Indonesian Journal of Applied Research IJAR

GROWTH AND PRODUCTION OF WATER SPINACH (Ipomea aquatica Forsk) IN VARIOUS TYPES OF HYDROPONIC NUTRITION SYSTEM NFT (Nutrient Film Technique)

Volume 3 Issue 1
(April 2022)
e-ISSN 2722-6395
doi: 10.30997/ijar.v3i1.194

Payumi[1], Oktavianus Lumban Tobing[1], Nani Yulianti[1], Nur Rochman[1]

[1]Agrotechnology Study Program, Faculty of Agriculture, Djuanda University, Indonesia

ARTICLE INFO

Article history:
Received: 17-04-2022
Revised version received: 21-04-2022
Accepted: 14-05-2022
Available online: 17-05-2022

Keywords:
cow urine; Lombok kale; AB mix; hydroponics; NFT

How to Cite:
Payumi, Tobing, O. L., Yulianti, N., & Rochman, N. (2022). GROWTH AND PRODUCTION OF WATER SPINACH (*Ipomea aquatica Forsk.*) IN VARIOUS TYPES OF HYDROPONIC NUTRITION SYSTEM NFT (Nutrient Film Technique). *Indonesian Journal of Applied Research (IJAR)*, 3(1), 66-76. https://doi.org/10.30997/ijar.v3i1.194

Corresponding Author:
Nani Yulianti
nani.yulianti@unida.ac.id

ABSTRACT

Efforts to increase the production of kale with a hydroponic cultivation system, the addition of nutrients is absolutely necessary for both macro and micronutrients. In addition to using AB mix nutrients, the use of other alternative fertilizers in hydroponic cultivation needs to be a big concern so that it can suppress the use of inorganic fertilizers. The purpose of this study was to determine the effect of giving various types of nutrient compositions AB mix and cow urine on the growth and yield of water spinach plants with the Nutrient Film Technique (NFT) hydroponic system . The design used in this study was a single factor randomized block design (RAK) with 4 levels of treatment of various types of hydroponic nutrients consisting of N 1 (100% AB mix), N 2 (75% AB mix + 25% Cow Urine), N 3 (50% AB mix + 50% Cow Urine), and N 4 (25% AB mix + 75% Cow Urine). The results of this study showed that the provision of various nutritional compositions significantly affected the growth and productivity of kale except for the variable number of books. Plant water spinach given nutritional composition N 4 (25% AB mix + 75% of cow urine) showed a markedly lower in all the observed variables, while the growth and productivity of water spinach best shown in the nutritional composition of 100% AB mix but not significantly different the nutritional composition treatment was 75% AB mix + 25% cow urine and 50% AB mix + 50% cow urine. The results of this study also show that the use of cow urine has not been able to replace the use of AB mix nutrition.

1. INTRODUCTION

The increasing population growth and awareness of a healthy lifestyle have resulted in the need for agricultural products, especially vegetables, which is also increasing, based on data from the (BPS, 2017), almost all of Indonesia's population (97.29%) consume vegetables. On the other hand, the need for built-up land has also increased. This causes the area of cultivated land to decrease due to the large number of conversions of agricultural land into non-agricultural areas in various regions. In line with Syaifuddin (2013.) which states that population growth in an area is associated with increased land use change. It was recorded that until 2014 the average conversion of agricultural land to non-agriculture in Java was 27,000 ha/year. Meanwhile, nationally, agricultural land conversion reaches 100,000 to 110,000 ha/year (BPS, 2017).

To overcome these problems, a cultivation technology is needed that can increase sustainable production without requiring a large area of land. One of the cultivation technologies that can be applied is hydroponic cultivation. According to Sumarni & Rosliani (2013) cultivation with hydroponic technology is one way to produce vegetable products with high quantity and quality continuously. Hydroponics is a method of growing crops without using soil media, hydroponics is an agricultural activity that is carried out using water and the addition of nutrients as a growth medium, crop production results can be multiplied and can be carried out in places with narrow land conditions (Binaraesa et al., 2016; Pohan & Oktoyournal, n.d.). One of the techniques in hydroponic cultivation is NFT (nutrient film technique). NFT is a cultivation of plants without soil in which plant roots are in a shallow circulating layer of water that contains nutrients for plant growth. The flow layer is very shallow (thin like a film) so that some of the plant roots are submerged in the solution layer and some are at the top (Omaranda et al., 2016). Plants that are often grown with the NFT hydroponic system are vegetable crops. One vegetable that is often cultivated with a hydroponic system is kale (Wahyuningsih et al., 2016).

