SALAGA Journal
Vol. 02, No. 1, June 2024, pp. 1 ~ 9
ISSN: 3032-2677
DOI: 10.70124/salaga.v2i1.1354

Effectiveness of the Application of Drip Irrigation In Some Planting Media for Caisim (*Barassica juncea L.*).

Muhammad Ikhsan Ali*[1], Suhardi[1], and Haerani[1]

[1] Agriculture Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University

Article Info

Keywords:

Irrigation
Water Needs
Planting Media
Caisim

ABSTRACT

Caisim plants are cultivated in highland areas. One of the methods to increase the productivity of caisim is by balancing the amount of water supplied and water needs of the plants. This can be done by applying drip irrigation where water was applied to the plants according to their needs. In addition, setting the appropriare composition of planting medium also needs to be done in increasing the productivity of caisim. This study aims to determine the effect of water application and the composition of several planting media in increasing the growth of caisim using drip irrigation. This research used a completely Randomized Disign (CRD) which consisted of two treatment factos, namely provision of water (A) and planting medium (B). The water supply factor consisted of three treatments, i.e AI (2.49 l/day), A2 (2.69 l/day) and A3 (2.89 l/day). The planting media factors consisted of 3 treatments, i.e B1 (soil + cocopeat 2:1), B2 (soil + husk charcoal 2:1) and B3 (soil + manure 2:1). Research data were analyzed using analysis of variance. In case the analyses results in a significant effect, Duncan's New Multiple Range Test (DNMRT) will be performed. The results of the study showed that the application of water at 2.69 l/day and the use of planting media (soil + cow dung manure 2:1) resulted in the best growth and yield of caisim.

This is an open access article under the CC BY-SA license.

Corresponding Author(s):

Muhammad Ikhsan Ali
Agriculture Engineering Study program, Department of Argicultural Technology, Hasanuddin University
Jl. Perintis Kemerdekaan KM.10, 90245, Tamalanrea, Makassar, Sulawesi Selatan, Indonesia
Email: ikhsanali122@gmail.com

1. INTRODUCTION

The growth and development of mustard greens can be cultivated in high or low altitude areas. Public interest in the demand for this vegetable is very high along with the increasing population. To produce better crop production, it is necessary to cultivate with the use of effective and efficient watering techniques such as drip irrigation technology [1]. However, the problem is that there is a smaller planting land so that green mustard plants are widely cultivated in the lowlands which of course will require more water and soil fertility which must always be moist in growth, this plant is a plant whose growth phase is fast and can only be harvested once in one growing season.

Currently, there are many food businesses that make mustard greens as the main ingredient of their food Its popularity is driven by its versatility in culinary applications, high nutritional content, and relatively short growing period, making it a critical crop for both commercial and subsistence farmers [2]. Rich in vitamins A, C, and K, as well as minerals and dietary fiber, green mustard contributes to the nutritional security of Indonesian households [3]. Green mustard itself has many nutrients that are beneficial for body health, high economic value and can grow in any plain area. So that more and more business actors make mustard greens as the main ingredient of their food.

The main cause of low production of vegetable crops is improper watering. Excess water in plants causes plant roots to decay so that most vegetable crops die and crop failure. This is due to the lack of knowledge of cultivation farmers about the importance of providing water that is in accordance with the needs of plants. Therefore, it is necessary to apply controlled drip irrigation to plants in increasing the yield of vegetable production, especially mustard greens. [4].

One irrigation method that can be applied by farmers is drip irrigation. Drip irrigation in its use is very efficient and effective for crops in areas with low rainfall. To control nutrient availability and water absorption, drip irrigation methods are very appropriate to be applied, in addition to saving water use, drip irrigation systems can also reduce contamination of groundwater, thereby increasing plant growth efficiency and reducing plant pests and diseases [5].

In addition to irrigation, the composition of the soil used as a planting medium can also affect plant growth. The growing medium can be a mixture of soil and compost in a certain ratio. A good planting medium will maintain the humidity of the air around the roots, provide enough air and can maintain the availability of nutrients for mustard green plants. Planting media is included in the category of elemental materials generally derived from components of living organisms, for example parts of plants such as leaves, stems, flowers, fruits, or bark [6]. Based on the description above, it is necessary to conduct research on the "effectiveness of applying drip irrigation to several planting media for mustard greens".

