

THE EFFECT OF WATER CONSTRAINT AND FOLIAR FERTILIZER APPLICATION ON THE GROWTH

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ABSTRACT

*This research aims to determine the impact of water stress and the use of leaf compost on increasing yields and ideal plant development. This inspection was completed at the Medan City Food Security Center, Jl. Selambo Ujung and Kramat are beautiful. between May and June 2023. The factorial randomized block design (RAK) used in this study consisted of two treatment factors symbolized by the symbol A at three levels, namely: A1) half KL (A2) 75% KL and (A3) 100 percent KL. The next factorial is with image P which consists of 3 levels, namely; (P1) is 1 g per liter of water, P2 is 2 g per liter, and P3 is 3 g per liter of water. With the aim of obtaining 9 drugs. Each treatment is repeated several times. The perception information is then investigated using the F test for changes at the 5% level. If the problem is large then proceed with the Duncan test. From the results of the examination and discussions carried out, results were obtained, including: 1). The influence of water pressure has a significant effect on plant height, number of leaves, leaf width, wet weight, and influences leaf length, leaf area and stem size of mustard greens (*Brassica juncea L.*). 2). Giving Gandasil D at a dose of 3 g/l of water basically increases the number of plants, number of leaves, leaf length, leaf width, stem size, new weight per plant, and selling weight. 3). The relationship between water stress treatment and use of leaf compost fundamentally affects plant height, number of leaves, leaf width, and wet load in mustard greens (*Brassica juncea L.*) while leaf length, leaf area and cross stem distance do not make a big difference.*

Keywords : water stress, foliar fertilizer and mustard greens

INTRODUCTION

Mustard greens have significant potential for development due to their popularity among people from all walks of life, from the middle to the upper classes. Besides being rich in nutrients like vitamins A, C, E, and K, mustard greens also offer good nutritional value, with 15 calories of energy, 1.8g of protein, 0.2g of fat, 2.5g of carbohydrates, 0.6g of fiber, 31mg of phosphorus, 225mg of calcium, and 92.4g of water. They also contain various essential nutrients such as manganese, folate, iron, teptophon, and magnesium (Alifah et al., 2019).

Mustard greens (*Brassica juncea L.*) are an important vegetable crop in Indonesia, and the development of mustard greens agribusiness and agroindustry can be a significant source of income for the country's

agricultural sector (Anjeliza, 2013). Mustard greens production in North Sumatra has increased annually, but it has not yet met the needs of the Indonesian population (BPS, 2017).

Mustard greens growth is heavily influenced by adequate water availability, and water stress can negatively impact plant growth (Moctava et al., 2013). Plants can experience drought even with sufficient water, and in these cases, fertilization can be a solution using foliar fertilizers such as Gandasil D, which contain various elements essential for plant growth (Palemba 2013).

Mustard greens' need for air and water is crucial for optimal growth. Research also shows that water stress and foliar fertilizer can interact to influence plant growth (Sari et al., 2011). Furthermore, research on the effects of foliar fertilizer application on water-stressed

mustard greens has not been conducted previously, so this research will provide further understanding of this interaction on mustard greens' growth.

RESEARCH MATERIALS AND METHODS

The research was conducted at the Medan City Food Security Agency on Jl. Kramat Indah / Selambo Ujung . The geographical location of this place is approximately 48 meters above sea level and has a rainfall of 2300 mm-2500 mm/year, with a temperature of 34°C and has a red-yellow podzolic soil type , from May to June 2023.

Research materials that will be used for research: Green mustard seeds, leaf fertilizer , and water

The tools used in this research are meter, hoe, machete, plywood, paranet, cutter knife, rapia rope, watering can, hand sprayer, bucket, measuring cup, ruler, marker, scales, stationery, UV plastic, polybag, sample pecak, nails, spray paint and bamboo u. (Ristianah et al., 2024)

RESEARCH IMPLEMENTATION

Soil Cultivation

The research area used was first cleared of debris, weeds, and remaining plant roots. The soil was loosened with a hoe and leveled. The area was then divided into 27 60x90 cm plots with a plot height of 15-30 cm.

