GROWTH AND PRODUCTION OF PAKCHOY (*Brassica rapa* L.) ON VARIOUS COMPOSITIONS OF COW URINE AND AB MIX WITH RAFT SYSTEM OF HYDROPONIC

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Abstract

Pakcoy (*Brassica rapa* L.) is one of the vegetables that people like because it tastes good and has high nutrition content, so it has a high selling value and there is a need to increase production. Limited agricultural land is one of the obstacles in increasing the production of pakcoy, so the application of hydroponic technology can be an alternative. Nutrition requirements are a factor that needs to be considered in hydroponic cultivation. The nutrient commonly used in hydroponic cultivation is AB mix, but the price is relatively high and is still difficult to find on the market. This study aims to determine the growth and production of pakcoy in various compositions of cow urine and AB mix and to obtain alternative fertilizers that can replace AB mix. This research used a single factor Completely Randomized Design (CRD), namely the composition of cow urine and AB mix which consisted of 11 levels, namely, AB mix 5 ml, cow urine 2 ml + AB mix 4.5 ml, cow urine 4 ml + AB mix 4 ml, cow urine 6 ml + AB mix 3.5 ml, cow urine 8 ml + AB mix 3 ml, cow urine 10 ml + AB mix 2.5 ml, cow urine 12 ml + AB mix 2 ml , cow urine 14 ml + AB mix 1.5 ml, cow urine 16 ml + AB mix 1 ml, cow urine 18 ml + AB mix 0.5 ml, cow urine 20 ml. The results showed that the composition of cow urine and ab mix had an effect on all the variables observed. 100% cow urine cannot replace AB mix nutrition because cow urine gave the lowest results in all the treatments observed. The use of cow urine must be accompanied by AB mix nutrition to achieve optimal results.

Keywords: *Alternative Ab mix, Nutrition, Hydroponic*

I. INTRODUCTION

The need for vegetables in Indonesia is still very high and cannot be met by conventional farmers. As the population grows and agricultural land becomes increasingly limited, efforts are needed to meet vegetable needs at the national level (Roidah 2014). Hydroponic system options can also use a static system without electricity, one of which is floating raft hydroponics by utilizing flooded land (Handriatni 2021).

Pakcoy is a leaf vegetable plant that belongs to the *Brassicaceae* family and is an introduced vegetable from China which is starting to be widely cultivated in Indonesia. The pak choy plant has benefits, namely improving digestion and preventing cancer in the body (Alfian and Muhardi 2022). The nutritional content of this plant is relatively high, such as vitamins K, A, C, E and folic acid (Rizal 2017).

The increasing population and awareness of the Indonesian population regarding nutritional needs has led to an increase in demand for vegetables. The increase in demand for pak choy vegetables is in line with the increase in pak choy vegetable production in Indonesia. This can be seen from the pak choy production

figures in Indonesia from 2018 to 2021 increasing every year by 635,990, 652,727, 667,473, 727,467 million tons (BPS 2023).

One effort to increase pak choy production in Indonesia can be done by hydroponic cultivation (Siregar *et al*. 2015). Hydroponics uses water efficiently so it is easy to apply in areas that have limited water (Susilawati 2019) and is suitable for limited land. Hydroponics also does not depend on natural conditions, so it is able to maintain production continuity. Crop production is more guaranteed and selling prices are higher (Roidah 2014).

The success factor in hydroponic cultivation is nutrition, because without nutrition plant growth will be hampered and can produce yields and vegetable production that are not optimal (Ali *et al*. 2021). Hydroponic nutrients are generally ready-to-use fertilizers that contain both macro and micro nutrients (Manullang 2019).

The nutrients used in the hydroponic system are AB Mix solution. The AB-mix solution contains nutrients that plants need, both macro and micro, elements, H, C, O. can be available from air and water (Iqbal 2016). Nutrient balance in hydroponic cultivation is very important to produce optimal production, however the price is relatively high and still difficult to obtain on the market. So alternative nutrients are needed that are cheap and easy to obtain to meet plant nutritional needs. Cow urine waste has the potential to be an alternative source of nutrition in hydroponic plant cultivation (Rahayu 2020).

According to Ilhamiyah *et al*. (2021) fermented cow urine contains the nutrients 2.2% nitrogen, 0.7% phosphorus, 2.1% potassium and contains a hormone that stimulates plant growth and development in the form of IAA (Indole Acetic Acid) which is known as the main auxin. So cow urine is an alternative to increase the availability of nutrients and ZPT for plants that contain microorganisms so that it can reduce the use of inorganic fertilizers and increase plant yields to the maximum.

