

# Combination of *Azolla microphylla* Extract with Urea Fertilizer On Growth and Production of Pakchoy Plant (*Brassica rapa* L)

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**ABSTRACT**--*Azolla microphylla* extract has a high enough N content which is good for increasing vegetable production. The purpose of this study was to determine the effect and get the best combination dose between *Azolla microphylla* extract and urea fertilizer on growth and production in pakchoy plants (*Brassica rapa* L). The study was conducted experimentally with a non-factorial Complete Randomized Design with 5 treatments and 4 replications so that there were 20 experimental units. each Unit consists of 4 plants and 2 plants as samples: A0 = Control (without treatment), A1 = *Azolla microphylla* extract 100 ml / l water / plot + 25% Urea (0.25 g / plant), A2 = *Azolla microphylla* extract 80 ml / l water / plot + 50% Urea (0.5 g / plant), A3 = *Azolla microphylla* Extract 60 ml / l water / plot + 75% Urea (0.75 g / plant), A4 = *Azolla microphylla* Extract 40 ml / l water / plot + 100% urea (1 g / plant). Based on the results of research that has been carried out that is the combination of *Azolla microphylla* extract with urea fertilizer on the growth and production of pakchoy plants (*Brassica rapa* L) can be concluded: The administration of *Azolla microphylla* extract and urea has a significant effect on the parameters of plant height, stem diameter, number of leaves, weight fresh, heavy consumption and dry weight of pakchoy plants (*Brassica rapa* L), A3 treatment that is by giving *Azolla microphylla* extract 60 ml / l water + Urea 0.75 g / plant is the best result on the growth and development of pakchoy plants (*Brassica rapa* L)

**Keywords**— combination, *azolla*, *microphylla* fertilizer, growth, production, pakchoy plant

## I. INTRODUCTION

Pakchoy plant (*Brassica rapa* L) is one type of vegetable that has commercial value and is widely favored by the community because it tastes good, crispy and fresh. Pakchoy is needed especially in Chinese cuisine restaurants which are now starting to penetrate all walks of life so that demand is increasing every day.

Pakchoy is in great demand as a vegetable because of its high nutritional content and delicious taste. Aside from being a vegetable it can also be beneficial for human health especially those that consume it continuously, Pakchoy can relieve the itching in the throat in patients with cough, headache healers because they contain vitamins and nutrients that are important for human health.

Based on 2015 fixed figure (ATAP) data that the production of mustard in Riau Province in 2013 was 3,484 tons, and in 2014 it was 3,190 tons, while in 2015 it was 1,540 tons (Department of Agriculture for Food Crops

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and Horticulture, Riau Province, 2015) . It can be seen that mustard vegetable production from 2013-2015 continues to decline.

The low production of pakchoy occurs due to the decrease in soil quality, both physical, chemical, and biological soil properties, caused by land use and continuous inorganic fertilizer application, which causes the loss of soil organic matter.

The use of inorganic fertilizers continuously in the process of crop cultivation can cause soil structure to become dense, fertilizer inefficiency and will cause disturbed nutrient balance and can also cause deficits of some nutrients. Such conditions can endanger growth in plants. Beside, the price of inorganic fertilizers is more expensive and tends to fluctuate from year to year due to a reduction in fertilizer subsidies by the government.

The use of urea fertilizer as nitrogen fertilizer in Indonesia is the most widely known and best known among farmers compared to other nitrogen fertilizers, such as ammonium sulfate. This is because urea contains high nitrogen (45-46 percent) and is the highest among other solid nitrogen fertilizers, and is easily found in the market, without the use of urea fertilizer, plant productivity will be low. However, the use of urea also has an unfavorable effect on soil productivity, giving urea can cause damage to soil structure, which results in the destroys of soil aggregates.

Need to be done Improving soil quality, to increase pakchoy crop production can be done by applying fertilizer that can maintain fertility in the soil. Fertilizers have an important role in the success of crop cultivation. Plants need suitable fertilizers to meet nutrient requirements so they can grow and develop properly.

Pakchoy is a vegetable crop where the consumption is part of the leaves so the fertilizer given should contain high N. The nature of N fertilizer is volatile, while plants lacking N show yellowing leaf symptoms, so the application of N fertilizer must still be fulfilled.

