Vol. 8 No. 2 March 2025

ISSN : 2597 - 8713 (ONLINE)
ISSN : 2598 - 5167 (PRINT)
Agricultural Science

Journal Of Agricultural Science And Agriculture Engineering
Faculty of Agriculture, Merdeka University Surabaya,Indonesia
Available on :
https://agriculturalscience.unmerbaya.ac.id/index.php/agriscience/index

Chinese Cabbage Plant *(Brassica Rapa)* Test of The K01 Variety on The Total Concentration of AB Fertilizer

Alfi Syahrin[1*], Alridiwirsah[1], Farah Zaidat[2]

[1]Agrotechnology Study Program, Faculty of Agriculture, Universitas Muhammadiyah Sumatera Utara, Indonesia

[2]Horticulture Research Center (HR1), MARDI Kuala Lumpur, Malaysia

*Correspondence Email : alridiwirsah@umsu.ac.id

Article History: Received: September 21, 2024; Accepted: January 12, 2025

ABSTRACT

This study aims to evaluate the response of K01 variety of Chinese cabbage (Brassica rapa) to different concentrations of AB fertilizer in a hydroponic system. The experiment was conducted for six weeks at the Horticulture Research Center, MARDI Serdang, Malaysia, using a Completely Randomized Design (CRD) with five AB fertilizer concentration treatments (T1 to T5), five replications, and six samples per replication. The tested AB fertilizer concentrations ranged from 0.8 to 2.0 EC. Parameters observed included leaf number, plant height, chlorophyll content, and leaf area index (LAI). The results showed that treatments with higher AB fertilizer concentrations (T2 and T3) produced the best results in leaf number, reaching 33.4 leaves by the sixth week. In contrast, treatments with lower AB fertilizer concentrations (T1 and T4) resulted in lower leaf numbers. This study concluded that optimal AB fertilizer concentrations can enhance leaf number and growth of K01 variety Chinese cabbage in a hydroponic system. Therefore, proper fertilizer concentration management is crucial in hydroponic cultivation of Chinese cabbage to achieve maximum growth.

Keywords: Cabbage, Fertilizer, Hydroponics, , LAI , Plant, Variety

1. INTRODUCTION

Plants are unique among all living things because plants are creatures that can make their food, unlike other creatures, such as animals and humans, who cannot make their food. Plants can produce their food through a process called photosynthesis. Plants have different species and certain naming and classification systems. In order to live, grow, and develop, plants often require different genes and environments that interact with complex physiological processes (Naisila et al., 2024). Plants are also living things like us humans. Plants also breathe every day. The difference is that if humans need oxygen to breathe, plants need carbon dioxide when breathing. Plants also need food intake for their life and development. For their lives, plants only need food in the form of water, air, sunlight, and other things, unlike humans or animals, which need food from other living things. One of the benefits of plants is medicinal plants or sources of medicine for living things. Both stems, leaves, roots, skin, and flowers can be used as traditional medicines that are very beneficial for the lives of living things on this earth. The use of conventional drugs is still

 DOI:https://doi.org/10.55173/agriscience.v8i2.157

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widely found in Indonesia, especially to treat diseases that are still relatively mild, such as coughs, skin diseases, stomach aches, colds, shortness of breath, and others (Rizal, 2020).

Chinese cabbage (Brassica rapa) is one of the important horticultural commodities, especially in hydroponic farming systems. This plant has high economic value and stable market demand, both for fresh consumption and for processed products. However, in the cultivation of Chinese cabbage, especially in hydroponic systems, one of the main challenges is optimal nutrient management, especially in the selection and provision of the right fertilizers. According to Masduki (2017), Since the 16th century, experiments on nutritional science by developing hydroponic farming methods have begun. Since then, this high-technology farming method has become more popular and known throughout the world. Hydroponics comes from the Latin hydros, which means water, and phonos, which means work. The literal meaning of hydroponics is water work. Planting hydroponically is then known as planting without soil medium (soilless cultivation, soilless culture). Initially, people planted using the hydroponic method using containers filled with water that had been mixed with micro and macro fertilizers. In addition, according to Radinka et al. (2023), hydroponics allows planting in various locations, including areas with limited land, such as urban areas. It can produce plants with better quality and shorter harvest times.