II. METHODOLOGY

This research was carried out from July to August at the KWT Asri greenhouse in Tlajung Udik village, Gunung Putri sub-district, Bogor regency. The tools used in this research were a sprayer, a hydroponic tray measuring 38 cm x 31 cm x 12 cm, styrofoam, a net pot, a caliper, a measuring cup, a seedling tray, a lux meter, a pH meter and an EC meter. The ingredients used are pakchoy plant seeds of the Nauli F1 variety, rockwool, AB mix nutrients, cow urine and water.

The experiment was carried out using a single factor completely randomized design consisting of 11 nutrient mixtures consisting of viz: (1) AB mix 5 ml ; (2) Cow urine 2 ml + AB mix 4,5 ml; (3) Cow Urine 4 ml + AB mix 4 ml; (4) Cow Urine 6 ml + AB mix 3,5 ml; (5) Cow Urine 8 ml + AB mix 3 ml; (6) Cow Urine 10 ml + AB mix 2,5 ml; (7) Cow Urine 12 ml + AB mix 2 ml; (8) Cow Urine 14 ml + AB mix 1,5 ml; (9) Cow Urine 16 ml + AB mix 1 ml; (10) Cow Urine 18 ml + AB mix 0,5 ml; (11) Cow Urine 20 ml. Each treatment was repeated 3 times so there are 33 units test. Each experimental unit consists of 4 plants so there are 132 observation units.

Research implementation carried out in several stages, namely:

Sanitize and sterilize the greenhouse by cleaning it from weeds and plant residues

Seeding in rockwool media cut to size 3x3 cm. Sowing is carried out for 10 days or until the plants have true leaves and are transplanted into hydroponic trays containing nutrients.

Nutrition preparation cow urine is fermented for 2 weeks and the AB mix nutrition is dissolved and then given according to the specified dose.

Maintenance includes checking pH, temperature, EC and RH periodically.

Harvesting is done at 4 weeks after planting. Plant in Harvest by separating the roots from the net pot so that all parts of the plant can be taken completely.

The observed variables included plant height, number of leaves, crown diameter, leaf length, leaf width, leaf area, stem diameter, root length, root volume, shoot fresh weight, root fresh weight, shoot dry weight, and root dry weight. Results Observations were analyzed using analysis of variance (Anova) at a significance level of 5%.

III. RESULTS AND DISCUSSION

Result

Providing various compositions of cow urine and ab mix in plant cultivation pakcoy (*Brassica rapa* L.) hydroponically has a significant effect on plant height, number of leaves, crown diameter, leaf length, leaf width, leaf area, stem diameter, root length, root volume, shoot fresh weight, shoot dry weight, root fresh weight , and root dry weight. This real influence is due to differences in the level of nutrient solubility in each composition nutrients used.

Table 1 Plant Height

Treatment	Plant Height			
	1 WAP	2 WAP	3 WAP	4 WAP
AB Mix 5 ml	9,75^{a}	17,06^{a}	21,5^{a}	23,96^{a}
Cow Urine 2 ml + AB Mix 4,5 ml	9,20^{ab}	16,50^{a}	19,91^{b}	22,42^{ab}
Cow Urine 4 ml + AB Mix 4 ml	8,5^{b}	16,41^{a}	19,29^{b}	20,64^{b}
Cow Urine 6 ml + AB Mix 3,5 ml	7,25^{c}	13,5^{b}	14,16^{c}	14,72^{c}
Cow Urine 8 ml + AB Mix 3 ml	7,16^{c}	12,08^{b}	13,58^{c}	15,16^{c}
Cow Urine 10 ml + AB Mix 2.5 ml	6,66^{c}	7,83^{c}	9,12d	9,88^{d}
Cow Urine 12 ml + AB Mix 2 ml	5,83^{d}	6,64^{cd}	7,3^{e}	7,7^{d}
Cow Urine 14 ml + AB Mix 1,5 ml	5,7^{d}	6,2^{d}	7,05^{e}	8,03^{d}
Cow Urine 16 ml + AB Mix 1 ml	4,87^{e}	5,66^{d}	6,59^{e}	7,61^{d}
Cow Urine 18 ml + AB Mix 0,5 ml	4,66^{e}	5,66^{d}	6,44^{e}	7,47^{d}
Cow Urine 20 ml	4,79^{e}	5,75^{d}	7,09^{e}	8,41^{d}