Water spinach is an important vegetable crop in Southeast Asia and South Asia. Besides being easy to cultivate and short-lived, this vegetable is also popular with the public because of its nutritional content. The nutritional content of water spinach is quite high, especially vitamin A, vitamin C, iron, calcium, potassium, and phosphorus, besides that, kale also contains phytol and palmitic acid compounds which are very useful (Zeng et al., 2021). In Indonesia, there are two types of water spinach, namely land kale which is often cultivated in fields or fields and water spinach which is often cultivated in ponds or swamps. Of the two types of water spinach, there is a local water spinach cultivar that is known by the community and has the potential to be developed, namely Lombok water spinach. Lombok water spinach has high quality with characteristic bright light green leaves and crispy stems (Kusandryani & Luthfy, 2006.). According to Simarmata et al. (2016) Lombok water spinach has the potential to be developed because it has its own features that distinguish it from other types of kale. Physically, Lombok water spinach looks very fat, green and fresh and has a crunchy texture. In addition, Lombok water spinach also has an average length of 30-40 cm.

In Indonesia, water spinach production has increased every year. This can be seen from the data from the Directorate General of Horticulture (2016) in the range of 2012 – 2016 the average production of water spinach is 6 tons/Ha (2012), 5.70 tons/Ha (2013), 6.08 tons/Ha (2014), 6.23 tons/Ha (2015), and 6.40 tons/Ha (2016), but in 2013 there was a decrease of 0.3 tons/Ha. In an effort to increase the production of kale with a hydroponic cultivation system, the addition of nutrients is absolutely necessary, both macro and micro essential nutrients (Wahyuningsih et al., 2016). Fulfillment of these nutrients can be done by giving AB mix nutrition consisting of ready-to-use macro and micro salts. The AB mix contains six macronutrients that are needed in large quantities (N, P, K, Ca, Mg, and S) and ten micronutrients that are needed in small amounts but must be met including Fe, Mn, Bo, Cu, Zn. , Mo, Cl, Si, Na, and Co.

In addition to using AB mix nutrients , the use of other alternative fertilizers in hydroponic cultivation needs to be a big concern to suppress the use of inorganic fertilizers. One of the alternative sources of fertilizer that can be used as nutrients in hydroponics is liquid organic fertilizer (POC) cow urine. The use of cow urine is very potential to be used as POC in hydroponic cultivation because cow urine contains various types of nutrients such as N, P, K, and Ca as well as auxin growth regulators such as IAA which plants need (Jasmidi et al., 2018). Several studies on hydroponics with cow urine nutrition have been carried out on kale plants with a floating raft system, but it has not been done on water spinach with the NFT system .

Based on the description above, it is necessary to conduct research on the effectiveness of giving AB mix inorganic fertilizer combined with liquid organic fertilizer of cow urine in hydroponic cultivation system. This study aims to determine the effect of giving various types of nutrient compositions AB *mix* and cow urine on the growth and yield of water spinach plants with the *Nutrient Film Technique* (NFT) hydroponic system. The provision of various types of nutrients AB *mix* and cow urine will affect the growth and production of kale.

2. METHODS

2.1 Time and Place

The research was conducted from October to November 2020 at Loji Cibeureum, Cibeureum Village, Cugenang District, Cianjur Regency. Cow urine testing was carried out at the Testing Laboratory of the Department of Agronomy and Horticulture, Bogor Agricultural University.

2.2 Tools and Materials

The tools used in this study include hydroponic installations, aquarium water pumps, nutrition tanks, seedling trays, netpots, EC meters, pH meters, measuring cups, digital scales, saws, rulers, and stationery. The materials used include water spinach seeds, hydroponic nutrition AB *mix* , fermented cow urine, and *rockwool.*

2.3 Research Method

This study used a randomized block design (RAK) with one factor, namely the type of hydroponic nutrition consisting of 5 levels, namely N_1 (100% AB *mix*), N_2 (75% AB *mix* + 25% Cow Urine), N_3 (50% AB *mix*). *mix* + 50% Cow Urine), and N_4 (25% AB *mix* + 75% Cow Urine) each treatment was repeated six times, so there were 24 experimental units. Each experiment consisted of 12 plants, so there were 288 plants.

The statistical model of the experiment with a single factor randomized block design (RAK) according to (Mattjik & Sumertajaya, 2002) is as follows:

Note:

Y_{ij} : The response value of the i-th treatment in the j-th group

μ : General average

N_i : Effect of treatment i

K_j : The influence of the j group

ε_{ij} : Experimental error from treatment i and group j

The data will be analyzed using variance (F test). If the treatment has a significant effect, further tests will be carried out with *Duncan's Multiple Range Test* (DMRT) at the 5% level.