AB Mix nutrients or mixed fertilizers are solutions made from chemicals that are given through the planting medium, which function as plant nutrients so that plants can grow well. In a hydroponic cultivation system, nutrients are an important part of plant growth. Providing good nutrition will make plants grow well, too; these nutrients are likened to "life" in hydroponic cultivation. If the planting medium functions as a place to develop and support plants, nutrients play a role in plant growth in the hydroponic system. Without providing nutrients, no matter how good the hydroponic system is made, plants will not grow well. Hydroponic nutrients are known as AB Mix nutrients in the market. This name is taken from two types of combined nutrients, namely nutrients A and nutrients B (Susila, 2018). This hydroponic system is expected to be an alternative to increase the productivity of vegetable plants (Pasaribu et al., 2020).

Article 6, paragraph (3) of the PVT Law states that the right to plant varieties is part of several activities, such as producing or duplicating seeds, preparing for propagation, advertising, offering, trading, exporting, and importing plants, and making plants. Based on Article 6, paragraph (5) establishes legal recognition and protection for genetically engineered plant varieties and states that essential derivative varieties must obtain approval from the owner of the original variety. The explanation of this article also includes the development of biotechnology, such as genetic engineering, which allows breeding activities to assemble new varieties by transferring

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genes with certain traits. New varieties can be created through genetic engineering with the same basic traits as the original variety except for one or two different traits (Batrisyia & Haryanto, 2023). Plant varieties play a crucial role in the success of hydroponic cultivation because each variety has genetic characteristics that affect the response to the environment and nutrients. Selecting the right variety can increase the efficiency of nutrient absorption, tolerance to environmental conditions, and plant production results. According to Muhammad & Guritno (2023), plant varieties that have efficient nutrient absorption capabilities could utilize nutrient solutions better, reduce waste, and increase yields. Research shows that selecting varieties that are suitable for hydroponic systems can improve the efficiency of nutrient use.

Research on the effect of the total concentration of AB Mix fertilizer on the growth and yield of Chinese cabbage (Brassica rapa) variety K01 in a hydroponic system is still limited. However, studies related to similar plants can provide a general picture of the effect of AB Mix concentration on plant growth. The K01 variety of Chinese cabbage is one type of cabbage that has special characteristics, such as large head size and resistance to certain diseases. However, specific information regarding the K01 variety is limited in available sources. In hydroponic cultivation, selecting the appropriate variety is very important to achieve optimal growth. The K01 variety of Chinese cabbage was chosen as the object of research because of its superior potential in terms of productivity and resistance to environmental stress in hydroponic systems. This study aims to evaluate the effect of AB fertilizer concentration on the growth and quality of the Chinese cabbage variety K01. By testing various concentrations of AB fertilizer in hydroponic systems, it is expected to find the optimal concentration that can increase plant growth results, especially those related to parameters such as plant height, number of leaves, chlorophyll content, and Leaf Area Index (LAI).

2. RESEARCH METHOD

This study was conducted at the Horticulture Research Center, MARDI Serdang, Malaysia, for six weeks using a Completely Randomized Block Design (CRBD). The variety used was Chinese cabbage K01 (Brassica rapa), which was planted in a hydroponic system using a mixture of perlite, coarse peat moss, and vermiculite. This study was conducted in a greenhouse with a temperature and sunlight intensity of 27-32 ℃. In this greenhouse study, environmental factors that can be anticipated for the growth and development of cabbage plants are pests and diseases that attack cabbage plants. AB fertilizer was given with different concentrations every week, ranging from 0.8 to 2.0 EC, to test its effect on plant growth. Each treatment was carried out with six

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replications, and each replication consisted of 5 plant samples. The parameters observed included plant height, number of leaves, chlorophyll content, and leaf area index (LAI). The data obtained were analyzed using analysis of variance (ANOVA) to determine the effect of fertilizer concentration on the growth parameters of Chinese cabbage plants. AB fertilizer is provided by mixing fertilizer A and fertilizer B and dissolved with water according to the desired concentration. The concentration of AB fertilizer is measured using an EC Meter. The concentration of AB fertilizer is different every week: Week 1- (0.8), Week 2- (1.0), Week 3- (1.2), Week 4- (1.8), and Week 5- (2.0).