Making beds/plots

The medium used is topsoil with a thickness of 15-20 cm. The soil is loosened and then placed in 30 x 35 cm polybags with a plant spacing of 30 x 30 cm, a distance of 20 cm between plots and 30 cm between replications. Drainage is then created to prevent erosion and excessive waterlogging.

Seed nursery

Growing mustard greens will not be hampered by anything. Ideally, seeds grown in a nursery will be free from pests and diseases that can affect young plants. Therefore, seeding mustard greens requires careful seeding by spreading the seeds evenly over the outer layer of the seedbed, then covering them with a 1-2 cm layer of fine, smooth soil. To

avoid excessive sun exposure and direct rainfall, shade or a protective roof is provided in the nursery. The seedbed is maintained for one week.

Planting

Once the mustard green seedlings have 2-3 leaves, they are transplanted to their designated location. The transfer from the cultivation site to the exploration site is carried out carefully to ensure the mustard seeds are not harmed. The nursery bed is first watered to facilitate seed removal and avoid damaging the plant roots. The spacing for mustard greens in this research is 30 x 30 cm, in one planting hole according to the division. Then, the planted seeds are transferred to plots or polybags. Once the seeds are mature, they are watered evenly until everything is wet to maintain soil moisture.

Foliar Fertilizer Application

Foliar fertilizer is given by spraying the leaves with a watering interval of once every two weeks after 7 days of transplanting or planting in polybags. (Munir et al., 2025)

Maintenance

Plant care begins from the time the seeds are planted until harvest, and includes various activities such as watering, replanting, weeding, maintenance, pest and disease control, and growth monitoring.

Watering is done in the morning and evening, depending on the growing medium conditions and the plant's developmental stage. As the intensive growth phase approaches, watering frequency is increased. Replanting is only done for plants that fail to grow or are undesirable within one week of planting. If the weather is dry or there are no strong winds, watering can be done day and night for several weeks. Plants used for replacement should be of the same age.

The process of removing weeds in the same area as the research site is called weeding. The timing of weeding should be adjusted to the level of weed presence, including adding soil around the base of the plants. This is done to protect the plants from the impact of rain or soil erosion, as well as to ensure good air circulation and maintain a clean planting area.

harvesting

After 40 days after planting (DAP), the plants are harvested by first uprooting

them and then cutting off all the roots. The ideal harvesting standard is based on the assumption that the base leaves have begun to turn yellow .

Observation

1. Plant height (cm)
Plant height is measured from the tip of the tallest leaf to the base above ground level. This measurement is carried out periodically, concluding in the third week .
2. Number of leaves (blades)
After the plants are half a month old, begin counting the number of fully opened leaves. Furthermore, the leaf tail length should reach 2 cm. Perception is carried out when the plants are 7 to 21 days old after planting in the experimental plot, with a perception period of 1 day.
3. Stem diameter (cm)
Raffia string is used to measure the diameter of the plant, which is then measured on a ruler. The stem distance is estimated at the base of the stem, similar to estimating the plant height.
4. Leaf width (cm)
Leaf width estimation was performed on the widest leaf of each sample. Not all of them were rigid by assessing the leaves from the edge of the largest leaf, and observations were made until the third week.
5. Leaf length (cm)
Leaf length was estimated using meters/roll, starting from the base of the leaf to the tip of the longest leaf. Measurements were taken when the plants were 21 days old after planting in the experimental plot.
6. Leaf Area (cm ²)

Estimating leaf length and width is done by estimating the longest leaf and estimating the width of the largest leaf. Leaf area is determined using the formula: PXLXK (0.759). Estimates are taken at 7-21 days after planting.

7. Wet Weight Per Sample (g)
Calculate the wet weight per test by measuring the entire plant after the base has been cut but has been cleaned of debris. This measurement is performed at the time the plants are collected.
8. Selling Weight Per Plant (g)
The selling weight per garden is calculated by weighing the plants after removing wilted and rotting roots, leaves, and stems. This measurement is taken at harvest time, at 3 weeks post-harvest (MSPT).