2.4 Observed Variables

The variables observed in this study included plant height, number of leaves, leaf area, stem diameter, number of nodes, total wet weight of plants, total dry weight of plants, and root length. The data collected was then analyzed using SPSS.

3. RESULTS AND DISCUSSION

3.1 Results of Cow Urine Analysis

The results of the analysis of cow urine (Table 1) showed N content of 0.30%, P 0.02%, and K 0.66%. This result is relatively higher when compared to the results of Khairunisa (2015) study with a N content of 0.14%, P 0.04%, and K 0.13%, but relatively lower when compared to the results of (Bahari, n.d.), namely of 0.4% N, 2.04% P, and 0.7% K.

Table 1 Results of cow urine analysis

Parameter	Score (%)	Method
N Total	0.30	Kjeldahl
P_2O_5	0.02	UV-VIS Spectrophotometer
K_2O	0.66	Extract HNO_3 65% + $HClO_4$ 60%

(Source: Testing Laboratory of the Department of Agronomy and Horticulture IPB, 2020)
The results of the analysis of cow urine used in this study showed moderate levels of N, P and K.

3.2 General Condition

During the experiment (October-November 2020), the *greenhouse* temperature ranged from 23 – 33.7 C with an average humidity of 77.2%. The experiment started at the beginning of the rainy season with an average rainfall of 247.9 mm/month (BMKG 2020).

3.3 Results of Observation of Water Spinach Plant Growth

3.3.1. *Plant Height*

The results of the variance (Table 1) showed that the treatment of various types of nutrients gave significantly different effects on the water spinach height variables (2 – 3 WAP). The results of further tests (Table 3) showed that the N3 treatment (50% AB *mix* + 50% Cow Urine) significantly resulted in higher kale plant height compared to the N4 treatment (25% AB *mix* + 75% Cow Urine) but was not significantly different from the N1 treatment. (100% AB *mix*) and N2 (75% AB *mix* + 25% Cow Urine) at the age of 2 – 3 MST.

Table 2 Height of water spinach plant units aged 1-3 WAP and total plant height of kale

Treatment	Plant Height (cm)		
	1 WAP	2 WAP	3 WAP
Nutritional Composition			
N1 (100% AB *mix*)	9.33	14.94 ^{b}	24.95 ^{b}
N2 (75% AB *mix* + 25% Cow Urine)	8.36	14.82 ^{b}	24.34 ^{b}
N3 (50% AB *mix* + 50% Cow Urine)	9.14	15.59 ^{b}	25.98 ^{b}
N4 (25% AB *mix* + 75% Cow Urine)	8.09	11.56 ^{a}	17.58 ^{a}

Description: The average value in the same column followed by the same letter is not significantly different according to the DMRT follow-up test at the 5% level.

3.3.2. *Number of Leaves*

Based on the results of variance (Table 2), the treatment of various types of nutrients significantly affected the number of leaves of kale at the age of 2-3 WAP. The results of the further test (Table 4) treatment of the nutritional composition of N4 (25% AB *mix* + 75% Cow Urine) showed a significantly lower number of leaves compared to other treatments (N1, N2, N3) at the age of 3 WAP, but not significantly different from that of the other treatments (Table 4). N2 treatment (75% AB *mix* + 25% Cow Urine) at the age of 2 WAP.

Table 3 Number of leaves of water spinach plants aged 1 – 3 WAP

Treatment	Number of Leaves (strands)		
	1 WAP	2 WAP	3 WAP
Nutritional Composition			
N1 (100% AB *mix*)	4.79	13.06 [b]	22.14 [b]
N2 (75% AB *mix* + 25% Cow Urine)	4.60	11.86 [ab]	21.49 [b]
N3 (50% AB *mix* + 50% Cow Urine)	4.82	12.67 [b]	21.08 [b]
N4 (25% AB *mix* + 75% Cow Urine)	4.29	9.81 [a]	13.86 [a]

Description: The average value in the same column followed by the same letter is not significantly different according to the DMRT follow-up test at the 5% level.

3.3.3. *Rod Diameter*

Based on the results of the variance (Table 3), the stem diameter variable of kale at the age of 1-3 WAP was significantly affected by the treatment of various types of nutrients. Further test results showed that kale treated with N4 (25% AB *mix* + 75% Cow Urine) actually had the smallest stem diameter compared to the other three treatments (N1, N2, N3) at 1-3 WAP (Table 5).