Information: Different superscripts in the average column showed significant differences ($p < 0.05$), WAP= Week After Planting

The composition of cow urine and AB mix was given to pakchoy plants has a significant effect on plant height at 1 week after planting to 4 week after planting. Giving AB Mix 100% without cow urine, gives the highest results compared to other treatments (Table 1)

Table 2 Number of Leaves

Treatment	Number of Leaves			
	1 WAP	2 WAP	3 WAP	4 WAP
AB Mix 5 ml	6,00^{a}	10,00^{a}	12,25^{a}	18,66^{a}
Cow Urine 2 ml + AB Mix 4,5 ml	5,33^{b}	9,00^{b}	11,91^{a}	17,41^{a}
Cow Urine 4 ml + AB Mix 4 ml	5,00^{bc}	8,50^{b}	10,33^{b}	15,41^{b}
Cow Urine 6 ml + AB Mix 3,5 ml	4,75^{cd}	6,66^{c}	8,25^{c}	10,25^{c}
Cow Urine 8 ml + AB Mix 3 ml	4,25^{de}	6,25^{cd}	7,16^{d}	9,66^{c}
Cow Urine 10 ml + AB Mix 2.5 ml	4,16^{de}	5,58^{de}	6,25^{e}	7,75^{c}
Cow Urine 12 ml + AB Mix 2 ml	4,25^{de}	5,41^{def}	6,16^{e}	6,75^{d}
Cow Urine 14 ml + AB Mix 1,5 ml	4,08^{e}	4,91^{efg}	5,83^{ef}	6,41^{d}
Cow Urine 16 ml + AB Mix 1 ml	3,66^{e}	4,66^{fgh}	5,50^{ef}	6,58^{d}

Cow Urine 18 ml + AB Mix 0,5 ml	3,08^{f}	4,16^{gh}	5,25^{fg}	6,08^{d}
Cow urine 20 ml	3,08^{f}	3,83^{h}	4,66^{g}	6,16^{d}

Giving the composition of cow urine and ab mix to pak choy plants has a significant effect on the number of leaves of the plant age 1 eek after planting to 4 week after planting (Table 2). Giving AB Mix 100% without cow urine, gives the highest results compared to other treatments.

Table 3 Header Diameter

Treatments	Header Diameter			
	1 WAP	2 WAP	3 WAP	4 WAP
AB Mix 5 ml	10,91^{a}	18,83^{a}	23,00^{a}	29,08^{a}
Cow Urine 2 ml + AB Mix 4,5 ml	9,12^{b}	17,66^{ab}	23,41^{a}	28,33^{a}
Cow Urine 4 ml + AB Mix 4 ml	9,54^{b}	17,00^{b}	23,08^{a}	28,58^{a}
Cow Urine 6 ml + AB Mix 3,5 ml	7,91^{c}	15,54^{c}	20,5^{b}	24,66^{b}
Cow Urine 8 ml + AB Mix 3 ml	7,12^{d}	11,16^{d}	14,66^{c}	17,41^{c}
Cow Urine 10 ml + AB Mix 2.5 ml	6,29^{e}	8,50^{e}	10,66^{d}	13,83^{d}
Cow Urine 12 ml + AB Mix 2 ml	5,75^{ef}	7,54^{ef}	9,08^{de}	12,03^{de}
Cow Urine 14 ml + AB Mix 1,5 ml	5,25^{fg}	6,87^{f}	8,58^{e}	10,75^{e}
Cow Urine 16 ml + AB Mix 1 ml	5,33^{fg}	7,33^{ef}	8,91^{de}	11,66^{de}
Cow Urine 18 ml + AB Mix 0,5 ml	4,91^{gh}	6,5^{f}	7,5^{e}	9,5^{e}
Cow Urine 20 ml	4,41^{h}	6,04^{f}	7,25^{e}	9,25^{e}

Information: Different superscripts in the average column showed significant differences ($p < 0.05$), WAP= Week After Planting

Providing the composition of cow urine and ab mix to pakchoy plants had a significant effect on crown diameter of the plant age 1 eek after planting to 4 week after planting (Table 3). Giving AB Mix 100% without cow urine, gives the highest results compared to other treatments.

