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Nutrient film in hydroponic system providing organic fertilizer of the *Tithonia diversifolia* and AB Mix for lettuce

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ABSTRACT: This study uses the Nutrient Film Technique (NFT) hydroponic system to grow and produce green lettuce (*Lactuca sativa*) to determine the impact of POC kipahit and AB Mix on those processes. Five treatments were used in this study's Completely Randomized Design (CRD. Each treatment was repeated four times, with five net pots, one for each replication containing lettuce plants. The hydroponic installation used in this research uses a 21-inch pipe. The pipe is designed to be an NFT system with a pipe slope of 2–10%, consisting of five holes with a distance between holes of 10 cm. Next, the NFT hydroponic installation was set up in the experimental area, with each installation having a nutrient tank attached and marked for each treatment. The acquired data was examined quantitatively, and analysis of variance (ANOVA) and tests of means were performed using Duncan's Multiple Range Test (DMRT) at the 5% level to verify whether the treatments were significantly different. SPSS 20 and Microsoft Excel were used for data processing and analysis. Using the NFT hydroponic system, the POC kipahit and AB Mix supply significantly impacted the development and production of green lettuce. A concentration combination of POC kipahit and AB Mix that can increase the growth and production of green lettuce compared to the use of 100% AB Mix has not yet been obtained.
Keywords: green lettuce; hydroponic system; growth; vegetable production.

Filme de nutrientes em sistema hidropônico para fornecimento de fertilizante orgânico de *Tithonia diversifolia* e AB Mix para alface

RESUMO: Este estudo utiliza o sistema hidropônico Nutrient Film Technique (NFT) para cultivar e produzir alface verde (*Lactuca sativa*) para determinar o impacto do POC kipahit e AB Mix nesses processos. Cinco tratamentos foram utilizados no Delineamento Completamente Randomizado (CRD), sendo cada tratamento repetido quatro vezes, com cinco vasos-rede, um para cada repetição, cada um contendo as plantas de alface. A instalação hidropônica utilizada nesta pesquisa foi com tubos de PVC de 21 polegadas. O tubo foi projetado para ser um sistema NFT com uma inclinação de 2–10%, consistindo em cinco furos com uma distância entre furos de 10 cm. Em seguida, foi montada a instalação hidropônica NFT na área experimental, sendo cada instalação foi acoplada um tanque de nutrientes e marcada para cada tratamento. Os dados adquiridos foram examinados quantitativamente e foram realizadas análises de variância (ANOVA) e testes de médias usando o Teste de Faixa Múltipla de Duncan (DMRT) no nível de 5% para verificar se os tratamentos são significativamente diferentes; foram usados os softwares como SPSS 20 e Microsoft Excel para processamento e análise de dados. Utilizando o sistema hidropônico NFT, o fornecimento de POC kipahit e AB Mix impactou significativamente o desenvolvimento e produção de alface verde. Ainda não foi obtida uma combinação de concentração de Kipahit POC e AB Mix, que possa aumentar o crescimento e a produção de alface verde em comparação com o uso de 100% AB Mix.
Palavras-chave: alface verde; sistema hidropônico; crescimento; produção vegetal.

1. INTRODUCTION

Lettuce (*Lactuca sativa*) is a vegetable that has many benefits because it is a high source of nutrients and vitamins for health, such as calcium, phosphorus, iron, and vitamins A, B1, and C. Public awareness of the benefits of lettuce has increased the demand for it. This can be seen in the increase in lettuce production. Lettuce production in Indonesia has increased from 2018 to 2020. Lettuce production in 2018 was 625 tons; in 2019, it was 639 tons; in 2020, it was 664 tons. Apart from that, lettuce production has not been able to meet demand (ARIFIATI et al., 2017).

Lettuce is in great demand by homemakers, fast food traders, food stalls, hotels, and other culinary businesses. Lettuce production in Indonesia has not been able to meet demand. According to lettuce production data in Indonesia in 2017, demand for lettuce reached 711,000 tons, while production was 627,611 tons. Apart from that, Indonesia imported 285 tons of lettuce in 2019 to meet the demand for lettuce. One of the reasons for the decline in production is the reduction in agricultural land. Efforts that can be made to increase lettuce production include using a hydroponic cultivation system. The hydroponic cultivation system uses planting media other than soil, so it does not require a large land area (BINARESA et al., 2016).