The method of making AB fertilizer used in providing nutrition to cabbage plants is as follows:

1. Mix the concentration of fertilizer A and fertilizer B with a ratio of 1 : 1 : 1, then mix with water and stir until evenly combined.
2. Furthermore, after mixing both fertilizers A and B into the water, the concentration of the fertilizer is measured using an EC meter.
3. After measuring the concentration of AB fertilizer, it is then applied evenly to the plants. Cabbage plants that are in the growth phase require different concentrations of EC. The concentration of AB fertilizer will increase along with the needs of plant growth

Place and time

This research was conducted at the Horticultural Research Center, Malaysia Agriculture Research and Development Institute (MARDI) Serdang, Malaysia. It has an altitude of 1,400 meters above sea level and a comfortable temperature. The research was conducted for 6 weeks from the initial planting period on August 8, 2024, to September 19, 2024.

Materials and tools

The tools used in this study are EC meter (Electrical Conductivity), SPAD, drum, Gloves, scissors, dipper, TDS meter (fertilizer content measuring tool), meter, ruler, pen, A4 paper, EC meter (Electrical Conductivity), and SPAD. Meanwhile, to calculate the results of the study using Microsoft Excel. The materials used in this study were cabbage plant varieties, namely K01. This cabbage plant variety was planted using plant media, namely perlite (50 L), coarse peat moss (250 L), and vermiculite (50 L). The provision of media was used at a ratio of 1 1 1. The fertilizer used in this study was AB fertilizer. The concentration of this AB fertilizer varies by following Weeks 1 to 6. Several tools were used in the study to measure and collect data, namely the Chlorophyll Meter (SPAD), Leave Area Index (LAI), and measuring instruments (Meter).

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3. RESULTS AND DISCUSSION

Table 1. Plant Height

TREATMENT	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
T1	27,6	28,8	28,8	28	27	28,2
T2	27,4	32,4	42,4	47,6	46	53,4
T3	25,4	32,4	38,4	47	52	58
T4	21,4	23,2	25,2	28,2	23	36,8
T5	23,6	26,8	28	29,4	32,6	43,3

From the table of plant height above, we can see the difference between weeks 1 and 6, with the highest and lowest results. We can see in the table above that the highest results were in week 1 treatment T1 (27.6) and T2 (27.4), while the lowest treatment was in T4 (21.4), T5 (23.6), and T3 (25.4). For the highest results in week 2 treatment, T2 (32.4), T3 (32.4), and T1 (28.8), while for the lowest results, T4 (23.2) and T5 (26.8). The highest results were in week 3 in treatment T2 (42.4), T3 (38.4), T1 (28.8), and T5 (28). at the same time, the lowest results are in T4 (25.2). In week 4, all treatments seen in the table had high results where T2 (47.6), and T3 (47) were the highest while for treatment T1 (28), T4 (28.2), and T5 (29.4). For the highest results, week 5 treatments were T3 (52), T2 (46), and T5 (32.6), while the lowest treatment results were T4 (23) and T1 (27). For the highest results in week 6 treatments, T2 (53.4), T3 (58), T5 (43.3), T4 (36.8), and for the lowest results, T1 (28.2). This is due to the slow growth of cabbage plants will greatly affect the development of the number of leaves, leaf width, plant height, and plant weight, so providing low nutrients can cause the color of the plant leaves to turn yellowish, the plant stems look small so that it inhibits the growth of plant height. This is in accordance with research from Efendi et al., (2017), in which the study explains that the availability of sufficient nutrients will be able to stimulate the height of horticultural plants, promote the growth of the root system, increase the production of a plant and increase the results of growth in leaves so that it can increase the photosynthesis process.

The diagram below shows the growth of plant height, with growth power results that are different from the highest that we can know: the T3 treatment week (week) 6 with a height of 60 cm, while the lowest diagram result is the T4 treatment week (week) 5 with a height of 20 cm.