RESEARCH RESULT

Plant Height (cm)

Data on mustard plant height at 7-21 days after planting and the results of the analysis of variance are documented in Appendix 4-9. Based on the analysis of variance, it is clear that the effects of water stress and foliar fertilizer application have a very significant impact on plant height at 7-21 days after planting. Water stress treatment also has a very significant impact at 7-21 days after planting. The interaction between the two treatments also has a very significant impact on plant height.

The impact of water stress (A) and foliar fertilizer application (P) on the height of mustard green plants (in centimeters) from 7 days after planting to 21 days after planting can be found in Table 1.

Table 1. Results of the Difference Test for Average Plant Height (cm) for Water Stress Treatment (A) with Foliar Fertilizer Application (P) of 7, 14, and 21 HSPT

Treatment	Plant Height (cm)		
	7 HS P T	14 HS P T	21 HS P T
A1	13.18 a	17.81 a	26.07 a
A2	14.14 b	18.94 b	27.90 b
A3	14.31 b	19.59 b	29.19 c
P1	12.80 a	17.33 a	25.56 a
P2	14.11 b	19.11 b	28.21 b
P3	14.71 c	19.91 c	29.40 c

Description: Numbers followed by the same letter in the same column mean no difference with the DMRT test at the 5% level.

From the table above, it can be observed that at the age of 7 days after planting, the highest average plant height was found in the Water Stress (A) treatment, namely A3, with a height of 14.31 cm. Meanwhile, in the Foliar Fertilizer Application (P) treatment, the highest average plant height was achieved by the P3 treatment, with a height of 14.71 cm.

At 14 days after planting, the Water Stress (A) treatment also produced the highest average plant height, especially in the A3 treatment, with a height reaching 19.59 cm. Meanwhile, in the Foliar Fertilizer Application (P) treatment, the highest average plant height was achieved by the P3 treatment, with a height reaching 19.91 cm, which is almost comparable to P2 (19.11 cm).

At 21 days after planting, the highest average plant height was also found in the Water Stress (A) treatment, especially in the A3 treatment, with a height reaching 29.19 cm. On the other hand, in the Foliar Fertilizer Application (P) treatment, the highest average plant height was found in the P3 treatment, with a height reaching 29.40 cm, which was only slightly different from P2 (28.21 cm).

The description of plant height development (in centimeters) at the age of 7, 14, and 21 days after planting in the water stress treatment (A) can be seen in Figure 1.

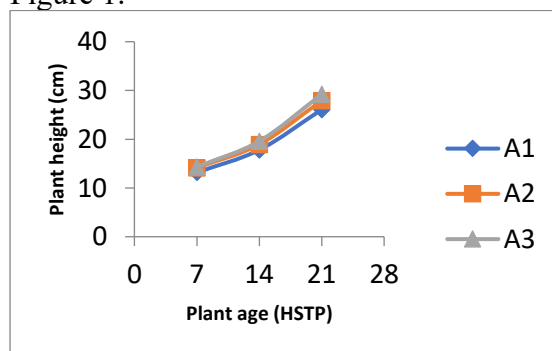


Figure 1. Development of Plant Height (cm) in Water Stress Treatment (A) at 7, 14, and 21 days after planting.

Figure 1 shows that the development of plant height in the water stress treatment increased simultaneously from 7 HS P T to 14 HS P T with no clear visible differences, but at 21 HS P T differences in plant growth began to be seen where A 3 (29.19 cm) was the highest, followed by A 2 (27.90 cm) , and A1 (26.07 cm) is at the lowest.

At the age of 7-14 HST, the development of plant height took place slowly, while at the age of 14-21 HS P T , rapid development was seen in plant height , and the differences for each treatment were different.

The development of plant height (cm) 7, 14 and 21 days after planting in various treatments of Leaf Fertilizer (P) can be seen in Figure 2.

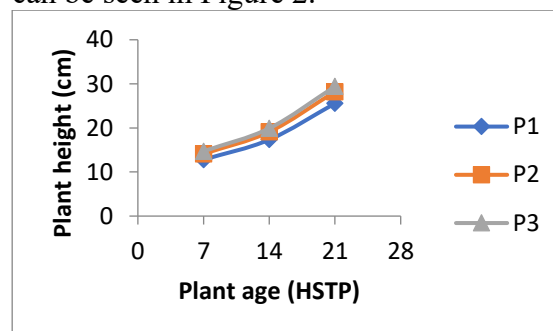


Figure 2. Development of Plant Height (cm) in the Treatment of Leaf Fertilizer (P) at 7, 14, and 21 days after planting.