In place of using soil, hydroponics uses water as a medium, nutrients, and oxygen to grow crops. Since hydroponic farming is more affordable and results in higher-quality veggies, it is more effective. The Nutrient Film Technique (NFT) system is a popular hydroponic method for growing leafy foods like lettuce. The NFT system benefits from a continuous nutrient supply, which ensures that nutritional requirements are constantly supplied. So that plants get enough water, nutrients, and oxygen, the shallow and circulating nutrient water layer keeps the flow of nutrients from becoming stagnant (HAFIZAH et al., 2019). A chemical fertilizer called AB Mix is utilized as a nutrient in hydroponic cultivation. The cost of the AB Mix fertilizer, which is required for hydroponic production, is rising. One package of fertilizer A and B containing 1000 liters costs between Rp. 80,000 and Rp. 100,000. The continued use of chemical fertilizers may also be harmful to human health. By employing organic materials instead of chemical fertilizers, this problem can be solved. Liquid organic fertilizer from kipahit plants is an organic substance that can be utilized for hydroponic nutrition (HARTUS, 2007).

Utilizing kipahit (Tithonia diversifolia) as a liquid organic fertilizer is possible. The nutrients that plants require are present in this plant. N, P, K, Ca, and Mg are the nutrients found in kipahit. The amount of nutrients in kipahit is quite high, consisting of 3.5–4.0% N, 0.35–0.38% P, 3.5–4.1% K, 0.59% Ca, and 0.27% Mg. In NFT hydroponic farming, kipahit was effectively employed as a natural nutrient on lettuce plants, with a dose of 1 L of kipahit liquid organic fertilizer (POC) per 5 L of water. In tests on pakcoy plants (*Brassica rapa* L.), kipahit leaf liquid organic fertilizer produced significantly different results for the parameters of leaf number, wet weight, dry weight, wet weight of roots, and dry weight of roots in the 20% POC bitter treatment. The liquid organic fertilizer used must pay attention to the dose given to the plants. Doses that do not match the plant's needs will result in wilting symptoms in the plant. Based on this description, the author will conduct research on the application of Kipahit (*Tithonia diversifolia*) and AB Mix Liquid Organic Fertilizer on the Growth and Production of Green Pepper (*Lactuca sativa* L.) using the Hydroponic Nutrient Film Technique System (ILHAMDI et al., 2020).

The hydroponic farming method dates back to the 16th century. Since then, hydroponics has become known all over the world. Hydroponics comes from the Latin words hydros, which means water, and phonos, which means work. Hydroponics means water work. Hydroponics is a farming technology that uses water as a medium for nutrients and oxygen. Hydroponics is known as farming without soil (soilless cultivation, soilless culture) using containers filled with water mixed with micro- and macro-fertilizers (MASDUKI, 2017). Hydroponic farming does not require a large area of land, so small land areas, such as home gardens, roofs, or other areas, can be used. The media used in hydroponic cultivation must be clean from pests, diseases, and toxins. Rockwool, gravel, sand, cork, charcoal, zeolite, or no aggregate media (only water) are employed as planting media. The medium will be watered manually or through pipes to provide the plants' nutritional needs. The media will take the nutrients needed to sustain plant development and growth. Nutrition is necessary for plant development and growth. AB Mix fertilizer is the usual nutrient used in hydroponic cultivation. AB Mix is a mixture of liquid formulas A and B that contains macro and micronutrients (MAULIDO et al., 2016).

Hydroponic systems are grouped into two categories: planting media culture and nutrient solution culture. Planting media culture uses planting media with a dense, porous texture as a place where plant roots grow. The planting media used is generally organic, inorganic, or a mixture of organic and inorganic media. Media culture based on providing nutrient solutions is divided into two groups: sub-irrigation (subsurface irrigation) and top irrigation (surface irrigation). Instead of using a planting medium, nutrient solution culture allows plants to grow either in the nutrient solution or the air (MUHADIANSYAH et al., 2016). There are three types of nutrient solution culture: hydroponics with still solution, hydroponics with circulating nutrient solutions, and aeroponics. The hydroponic system must consider the plant type to be cultivated, investment policy, workforce competency, and climate conditions. Hydroponic systems currently being used and developed are aeroponics, drip irrigation, floating rafts, wicks, DFT (Deep Floe Technique), fertigation, and NFT (Nutrient Film Technique) (PURBOSARI et al., 2021).

