

Use of Various Types of Nutrition and Plant Regulatory Substances in Hydroponic Plants

The Use of Various Types of Nutrients and Plants Regulatory Substances in Hydroponic Plants

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ABSTRACT

The narrowing of agricultural land, especially in urban areas, accompanied by consumer demand for plant products, requires innovation in the cultivation system. Hydroponics can be a solution because it can be applied to narrow land, not determined by conditions and places, and does not use soil. The provision of appropriate nutrients in hydroponic cultivation techniques can optimize plant growth. This research is a literature study on the provision of alternative nutrients and growth regulators in hydroponic plants. These nutrients include organic fertilizers from animals and plants, NPK fertilizers, plant catalysts, CaCl₂, nitrogen, fertimix, rice washing water, NPK phoska, KCl, growmore, vinasse, magnesium, azolla, and glycerides. There are also alternative growth regulators (ZPT), namely gibberellins, auxins, and 'Areta' cytokinins (young coconut water, bamboo shoot extract, and bamboo sprout extract). Some of these nutrients and PGRs have a real and positive effect on plants so that they can be used by farmers of hydroponic cultivation. It was concluded that there are many alternative nutrients and PGRs that have been used and played a role in hydroponic cultivation.

Keywords: hydroponics; narrow land; nutrition; plants; plant growth regulator.

ABSTRACT

The reduction in agricultural land, especially in urban areas, is accompanied by consumer demand for the product plants, demands innovation in the cultivation system. Hydroponics can be a solution because it can be applied to narrow land, not determined by conditions and places, and does not use soil. Provision of appropriate nutrition in cultivation with hydroponic techniques can optimize plant growth. This research is a literature study regarding the provision of alternative nutrients and growth regulators in hydroponic plants. These nutrients include organic fertilizers derived from animals and plants, NPK fertilizer, plant catalyst, CaCl₂, nitrogen, fertimix, rice washing water, NPK phoska, KCl, growmore leaves, vinasse, magnesium, azolla and glycerides. There are also alternative growth regulators (ZPT), namely gibberellin, auxin, and 'Areta' cytokinins (young coconut water, bamboo shoot extract and bean sprout extract). Some of these nutrients and ZPT have a real and positive influence on plants so that they can be used by farmers cultivating plants hydroponically. It was concluded that there are many alternative nutrients and PGR that have been used and play a role in hydroponic cultivation.

Keywords: hydroponics; narrow field; nutrition; plant; plant regulators.

INTRODUCTION

Indonesia is an agricultural country, where most of the population works as farmers. So that almost the entire area is used as agricultural land. However, population growth, especially in densely populated urban areas, has forced agricultural land to shift into buildings used as community residences, resulting in reduced land for farming (Gultom and Harianto, 2022).

In direct proportion to population growth, the level of food consumption has also increased. Based on reports from the Central Statistics Agency (BPS), it is known that the production of vegetable crops for the last 5 years starting from 2015 – 2020, especially for vegetables such as cabbage, mustard greens, carrots and several other crops has continued to increase every year. This can be interpreted that the demand for and consumer interest in vegetables continues to increase and increase. This increase in demand requires farmers in Indonesia to increase their production.

The lack of land and the high demand for vegetables is one of the factors that make people have to innovate to find alternative cultivation. Along with the times. The agricultural sector has progressed in its cultivation process. The cultivation technique that is considered appropriate to be used to overcome these problems is hydroponics. Romala and Sobari (2019) state that hydroponics is a plant cultivation technique that uses water as a planting medium. This medium has various management systems for regulation of nutrients and oxygen.

The most influential factor in a hydroponic plant production system is nutrition which determines plant quality (Tripama and Yahya, 2018). Nutrition is the main mechanism because it is the main supplier of water and mineral needs for plants whose dosage must be according to needs, so that it will affect the quality of crop yields (Setiawan, 2018). Many studies have been conducted regarding nutrition and growth regulators in hydroponic plants.