Table 4 Diameter of stems of water spinach plants aged 1 – 3 WAP

Treatment	Rod Diameter (cm)		
	1 WAP	2 WAP	3 WAP
Nutritional Composition			
N1 (100% AB *mix*)	0.30 [b]	0.54 [b]	0.87 [b]
N2 (75% AB *mix* + 25% Cow Urine)	0.29 [b]	0.51 [b]	0.86 [b]
N3 (50% AB *mix* + 50% Cow Urine)	0.29 [b]	0.54 [b]	0.86 [b]
N4 (25% AB *mix* + 75% Cow Urine)	0.24 [a]	0.37 [a]	0.56 [a]

Description: The average value in the same column followed by the same letter is not significantly different according to the DMRT follow-up test at the 5% level.

3.3.4. *Root Length, Number of Books, and Leaf Area*

The results of variance (Table 4) showed that the treatment of various types of nutrients significantly affected the variables of root length and leaf area of kale, but had no significant effect on the number of books of kale. The results of further tests (Table 6) showed that water spinach plants treated with N1 (100% AB *mix*) had significantly higher root length and leaf area than those treated with N4 (25% AB *mix* + 75% cow urine), but not significantly different. treated with N2 (75% AB *mix* + 25% Cow Urine) and N3 (50% AB mix + 50% Cow Urine).

Table 5 Root length and number of water spinach plants

Treatment	Root Length(cm)	Number of Books	Leaf Area (cm ^{2})
Nutritional Composition			
N1 (100% AB *mix*)	32.38 ^{b}	9.53	52.62 ^{b}
N2 (75% AB *mix* + 25% Cow Urine)	30.45 ^{b}	9.11	46.18 ^{b}
N3 (50% AB *mix* + 50% Cow Urine)	29.76 ^{b}	9.56	47.92 ^{b}
N4 (25% AB *mix* + 75% Cow Urine)	17.08 ^{a}	8.36	27.43 ^{a}

Description: The average value in the same column followed by the same letter is not significantly different according to the DMRT follow-up test at the 5% level.

3.4. Water Spinach Plant Productivity

3.4.1. *Root Weight*

Based on the results of the variance (Table 5), the treatment of various types of nutrients significantly affected the wet weight and dry weight of kale roots, both individually and per netpot. The results of further tests (Table 7) showed that water spinach plants treated with N4 (25% AB *mix* + 75% Cow Urine) showed significantly lower wet and dry root weights compared to other treatments (N1, N2, and N3) in body weight. unit root and root weight per netpot.

Table 6 Wet and dry weights of water spinach roots

Treatment	Root Weight (g)		Root Weight/Netpot (g)	
	Wet	Dry	Wet	Dry
Nutritional Composition				
N1 (100% AB *mix*)	7.85 ^{b}	3.05 ^{b}	17.65 ^{b}	7.65 ^{b}
N2 (75% AB *mix* + 25% Cow Urine)	7.87 ^{b}	2.49 ^{b}	16.57 ^{b}	6.31 ^{b}
N3 (50% AB *mix* + 50% Cow Urine)	8.16 ^{b}	2.71 ^{b}	17.12 ^{b}	6.40 ^{b}
N4 (25% AB *mix* + 75% Cow Urine)	3.24 ^{a}	0.77 ^{a}	5.92 ^{a}	1.77 ^{a}

Description: The average value in the same column followed by the same letter is not significantly different according to the DMRT follow-up test at the 5% level.

3.4.2. *Heading Weight*

The results of the variance (Table 6) showed that the wet and dry weights of the kangkung shoots, both individually and per netpot, were significantly affected by the treatment of various types of nutrients. The results of further tests showed that kangkung plants treated with N4 (25% AB *mix* + 75% Cow Urine) had significantly lower wet and unit dry weights and per netpot compared to treatments N1, N2, and N3 (Table 8).

Table 7 Wet weight and dry weight of water spinach plant canopy

Treatment	Header Weight (g)		Header Weight/Netpot (g)	
	Wet	Dry	Wet	Dry
Nutritional Composition				
N1 (100% AB *mix*)	28.96 ^{b}	13.96 ^{b}	50.05 ^{b}	24.86 ^{b}
N2 (75% AB *mix* + 25% Cow Urine)	29.18 ^{b}	13.02 ^{b}	49.03 ^{b}	24.28 ^{b}
N3 (50% AB *mix* + 50% Cow Urine)	27.21 ^{b}	13.36 ^{b}	43.55 ^{b}	22.18 ^{b}
N4 (25% AB *mix* + 75% Cow Urine)	9.20 ^{a}	3.64 ^{a}	15.68 ^{a}	6.33 ^{a}

Description: The average value in the same column followed by the same letter is not significantly different according to the DMRT follow-up test at the 5% level.