Farming using a hydroponic system has advantages and disadvantages (Hasegawa, 2004). The advantages of cultivating plants using a hydroponic system are that successful growth of plants is guaranteed; maintenance is easier and more practical, so it is easier to control pests; more efficient use of fertilizer and water, does not require a lot of labor, plant growth can be faster, production results are better, the selling price of the product is higher, seasonal crops can be cultivated outside the season, there is no risk of natural disasters, it can be done on limited land, such as on the roof of a house, kitchen or garage, the growth and quality of the harvest can be regulated, the product produced is cleaner and hygienic, shorter planting period, and cheaper operational costs. The disadvantages of cultivating plants using a hydroponic system are: the initial expenditure is expensive; special skills are needed to weigh and mix chemicals; maintenance of hydroponic equipment is difficult; and growth is greatly influenced by nutrient content, pH, and temperature (RAJA et al., 2013).

AB Mix Nutrition is a chemical solution that functions as nutrition for plant development and growth. AB Mix contains nutrients that plants need, namely macro and microelements, formulated as nutrients. AB Mix nutrition generally consists of 12 out of the 16 nutrients plants need (RUSMAYADI; ZULHIDIANI, 2020). The elements C, H, and O are obtained from air and water, while the element Cl is not added because plants are susceptible to excess Cl. The hydroponic nutrients used are divided into two groups, namely stock A and stock B. Stock A consists of the elements N, P, K, Ca, Mg, CO2, H, H2O, and S. Stock B consists of the elements Fe, Mn, Bo, Cu, Na, Mo, Cl, Si, and Zn

(SINGGIH et al., 2019). Stock A, which contains the Ca element in a concentrated state, must not be mixed with stock B, which contains sulfate and phosphate in a concentrated state. This division aims to ensure that in concentrated conditions, no precipitate occurs because calcium (Ca), when it meets sulfate or phosphate in a concentrated state, becomes calcium sulfate or calcium phosphate and forms a precipitate (SIREGAR et al., 2021). Deposition of these nutrients can cause plant roots to be unable to absorb the necessary nutrients. AB Mix nutrition is formulated according to plant types, such as fruit and vegetable plants, plant species and varieties, plant growth phases, plant parts to be harvested (roots, stems, leaves, fruit), and weather factors (TJENDEPATI, 2017). AB Mix nutrient solutions generally use a dose of 5 ml of solution A and 5 ml of solution B in 1 liter of water.

2. MATERIAL AND METHODS

2.1. Research design

The five treatments in this study are P1 = POC kipahit 0% + AB Mix 100% (control), P2 = POC kipahit 25% + AB Mix 75%, P3 = POC kipahit 50% + AB Mix 50%, P4 = POC kipahit 75% + AB Mix 25%, and P5 = POC kipahit 100% + AB Mix. This study employs experimental research methods. Each treatment was replicated four times, with five net pots, one for each replication, each containing a lettuce plant.

2.2. Ways of working

Kipahit POC is made using a fermentation method using EM4 and coconut water as the bioactivators. Kipahit POC's ingredients are 25 kilograms of chopped, roughly 3-cm-long kipahit plants, 25 liters of purified water, 25 liters of coconut water, 1 kg of melted brown sugar in 1 liter of water, and 1 liter of EM4. Put all the ingredients into a 150-liter barrel, stir until evenly mixed, then close tightly and store in a shady place. The barrel is opened and stirred daily so oxygen exchange occurs. Fermentation lasts for 14 days. POC can be applied if the fermentation process is successful. Successful POC fermentation is characterized by a pH value of around 4–8, the solution is brownish–yellow in color, the smell is typical of fermentation, like the aroma of tapai, there are no larvae, and the surface has white spots, which indicate the activity of microorganisms decomposing organic waste. Before application, the POC solution is filtered three times using a coconut filter to separate the POC from the dregs.