2. MATERIALS AND METHODS

2.1 Materials

The tools used in this study include stationery, buckets, pvc pipes, grip hoses, polybags, faucets, stopwatches, thermometers, mobile phone cameras, digital scales FSR-A, 38 watt water pumps with a pump capacity of 2000 l/ hour, ovens, aluminum foil and measuring cups.

The materials used in this study were green mustard seeds, water, soil, cocopeat, husk charcoal, manure.

2.2 Research Procedure

In this study, there are several stages, namely as follows:

2.2.1 Seed Preparation of Green Mustard Plants

Prepare green mustard seeds that have been soaked using warm water which aims to separate the seeds that are good for planting. At the time of soaking the seeds, it can be seen that there are seeds that sink and float. After that separate the two seeds, by taking the sunken seeds for planting while the floating seeds are not used. This is an indicator that can be used to see the quality of good seeds for planting.

2.2.2 Preparation of Growing Media

The preparation carried out is by preparing planting media in the form of soil mixed with compost with three different treatments, namely:

1) Soil + cocopeat in a ratio of 2:1
2) Soil + husk charcoal in a ratio of 2:1
3) Soil + manure ratio 2:1

After the planting media is mixed evenly, it is then put into a polybag measuring 25 x 30. Then the planting media is dried in the sun directly within 3-4 days so that the planting media is free from disease seeds.

2.2.3 Functional Test

The fractional test in this study aims to determine the effectiveness of drip irrigation whether the flow runs well or not which is done by observing flow uniformity.

2.2.4 Planting

Planting mustard greens is carried out when the seedlings are 1 week old after planting (has four leaves). When the plants will be transferred to polybags, the plants are watered first so that the soil is moist, so that mustard greens are easily moved. Removal is carried out using a tablespoon with the aim of not damaging the roots and can be planted directly into the planting media provided.

2.2.5 Maintenance

Maintenance is carried out to maintain the cleanliness of the field to avoid the presence of pests and weeds. Plant maintenance is carried out by clearing the land from weeds and pruning leaves regularly.

2.2.6 Harvesting

Green mustard greens can be harvested after the plant has reached the age of 40-50 days. Harvesting is done by carefully removing all parts of the plant and its roots.

2.2.7 Plant Water Requirements

Consumptive water needs of green mustard plants (ETc) can be calculated by the following equation:

$$ETc = Kc \times Eto \quad (1)$$

where:

Etc=Plant evapotranspiration (mm/day)

Kc= Coefficient of mustard greens
Eto= Reference evapotranspiration (mm/day)

2.2.8 Research Design

This study used a Complete Randomized Sequence (CRS) with a 3 x 3 factorial pattern with 9 repeats. The factors studied include the amount of water (A) and planting media (B).

The discharge of irrigation water for mustard greens for each installation (A) is:
A1 = 2.49 l/day
A2 = 2.69 l/day
A3 = 2.89 l/day

The growing media factor (B) consists of 3 levels, namely:
B1 = Soil + Cocopeat
B2 = Soil + Husk Charcoal
B3 = Soil + Manure

Thus there are 9 repetitions, so there are 27 units of experimental units. The arrangement of combinations can be seen in Table 1.

Table 1. Arrangement of Treatment Combinations

No.	Treatment Combination	Many Gifts Air **(l/day)**	Planting Media
1	A1B1	2.49	2:1
2	A1B2	2.49	2:1
3	A1B3	24.9	2:1
4	A2B1	2.69	2:1
5	A2B2	2.69	2:1
6	A2B3	2.69	2:1
7	A3B1	2.89	2:1
8	A3B2	2.89	2:1
9	A3B3	2.89	2:1

2.2.9 Irrigation Network Design

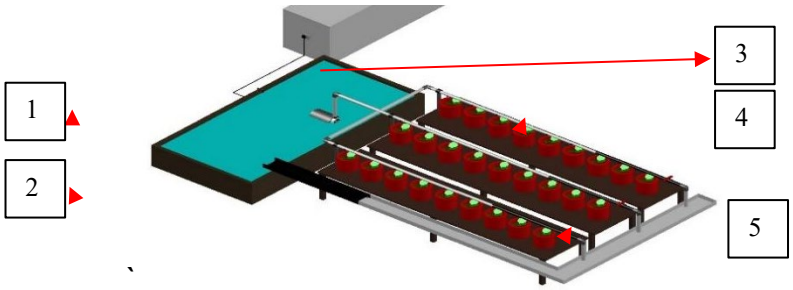


Figure 1. Drip irrigation installations.

