as the priming effect [33]. In a laboratory study, Mehnaz, Corneo [34] demonstrated an increase in gross nitrogen mineralization in soil with the addition of readily available organic carbon. Liu, van Groenigen [35] reported an increase in nutrient uptake from native soil N after application of both organic and inorganic fertilizers. The accelerated rate of nitrogen mineralization with the addition of various types of manure has been observed in both mineral soils [36-38] and organic soils [39].

The availability of P in the planting medium was significantly affected by the interaction of vegetation type and livestock manure addition (P < 0.001) (Table 2). The application of both cow dung and chicken manure increased the availability of P in all planting media, in which the increase in available P was more pronounced with the application of chicken manure compared to cow dung (Figure 2C). Specifically, the application of cow dung and chicken manure raised the available P from 73.9 mg kg^{-1} to 80.4 mg kg^{-1} and 146.7 mg kg^{-1}, respectively, in the planting medium of *E. crassipes* (Figure 2C). In the planting medium of *P. stratiotes*, the availability of P increased by 94.1% with cow dung and by 672.7% with chicken manure (Figure 2C). Similarly, in the planting medium of *M. pigra*, the available P increased by 41.6% to 101.5% with the application of cow dung and chicken manure (Figure 2C).

The application of cow dung and chicken manure to the planting media originated from three different vegetations enhances the availability of substrates, thereby increasing the activity of microorganisms involved in the decomposition of organic matter and nutrient release. The addition of fresh organic matter containing nitrogen (N) lowers the carbon-to-nitrogen (C/N) ratio, which in turn boosts microbial activity in the decomposition process [40]. Several studies have demonstrated an increase in the decomposition of organic carbon when fresh organic matter is added [41, 42]. Consequently, the enhanced decomposition process increases the availability of essential nutrients such as phosphorus (P), promoting plant growth and production.

The Growth dan Production of Pakcoy in the Planting Media

The ANOVA results showed that several parameters for plant growth and production such as plant height, leaf number, shoot diameter, and dried weight shoot were influenced by the type of vegetation used for planting media (P <0.001) (Table 2). The *E. crassipes* planting medium resulted in the lowest the growth and production of plants, including plant height, number of leaves, stem diameter, and stem dry weight, when compared to other media (Figure 3). Specifically, plant height was 18.6% higher in *P. stratiotes* medium and 58.1% higher in *M. pigra* medium than in *E. crassipes* medium (Figure 3A). The number of leaves increased by 36.7% in *P. stratiotes* medium and 67.7% in *M. pigra* medium compared to *E. crassipes* medium (Figure 3B). Similarly, stem diameter was 31.8% greater in *P. stratiotes* medium and 59.4% greater in *M. pigra* medium than in *E. crassipes* medium (Figure 3C). Furthermore, the stem dry weight was significantly higher in *P. stratiotes* and *M. pigra* media, by 69.9% and 396.5%, respectively, compared to *E. crassipes* medium (Figure 3D).

The ANOVA results indicated that root length of Chinese cabbage in the floating farming system was significantly affected by the interaction between the type of vegetation used as the planting medium and the application of manure (P < 0.001) (Table 2). Figure 4 illustrates the impact of different vegetation types as planting media and manure application on the root length and dry weight of roots. Specifically, the addition of chicken manure to the *E. crassipes* planting medium reduced root length from 18 cm to 15 cm. Similarly, applying cow manure to the *P. stratiotes* medium resulted in a 10% decrease in root length (Figure 4A). A reduction in root length from 32 cm to 28 cm was observed in the *M. pigra* medium with cow manure application (Figure 4A). These findings suggest that the use of both chicken and cow manure generally leads to decrease in root length across various planting media.

The analysis of variance revealed that the dry weight of Chinese cabbage roots in the floating farming system was affected by the interaction between the type of vegetation used as the planting medium and the application of manure ($P < 0.049$). Figure 4B illustrates the dry weight of Chinese cabbage roots across different planting media and manure treatments in the floating farming system. The application of cow dung and chicken manure did not significantly influence the root dry weight in the *E. crassipes* and *P. stratiotes* planting media (Figure 4B). However, the root dry weight decreased from 4.7 g to 3.5 g in the *M. pigra* planting medium (Figure 4B). These findings indicate that the effect of manure application on root dry weight varies depending on the type of vegetation used as the planting medium.