The hydroponic installation used in this research uses a 21-inch pipe. The pipe is designed to be an NFT system with a 2–10% pipe slope. One pipe consists of five holes with a distance between holes of 10 cm. Then, the NFT hydroponic installation was assembled in the experimental area and cleaned of rubbish and weeds. Each installation is added to a nutrient tank and marked for each treatment. The nutrient solution consists of nutrient solutions A and B. Nutrient solution A consists of the elements Ca nitrate, K nitrate, and BMX fertilizer. Nutrient solution B consists of MKP, ammonium sulfate, K sulfate, and Mg sulfate. The AB Mix solution is created by combining nutrients A and B in a ratio of 5 ml of solution each into 1 liter of water. Making a nutrient solution involves dissolving stock A and stock B solutions in 15 liters of water. The solution is stirred until evenly distributed and measured using TDS to determine the ppm value of water. The ppm value of raw water in this study was 145 ppm, while the ppm value of the nutrient solution used was 730–1122 ppm. In addition, the pH of the water was measured using litmus paper. The pH of the solution used is around 5–6.

Sowing is carried out in rockwooll media. One planting medium consists of one plant seed. Seeding is carried out for 14 days. After 14 days, the seedlings were transferred to the rejuvenation installation for seven days. Seedlings that are 21 days old and have three leaves are transferred to the production installation. Seedlings that have been sown and contain three leaves are transferred to the production installation and placed in a net pot. One net pot contains one lettuce plant. Consider the rock wool planting medium when inserting seeds into a net pot. The planting medium must be exposed to water to distribute the nutrient solution during planting.

Plant maintenance activities are carried out every day. This maintenance includes controlling clogged water pumps and hoses, controlling nutrients, adding nutrient solutions, replanting, measuring growth and physical factors, and protecting plants from plant pest organisms. Harvesting is done after the plants are 43 days after planting (DAP). The characteristics of plants that can be harvested are that they have a leaf length of around 20–25 cm, a leaf width of around 15 cm, a weight of around 100–400 g, a physical appearance with fresh characteristics, are not disturbed by plant pest organisms (OPT), are not damaged, and are not wilted. Harvesting is done by removing all plants and the planting medium.

2.3. Observation Parameters

From the surface of the planting media to the tip of the plant's tallest leaf, measure the height of the plant in centimeters (cm). Plant height measurements were carried out at 22–42 HST every seven days. Leaf width (cm), measured with a ruler on the widest leaf at the time of observation, is measured starting from the left edge to the right edge or vice versa. Measurements were carried out at 22–42 HST every seven days. Leaf length (cm), measured using a ruler on the longest leaf at the time of observation, is measured starting from the petiole to the tip of the leaf. Measurements were carried out at 22–42 HST every seven days. The number of leaves (strands) is calculated from leaves that have opened completely. Measurements were carried out at 22–42 HST every seven days. Root length (cm), measured using a ruler from the root's base to the root's tip. Measurements are taken after harvesting. The wet weight of the plant (g) is carried out after harvesting by weighing all parts of the plant using a digital scale.

2.4. Data Analysis

Tables and graphs are used to present the data. The acquired data were quantitatively examined, and an analysis of variance (ANOVA) at the 5% level was performed. To identify which treatments are significantly different, do Duncan's Multiple Range Test (DMRT) at the 5% level if the effect is significant ($P < 0.05$), using SPSS 20 and Microsoft Excel to process and analyze data.

3. RESULTS

The growth indicators that were seen were the plant height, number of leaves, leaf breadth, leaf length, and root length (Table 1). On all plant growth metrics, feeding the plants AB Mix and POC kipahit nourishment had a substantial impact. P1 is the treatment that results in the highest plant height, leaf length, leaf breadth, and leaf count characteristics. The procedure that results in the maximum root length parameter is P5. P4 is the treatment that results in the lowest plant height, leaf length, leaf breadth, and leaf count characteristics. For the criteria of plant height, leaf length, leaf breadth, and leaf number, P2 outperforms other combination treatments.

The production parameter for lettuce plants is the wet weight of the plant (Table 2). Providing AB Mix and POC Kipahit nutrients had a significant effect ($P > 0.05$) on the fresh weight of the plants.

Table 1. Average growth parameters of green lettuce when given POC Kipahit and AB Mix at 43 HST.
Tabela 1. Parâmetros médios de crescimento da alface verde quando administrados POC Kipahit e AB Mix aos 43 HST.