3.4.3. *Water spinach plant weight*

Based on the results of the variance (Table 7) on the variables of wet weight and dry weight of kale plant unit and per netpot, it was significantly influenced by the treatment of various types of nutrition. The results of further tests showed that water spinach plants treated with N1 (100% AB mix) significantly obtained higher wet and dry weights than kale plants treated with N4 in unit weight and weight per netpot, but not significantly different from treatment N2 (75 % AB mix + 25% Cow Urine) and N3 (50% AB mix + 50% Cow Urine) (Table 8)

Table 8 Wet weight and dry weight of water spinach

Treatment	Plant Weight (g)		Plant Weight/Netpot (g)	
	Wet	Dry	Wet	Dry
Fertilizer Composition				
N1 (100% AB *mix*)	37.06 [b]	17.01 [b]	67.70 [b]	32.51 [b]
N2 (75% AB *mix* + 25% Cow Urine)	36.81 [b]	15.51 [b]	65.61 [b]	30.58 [b]
N3 (50% AB *mix* + 50% Cow Urine)	35.37 [b]	16.07 [b]	60.68 [b]	28.58 [b]
N4 (25% AB *mix* + 75% Cow Urine)	12.44 [a]	4.41 [a]	21.60 [a]	8.11 [a]

Description: The average value in the same column followed by the same letter is not significantly different according to the DMRT follow-up test at the 5% level.

3.5. Discussion

3.5.1. *Water Spinach Plant Growth*

The results showed that the treatment of various types of nutrient composition had a significant effect on the growth variables of kale (unit plant height, plant height per netpot, number of leaves, leaf area, stem diameter, and root length) except for the number of books. Water spinach plants treated with N4 nutrient composition (25% AB *mix* + 75% Cow Urine) always showed the lowest yields on all observed variables. It is suspected that the nutritional composition of N4 (25% AB *mix* + 75% Cow Urine) the availability of nutrients contained is not balanced. This is in line with Khairunisa (2015) stating that the optimal dose of fertilizer is very important for plant growth and development, because plants really need the availability of balanced nutrients. If the availability of nutrients is not in a balanced state, it can reduce or even kill its growth. According to Naibaho (2020) revealed that the availability of sufficient and balanced nutrients will affect metabolic processes in plant tissues. Metabolism is a chemical reaction that occurs in organisms enzymatically. These enzymatic reactions are the basis of life that allows cells to grow and develop, maintain their structure and respond to the environment and become a source of energy so that plants can grow and develop optimally (Wiraatmaja, 2017).

In addition to the imbalance in nutrient content, other allegations refer to the low dose of cow urine used (2.5 ml AB *mix* + 7.5 ml cow urine / liter of water), so it has not been able to replace the nutrients contained in the AB *mix* nutrition (Omaranda et al., 2016). Considering that based on the results of the analysis, the nutrient content in cow urine is relatively low, namely 0.30% N, 0.02% P, and 0.66% K, so that the nutrient requirements needed for growth and development of kale plants cannot be fulfilled optimally. . This is in accordance with the statement of Nawawi et al. (2016) who stated that the relatively low content of cow urine and difficult to make available to plants was unable to meet the nutrient needs of plants to support their growth and development. Omaranda et al. (2016) also stated that if the nutrients (macro and micro) contained in a fertilizer are insufficient, then the plant will not be able to grow optimally and these nutrients cannot encourage plant metabolism in its growth. According to Ngapu et al. (2020) stated that the use of the most optimal concentration of bio urine for the growth and production of kale is 500 ml/1 liter of water.

The availability and fulfilment of sufficient and balanced macro and micro nutrients is absolutely necessary to form a compound that functions in plant growth and development. Nitrogen nutrient is one of the macro nutrients that must be fulfilled. Endah (2003) states that nitrogen nutrients are needed in relatively large amounts in the vegetative growth phase of plants such as shoot formation, stem development and leaf formation. In line with Mokhele et al. (2012); Patti et al. (2013) which states that during the growth and development of plants (vegetative growth), nitrogen is *mobile* and forms amino acids and proteins which are then transported to various plant organs such as roots, stems, and leaves. In addition to nitrogen, the availability of other macro nutrients such as phosphorus (P) and potassium (K) must also be met. Although not as large as the need for nitrogen, phosphorus (P) is needed by plants to strengthen cell walls and play a role in root growth and elongation, so as to increase the effectiveness of nutrient absorption as a basic material for forming compounds that support plant growth (Lingga, 1984). Likewise with the element potassium (K) which plays a role in the process of synthesizing amino acids and proteins from ammonium ions and maintaining the turgidity of the guard cells to remain optimum in order to ensure the continuity of plant metabolic processes (Ngapu et al. 2020).