Information:

No.	Name	Specifications
1.	Pump	Capacity 2000 liters per hour
2.	Polybag	Size 20x25 cm
3.	Sump	Drip irrigation water source
4.	Emitter	Penetes
5.	Pipe	PVC 2 inch

2.2.10 Drip irrigation performance calculation

According to [7], to determine the performance of drip irrigation, one of them is by calculating the uniformity of distribution, namely the percentage of uniformity of water flow to each plant pot, the steps are as follows:

1. Measure the discharge of water released by each emitter using a measuring cup and stopwatch.
2. Calculate the uniformity of distribution using the following equation: [2]

$$Cu = 100\{1-\}\frac{\sum_i^n [xi-x]}{\sum xi} \quad (2)$$

where:
Cu= irrigation uniformity coefficient (%)
xi= value of each measurement
$\underline{x}$ = average value of measurement results
$\sum_i^n [xi - x]$ = number of deviations a si absolute average measurement

2.2.11 Research Parameters
The research parameters to be measured are:

2.2.11.1 Plant height
The height of green mustard plants can be observed by measuring the length of the plant from the base of the stem to the tip of the leaf farthest from the base of the stem.

2.2.11.2 Number of leaves of the plant
Counting the number of leaves on green mustard plants that have undergone complete development. The number of leaves (strands) is calculated from the number of leaves that grow once a week.

2.2.11.3 Leaf area
In the area of leaves of green mustard plants measured by picking leaves (destruction), measuring the area of leaves of mustard greens is carried out after going through the harvesting process. The method used is the millimeter column method, this method is very simple by calculating the amount of mapped area (mm column) covered by the area of leaves placed on a millimeter column sheet. Millimeter column covered by leaves, then calculated the area.

2.2.11.4 Biomass
The biomass of leaves and headers can be calculated by measuring the wet weight and dry weight of leaves and headers first. According to [8] the formula used is as follows:

$$BD = \frac{berat\ kering\ sampel\ daun}{berat\ basah\ sampel\ daun} \times bbt \quad (3)$$

$$BA = \times\ bbt\ \frac{berat\ kering\ sampel\ daun}{berat\ basah\ sampel\ daun} \quad (4)$$

where:
BD = Leaf biomass
BA = Root Biomass
BBT = Total wet weight

The total biomass of green mustard plants includes Leaf Biomass (BD), Root Biomass (BA) with the following equation:

$$Btot = BD+BA \quad (5)$$

Measurement of wet and dry biomass of green mustard plants is carried out by weighing one by one plant parts consisting of leaves, branches and roots. The tool used for weighing is a digital scale. To obtain wet biomass, mustard greens are directly weighed using digital scales. Furthermore, to obtain dry biomass, the separated mustard green plant parts are then wrapped using aluminum foil and ovened for 48 hours with a temperature of 70 oC. Plants that have been ovened are then weighed to obtain dry biomass.

2.2.12 Data Analysis
The data obtained were analyzed statistically using analysis of variance (ANOVA) with a signification level of 5%. Statistical analysis is carried out using the SPSS program, where:

H0 = Treatment of the influence of planting media has no effect on the growth of mustard greens.
H1 = Treatment of the influence of planting media affects the growth of mustard greens.

If F counts ≤ F table then H0 is accepted, otherwise if F counts > F table then H0 is rejected and H0 is accepted, so further testing is done with Duncan Multiple Range Test (DMRT).

The parameters observed are plant water consumption, plant height, number of leaves, leaf area and biomass.