Treatment	Plant height (cm)	Leaf length (cm)	Leaf width (cm)	Number of leaves (pieces)	Root length (cm)
P1 (0% POC kipahit +100% AB Mix)	23.52 ±0.27^{a}	16.58 ±0.27^{a}	13.35 ±0.12^{a}	10.25 ±0.50^{a}	9.05 ±0.64^{bc}
P2 (25% POC kipahit +75% AB Mix)	20.40 ±0.57^{b}	14.50 ±0.25^{b}	11.45 ±0.26^{b}	7.75 ±0.50^{b}	8.50 ±0.76^{c}
P3 (50% POC kipahit +50% AB Mix)	18.58 ±0.29^{c}	14.73 ±0.50^{c}	9.50 ±0.18^{c}	6.50 ±0.57^{c}	6.63 ±1.05^{d}
P4 (75% POC kipahit +25% AB Mix)	15.40 ±0.49^{e}	11.73 ±0.78^{e}	7.35 ±0.20^{e}	5.00 ±0.00^{e}	9.93 ±1.38^{bc}
P5 (100% POC kipahit +0% AB Mix)	15.88 ±0.92^{d}	13.58 ±0.71^{d}	8.95 ±0.67^{d}	5.78 ±0.50^{d}	10.45 ±1.36^{a}

Note: A different letter after the average value denotes a significant difference between the treatments at the 5% Duncan Test level.
Nota: Letras diferentes após o valor médio denota uma diferença significativa entre os tratamentos ao nível de 5% do Teste Duncan.

Table 2. Effect of POC application on average wet weight of plants.
Tabela 2. Efeito da aplicação de POC na massa fresca média das plantas.

Treatment	Wet weight (g)
P1 (0% POC kipahit + 100% AB Mix)	101,00 ± 2.16^{a}
P2 (25% POC kipahit + 75% AB Mix)	74,25 ± 5.67^{b}
P3 (50% POC kipahit + 50% AB Mix)	52,25 ± 3.50^{c}
P4 (75% POC kipahit + 25% AB Mix)	33,00 ± 1.82^{e}
P5 (100% POC kipahit + 0% AB Mix)	42,00 ± 1.82^{d}

4. DISCUSSION

Compared to the combined treatment and POC therapy, P1 produced the maximum growth in the plant height, leaf length, leaf breadth, and number of leaves (Table 1). Complete nutrients, including macro and micronutrients in proportions good for plant growth, are present in AB Mix nutrition. The availability of nutrients influences the rate of a plant's vegetative development. The stock solutions A and B comprise the AB Mix's nutritional content. The elements Ca, K, N, and P are present in stock solution A. Mg, S, and Fe are present in stock solution B. The nutrients in AB Mix are in a purer form, which makes them more stable and quick to dissolve in water. A suitable amount of plant growth can be increased by consuming more AB Mix nourishment. This is consistent with earlier research. The nutrient content of the AB Mix increases with increasing nutrient concentration, which can promote plant development. In hydroponic cultivation, the maximum AB Mix nutrient concentration of 1200 ppm produced the best results for plant growth regarding height, leaf area, root weight, and lettuce plant weight.

Regarding plant height, leaf length, width, and leaf count, P2 is the optimal combination of AB Mix and POC kipahit for growing lettuce (Table 1). The greatest combo therapy for hydroponic cultivation that can lower the need for AB Mix nutrients is P2. Compared to other combo therapies, P2 has a higher proportion of AB mix. Because AB Mix nutrition contains all of the essential elements that plants require, using Kipahit POC in hydroponic gardening requires the addition of AB Mix nutrition to generate good growth. According to earlier studies, giving AB Mix 75% nutrition and POC paitan 25% to kailan plants produces the highest number of leaves and tallest plants compared to other combinations. As the age of the plants rose in all treatments, the development of green lettuce plants with the AB Mix and POC Kipahit treatments increased. This is because increasing plant age will increase the growth of the plant's vegetative organs. As the age of the plant increases, plant development is directed towards forming plant vegetative organs to expand plant growth to meet its nutritional needs.

The growth of green lettuce plants at 22 HST showed relatively the same growth because each plant had not been treated. The growth of lettuce plants at 29 HST increased in all treatments, but P1 showed higher yields than other treatments. Plant growth looks different at 36–43 HST because it experiences faster growth. This is because at 36–43 HST, the nutrient concentration is optimal to provide the nutrients needed for lettuce plant growth in appropriate amounts. Providing too much nutrition can cause plant poisoning. Providing too little nutrition can cause inhibition of root development, disrupting nutrient uptake.