Table 4 Length, Width and Area of leaves

Treatments	Leaf Length (cm)	Leaf Width (cm)	Leaf Are (cm^2)
AB Mix 5 ml	13,23^{a}	8,49^{a}	136,29^{a}
Cow Urine 2 ml + AB Mix 4,5 ml	12,32^{b}	8,29^{a}	129,78^{a}
Cow Urine 4 ml + AB Mix 4 ml	11,6^{c}	7,35^{b}	117,21^{b}
Cow Urine 6 ml + AB Mix 3,5 ml	9,00^{e}	7,05^{bc}	100,56^{c}
Cow Urine 8 ml + AB Mix 3 ml	9,75^{d}	6,57^{c}	99,97^{c}
Cow Urine 10 ml + AB Mix 2.5 ml	8,72^{e}	5,93^{d}	94,81^{cd}
Cow Urine 12 ml + AB Mix 2 ml	7,63^{f}	5,44^{e}	88,68^{d}
Cow Urine 14 ml + AB Mix 1,5 ml	6,01^{g}	5,09^{e}	76,34^{e}
Cow Urine 16 ml + AB Mix 1 ml	5,5^{gh}	4,27^{f}	73,91^{e}
Cow Urine 18 ml + AB Mix 0,5 ml	5,02^{h}	3,40^{g}	57,44^{f}
Cow Urine 20 ml	4,27^{i}	2,15^{h}	44,02^{g}

Information: Different superscripts in the average column showed significant differences ($p < 0.05$)

Providing the composition of cow urine and ab mix to pakcoy plants has a significant effect on the length, width and area of the leaves. In terms of leaf width and area, giving 5 ml of AB mix was not significantly different from giving 2 ml of cow urine + 4.5 ml of AB mix (Table 4).

Table 5 Stem Diameter, Root length, and volume

Treatments	Root Length (cm)	Root Volume (mL)	Stem Diameter (cm)
AB Mix 5 ml	15,09[a]	35,66[a]	8,39[a]
Cow Urine 2 ml + AB Mix 4,5 ml	14,42[a]	31,75[b]	7,79[a]
Cow Urine 4 ml + AB Mix 4 ml	12,15[b]	30,75[c]	6,09[b]
Cow Urine 6 ml + AB Mix 3,5 ml	10,91[c]	29,75[d]	4,80[c]
Cow Urine 8 ml + AB Mix 3 ml	8,89[d]	27,58[e]	4,48[c]
Cow Urine 10 ml + AB Mix 2.5 ml	7,50[e]	28,00[e]	2,42[d]
Cow Urine 12 ml + AB Mix 2 ml	6,70[f]	24,75[f]	2,19[d]
Cow Urine 14 ml + AB Mix 1,5 ml	5,39[g]	19,66[g]	1,58[de]
Cow Urine 16 ml + AB Mix 1 ml	4,20[h]	15,50[h]	1,16[e]
Cow Urine 18 ml + AB Mix 0,5 ml	3,59[h]	13,58[i]	1,20[e]
Cow Urine 20 ml	2,60[i]	8,41[j]	1,15[e]

Information: Different superscripts in the average column showed significant differences ($p < 0.05$)

Providing the composition of cow urine and ab mix to pakcoy plants has a significant effect on stem diameter, root length and root volume. In terms of stem diameter and root length, giving 5 ml of AB mix was not significantly different from giving 2 ml of cow urine + 4.5 ml of AB mix (Table 5).

Table 6 Fresh and Dry Weight of Shoots

Treatments	Fresh Weight of The Crown (g)	Crown dry weight (g)
AB Mix 5 ml	105,16[a]	7,35[a]
Cow Urine 2 ml + AB Mix 4,5 ml	86,25[b]	6,77[a]
Cow Urine 4 ml + AB Mix 4 ml	76,33[c]	5,73[b]
Cow Urine 6 ml + AB Mix 3,5 ml	69,08[d]	5,79[b]
Cow Urine 8 ml + AB Mix 3 ml	59,25[e]	5,29[b]
Cow Urine 10 ml + AB Mix 2.5 ml	51,5[f]	4,29[c]
Cow Urine 12 ml + AB Mix 2 ml	28,66[g]	4,16[c]
Cow Urine 14 ml + AB Mix 1,5 ml	25,58[g]	3,91[c]
Cow Urine 16 ml + AB Mix 1 ml	13,91[h]	2,51[d]
Cow Urine 18 ml + AB Mix 0,5 ml	10,61[hi]	1,68[e]
Cow Urine 20 ml	7,91[i]	1,21[e]

Information: Different superscripts in the average column showed significant differences ($p < 0.05$)

Providing the composition of cow urine and ab mix to pak choy plants had a significant effect on the fresh and dry weight of the shoot. In terms of crown dry weight, giving 5 ml of AB mix was not significantly different from giving 2 ml of cow urine + 4.5 ml of AB mix (Table 6).