2.2.13 Research Flow Chart

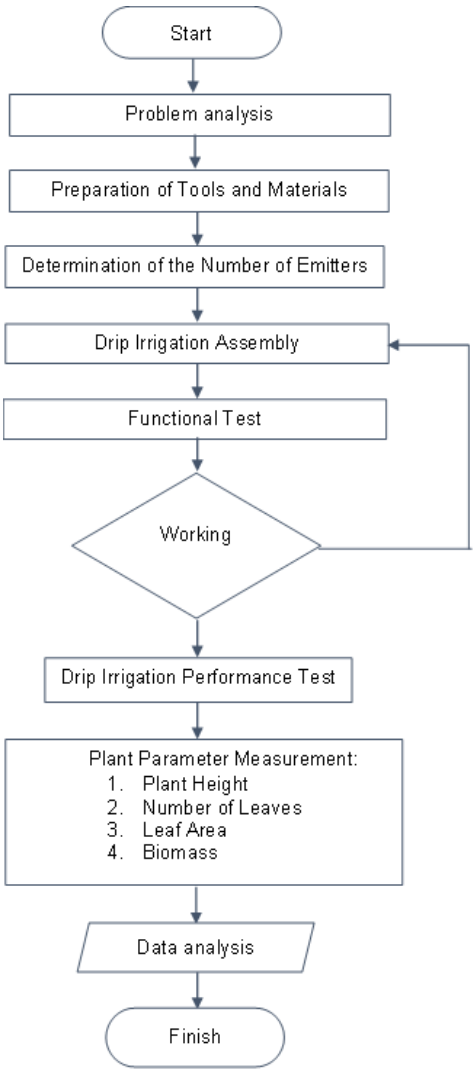


Figure 2. Research flow chart

3. RESULTS AND DISCUSSION

3.1. Drip Irrigation System Test Results

3.1.1 Emitter Discharge

Discharge measurement is carried out to determine how much flow is removed from the emitter by directly operating the drip irrigation system installed in the greenhouse. When measuring droplet discharge with time intervals of two, four and six minutes, it was found that the longer the time given, the higher the volume released, so that it approached the uniformity of coefficient uniformity (Cu) values of more than 90%.

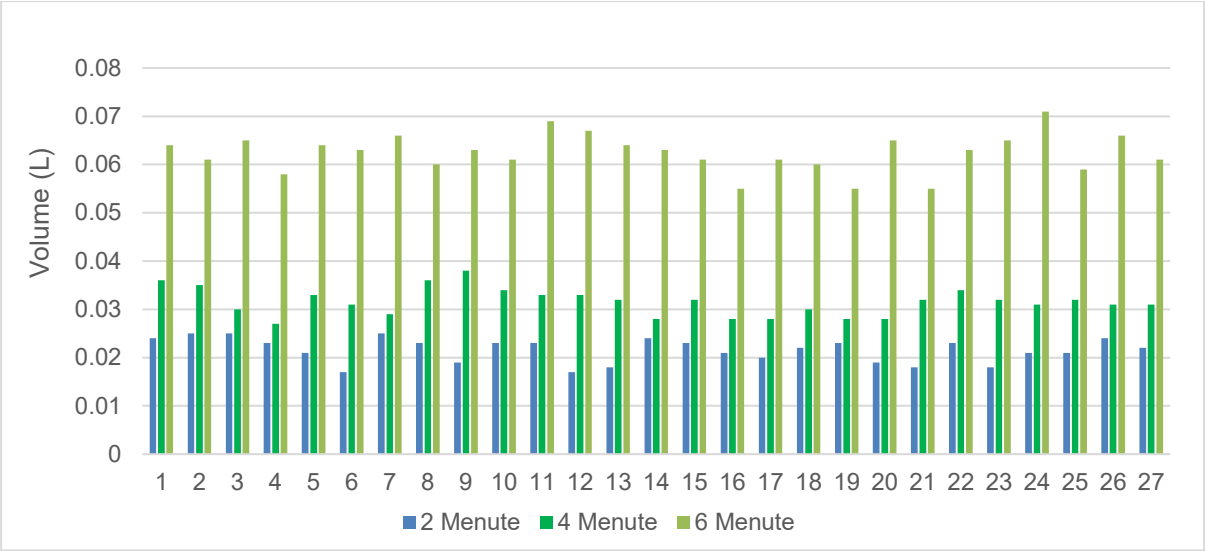


Figure 3. Emitter Discharge.