Diagram 1. Plant Height

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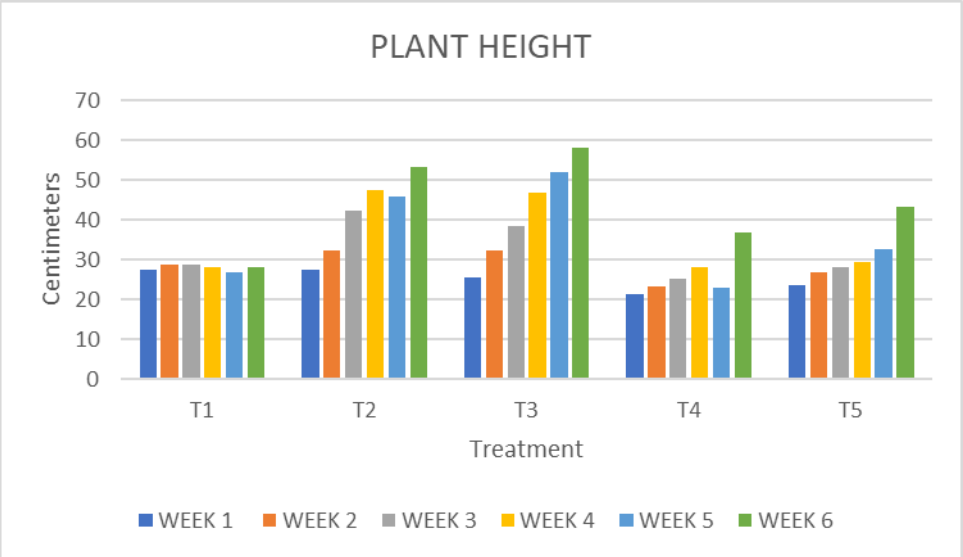

Table 2. Number of Leaves

TREATMENT	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
T1	7,4	10,2	13,2	21,8	28,6	27,2
T2	6,4	15,25	20	21	28	33,4
T3	7,2	11,8	15	18,4	30,6	33,4
T4	6,8	8	11	17,6	27,6	25,4
T5	6,6	8,6	11	21	28,8	29,2

From Table 2, it can be seen that the differences in observations of the number of leaves on Chinese cabbage plants of the K01 variety showed significant differences between AB fertilizer concentration treatments (T1 to T5) throughout the study period. In the first week, the number of leaves between treatments varied from 6.4 to 7.4 leaves per plant, with treatment T1 producing the highest number of leaves. Over time, there was a faster increase in the number of leaves in treatments with higher fertilizer concentrations, such as T2 and T3. In the sixth week, treatments T2 and T3 showed the highest number of leaves, each reaching 33.4 leaves, which was the best result compared to other treatments.

The increase in the number of leaves in the 6th week in treatments T2 and T3 may have been caused by the AB fertilizer concentration, which provided a more optimal supply of nutrients and supported better leaf growth. Conversely, treatment T4, which used a lower fertilizer concentration, showed a relatively lower number of leaves at the end of the observation, with only 25.4 leaves. This indicates that less than optimal fertilizer concentration can inhibit the growth of Chinese cabbage leaves. Overall, these results indicate that higher concentrations of AB fertilizer can stimulate an increase in the number of leaves in Chinese cabbage plants. However, there is a

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tendency for a decrease in the number of leaves in the sixth week for the T1 treatment, which has the lowest fertilizer concentration. The increase in stem height is due to the leaves growing at the stem nodes. When the plant stem experiences growth with an increase in stem height followed by an increase in the number of leaves, this is in accordance with the literature from (Mulyani, 2006), which explains the division that occurs in cells in the epical meristem tissue along with the formation of leaf primordia that form protrusions. The leaf primordia that have been formed will experience division, enlargement, and cell differentiation in forming new perfect leaves so that the number of new leaves can increase.

From the diagram showing the power, the level of development in the number of leaves that occurred during 6 weeks in the T5 and T3 treatments both had a height of 30 cm. In week 5, there was a very low development result in the number of leaves with a height of 0.5 cm.

Diagram 2. Number of Leaves.