AB Mix nutrition is a study material commonly used in hydroponic cultivation. One of them is Tripama and Yahya's research (2018) regarding mustard greens given AB Mix nutrition. This plant has increased in height, number of leaves and plant weight. Meanwhile, the research by Romalasari and Sobari (2019) found that lettuce plants that were given AB Mix nutrition experienced an increase in the quality of plant height and number of leaves. Furthermore, the results of the research by Narulita *et al.* (2019) showed that mustard plants given AB Mix nutrition experienced an increase in height, number of leaves, chlorophyll content, and plant wet weight. Likewise research Zamriety *et al.* (2019) concerning mustard greens that were given AB Mix nutrition also showed an increase in plant height, number of leaves, sample production, highest plant production. In addition, the research by Manullang *et al.* (2019) on lettuce plants that were given AB Mix nutrition, the quality of the plant height and wet weight increased. Research Lestari *et al.* (2020) concerning celery plants that were given AB Mix nutrition also showed an increase in plant height, number of main petioles, number of leaves, fresh weight and root weight. Therefore, this study aims to conduct a literature review on alternative nutrients other than AB Mix nutrients and plant regulators in hydroponic plants.

RESEARCH METHODS

The method used in this research is a literature *review system*. This is the literature review procedure suggested by Cooper (1988) regarding literature synthesis. The literature review in this study focused on reviewing previous research regarding alternative nutrients and plant regulatory substances in hydroponic plants.

The study materials in this study were journals that were appropriate to the topic as a reference in *the literature review* with the keyword 'hydroponic plant nutrition'. Based on the search that has been done, the total number of journals obtained is 78 journals, but only 51 journals are used because they are considered the most appropriate to the topic. Appropriate articles include previous research articles using experimental methods using alternative nutrients other than AB Mix nutrients, as well as plant regulators in hydroponic plants.

The articles reviewed were obtained from *Google Scholar* with a span of the last 10 years.

RESULTS AND DISCUSSION

Use of Alternative Nutrition

The results of a literature review regarding the use of alternative nutrients in hydroponic plants, the results are as presented in Table 1. Hydroponics is a planting technique that does not require a lot of land, so that people from urban areas can still grow vegetables or fruit. Tyana *et al.* (2021) planting using hydroponic techniques can be done on narrow land or even indoors. The hydroponic technique has the advantage of being able to do it all the time, so it doesn't depend on the season, and the types of commodities planted are not limited. In hydroponic cultivation, additional nutrients are needed because there are ingredients that can affect plant growth with optimal results. The nutrient solution given must contain macro and micro elements. The macro elements consist of N, P, K, Ca, Mg and S while the micro elements consist of Fe, Cl, Mn, Cu, Zn, B and Mo.

Based on the literature study that has been carried out on several previous studies, the results obtained are several types of alternative nutrients that can be used to increase vegetative growth of plants which include (plant height, root length and leaf area) and increase the quality of crop production which includes (plant weight, number of leaves or fruit). Certain plants have a response to certain nutrients, and almost all of these nutrients affect the vegetative growth of plants, and the quality of plant production. The following are some of the literature reviews that have been conducted:

Mustard greens (pakchoy)

Mustard plants fed nutrients from catfish pond water and goat urine in Kuswoyo and Zein's (2018) study had an effect on plant height and weight; Tofu Liquid Waste in the research of Sutrisno *et al.* (2015) effect on the number of leaves, plant height and wet biomass; AB mix was added with paitan extract and rabbit droppings in the study by Nurrohman *et al.* (2014) effect on plant height and weight, number, area and weight of leaves; chicken feather compost tea in the study of Rianti *et al.* (2019) affected the wet weight, dry weight, and leaf color. These nutrients can increase the mass, number of leaves and area of the plant. In general, the response of plants to the nutrients given is an increase in plant height, number of leaves, and plant weight.