Figure 2 shows that the development of plant height in the treatment of foliar fertilizer (P) increased simultaneously starting from 7 HS P T , the administration of foliar fertilizer at the age of 7-14 MSPT, the growth of plant height experienced a slow change, but at the age of 14-21 MSPT, plant growth became faster.

At the age of 21 HS P T leaf fertilizer (P) treatment can be seen that treatment P3 (29.40 cm) experienced the fastest growth in plant height, followed by treatment P2 (28.21 cm) and P 1 (25.56 cm) which is the leaf fertilizer (P) treatment with the smallest plant height value .

Number of Leaves (Sheets)

Data on the number of leaves and analysis of variance of mustard green plants at the age of 14, 17, and 21 days after planting due to the influence of water stress and foliar fertilizer application are presented in appendices 10-15.

Based on the analysis of variance, it shows that the treatment of Water Stress (A) and the provision of Leaf Fertilizer (P) had no significant effect on plant growth at the age of 7 days after planting, while having a significant effect on plant growth at the age of 14-21 days after planting.

Water stress (A) and foliar fertilizer application (P) number of mustard green leaves (strands) at 7, 14 and 21 days after planting can be seen in table 2.

Table 2. Results of the Difference Test for the Average Number of Leaves (Sheets) in Water Stress Treatment (A) with Foliar Fertilizer Application (P) of 7, 14, and 21 HSPT.

Treatment	Number of leaves (blades)		
	7 HS PT	14 HS PT	21 HS PT
A1	5.07	5.83 a	8.50 a
A2	5.31	6.06 b	8.50 b
A3	5.31	6.19 b	8.57 b
P1	5.02	5.76 a	8.26 a
P2	5.30	6.00 b	8.59 b
P3	5.39	6.31 c	8.72 b

Description: Numbers followed by the same letter in the same column mean no difference with the DMRT test at the 5% level.

From the table above, it can be seen that the average number of leaves at the age of 7 days after planting that obtained the largest value in the water stress treatment (A) was A3 (5.31 strands) and A2 (5.31 strands) , while for the leaf fertilizer treatment (P) the largest average number of leaves was obtained from the P3 treatment (5.39 strands) . At the age of 14 days after planting, the largest average number of leaves was obtained in the water stress treatment (A), namely A3 (6.19 strands) , while for the leaf fertilizer treatment (P) the largest average number of leaves was obtained from the P3 treatment (6.31 strands) . At the age of 21 days after planting, the largest average number of leaves was obtained in the water stress treatment (A), namely A3 (8.57 strands) , while for the leaf fertilizer treatment

(P) the largest average number of leaves was obtained from the P3 treatment (8.72 strands)

Leaf Width (cm)

data and analysis of variance of mustard green plants at the ages of 14, 17, and 21 days after planting due to the influence of water stress and foliar fertilizer application are presented in appendices 16-21.

Based on the analysis of variance, it shows that the treatment of Water Stress (A) and the provision of Leaf Fertilizer (P) has a significant effect on plant growth at the age of 7 days after planting, has no significant effect on plant growth at the age of 14 days after planting, while it has a very significant effect on plant growth at the age of 21 days after planting.

The effect of water stress (A) and foliar fertilizer application (P) on the width of mustard green leaves (cm) from 7 days after planting to 21 days after planting can be seen in Table 3.

Table 3. Results of the Difference Test for Average Leaf Width (cm) of Water Stress Treatment (A) with Foliar Fertilizer Application (P) of 7, 14 and 21 HSPT

Treatment	Leaf Width (cm)		
	7 HS PT	14 HS PT	21 HS PT
A1	3.92 a	6.88	10.20 a
A2	3.95	6.81	10.16 ab
A3	ab	6.52	10.24 c
P1	4.04 b	6.31	9.57 ab
P2	3.75 a	6.75	11.04 a
P3	4.23 b	7.15	11.04 ab

Description: Numbers followed by the same letter in the same column mean no difference with the DMRT test at the 5% level.