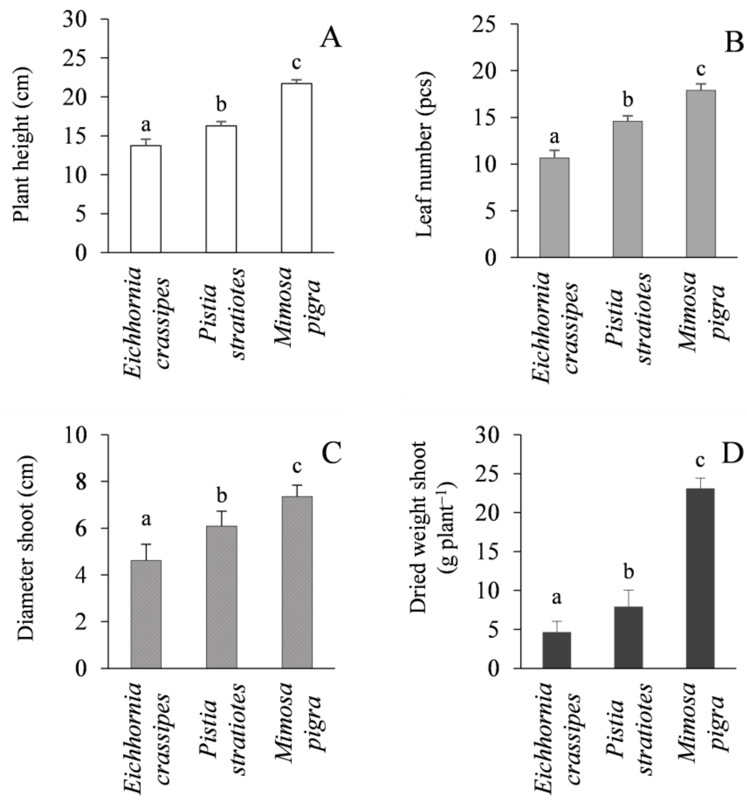

Figure 3. Effect of vegetation types on plant height (A), leaf number (B), shoot diameter (C), and dried weight of shoot (D) of Chinese cabbage grown in the floating farming system. The line above each bar represents the standard deviation (n=9), and the letters above the line indicate the effects of treatments that are not significantly different based on the least significant difference (LSD) test at $p < 0.05$

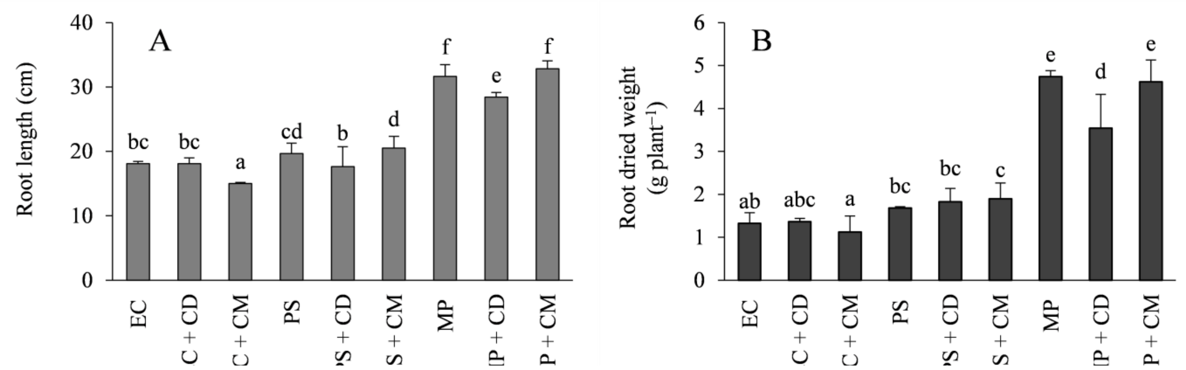

Figure 4. Effect of the interaction between vegetation types and livestock manure on root length (B), and dried weight of root (B) of Chinese cabbage grown in the floating farming system. The line above each bar represents the standard deviation (n=9), and the letters above the line indicate the effects of treatments that are not significantly different based on the least significant difference (LSD) test at $p < 0.05$.