Table 1. Results of a Literature Study on the Use of Nutrition

Type plant	Types of nutrient sources	Reference source
Say	Catfish pond water nutrition	Kuswoyo and Zein (2018)
	Nutrition of catfish pond water and goat urine	
	Catfish pond water nutrition and AB Mix nutrition	
	AB mix nutrition	
	AB mix and chicken feather compost tea	
	AB mix	
Cucumber	liquid waste tofu	Rianti <i>et al.</i> (2019)
	AB mix and paitan and liquid rabbit manure	Sutrisno <i>et al.</i> (2015)
	NPK fertilizer and mixed micro fertilizer	Nurrohman <i>et al.</i> (2014)
	He did	Frasetya (2018)
	Alvesindo	Gumelar <i>et al.</i> (2021)
	In the window	
Celery	Moringa leaf extract	Sari <i>et al.</i> (2019)
	AB mix	
	Rice Water Wash	
	AB mix nutrition	
	NPK phoska	
	KCl	
Lettuce	Growmore leaves	Citizens <i>et al.</i> (2015)
	AB mix	
	Nitrogen	
	Plant catalyst	
	Interaction of liquid fertilizer <i>plant catalyst</i> and nitrogen concentration	
	CaCl ₂	
Red spinach	AB mix	Kamalia <i>et al.</i> (2017)
	Waste tofu	Yustiningsih <i>et al.</i> (2019)
	Waste of tofu & Apu wood	
	Golden snail and AB mix 3 EC	Ananda <i>et al.</i> (2021)
	AB mix	
	Cow compost	Adimihardja <i>et al.</i> (2013)
Flower Cabbage	Fertimix	Raharjen <i>et al.</i> (2018)
	Tofu liquid waste	
	Liquid organic nutrition	
	Combination of compound NPK, foliar fertilizer, POC cow urine	
	LITTLE	
	LITTLE	
Strawberry	liquid waste tofu	Trisnalindo <i>et al.</i> (2020)
	Cow urine	Laksono and Sugiono (2018)
	Cow urine and fermented cow urine	Ahdiyanto <i>et al.</i> (2018)
	POC selinci and fermented cow urine	Ma'ruf <i>et al.</i> (2021)
	POC knows	
	Goat POC	Mappanganro (2013)
Tomato	POC rabbit	Mappango and Baharudin (2021)
	POC ayam	
	POC Super Bionik	
	Combination of inorganic nutrients and biological fertilizers	
	Combination of AB mix, POC and biological fertilizers	
	Kombinan POC Vinasse + Feces Domba	
Melon	Feces Domba	Oktarina <i>et al.</i> (2017)
	AB Mix	Afrilandha and Setiawan (2018)
	Magnesium	Wulansari <i>et al.</i> (2021)
	AB Mix	Putra <i>et al.</i> (2021)
	Vinase, Azolla and Gliriside	
	Vinasase and Goat Feces	

Lettuce

Some alternative nutrients that can be used to improve the growth quality of lettuce in including: CaCl_2 in the study by Kamalia *et al.* (2017) had an effect on increasing leaf volume, fresh weight, and growth rate; nitrogen, *catalyst plant* in the research of Warganegara *et al.* (2015) affected plant height, root length, and plant fresh weight. Nutrition of tofu and lime wood waste in the study of Yustiningsih *et al.* (2019) affected plant height, number of leaves, root and stem length, and biomass in the low and medium categories. Golden snail nutrition and AB Mix in the study of Ananda *et al.* (2021) affected plant height, number and area of leaves, and plant fresh weight; *fertimix*, and cow compost in a study by Adimihardja *et al.* (2013) affected plant height, number of leaves, root length, fresh and dry weight of plant shoots. In general, the response shown by lettuce to the provision of some of these nutrients was an increase in growth in the form of plant height, root length, plant fresh weight, and leaf volume.