From the table above, it can be seen that the average leaf width at 7 days after planting that obtained the largest value in the water stress treatment (A) was A3 (4.04 cm) . While for the leaf fertilizer treatment (P), the largest average leaf width was obtained from the P2 treatment (4.23 cm) . At the age of 14 days after planting, the largest average leaf width was obtained in the water stress treatment (A), namely A1 (6.88 cm) , while for the leaf fertilizer treatment (P), the largest average leaf width was obtained from the P3

treatment (7.15 cm) . At the age of 21 days after planting, the largest average leaf width was obtained in the water stress treatment (A), namely A3 (10.24 cm) , while for the leaf fertilizer treatment (P), the largest average leaf width was obtained from the P3 treatment (11.04 cm) and P2 (11.04 cm) .

Leaf Length (cm)

data and analysis of variance of mustard green plants at the age of 14, 17, and 21 days after planting due to the influence of water stress and foliar fertilizer application are presented in appendices 22-27.

Based on the analysis of variance, it shows that the treatment of Water Stress (A) and the provision of Leaf Fertilizer (P) had no significant effect on plant growth at the age of 7-21 days after planting.

The effect of water stress (A) and foliar fertilizer application (P) on the length of mustard green leaves (cm) at 7, 14 and 21 days after planting can be seen in Table 4.

Table 4. Results of the Difference Test for Average Leaf Length (cm) of Water Stress Treatment (A) with Foliar Fertilizer Application (P) 7, 14 and 21 HSPT

Treatment	Leaf Length (cm)		
	7 HS PT	14 HS PT	21 HS PT
A1	5.81	10.59	14.31
A2	5.77	10.33	14.94
A3	5.56	10.26	14.31
P1	5.69	9.98	14.19
P2	5.81	10.47	14.68
P3	5.66	10.73	14.71

Description: Numbers followed by the same letter in the same column mean no difference with the DMRT test at the 5% level.

From the table above, it can be seen that the average leaf length at 7 days after planting that obtained the largest value was in the water stress treatment (A), namely A1 (5.81 cm) . While for the leaf fertilizer treatment (P), the largest average leaf length was obtained from the P2 treatment (5.81 cm) . At the age of 14 days after planting, the largest average leaf length was obtained from the water stress treatment (A), namely A1 (10.59 cm) , while for the leaf fertilizer treatment (P), the largest average leaf length was obtained from the P3 treatment (10.73 cm) . At the age of 21 days after planting, the largest average leaf length was obtained from

the water stress treatment (A), namely A2 (14.94 cm) , while for the leaf fertilizer treatment (P), the largest average leaf length was obtained from the P3 treatment (14.71 cm) .

Leaf Area (cm²)

data and analysis of variance of mustard green plants at the age of 14, 17, and 21 days after planting due to the influence of water stress and foliar fertilizer application are presented in appendices 28-33.

Based on the analysis of variance, it shows that the treatment of Water Stress (A) and the provision of Leaf Fertilizer (P) had no significant effect on plant growth at the age of 7-14 hspt, but at the age of 21 hspt, it had a significant effect on plant growth.

The effect of water stress (A) and foliar fertilizer application (P) on the leaf area of mustard green plants (cm²) at the ages of 7, 14 and 21 days after planting can be seen in Table 5.

Table 5. Results of the Difference Test for Average Leaf Area (cm²) of Water Stress Treatment (P) with Foliar Fertilizer Application (P) of 7, 14 and 21 HSPT

Treatment	Leaf Area (cm ²)		
	7 HSP T	14 HS PT	21 HS PT
			122.07
A1	21.38	63.94	ab
A2	21.20	60.82	125.78 a
			126.77
A3	20.15	57.63	ab
P1	19.99	54.87	113.95 a
			120.33
P2	21.94	61.12	ab
P3	20.80	66.40	140.35 c

Description: Numbers followed by the same letter in the same column mean that they are not different from the DMRT test at the 5% level.