The growth pattern in all treatments experienced a logarithmic phase at 36–43 HST. This is because the growth of green lettuce in the initial phase is slow, and in the final phase, there is a rapid increase. The growth rate is moderate at the beginning of growth but will pick up speed later on, according to the logarithmic phase. Compared to the other treatments, P1 showed the fastest rate of increase in plant height. Compared to the other treatments, P4 exhibited the slowest rate of plant height growth. Giving plants 100% AB Mix nourishment gives them the full range of required nutrients. For plant growth activities like cell division and cell elongation to be accelerated and increase plant height, plants require the optimum amounts of nutrients N, P, and K.

Leaves are where fontocytosis occurs. Photosynthesis that goes well will produce many photosynthesis products, which will later be used to form organs and tissues in plants. Compared to the other treatments, P1 showed the greatest growth in terms of leaf length, leaf width, and leaf count. In contrast to other treatments, P4 had the least growth in terms of leaf length, width, and count. This is because P1 has complete nutritional elements for plant growth and development. AB Mix nutrition has completed nutritional elements for plant growth, especially leaf growth. Leaf growth will grow optimally if the nutrients contained in a fertilizer are sufficient to encourage plant metabolism in leaf growth. Leaf growth in P4 and P5 obtained less good results than other treatments. The treatment experienced a deficiency of N nutrients and micronutrients: Zn, Mo, Fe, Mn, Co, and B.

The nutrient N and micronutrients act as constituents of chlorophyll. The greater the amount of chlorophyll, the more photosynthetic activity will produce photosynthate, which plays a role in developing leaf meristematic tissue. Micronutrients are needed in small amounts, but if the plant lacks these elements, it can cause leaf growth to be suboptimal. Micronutrient deficiencies can affect vegetative growth. The adequacy of nutrients for plant growth will determine the value of plant biomass, because the amount of nutrients given and absorbed by plants greatly influences the rate of plant vegetative growth. Chlorophyll formation largely depends on the number and size of leaves. The length and width of the leaf determine the leaf area. The larger the leaf area, the greater the amount of sunlight received, because the leaves will more easily receive the light. Sunlight is a source of energy used in the photosynthesis process. The more leaves there are, the more places to carry out the photosynthesis process, and the results also increase so that they can be translocated to all parts of the plant.

Roots are plant organs that absorb and obtain nutrients as food substances, which are then translocated to all parts of the plant. Root length in P5 was the highest compared to other treatments. The P5 nutrient content cannot meet the needs of plant growth and development, so plants experience nutrient deficiencies. Nutrient deficiencies cause plant roots to grow longer. This is because the distribution of assimilate is greater, so the roots will grow faster and longer to supply nutrients for plant growth. The Kipahit POC concentration in P5 was the highest among other treatments. Kipahit POC contains P elements that grow seeds, roots, flowers, and fruit. The P element helps improve root structure by absorbing nutrients in plant root growth. Kipahit POC has the effect of accelerating and multiplying roots more quickly.

P1 is the treatment that produces the highest wet weight, while P4 is the treatment that produces the lowest wet weight (Table 2). The increase in wet weight of lettuce in all treatments is related to the content of N, P, and K elements, which play a role in increasing plant production. The number of leaves, leaf area, water content, stem diameter, and plant height affect a plant's wet weight. To increase biomass, plants shape their bodily components. The availability of nutrients and water for plants affects wet weight. Water makes up over 80% of the plant's moist weight. Plants will grow and have high production levels if the nutrients the plants need are sufficient and balanced. The nutrients N, P, and K are macroelements that plants need. Lack of N will cause plants to grow stunted, slow, and weak. Based on Table 2, P1 provides the best wet weight results because AB Mix nutrition contains essential nutrients that support plant growth and production. Meanwhile, P4 and P5 treatments did not give good results in terms of plant wet weight. This is because it contains more POC than AB Mix nutrients. This follows previous research, which found that organic fertilizer only contains a lot of organic material and low levels of nutrients.

5. CONCLUSIONS

Using the NFT hydroponic system, POC kipahit and AB Mix have a substantial impact on the growth and production of green lettuce. The growth and output of green lettuce can be increased by utilizing a mix of Kipahit POC concentration and AB Mix instead of using 100% of either. AB Mix. Further research is needed regarding more optimal doses for the growth and production of green lettuce plants. Improvements are needed in the kipahit POC filtering process so that no dregs remain, and research is needed using plants and other hydroponic systems to determine the effectiveness of using kipahit POC.

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Nutrient film in hydroponic system providing organic fertilizer of the Tithonia diversifolia and AB Mix for lettuce

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