Based on Figure 3, the average discharge issued at the emitter of each installation varies, such as at a six-minute time interval on emitter 24 emitting the largest discharge and a two-minute time interval on emiter 6 with the smallest. This is caused by several factors such as distance from the reservoir, lateral and manifold, thus affecting water pressure, the flow will experience pressure loss along the channel caused by friction forces on the pipe / hose wall and impact on the turning pipe. As stated by [9], the main factors that cause variations in discharge from application tools along lateral pipes and manifolds are operating pressure differences that occur due to friction, minor losses and elevation (head) differences.

Droplet Distribution Uniformity

The design plan of a drip irrigation system can be said to be ideal if the emitter has a drip uniformity value of 100%, so that plant growth results can be optimal. However, in reality100% uniformity is difficult to obtain due to the many inhibiting factors in a drip irrigation system.

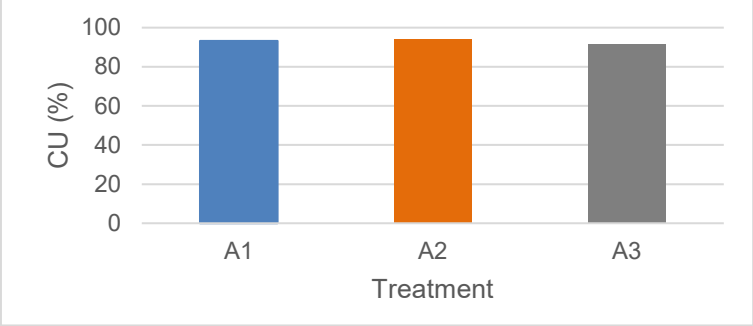


Figure 4. Graph of uniformity of droplet distribution.

Based on Figure 4, the results of drip irrigation performance tests applied to mustard greens, obtained a uniform value of droplet distribution for A1 = water administration of 2.49 l / day is 93.22%. For A2 = water (2.69 l / day) the uniformity value is 94.31% and A3 = water (2.89 l / day) is 91.77%. so that it is close to the uniformity of the coefficient uniformity (Cu) value of more than 90%, where the resulting value is included in the good category with a droplet level (Cu) value of more than 90%. This is in accordance with the statement [10] which states that the droplet value is said to be uniform if the Cu value obtained is more than 90%.

Plant Height

The following average height measurement results in mustard greens are presented in WAP (weeks after planting). In Appendix 1 it can be seen that at observation of 5 mst (weeks after planting) the A2B3 treatment showed a marked difference with other treatments. Which in the A2B3 treatment showed the highest mustard green plants at 51,667 cm while the lowest was found in the A3B1 treatment at 40,178 cm. This is because the planting media used with a ratio of soil 2 and cow dung manure compost 1 is in an optimal state and is supported by nutrients that are in accordance with plant growth. This is in accordance with the statement of [11] which explains that good

plant growth can be achieved if the nutrients needed for growth and development are in an available, balanced and optimal dose form and supported by environmental factors.

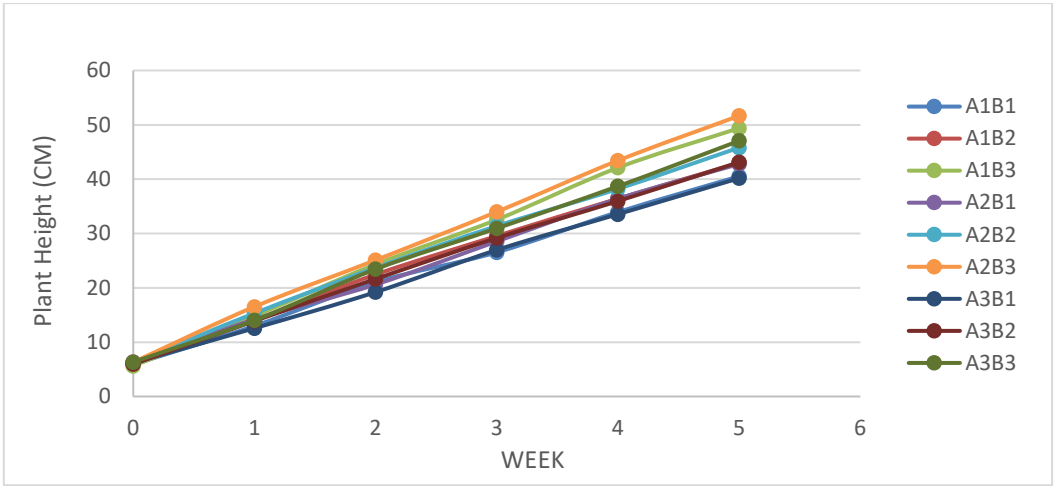


Figure 5. Graph of the height of mustard greens.