From the table above, it shows that the leaf area of the mustard greens experienced growth starting from 7 days after planting to 21 days after planting. The average leaf area at 7 days after planting that obtained the largest value in the water stress treatment (A) was A1 (21.38 cm²) . While for the leaf fertilizer treatment (P), the largest average leaf area was obtained from the P2 treatment (21.94 cm²) . At the age of 14 days after planting, the largest average leaf area was obtained in the water stress treatment (A), namely A1 (63.94 cm²)

, while for the leaf fertilizer treatment (P), the largest average leaf area was obtained from the P3 treatment (66.40 cm²). At the age of 21 days after planting, the largest average leaf area was obtained in the water stress treatment (A), namely A3 (126.77 cm²), and for the leaf fertilizer treatment (P), the largest average leaf area was obtained from the P3 treatment (140.35 cm²).

Bar Diameter (mm)

data and analysis of variance of mustard green plants at different ages 21 hspst due to the influence of water stress and foliar fertilizer application is presented in appendices 34-35.

Based on the analysis of variance, it shows that the treatment of Water Stress (A) and the provision of Leaf Fertilizer (P) had a significant effect on plant growth.

The effect of water stress (A) and foliar fertilizer application (P) on the stem diameter of mustard green plants (mm) at 21 days after planting can be seen in Table 6.

Treatment	Bar Diameter (mm)
	21 HSTP
A1	6.81 a
A2	7.63 ab
A3	7.35 ab
P1	6.27 a
P2	7.91 ab
P3	7.61 b

Table 6. Results of the Difference Test of Average Stem Diameter (mm) of Water Stress Treatment (P) with Foliar Fertilizer Application (P) 21 HSPT.

Description: Numbers followed by the same letter in the same column mean no difference with the DMRT test at the 5% level.

From Table 6 it can be seen that the stem diameter of the green mustard plant at 21 days after planting, the largest average stem diameter was obtained in the water stress treatment (A), namely A2 (7.63 mm), while the smallest average stem diameter was in the water stress treatment (A), namely A1 (6.81 mm) .

The average stem diameter for the foliar fertilizer treatment (P) which obtained the largest stem diameter value was P2 (7.91 mm) , while the smallest average value for the

foliar fertilizer treatment (p) was P1 (6.27 mm) .

Wet Weight Per Plant (g)

Data on the wet weight of mustard green plants can be seen in appendices 36-37. Based on the analysis of variance, the water stress treatment had no significant effect, while the foliar fertilizer treatment had a very significant effect on the wet weight observation parameters.

The effect of water stress treatment (A) and foliar fertilizer application (P) on the wet weight of the plants (g) for 21 HSPT can be seen in Table 7.

Table 7. Results of the Average Wet Weight Difference Test (g) for Water Stress Treatment (A) with Foliar Fertilizer Application (P) 21 HSPT

Treatment	Wet Weight
	21 HSTP
Recording (A)	
A1	41.79 a
A2	45.18 ab
A3	43.87 ab
Leaf fertilizer (P)	
P1	35.85 a
P2	46.09 b
P3	48.90 b

Description: Numbers followed by the same letter in the same column mean that they are not different from the DMRT test at the 5% level.

Table 7 shows the average wet weight of green mustard plants at 21 days after planting. The largest average wet weight was obtained in the water stress treatment (A), namely A2 (45.1 g), while the smallest average wet weight value was obtained from the water stress treatment (A), namely A1 (41.79 g) .

The average wet weight for the foliar fertilizer (P) treatment which had the highest value was P3 (48.90 g) while the smallest value for the foliar fertilizer (P) treatment was P1 (35.85 g) .

Selling Weight Per Plant (g)

Data on the selling weight of mustard green plants can be seen in appendices 38-39. Based on the analysis of variance, the water stress treatment had no significant effect, while the foliar fertilizer treatment had a very significant effect on

the observed parameters of the selling weight of plants.

The effect of water stress treatment (A) and foliar fertilizer application (P) on the selling weight per crop (g) for 21 HSPT can be seen in Table 8.