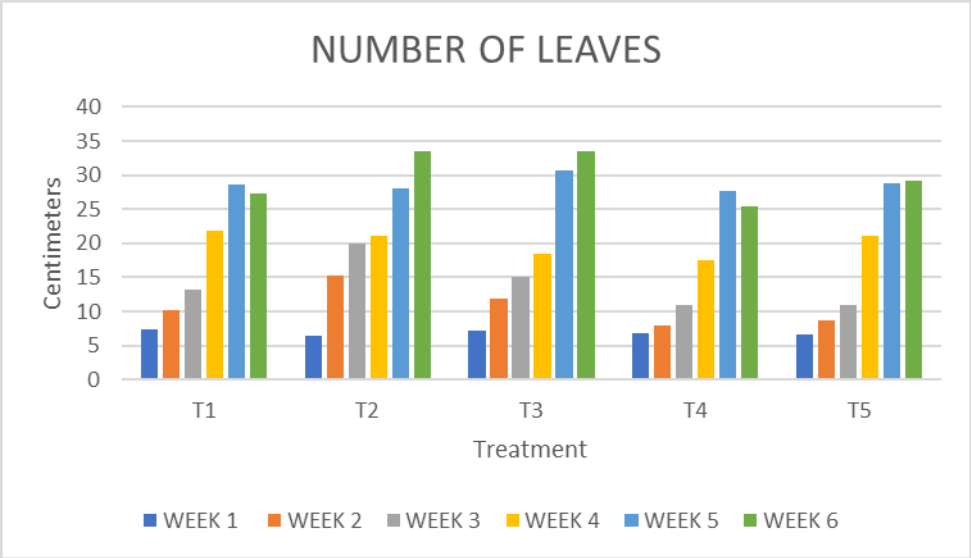

Table 3. Number of Chlorophyll

TREATMENT	Week 3	Week 4	Week 5	Week 6
T1	24,33	27,22	29,65	23,83
T2	24,59	24,29	23,59	17,61
T3	25,13	22,65	24,66	18,65
T4	23,81	26,45	28,53	21,82
T5	25,69	27,76	29,08	24,35

Table 3 shows the amount of Chlorophyll above and the difference from week 3 to week 6, which has the highest and lowest results. We can see in the table above the highest results in week 3 treatment T3 (25.13) and T5 (25.69) for the lowest value in T1 (24.33), T2 (24.59), and T4

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(23.81). For the highest results in the week 4 treatment, T1 (27.22), T4 (26.45), and T5 (27.76), for the lowest value in mention the treatment (24.29) and T3 (22.65). The highest results were in week 5 treatment: T1 (29.65), T5 (28.53), and T4 (28.53). For the lowest value in T2 (23.59) and T3 (24.66). The highest results were in week 6 of treatment T5 (24.35), T1 (23.83), and T4 (21.82). The lowest results were T2 (17.61) and T3 (18.65). This is because the Chlorophyll formed in the leaves will be a place to produce food through a process of photosynthesis, which can make a large amount of Chlorophyll. This is in accordance with the literature (Rizal, 2017), which states that the more Chlorophyll produced by the leaves through the process of photosynthesis, the more the plant growth process will increase, both in terms of plant height, number of leaves, and production results. The increase in wet weight in plants will be closely related to other growth processes, namely plant height, number of leaves, and chlorophyll content in the leaves.

From the diagram, write the diagram; how we can see the results of the photosynthesis process so that it produces Chlorophyll that occurs in the leaves. This shows the growth in the amount of Chlorophyll from week 3 to week 6 has a different height; it can be seen in treatment T1. Week 5 has a height (of 30.00 mgcm2).

Diagram 3. Amount of Chlorophyll.

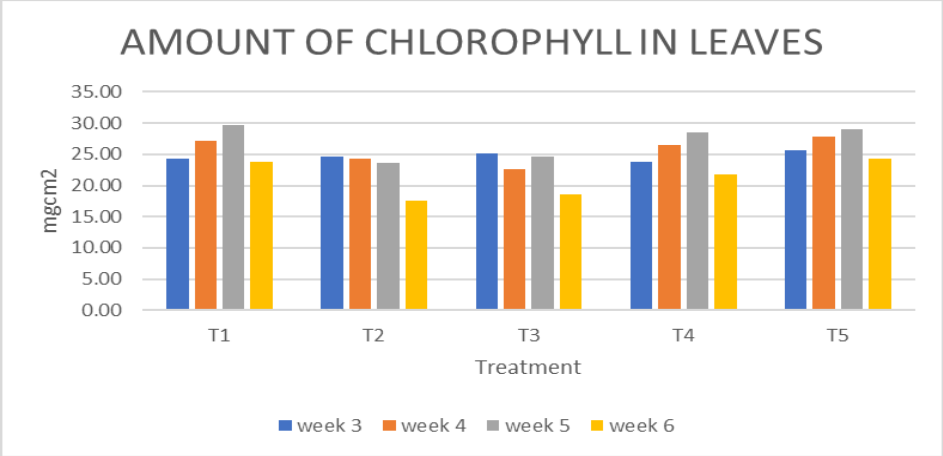

Table 4. Leaf area index (LAI)