Cucumber

Alternative nutrients that can be utilized to improve the quality of cucumber growth as well as the quality of cucumber crop production are NPK fertilizers combined with mixed microfertilizers. In Frasetya's research (2018), the response shown by plants to providing these nutrients was better plant height, as well as increased or better leaf area, age span and fruit mass, although not optimal.

Apart from using NPK fertilizer, the same response can also be achieved by using Enza, Alfasindo and Ewindo nutrients.

Based on research that has been conducted by Gumelar (2021), it can be seen that

the use of Enza and Ewindo nutrients with the same volume, namely 500 ml for 3-4 applications, produced the best or highest plant height, dry weight, fruit length and number of fruits compared to Alfasindo nutrition. However, for fruit diameter, the highest was obtained from using Alfasindo nutrition, and the highest fruit weight was only obtained from using Ewindo nutrition.

Celery

Moringa leaf extract in a study by Sari *et al.* (2019) is an alternative type of nutrition that can be used in an effort to improve the growth quality and production quality of celery, although it is not optimal. The influence or response given was in the form of plant height, number of leaves and number of branches which were not significant. Astiaji and Anita (2021) conducted research on the use of rice washing water or Leri water with different concentrations, namely 0%, 25%, 50% and 75%. The application of rice washing water with a concentration of 50% produced the highest plant height, and the application of rice washing water with a concentration of 25% produced the highest or highest number of celery leaves. In Yunandanovi's study (2018) the best root length growth was obtained by giving AB Mix nutrition (10 g). However, for plant height, number of leaves, number of clumps, stem diameter and productivity, the same response was obtained between the use of AB mix nutrition, composition I (NPK Phoska (1 g) plus KCl (1 g) and GrowMore (0.5 g)), composition II (NPK Phoska (1 g and Growmore (1.5)) and Composition III (Growmore (2.5g)).

Red Spinach

Provision of liquid tofu waste in the research of Raharjen *et al.* (2018) can improve the quality of growth with a response in the form of a significant effect related to plant height, root length and number of root branches. Besides affecting plant growth, tofu liquid waste also affects the quality of plant production with an increase in the number of leaves in response. Another research conducted by Trisnalindo (2020) shows that liquid organic nutrition at a dose of 35 ml had a significant effect on plant height, number of leaves and plant weight. The use of other alternative nutrients such as tofu liquid waste and liquid organic nutrients can have a real effect and approach the results achieved by providing AB Mix nutrients on plant growth and production.

Flower cabbage

Alternative nutrition to improve the quality of growth and quality of production of cauliflower plants is a combination of compound NPK, foliar fertilizers and POC from cow urine as in Laksono and Sugiono's research (2018). The response of cauliflower to these nutrients was in the form of a significant effect on the growth components of cauliflower, including plant height, leaf area, root length, leaf diameter and number of leaves, flower weight without leaves, flower weight with leaves and flower diameter.

Research on the use of POC as a nutrient in hydroponically cultivated cauliflower plants has been carried out by Ahdiyanto *et al.* (2018) with the use of liquid organic fertilizer. Based on the results of his research

a response was obtained in the form of a significant effect on the growth and yield of cauliflower. The use of POC can also utilize tofu liquid waste to become organic fertilizer (Zulfa, 2019). Based on this, Ma'ruf *et al.* (2021) conducted research related to the use of POC from tofu liquid waste on the growth and yield of cauliflower, with the response obtained in the form of a significant effect on the production yield of flower weight with leaves, flower weight without leaves, and cauliflower head diameter, but had no effect on growth of plant height, stem diameter, and number of leaves of cauliflower plants.

Strawberry

The nutrients in hydroponic strawberry plants that have been studied include cow urine, cow urine added with fermented cow urine, and rabbit POC added with fermented cow urine. Research conducted by Mappanganro (2013) showed that cow urine nutrition gave the best results for the growth of strawberry plants. Cow urine nutrition added with cow urine fermentation gives the best results on plant height and number of strawberry plant leaves compared to liquid organic fertilizer from other livestock manure. Rabbit POC nutrition added with fermented cow urine gave the best results on the number of flowers.