The growth and yield of Chinese cabbage in the floating farming system were influenced by the type of vegetation used as a planting medium and its interaction with manure application, primarily through enhanced nutrient availability. Different vegetation types and manure applications lead to varying the availability of nutrient levels, ultimately affecting plant growth and production. Analysis revealed a negative correlation between the pH of the planting medium and the growth and production of Chinese cabbage (Table 3). Observations indicated that the pH of the planting medium ranged from 4.5 to 8.2, with higher pH levels correlating with reduced growth and production of Chinese cabbage. This study is in agreement with the previous research by Lee, Wang [43], which found that the optimal pH for Chinese cabbage growth is between 5.5 and 7.0, in which a pH level above 7.0 decreases plant production due to potential root rot.

Table 3. Correlation between nutrient availability, growth and yield of Chinese cabbage cultivated in planting media from various the types of vegetation and the application of manure in floating farming systems.

Parameters of growth and yield of plants	pH of planting media (H_2O)	NH_4^+	NO_3^-	Available P (P Bray I)
Plant height	-0.54**	0.87**	0.87**	0.75**
Number of leaves	-0.73**	0.74**	0.93**	0.63*
Stem diameter	-0.62**	0.67**	0.81**	0.58**
Root length	-0.39*	0.92**	0.83**	0.80**
Dried weight of root	-0.38*	0.90**	0.83**	0.76**
Dried weight of stem	-0.41*	0.93**	0.83**	0.83**

The availability of nitrogen and phosphorus nutrients demonstrated a significant positive correlation with plant growth and production parameters (Table 3). This study suggests that variations in nitrogen and phosphorus availability, influenced by the type of vegetation used as planting media and manure application, lead to corresponding changes in plant growth and production. An increase in the availability of these nutrients is associated with enhanced plant growth and production. These findings align with previous research, which indicated that the nutrients generated from the mineralization of organic matter are sufficient to support plant growth and production [44, 45]. Additionally, Osterholz, Rinot [46] found that the rate of gross ammonification, a reaction in nitrogen mineralization producing NH_4^+, at a soil depth of 0-80 cm, is 3.4 to 4.5

times greater than the rate of nitrogen uptake. This suggests that nitrogen availability from the mineralization process is adequate to meet the nitrogen requirements in corn cultivation [46, 47].

IV. Conclusion

The study demonstrates that the availability of nitrogen and phosphorus is influenced by the type of vegetation used as planting media and the addition of livestock manure. The application of chicken manure to all planting media resulted in greater availability of NH_4^+, NO_3^-, and available phosphorus compared to cow dung. This increase in nutrient availability is attributed to the mineralization of organic nitrogen and phosphorus contained in the manure. Additionally, the presence of manure may enhance the activity of microorganisms in decomposing organic matter in the planting media, thereby increasing nutrient release. Plant height, number of leaves, stem diameter, and dried stem weight in the floating farming system varied based on the type of vegetation used as planting media. The ability of the vegetation types to support plant growth and production increased in the order of *Eichhornia crassipes* < *Pistia stratiotes* < *Mimosa pigra*. Correlation analysis showed that the increase in plant growth and production was related to the enhanced nutrient availability due to the variation in vegetation type and the application of livestock manure. These findings highlight the importance of selecting appropriate materials for creating planting media and using suitable ameliorants. Such choices are crucial for optimizing the nutrient-providing capacity of planting media, thereby supporting sustainable plant growth and production in floating farming systems

V. Acknowledgements

The authors extend their gratitude to the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia for funding this research through the Research Grant for Thesis No. 1015/UN8.2/PG/2024. The assistance provided by laboratory technicians and field officers during the laboratory and field work is also gratefully acknowledged.

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