TREATMENT	Week 4	Week u 5	Week 6
T1	28,014	1,234	1,206
T2	25,426	1,124	3,6
T3	22,074	1,06	1,046
T4	26,658	1,092	1,106
T5	26,798	1,176	1,096

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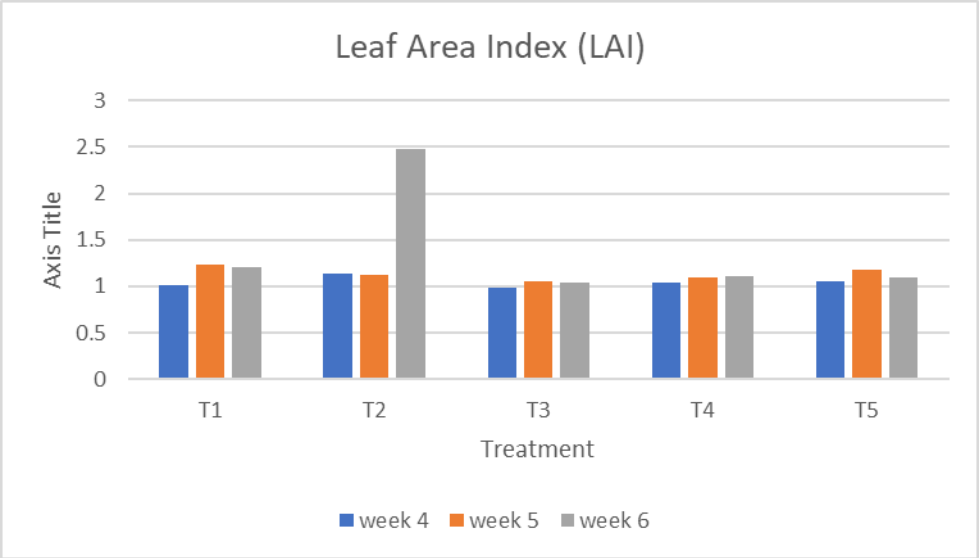
Diagram 4. Leaf area index (LAI)



From the leaf area index (LAI) table above, we can see the difference between week 4 and week 6, with the highest and lowest results. We can see in the table above the highest results in week 4 treatment T1 (28.014), T4 (26.658), T5 (26.798), and T2 (25.426) for the lowest value T3 (22.074). For the highest results in week 5, treatment T1 (1.234), T5 (1.176), T2 (1.124), and T4 (1.092), for the lowest results in treatment T3 (1.06). For the highest results in week 6 in treatment T1 (1.206), T4 (1.106), T5 (1.096), and T3 (1.046), for the lowest results, T2 (3.6). Because the leaf area will increase in width with the presence of nutrients, along with the development and growth of plants, the leaves will be able to carry out the process of photosynthesis in plants. This is in accordance with the literature from (Purba et al., 2021), which states that to increase the leaf area index in plants, nutrients are needed because the presence of nutrients in plants can stimulate the growth rate of organs that are closely related to the process of photosynthesis such as leaves. If the plant gets enough supply, it will form leaves that have wider blades.

From diagram 4, it can be seen that the Leaf Area Index (LAI) starts from week 4 to week 6. In week 1, the results are higher compared to weeks 5 and 6, which have a height below average.

4. CONCLUSIONS

Research on the response of Chinese cabbage (Brassica rapa) variety K01 to various concentrations of AB fertilizer in a hydroponic system showed significant results. Treatment with higher concentrations of AB fertilizer, especially in T2 and T3, resulted in optimal growth with a plant height reaching 58 cm and a leaf number of 33.4 strands in the sixth week. The highest

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chlorophyll content was found in the T5 treatment, with a value of 24.35 mg/cm² in the sixth week, while the optimal leaf area index (LAI) was recorded in the T2 treatment, with a value of 3.6. These results indicate that proper management of AB fertilizer concentration, with a gradual increase from 0.8 to 2.0 EC during the growth period, is crucial in optimizing the growth of the Chinese cabbage variety K01. This study also proves that a hydroponic system with proper nutrient management can produce better plant growth, especially in vegetative parameters such as plant height and leaf number. These findings provide important contributions to the development of hydroponic cultivation protocols for Chinese cabbage plants, especially in terms of optimal nutrient management.

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