In Mappanganro and Burhanudin's research (2021) alternative nutrients were used in the form of cow urine, chicken POC, goat POC, cow POC and rabbit POC. The responses obtained based on his research were that the age of producing the fastest fruit, producing the most fruit, the diameter of the widest fruit, producing the longest average fruit, producing the heaviest fruit average and the highest production per plant, were obtained from the treatment of the POC group of rabbits with the addition of urine fermented beef.

Tomato

The combination of inorganic nutrients and biological fertilizers given to tomato plants using a hydroponic cultivation system in the study of Afrilandha and Setiawati (2018) had no significant effect on tomato plants where the combination of inorganic fertilizers with biological fertilizers was unable to increase the amount of chlorophyll content, N uptake of plants, fruit number and fruit weight. The results of this study are slightly contradictory to research conducted by Wulansari *et al.* (2021) Based on his research, 75% AB Mix plus POC and biological fertilizers showed growth and yield of cherry tomato plants which were equivalent to the 100% AB Mix nutritional formula. This statement means that the combination of biological fertilizers with inorganic fertilizers has an effect even though it is not significant and still requires POC fertilizers. So that the combination of the 75% AB Mix formulation plus POC and biological fertilizers can be used as an alternative in minimizing the use of AB Mix nutrients.

In addition to these nutrients POC from vinasse and sheep feces in the study by Putra *et al.* (2021), the effect shown by cherry tomato plants cultivated hydroponically was the similarity in fruit weight per plant between the treatments by providing nutrients in the form of AB Mix, POC from vinasse or sheep feces. Treatment with a combination of POC nutrition from vinasse and sheep feces was able to speed up the flowering time than other treatments. While the largest diameter resulted from treatment by providing control nutrition in the form of AB Mix.

Melon

Research conducted by Yuwono and Basri (2021) by adding magnesium to melons cultivated hydroponically obtained the result that there was an effect on plant height and the number of melon fruit segments, magnesium is needed by plants to produce chlorophyll as a source of plant growth. In the study of Hakim *et al.* (2020) carried out a combination of POC from vinase, azolla and gliriside; POC from vinasse and goat feces; and AB Mix as a nutritional control with several effects on the treatment given including a significant effect on the variables of plant height, first fruit diameter, first fruit weight and total fruit weight with the three treatments.

In addition to adding a nutrient solution, the concentration of the added concentration can affect the results of optimally growing plants. This statement is in line with Suhastyo and Raditya (2021) that optimal plant growth can be influenced by several factors including external factors (climate, soil, and biology) and internal factors (plant resistance, photosynthetic rate and respiration). The process of photosynthesis is influenced by the availability of nutrients and environmental factors that are met.

The addition of nutrients can use organic fertilizers originating from animals which are obtained from metabolic wastes which contain ammonia as a nutrient which plays a role in plant growth and development. Ammonia is obtained from the protein contained in fish feed and fish metabolic waste in the form of faeces and urine. The content of ammonia is affected by the pH and temperature of the pond water. This ammonia is absorbed by the roots to support plant growth (Handayani *et al.*, 2020). Leftovers from fish feces contain nitrates and ammonia which are needed in the process of forming plant cells (Wijaya, 2018). Nitrogen content in water

ponds that are too high can be toxic to fish, so this waste is better utilized as nutrients in hydroponic plants (Saleh, 2018).