Not only macro nutrients, micro nutrients such as Mn, Zn, Fe, S, B, Ca, and Mg must also be met. Although they are needed in small amounts, these elements are absolute and can cause plants to become less fertile if they are not met for plants (Omaranda et al., 2016). In line with Stevanus et al. (2015) stated that the deficiency of micro nutrients (Zn, Mo, Fe, Mn, Co, and B) can affect the vegetative growth of plants. Such as Zn deficiency will result in stem segments and the division of meristem cells becomes imperfect. These micronutrients also act as catalysts for the process of protein synthesis and the formation of chlorophyll, so as to increase photosynthetic activity which will produce photosynthate to be allocated to plant growth and development (Makky, 2020).

3.5.2. *WaterSspinach Plant Productivity*

Based on the results of research on the productivity variables of water spinach, plants that were given the nutritional composition of N4 (25% AB *mix* + 75% cow urine) significantly showed lower fresh and dry weights of roots, shoots and whole plants compared to other treatments (N1, N2 , and N3). This is related to the less than optimal growth of water spinach. Judging from the plant height, the number and area of leaves in this treatment were also relatively lower. According to Haryadi et al. (2015) the weight of the resulting plant is closely related to the variables of plant height and number of leaves. This is also in line with Pramitasari et al. (2016) which states that the higher the plant height, number and leaf area of a plant, the higher the fresh weight of the plant.

Another thing is also thought to be due to the low nutrient content in the nutritional composition of N4 (25% AB mix + 75% cow urine) so that it does not meet the needs of plants that have started to enter the pre-productive phase. In line with EtyRosa (2013) which states that the nutrient requirements in the pre-productive phase are very large compared to the pre-production phase, so that if given organic fertilizer, there will be a shortage of macro and micro nutrients. Reinforced by Endah (2003), micronutrient deficiencies in plants can drastically reduce crop yields or production as well as macronutrient deficiencies. Lack of nutrients will also affect the rate of growth and development of the roots of the plant itself. As we know the function of the root itself is to absorb water, nutrients, and organic matter to trigger plant growth and development. Good root growth and development will be able to support the wet weight of the plant because it can supply more nutrients. According to Naibaho (2020) the better and the more growth of plant roots, the faster the nutrients will be absorbed and translocated to plant organs. This is in line with Koryati (2004), which states that the more plant organs are formed, the more water content is bound by plants which will affect the fresh weight.

According to Widaryanto et al. (2017) the representation of the fresh weight of the plant is expressed as the dry weight of the plant, which is the amount of accumulation of organic matter contained in the plant without any moisture content. The dry weight of the plant is the final result of the efficiency of absorption and utilization of solar radiation available by the plant canopy . The more and longer absorption of solar radiation by the plant canopy makes the production of higher weight of the plant (EtyRosa, 2013). In line with Mubarak et al. (2022) which states that the total dry weight of crop yields is influenced by the amount of solar radiation absorbed and the ability of plants to convert solar energy into biomass.

Based on the overall results of research on water spinach plants by giving various types of hydroponic nutrient compositions for both growth and productivity variables, treatment N1 (100% AB *mix*) significantly showed higher results than treatment N4 (25% AB mix + 75% cow urine). but not significantly different from the treatment of N2 (75% AB *mix* + 25% Cow Urine) and N3 (50% AB *mix* + 50% Cow Urine). It is suspected that the nutritional composition of N2 (75% AB *mix* + 25% Cow Urine) and N3 (50% AB *mix* + 50% Cow Urine) the macro and micro nutrient content is close to the optimum composition as found in the N1 nutrient composition (100% AB *mix*). In line with Muhadiansyah et al. (2016) which stated that the provision of 50% or more AB mix nutritional composition was able to provide sufficient nutrient needs. Reinforced by Hambali (2018) which states that plants given the nutrient composition of AB *mix* 50% or more will have a higher chance of getting optimal results both from growth variables (plant height, number of leaves and root length) and productivity (total weight) at harvest. This is due to the complete content of macro and micro nutrients contained in the AB *mix* nutrition (Sutiyoso, 2004).

The results of this study also indicate that the use of cow urine for future prospects cannot completely replace the use of AB *mix* nutrition in hydroponic cultivation systems (EtyRosa, 2013). Cow urine can only be used as a substitute or a complementary nutritional mixture with a balanced composition. Considering that the nutrient content in cow urine is relatively low, so its use must be combined with other fertilizer sources. In line with Muhadiansyah et al. (2016) which states that the use of liquid organic fertilizer (cow urine) without AB *mix* fertilizer causes plants to become less fertile due to lack of micro nutrients (Zn, Mo, Fe, Mn, Co, and B). although needed in small quantities, these elements are absolutely available.