Table 7 Fresh and Dry Weight of Roots

Treatments	Fresh Weight of Roots (g)	Root Dry Weight (g)
AB Mix 5 ml	52,58[a]	5,47[a]
Cow Urine 2 ml + AB Mix 4,5 ml	53,83[a]	4,82[b]
Cow Urine 4 ml + AB Mix 4 ml	39,16[b]	4,24[c]
Cow Urine 6 ml + AB Mix 3,5 ml	25,66[c]	3,93[cd]
Cow Urine 8 ml + AB Mix 3 ml	21,91[d]	3,54[d]
Cow Urine 10 ml + AB Mix 2.5 ml	19,16[e]	2,8[e]
Cow Urine 12 ml + AB Mix 2 ml	10,47[f]	2,52[e]
Cow Urine 14 ml + AB Mix 1,5 ml	3,16[g]	1,99[f]
Cow Urine 16 ml + AB Mix 1 ml	2,66[gh]	0,94[g]
Cow Urine 18 ml + AB Mix 0,5 ml	1,66[gh]	0,21[h]
Cow Urine 20 ml	1,25[h]	0,15[h]

Information: Different superscripts in the average column showed significant differences ($p < 0.05$)

Providing the composition of cow urine and ab mix to pak choy plants had a significant effect on the fresh and dry weight of the roots. In fresh root weight, giving 5 ml of AB mix was not significantly different from giving 2 ml of cow urine + 4.5 ml of AB mix (Table 7).

Discussion

The composition of 5 ml AB mix gave the highest results in plant height at 4 WAP, but was not significantly different from the composition of 2 ml cow urine + 4.5 ml AB mix but was significantly greater than other treatments. Differences in plant height influence the differences in the composition of the mixture of cow urine and AB mix. This is because this treatment is able to provide the plant's nutritional needs so that it can support the plant growth process. An increase or increase in plant height is the result of cell division or meristem tissue activity. According to Alpandari and Prakoso (2022), plant height is greatly influenced by photosynthate yield.

Treatment composition of 20 ml cow urine + 0 ml Ab mix resulted in slow plant growth and development. This is caused by a lack of macro nutrients. The content of the nutrients Nitrogen and Phosphorus in the vegetative phase is very important so their availability must be appropriate (Fathoni *et al*. 2017). Plants that lack nutrients will experience abnormal morphological changes such as slowed growth, changes in leaf shape and color (Adotey *et al*. 2021).

The composition of AB mix 5 ml is not significantly different from the composition of cow urine 2 ml + AB mix 4.5 ml in the number of leaves, crown diameter, leaf width, stem diameter and leaf area. The increase in the number of leaves is directly proportional to the weight. fresh plants. Based on research by Sholikin *et al*. (2014) the edible weight of pakcoy plants is influenced by the number of leaves, leaf area, and increase in plant height. This is in line with the higher the observed variable, the greater the edible weight. The greater the number of leaves, the better the plant growth (Restiani *et al*. 2015).

The treatment of 20 ml cow urine shows a low number of leaves because sufficient nutrients will be absorbed for the photosynthesis process which can cause an increase in the rate of photosynthesis and have an effect on increasing plant growth and development (Putri *et al*. 2017). The composition of cow urine

and AB mix in hydroponic vegetable cultivation is able to provide good growth and results compared to using cow urine alone.

Observations of the fresh weight of the crown and the dry weight of the crown treated with 20 ml cow urine showed the lowest results. This is because the fresh weight of the crown and the dry weight of the crown are influenced by plant height and number of leaves. Plant fresh weight is the result of photosynthesis in the form of plant biomass and water content in leaves (Utama and Jannah 2014).

IV. CONCLUSIONS AND NEWNESS

Providing the composition of cow urine and AB mix has a real influence on the growth and yield of pak choy plants. The highest increase was in the treatment with the composition of cow urine 0 ml + AB mix 5 ml, while the lowest treatment was in the treatment with the composition of cow urine 20 ml + AB mix 0 ml. The floating raft hydroponic system has not been able to provide the best results on the composition of cow urine and AB mix. Based on the research results, it is necessary to carry out further research on the growth and production of pak choy with different compositions of cow urine and AB mix with different systems.

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