Livestock manure that can be used includes cow, goat, rabbit, chicken or other livestock manure. Cow dung can be used as the main ingredient for liquid organic fertilizer. Cow manure (feces) mixed with cow urine through a fermentation process produces the hormone IAA (auxin type hormone). It is this hormone that gives the highest response with the optimal dose for the development of cells in plant height and number of leaves (Mapangangarno, 2013). Ranchman in Laksono & Sugiono (2019) states that the POC of cow urine contains (1.1% N, 0.5% P, 0.9% K, 1.1% Ca, 1% Hg, 0.2% Na, 34% Mn, 22% Zn, 20% Cu, and 6% Cr) which means that it complies with the provisions of the criteria for assessing the chemical properties of organic fertilizers. Essential micro elements are needed by plants in small quantities, if excess becomes toxic which causes the plant to die (Laksono and Sugiono, 2019). All organic fertilizers liquid made from livestock urine after being fermented has an increase in P elements, and has decreased K elements and pH, so that it can increase the number of leaves and plant height (Royadi *et al.*, 2021).

Golden snail (*Pomacea canaliculata* L.) can also be used as an alternative liquid fertilizer for hydroponic plants. Golden snail contains nutrients such as omega 3, 6 and 9 acids. Liquid organic fertilizer with the basic ingredients of golden snail contains microorganisms such as: *Azotobacter*, *Azospirillum*, phosphate-solubilizing microbes, *Staphylococcus*, *Pseudomonas*, as well as auxin and various enzymes (Ananda *et al.*, 2021). The combination of nutrients from fermented paitan extract, liquid rabbit manure fermentation and AB mix can also be used as hydroponic nutrition. Organic materials such as the paitan plant (*Tithonia diversifolia* L.) is a herbaceous plant from the *Asteraceae* group. This plant has advantages, namely a faster decomposition time than other plants, as well as the nutrient content in the canopy. Manure in the form of rabbit manure and urine is an organic fertilizer which contains elements of N 2.72%, P 1.1%, K 0.5% (Handayani, 2020). Therefore, the nutrient content in rabbit droppings and paitan extract can be used as alternative media and nutrients in mustard greens production (Nurrohman *et al.*, 2014).

Organic fertilizers can also be obtained from plant extracts. From the research results, there are moringa extracts that are used to provide nutrition to plants. Moringa extract contains nitrogen which plays a role in plant growth and development and is useful for plant photosynthesis. besides nitrogen, There is phosphate in the content of Moringa extract which plays a role in fruit formation. In addition to these two elements, moringa extract also contains magnesium, phosphorus, iron, calcium, and sulfur compounds. These compounds can lead to increased efficiency in plants (Pelia, 2021). Moringa leaf extract contains potassium which plays a role in maintaining turgor pressure for plant growth, which has an impact on increasing the number of leaves; and contains cytokinin hormones that cause plants to experience an increase in cell division. The IAA hormone is produced by microbes in liquid fertilizer (Suwirmen *et al.*, 2022). This is also supported by Suhastyo and Raditya (2021) that Moringa contains complete macro elements and amino acids, and this Moringa leaf extract accelerates plant growth naturally because it contains zeatin, cytokinins, ascots, phenolics, and minerals. *Growmore* nutrition has almost the same effect as using AB Mix, because it has a complete composition of macro and micro elements needed by plants (Yunandanova *et al.*, 2018).

Pure tofu liquid waste can also be an alternative nutrient and has a good effect on hydroponic plants. Tofu liquid waste contains several components of organic substances such as protein, fat, carbohydrates, minerals, calcium, phosphorus, iron and nitrogen which are used as nutrients (Hadiyanto, 2018). The content in tofu liquid waste is beneficial for plant growth (Raharjeng *et al.*, 2018). The use of EM4 in tofu liquid waste fermentation can speed up the fermentation process so that the nutrient content is easily absorbed (Maulana *et al.*, 2017). In EM4 there are nitrogen-fixing bacteria such as heterotrophic *Azobacter* and *Actinomycetes* bacteria which are able to produce NO₃ from NH₄ to increase nitrogen content. In EM4 there are also phosphate solubilizing bacteria such as *Lactobacillus*, *Bacillus*, *Pseudomonas* to process phosphate content and release potassium elements (Achmad, 2021). Rice water washing contains various nutrients that are useful for plant growth, such as, Stimulates growth and metabolism in roots. Rice washing water contains carbohydrates, nitrogen, phosphorus, potassium, magnesium, sulfur, iron and vitamin B1 (Baning and Rahmatan, 2016). The nutritional content is included in the complex content so that its use with concentrations that are not too concentrated (diluted) aims to facilitate the absorption process, low liquid viscosity, plant roots more easily adsorb nutrients in the rice washing water (Astiaji and Anita, 2021).