Based on the results of observations made, it can be seen in figure 5 showing an increase in plant height every week until the harvest period. The results of height measurements on mustard greens vary with each treatment given. This is in accordance with the statement of [12] generally in the process of a good growth system in plants characterized by good plant height growth as well.

Number of leaves

The results of the 5% DMRT Test in Appendix 2 showed that at the observation of 5 mst (weeks after planting) the highest number of leaves was produced in the A2B3 treatment, namely the application of water of 2.69 l / day (A2) and treatment with soil planting media and manure 2: 1 (B3). This shows that the use of water and the ratio of planting media are in accordance with those given to mustard greens so that mustard greens can grow well. This is in accordance with the statement of [13] that the provision of organic matter in the form of compost can increase and provide nutrients both macro and micro for plants. Nutrients will later be used by plants in the process of plant growth and development.

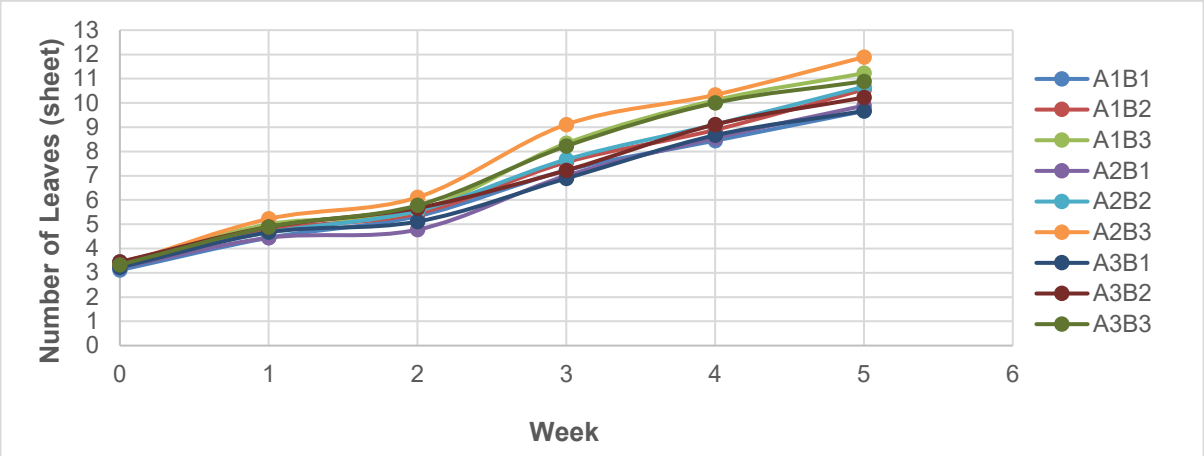


Figure 6. Graph of the number of green mustard leaves in each treatment of water and planting media.

The graph in figure 6 is a graph that illustrates the increase in the growth pattern of a plant. From the graph, it can be seen that the number of leaves each week is increasing. According to [14] that during the photosynthesis process plants that are able to produce higher photosyntasis will have many leaves, because the results of photosynthetes will be used to form organs such as leaves and stems in line with the increase in dry weight of plants. The more light absorbed by plants, the higher photosynthesis produced.

Leaf Area

The results of leaf area measurement can be seen in Appendix 3. In the treatment with water administration of 2.69 l / day and the treatment of soil planting media and manure 2: 1 (A2B3) obtained the highest leaf area value.

It can be seen in graph that the leaf area value of A2B3 is 247.44 cm 2 while the lowest leaf area value is found in the treatment of giving water 2.89 l / day and the treatment of soil planting media and *cocopeat* 2: 1 (A3B1) which is 117.00 cm ^{2}. This shows that the water needs for mustard greens have been fulfilled so that it affects the development of the leaves. In addition, the use of manure compost as a planting medium will also affect the value of the leaf area where the compost contains Nitrogen. According to [15] that water is needed by plants in all physiological processes of plants including cell division and the process of leaf formation and widening.