Table 8. Results of the Difference Test for Average Selling Weight (g) of Water Stress Treatment (A) with Foliar Fertilizer Application (P) 21 HSPT

Treatment	Leaf Width
	21 HSPT
Recording (A)	
A1	38.8 1a
A2	41.09 ab
A3	39.75 ab
Leaf fertilizer (P)	
P1	32.8 9a
P2	42.46 ab
P3	44.3 1b

Description: Numbers followed by the same letter in the same column mean that they are not different from the DMRT test at the 5% level.

Table 8 shows the average selling weight of green mustard plants at 21 days after planting. The highest selling weight was obtained in the water stress treatment (A), namely A2 (41.09 g) , while the lowest average selling weight value was obtained from the water stress treatment (A), namely A1 (38.8 1 g) .

The average selling weight for the foliar fertilizer treatment (P) which had the highest value was P3 (44.3 1 g) while the smallest value for the foliar fertilizer treatment (P) was P1 (32.8 9 g) .

DISCUSSION

The Effect of Water Stress on the Growth and Yield of Mustard Greens

Based on the results of the variety analysis, it appears that water stress has a significant impact on the growth and yield of pak choi plants. Overall, the research results showed that the water stress treatment with 100% Field Capacity (FLC) (A3) resulted in larger plants, a greater number of leaves, and wider leaves compared to the water stress treatment with 50% FLC (A1). This indicates that the higher the level of water stress applied, the lower the yield per plant. This

increase in yield is supported by the vegetative development of pak choi plants, particularly the plant size between 14 and 21 days after planting.

Water limitation is one aspect of the assimilation process in plant tissue that can reduce growth rates. Water stress can reduce both fresh and dry plant weight. Research by Barus and Yusuf (2004) found that the duration of watering significantly impacts plant dry weight, as water limitation is a crucial factor in plant assimilation and metabolism.

Efendi and Azrai (2008) wrote that the higher the level of water stress, the greater the severity of leaf damage, which can disrupt chloroplasts. This causes leaf chlorosis and senescence, which reduces the number of leaves contributing to the total number of leaves responsible for assimilation, ultimately reducing net assimilation and plant production.

During water stress, there is often a reduction in cell volume and leaf size, which reduces water loss and delays more severe drought conditions. This reduction in cell volume leads to a reduction in hydrostatic pressure and turgor pressure. This results in leaves becoming smaller than normal. Taiz and Zeiger (2002) explained that the most rapid response to water stress is seen in plant physiology, rather than chemical changes. Decreased cell volume causes a reduction in hydrostatic pressure and turgor pressure, causing the plasma membrane to shrink and contract. Leaves shrink due to the loss of pressure, which contributes to water stress reduction.

Gardner et al. (2008) also proved that water shortages can reduce plant vegetative growth and crop yields by reducing leaf development and reducing leaf assimilation rates.

The Effect of Foliar Fertilizer Application on the Growth and Production of Green Mustard Plants

Fluctuation test showed that Gandasil D treatment with 3 g/liter of water basically increased plant height, number of leaves, leaf length, leaf width, wet weight per plant, wet weight per plot, wet transaction production per plot and leaf area.

The application of Gandasil D manure fundamentally affects the development and growth of mustard greens. This is because foliar fertilizer accelerates the supply of nutrients to plants, as Gandasil D compost contains micronutrients that can nourish plant roots. With faster root formation, the plant's nutrient absorption will improve, thereby increasing plant growth and production. Gandasil D compost's ability to act as a driver to expedite or increase the utilization of large-scale supplements, resulting in high plant efficiency. The components are ready-made, for both large-scale and miniature supplements. The presence of micronutrients Mn, Cl, Cu, B, Mo, Zn, and Fe has the ability to overcome deficiencies in inactive nutrients (extremely stable inadequacies) required by plants (Anonimus, 2001).

Leaves are the site of photosynthesis, particularly carbohydrate mixtures. Foliar fertilizer application increases nutrient availability, thus increasing the rate of photosynthesis. This results in greater starch delivery (Sitompul and B. Guritno, 1994). Some of this sugar is used for the plant's growth cycle, while the rest is stored in the stems and leaves (Napitupulu, 1987). Furthermore, with increased photosynthesis, more photosynthesis is produced. Photosynthates are distributed throughout the plant, where they can be utilized effectively for growth. The supplement contained in Gandasil-D can address this issue and impact bok choy yields.