Increased vegetative growth of hydroponic plants can be achieved by adding or administering *plant catalyst liquid fertilizer*. *Catalyst plants* have a complete nutrient content, thus affecting the growth of plant height, root length, and plant fresh weight will increase (Warganegara *et al.*, 2018). Enza, Elwindo, and Alfesindo nutrients also contain nitrogen elements, but Enza and Elwindo nutrients have a higher nitrogen content than Alfesindo nutrients (Gumelar *et al.*, 2021). The addition of nitrogen plays a role in the formation of important compounds, such as chlorophyll, nucleic acids and enzymes, increasing the number of leaves which also affects leaf area. The addition of sufficient nitrogen can accelerate the rate of division, cell elongation, growth of roots, stems and leaves (Gustiar *et al.*, 2021).

NPK fertilizer in the literature under study is fertilizer derived from organic matter containing the elements N, P, and K. The role of the N element is to accelerate the rate of cell division and elongation, growth of roots, stems, and leaves. The role of element P is to regulate metabolism so that it runs well so that division,

enlargement, and cell differentiation are well under way. The role of K is as an enzyme activator in the process of photosynthesis and respiration (Wahyuningsih *et al.*, 2016). Meanwhile, according to Anggraeni *et al.* (2021) NPK is an example of a compound NPK with a content of 16% N, 16% P₂O₅, 16% K₂O, 0.5% Mg, 6% Ca. This NPK nutrition can meet the needs of macro-micro nutrient elements of plants, helping plant growth. The use of NPK fertilizer can also be combined with foliar fertilizer and cow urine which also contain macro and micro nutrients for plant survival, so that it can be used as an alternative source of nutrition; Foliar fertilizers can easily be found on the market (Laksono and Sugiono, 2018).

CaCl₂ can also be used as a nutrient in hydroponic plants at a concentration that suits the needs of the plants; can have a very good influence on the growth of plants. However, if the concentration given is too high it can reduce the level of production of a plant. This is because the high levels of CaCl₂ affect the pH level of the growing media which is getting higher. High or increasing pH concentrations cause micronutrients to be unavailable, and a lack of micronutrients can

interfere with plant growth (Kamalia *et al.*, 2017).

Fertimix is a hydroponic nutrient that is mixed from high quality ingredients so it has several nutrient contents, such as Ca (NO₃)₂, Fe-HEEDTA 12%, KNO₃, K₂PO₄, MgSO₄, K₂SO₄, MnSO₄, ZnSO₄, Borax CuSO₄, and sodium. molybdenum (Adimihardja *et al.*, 2013). Liquid tofu waste can also be combined with apu wood. Gregori Yustiningsih (2019), revealed that microorganisms in the roots of wormwood,

namely *rhizosphere* bacteria , play a role in absorbing and breaking down organic compounds in waste aerobically so as to reduce the concentration of the solution and lower the EC value. The combination of vinasse, azolla and glycericide contains macro nutrients including N, P, K, Ca, Mg, Si, Fe, Zn and Mn, so that this combination of nutrients has almost the same benefits and effects as AB Mix nutrients (Hakim *et al.* , 2020).

Use of Plant Regulating Substances

Based on the results of a literature review on the use of plant regulators in hydroponic plants the results obtained are as presented in Table 2.