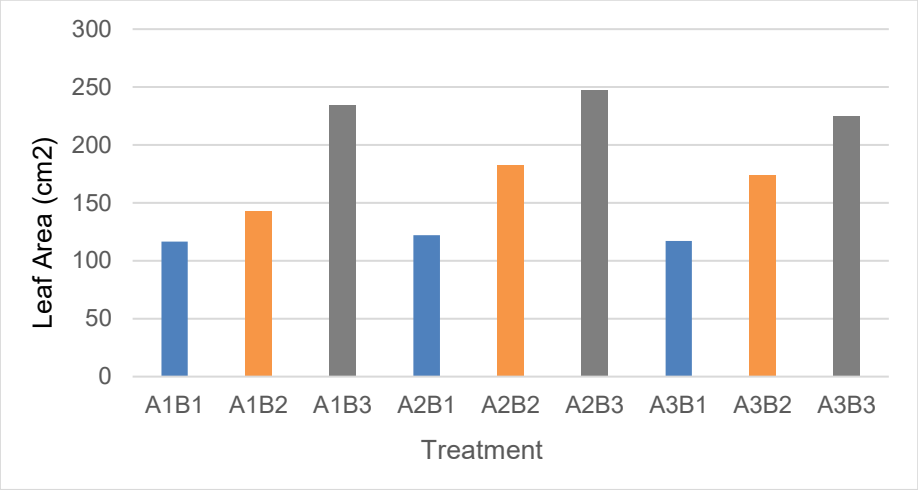


Figure 7. Leaf area graph.

The graph above shows that the water treatment of 2.69 l / day and the ratio of soil planting media and manure 2: 1 (A2B3) have the highest average leaf area compared to other planting media treatments and the lowest leaf area is found in the treatment of water 2.89 l / day and the ratio of soil and *cocopeat* planting media 2: 1 (A3B1). The highest leaf area is caused by good cell division due to the fulfillment of appropriate water, this is in accordance with the statement of [13], that water is needed by plants in all physiological processes of plants including cell division and the process of leaf formation and widening.

Biomass

The results of leaf and root biomass measurements can be seen in Appendix 4. Table 5 in annex 4 shows that the application of water of 2.69 l / day and the treatment of soil planting media and manure 2: 1 (A2B3) showed the highest biomass value, while the application of water of 2.49 l / day and the treatment of soil and cocopeat planting media 2: 1 (A1B1) showed the lowest biomass value both in root and leaf biomass. The increase in biomass with each treatment shows that plants are able to absorb more water and nutrients.

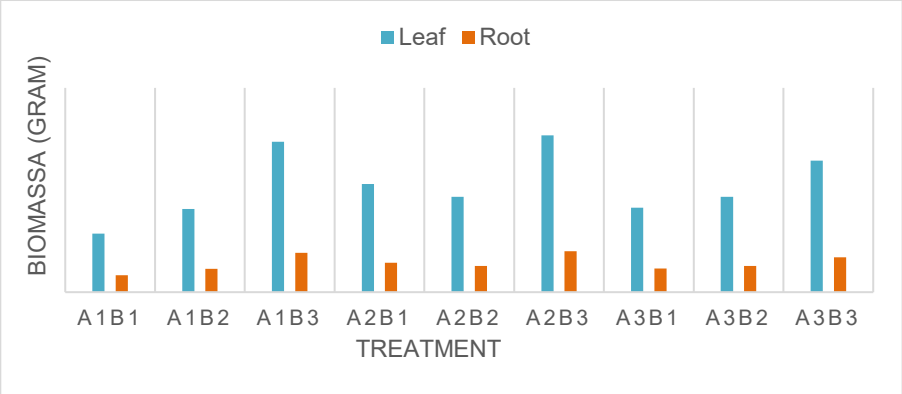


Figure 8. Biomass Chart.

According to [16] nutrients and water absorbed by plants are a reflection of plant biomass. Nutrients absorbed by plantsthrough the roots along with water will affect growth such as height, number of leaves and leaf area. The accumulation of height, number of leaves and leaf area will affect the biomass of the plant. The better the growth of maka plants, the more the biomass of the plant.

.