Leaves are the site of photosynthesis, particularly carbohydrate mixtures. Foliar fertilizer application increases nutrient availability, thus increasing the rate of photosynthesis. This results in greater starch delivery (Sitompul and B. Guritno, 1994). Some of this sugar is used for the plant's growth cycle, while the rest is stored in the stems and leaves (Napitupulu, 1987). Furthermore, with increased photosynthesis, more photosynthesis is produced. Photosynthates are distributed throughout the plant, where they can be utilized effectively for growth. The supplement contained in Gandasil-D can address this issue and impact bok choy yields.

Increased plant height growth and number of leaves will support increased wet

weight per plant, wet weight per plot and wet production for sale. This is because with the increase in the number of leaves and the number of plants, the photosynthesis cycle will be smoother, where the results of photosynthesis are needed in the growth of plant tissue including roots, so that it will increase wet weight per plant, wet. weight per plot, wet transaction production, and development rate. relative plants. Gandasil D compost contains total supplements, the composition of Grandasil D leaf fertilizer is: Nitrogen (N) 28%, Phosphoric Acid (P_2O_5) 15%, Chlorine-free Potassium (K_2O) 15%, Magnesium Sulfate (1%), as well as other micronutrients such as Mn, B, Cu, Co and Zn (Anonimus, 2001).

Interaction of the Effect of Water Stress and Foliar Fertilizer Application on the Growth and Yield of Green Mustard Plants.

Plant growth is very susceptible to water stress, which is related to the reduction of cell turgor, which can limit cell separation and expansion, resulting in the dimensions of plant organs becoming smaller (Manan and Mahfudz, 2015).

Gandasil foliar fertilizer has a very high nitrogen content, reaching 20% compared to other fertilizers. Gandasil D is a water-soluble crystal, allowing plants to easily absorb and transport it to all parts of the plant. This supports plant growth and development (Lingga and Marsono, 2007).

The results of the variety analysis showed that the interaction between water stress and foliar fertilizer application significantly affected plant size, leaf number, leaf area, water content, and yield. Furthermore, this interaction significantly affected stem diameter. However, there was no significant effect on leaf length or leaf size.

In all observational benchmarks, the treatment with water stress of 50% Field Capacity (KL) and all foliar fertilizer concentrations resulted in lower values compared to the other mixtures, particularly in terms of water content. Plant water content reflects the number of plant organs such as leaves, stems, and roots, which are influenced by the water content and nutrient content of plant tissue cells.

Low water content (50% KL) disrupts the growth of pak choi plants, resulting in low water content. Treatments with water stress of 75% KL and 100% KL, combined with 3 grams of foliar fertilizer per liter, resulted in higher water content. This is due to the nitrogen content of foliar fertilizer, which aids in the production of photosynthates, which are then used for new cell formation, cell elongation, and tissue growth. According to Harjadi (1991), water and nutrient availability are crucial for assimilation, and the level of nutrient availability influences plant biomass.

Based on this research, in water stress conditions of 50%, 75%, and 100% KL, the application of foliar fertilizer with a Focus of 3 grams or L is the best treatment for the growth of pakchoi plants, including plant size, leaf distance, leaf size, number of leaves, water weight, dry weight, and stem diameter.

CONCLUSION AND SUGGESTIONS

conclusion

1. The effect of water stress has a very significant effect on plant height, number of leaves, leaf width, wet weight, and has no significant effect on leaf length, leaf area and stem diameter of mustard greens (*Brassica juncea* L.).
2. The administration of Gandasil D with a concentration of up to 3 g/l of water had a significant effect on increasing plant height, number of leaves, leaf length, leaf width, leaf area, stem diameter, wet weight per plant, and selling weight.
3. The relationship between water stress treatment and leaf compost utilization fundamentally affects plant height, number of leaves, leaf width, and wet load in mustard greens (*Brassica juncea* L.) while the limits of leaf length, leaf area and cross-stem distance do not make a big difference.

suggestion

For the following research, further research should be carried out with sufficient field capacity and fertilizer concentrations that suit plant needs to obtain better results. Good.

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