4. CONCLUSIONS AND SUGGESTIONS

4.1. Conclusion

The results showed that the provision of various nutritional compositions significantly affected the growth and productivity of water spinach except for the number of books variable. Water spinach plants given the nutritional composition of N4 (25% AB *mix* + 75% cow urine) significantly showed lower yields on all observed variables, while the best growth and productivity of kale was shown in the nutritional composition of 100% AB *mix* but not significantly different with the nutritional composition treatment was 75% AB *mix* + 25% cow urine and 50% AB *mix* + 50% cow urine. The results of this study also show that the use of cow urine cannot completely replace the use of AB *mix* nutrition .

4.2. Suggestion

Further research is needed on various concentrations of cow urine fertilizer regarding the duration of fermentation and the dose of cow urine mixture used for plants so as to obtain optimal growth.

REFERENCES

Adimihardja SA, Hamid G, R. E. (2013). No Title. *Jurnal Pertanian*.

Bahari, F. (n.d.). *Effect of cow urine and urea on growth, production and quality of katuk (Sauropus androgynus (L.) Merr*.

Binaraesa, N. N. P. C., Sutan, S. M., & Ahmad, A. M. (2016). The EC (electro conductivity) value of plant age for green leaf lettuce (Lactuca sativa L.) using NFT (nutrient film technique) hydroponic systems. *Jurnal Keteknikan Pertanian Tropis Dan Biosistem*, *4*(1), 65–74.

Central Bureau of Statistics [BPS]. 2017. *Consumption of Fruits and Vegetables in 2016* . http://www.bps.go.id [25 November 2020]

Endah, H. (n.d.). Novizan. 2003. *Mengendalikan Hama Dan Penyakit Tanaman. AgroMedia Pustaka, Jakarta*.

EtyRosa, S. (2013). Pengaruh pemberian kombinasi kompos sapi dan fertimix terhadap pertumbuhan dan produksi dua kultivar tanaman selada (Lactuca sativa L.) dalam sistem hidroponik rakit apung. *Jurnal Pertanian*, *4*(1), 6–20.

Hambali, P. F. (2018). *Pengaruh Substitusi Ab Mix Dengan Pupuk Organik Cair Kelinci Pada Pertumbuhan Dan Hasil Tanaman Selada Merah (Lactuca Sativa L.) Dengan Sistem Rakit Apung*.

Haryadi, D., Yetti, H., & Yoseva, S. (2015). *Pengaruh pemberian beberapa jenis pupuk terhadap pertumbuhan dan produksi tanaman kailan (Brassica alboglabra L.)*.

Jasmidi, J., Zainuddin, M., & Prastowo, P. (2018). Pemanfaatan Urin Sapi menjadi Pupuk Organik Cair Kelompok Tani Desa Sukadamai Timur. *Jurnal Pengabdian Kepada Masyarakat*, *24*(1), 570–575.

Khairunisa, K. (2015). *Pengaruh pemberian pupuk organik, anorganik dan kombinasinya terhadap pertumbuhan dan hasil sawi hijau (Brassica juncea L. Var. Kumala)*.

Koryati, T. (2004). Pengaruh penggunaan mulsa dan pemupukan urea terhadap pertumbuhan dan produksi cabai merah (Capsicum annum L.). *Jurnal Penelitian Bidang Ilmu Pertanian*, *2*(1), 13–16.

Kusandryani, Y., & Luthfy. (2006). Karakterisasi plasma nutfah kangkung. Bul. Plasma Nutfah 12: 30-32.

Lingga, P. (1984). *Hidroponik: Bercocok tanam tanpa tanah*. Niaga Swadaya.

Makky, M. N. (2020). PENGUJIAN NUTRISI ORGANIK CAIR PLUS AGENS HAYATI PADA SISTEM NUTRIENT FILM TECHNIQUE (NFT) HIDROPONIK TANAMAN KANGKUNG (Ipomoea aquatica). *Pro-STek*, *1*(2), 106–112.

Mattjik, A. A., & Sumertajaya, I. M. (2002). *Design of Experiments with SAS and Minitab applications*. IPB Press.

Mokhele, B., Zhan, X., Yang, G., & Zhang, X. (2012). Nitrogen assimilation in crop plants and its affecting factors. *Canadian Journal of Plant Science*, *92*(3), 399–405.

Mubarak, A., Musthapha, M., Roshana, M., & Kumara, A. (2022). *Influence of canopy architecture on the light interception, photosynthetic and biomass productivity in irrigated elite Sri Lankan rice varieties*.