4. CONCLUSION

Based on the results of the research that has been done, it can be concluded

The research concludes that the drip irrigation system demonstrates a high Coefficient of Uniformity (CU) value of over 90%, making it suitable for application. Water treatment significantly influences plant height,

the number of leaves, and root and leaf biomass, although it has no noticeable effect on leaf area. In contrast, the treatment of planting media significantly affects all growth parameters, including plant height, the number of leaves, leaf area, and root and leaf biomass. The most optimal plant growth is achieved with a water application rate of 2.69 liters per day and a planting media composition ratio of 2:1 (soil to manure).

REFERENCES

[1] Simangunsong, F. T., Rohanah, A., &; Susanto, E. (2013). Analysis of Drip Irrigation Efficiency and Water Requirements of Mustard Plants (Brassica juncea) on Inceptisol Soil. Journal of Food and Agricultural Engineering, 2(1), 90–95.

[2] Mustawa, M., Abdullah, S. H., Mahardhian, G., &; Putra, D. (2017). Analysis of Drip Irrigation Efficiency on Various Soil Textures for Mustard Plants (Brassica juncea). Scientific Journal of Agricultural Engineering and Biosystems, 5(2), 408–421

[3] Rukmana, R. (2000). Budidaya Tanaman Sayuran. Yogyakarta: Kanisius.

[4] Putri, A. D. (2018). "Nutritional Benefits of Leafy Vegetables in Indonesia." Journal of Agricultural Nutrition, 7(2), 45-58.

[5] Kusmali, M., Munir, A., &; Faridah, S. N. (2015). Application of Drip Irrigation on Red Chili Plants in Enrekang Regency. AgriTechno, 8(2), 140–148.

[6] Pranata, E. (2018). The Influence of the Type of Planting Media and the Provision of Coconut Water on the Growth of Pakcoy Mustard Plants (Brassica rapa L.). University of Muhammadiyah North Sumatra Medan.

[7] Sumarsono, J., Margana, C. C. E., & Mardani, N. (2014). Design and Performance of low fluid pressure drip watering system with constant head for cayenne pepper plants (capsicum frutescens L. on plastic polybags. Scientific Journal of Agricultural Engineering and Biosystems, 2(1), 36–44.

[8] Niapele, S. (2013). Estimation of biomass and carbon stands of dipterocarpa in primary forest ecosystems and LOA (Log Over Area) at PT. Sari Bumi Kusuma (SBK) Central Kalimantan. Agrikan: Journal of Fisheries Agribusiness, 6(1), 29–36. https://doi.org/10.29239/j.agrikan.6.1.29-36

[9] Prastowo. (2010). Development of a Drip Irrigation Design Model for a Sustainable Shallow Groundwater Irrigation System in Nganjuk Regency - East Java. Bogor Agricultural Institute: Bogor.

[10] Sapei, A. (2006). Drip irrigation (2006 Edition). Bogor Agricultural University.

[11] Marlina, E., Anom, E., &; Yoseva, S. (2015). The Effect of Organic NPK Fertilizer on Soybean Growth and Production (Glycine max (L.) Merril). 4(12), 10–14. https://doi.org/10.3969/j.issn.1008-0813.2015.03.002

[12] Muis, A., Sulistyawati &; Arifin, A. Z. (2018). The Effect of Combining NPK Fertilizer and Cow Manure on the Growth and Yield of Sorghum (Sorghum bicolor L.). Journal of Agrotechnology Merdeka Pasuruan. 2(2), 23-130.

[13] Widodo, K. H., & Kusuma, Z. (2018). Effects of Compost on Soul Physical Properties and Growth of Maize on an Inceptisol. Jurnal Tanah Dan Sumberdaya Lahan, 5(2), 959–967.

[14] Nugraheni, F. T., Haryanti, S., &; Prihastanti, E. (2019). Effect of Differences in Planting Depth and Water Volume on Germination and Growth of Sorghum Seeds (Sorghum Bicolor (L.) Moench). Bulletin of Anatomy and Physiology, 3(2), 223–232. https://doi.org/10.14710/baf.3.2.2018.223-232.

[15] Soemartono. 1990. Quantitative Genetics and Molecular Biology. PAU-UGM. Yogyakarta.

[16] Zaenuddin, (2012). Klasifikasi Tanah Dasar teori bagi peneliti tanah dan pelaksaan pertanian di Indonesia. Skripsi Yogyakarta: Gajah Mada University.