Table 2. Results of a literature review on the use of growth regulators (ZPT) and hydroponics

Plant type	Types of growth regulators	Article source
Strawberry	ZPT ARETA (10% Young Coconut Water, 15% Bamboo Shoots Extract, and 20% Bean Sprouts Extract)	Sari <i>et al.</i> (2021)
	ZPT ARETA (15% Young Coconut Water, 20% Bamboo Shoots Extract, and 10% Bean Sprouts Extract)	
	ZPT ARETA (20% Young Coconut Water, 10% Bamboo Shoots Extract, and 15% Bean Sprouts Extract)	
Plant Type	Types of Plant Regulatory Substances	Article Source
Strawberry	ZPT Auxin	Tikafebrianti and
	Cytokinin ZPT	Anggraeni (2021)
	ZPT Gibberellins	
Melon	ZPT Gibberellins	Jazuli <i>et al.</i> (2021)

Strawberry

Growth regulators (ZPT) also play a role in increasing yields in hydroponically cultivated plants. One type of ZPT given is ZPT ARETA which is a combination of young coconut water, young bamboo shoots or bamboo shoots extract and bean sprouts extract with different concentrations. Plant height growth, number of leaves obtained at a concentration of 15% coconut water and 20% bamboo shoots extract and 10% bean sprouts extract; while the best number of flowers, highest number of fruit, highest fruit weight, diameter and best production were obtained with a concentration of 20% coconut water and 10% bamboo shoot extract and 15% bean sprout extract (Sari *et al.*, 2021) . In the study by Tikafebrianti and Anggraeni (2021) which used auxin, cytokinin, and gibberellin ZPT types where the response in the form of the best plant height results was obtained by applying gibberellin ZPT. The best results in the growth of tendrils, the number of tillers and the increase in the amount of chlorophyll in strawberry plants were obtained by applying cytokinin ZPT.

Melon

In the research of Jazuli *et al.* (2021) found that reclamation of ZPT gibberellin on melon plants has an effect on the growth and yield of melon plants, thereby overcoming the problem of small melon plant size.

Growth regulators, such as auxins, cytokinins and gibberellins are organic compounds produced by plants in small amounts, plays an important role in regulating plant physiology (Tikafebrianti *et al.*, 2021). Gibberellin is a PGR that plays a role in influencing various plant physiological processes (Maharani *et al.*, 2018). Giving gibberellins can stimulate cell division and enlargement thereby stimulating seed germination and stimulating plant growth by increasing plant height and leaf area (Mulyani, 2020). Cytokinins are influential in the process of branch formation and cell division. Auxins play a role in the process of cell elongation and cytokinins affect the formation of shoots in plants. ZPT ARETA is a combination of alternative nutrients in the form of young coconut water which contains the hormones auxin, cytokinins and gibberellin, bamboo shoot extract which contains the hormone gibberellin, and bean sprout extract which contains the hormone auxin. ZPT ARETA can increase plant growth and production. The cytokinin hormones found in young coconut water can affect the growth of plant height and number of leaves (Sari *et al.*, 2021).

CONCLUSION

Based on the literature review that has been carried out, it can be concluded that there are many types of nutrients that can be used in an effort to improve the quality of growth and development in several types of plants cultivated hydroponically, with several positive effects. Sources of nutrition include catfish pond water, goat urine, cow manure, rabbit manure, moringa leaf extract, NPK fertilizer, tofu liquid waste, paitan extract, *plant catalyst*, CaCl₂, nitrogen, *fertimix*, lime wood, golden snail, cow urine, cow urine added with fermented cow urine, and POC rabbit added with fermented cow urine, rice washing water, NPK phoska, KCL, *growmore*, POC vinasse and sheep feces, Mg, combined POC vinasse, azolla and glyceride as well as a combination of vinasse and goat feces. In addition to nutrients, there are also ZPT in the form of gibberellins, auxin, cytokinins, and areta (young coconut water, bamboo shoot extract and bean sprout extract) which regulate or control the growth of hydroponic plants.

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