Muhadiansyah, T. O., Setyono, A. S., & Adimihardja, S. (2016). Efektivitas Pencampuran Pupuk Organik Cair Dalam Nutrisi Hidroponik Pada Pertumbuhan Dan Produksi Tanaman Selada (Lactuca sativa L.). *Jurnal Agronida*, *2*(1), 37–46.

Naibaho, R. N. (2020). *Respon Pertumbuhan dan Produksi Tanaman Kangkung Darat (Ipomea reptans Poir.) Terhadap Jenis dan Waktu Pemberian Nutrisi AB Mix Secara Hidroponik*.

Nawawi, A. H. S., Rahayu, A., & Mulyaningsih, Y. (2016). Pertumbuhan, produksi dan kualitas sawi manis (Brassica juncea L.) pada berbagai konsentrasi urin sapi dan dosis pupuk N, P dan K. *Jurnal Agronida*, *2*(1).

Ngapu, A., Raka, I. D. N., & Hanum, F. (2020). PENGARUH PERLAKUAN KOSENTRASI BIOURINE SAPI TERHADAP PERTUMBUHAN DAN HASIL TANAMAN KANGKUNG DARAT (Ipomoea reptans Poir). *AGRIMETA: Jurnal Pertanian Berbasis Keseimbangan Ekosistem*, *10*(19), 27–31.

Omaranda, T., Setyono, S., & Adimihardja, S. A. (2016). Efektivitas Pencampuran Pupuk Organik Cair dalam Nutrisi Hidroponik pada Pertumbuhan dan Produksi Tanaman Selada (Lactuca sativa L.). *Jurnal Agronida*, *2*(1).

Patti, A., Gennari, L., Merlotti, D., Dotta, F., & Nuti, R. (2013). Endocrine actions of osteocalcin. *International Journal of Endocrinology*, *2013*.

Pohan, S. A., & Oktoyournal, O. (n.d.). Pengaruh Konsentrasi Nutrisi AB Mix terhadap Pertumbuhan Caisim secara Hidroponik (Drip System). *Lumbung*, *18*(1), 20–32.

Pramitasari, H. E., Wardiyati, T., & Nawawi, M. (2016). *Pengaruh dosis pupuk nitrogen dan tingkat kepadatan tanaman terhadap pertumbuhan dan hasil tanaman kailan (Brassica oleraceae L.)*.

Simarmata, T., Hersanti, Turmuktini, T., Fitriatin, B. N., Setiawati, M. R., & Purwanto. (2016). Application of Bioameliorant and Biofertilizers to Increase the Soil Health and Rice Productivity. HAYATI Journal of Biosciences, 23(4), 181–184. doi:10.1016/j.hjb.2017.01.001

Stevanus, C. T., Saputra, J., & Wijaya, T. (2015). Peran unsur mikro bagi tanaman karet. *Warta Perkaretan*, *34*(1), 11–18.

Sumarni, N., & Rosliani, R. (2013). Optimasi Jarak Tanam dan Dosis Pupuk NPK untuk Produksi Bawang Merah dari Benih Umbi Mini di Dataran Tinggi. *Jurnal Hortikultura*, *22*(2), 148–155.

Sutiyoso, Y. (2004). Hidroponik ala Yos. Jakarta: Penebar Swadaya.

Syaifuddin, H. A. (n.d.). Dahlan. 2013. Hubungan antara jumlah penduduk dengan alih fungsi lahan di Kecamatan Somba Opu Kabupaten Gowa. *Jurnal Agrisistem*, *9*(2), 169–179.

Wahyuningsih, A., Fajriani, S., & Aini, N. (2016). Komposisi Nutrisi Dan Media Tanam Terhadap Pertumbuhan Dan Hasil Tanaman Pakcoy (Brassica Rapa L.) Sistem Hidroponik The Nutrition And Growth Media Composition On The Growth And Yield Of Pakcoy (Brassica Rapa L.) Using Hydroponics System. *Jurnal Produksi Tanaman*, *4*(8), 595–601.

Widaryanto, E., Azizah, N., & Fitriyah, N. L. (2017). Effect of water deficit and planting materials on growth and yield of watercress (Nasturtium officinale) in urban farming system. *BIOSCIENCE RESEARCH*, *14*(2), 170–177.

Wiraatmaja, I. (2017). Metabolisme pada Tumbuhan. *Bahan Ajar Program Studi Agroteknolgi Universitas Udayana, Denpasar*.

Zeng, W., Tao, H., Li, Y., Wang, J., Xia, C., Li, S., Wang, M., Wang, Q., & Miao, H. (2021). The flavor of Chinese kale sprouts is affected by genotypic variation of glucosinolates and their breakdown products. *Food Chemistry*, *359*, 129824.