An alternative that can be proposed in the problem of providing fertilizer for plants is to combine N fertilizer with natural resources that are already available in the form of organic material (Putra, Soenaryo, and Tyasmoro, 2013).

The Provision of organic fertilizer can increase nutrient reserves in the soil, improve soil structure and increase soil organic matter content. Organic fertilizer is the fertilizer that comes from living things, both animals and plants. One form of organic fertilizer is Azolla Extract. Azolla extract has advantages compared to solid fertilizer because the nutrient absorption process that occurs in plants is faster.

Azolla microphylla extract has a high enough N content which is good for increasing vegetable production. Azolla microphylla extract can increase the growth and production of mustard plants in hydroponics (Azhari, Febriansyah, and Putra, 2017). Combining Azolla microphylla extract with nitrogen fertilizer is one way to prevent nutrient deficiencies in the soil.

Based on the description of the problem above, the author has conducted a study "Combination of Azolla microphylla Extract with Urea Fertilizer in Efficient Nitrogen in the Growth and Production of Pakchoy Mustard (*Brassica rapa L*)"

This purpose of this study was to determine the effect and get the best combination dose between Azolla microphylla extract and urea fertilizer on growth and production in pakchoy plants (*Brassica rapa L*).

## II. RESEARCH METHODS

The study was conducted experimentally with a non factorial Complete Randomized Design with 5 treatments and 4 replications so that there were 20 experimental units. Each Unit consists of 4 plants and 2 plants as samples:

A0 = Control (without treatment)

A1 = Azolla mycophylla extract 100 ml/l water/plot+Urea 25% (0.25g/ plant)

A2 = Azolla mycophylla extract 80 ml/lwater/plot + Urea 50% (0.5 g / plant)

A3 = Azolla mycophylla extract 60 ml/lwater/plot+75% Urea (0.75 g / plant)

A4 = Azolla mycophylla extract 40 ml/l water plot + Urea 100% (1 g / plant)

The RAL mathematical model is as follows:

$$Y_{ij} = \mu + A_i + \epsilon_{ij} \quad (1)$$

Where :

$Y_{ij}$  = Observation results on the i-th treatment and j-th test

$\mu$  = Middle value

$A_i$  = Effect of extract treatment on i level

$\epsilon_{ij}$  = Influence of errors due to first treatment and j-test

(Surtinah, 2013).

The data obtained were analyzed using analysis of variance, F arithmetic  $\geq$  F table, then the Duncan New Multiple Range Test (DNMRT) was conducted at a level of 5%.

### 2.1. Research Implementation

#### 2.1.1. Land Preparation

The study site measuring 6 m x 5 m, cleaned of weeds, wood, and other materials, then land leveled with a hoe and formed a plot measuring 70x70 cm, height 20 cm, with a spacing between plots 50 cm, then made para net shade with 1.5 m high.

#### 2.1.2. Planting Media Preparation

The planting media used consisted of topsoil (topsoil FMD) taken from around the study site and cow manure with a ratio of 2: 1. Soil media was sieved clean from the rest of the roots and grass and then put into a polybag measuring 35 cm x 30 cm with an average weight of 10 kg /polybag, then neatly arranged according to the Research Experiment Design chart.

#### 2.1.3. Nursery

The seeds used in the study were first soaked with water for 10 hours. The soil used for nursery is topsoil mixed with cow manure with a ratio of 2: 1. The media is stirred evenly, then put into a baby polybag, then the seed is sown two seeds per polybag, after that it is watered until moist.

#### 2.1.4. Label Installation

Labeling aims to facilitate the implementation of treatment and observation in each plot by following the treatment. The label is made of a plastic map with a size of 10 cm x 10 cm and then is placed on each trial plot by following the experiment layout.

### **2.1.5. Planting**

Planting or transferring Pakchoy seeds into large polybags that are already available in the plot is carried out after the seeds are 2 weeks after seedling in the afternoon. Transplanted plants are healthy plants, strong, have straight stems, have 4 leaves, have a uniform height. Transfer seedlings and soil by tearing the polybags, then making a hole as big as a nursery polybag in a large polybag and planting the seedlings, then watering until moist.

### **2.1.6. Treatment**

The treatment of *Azolla microphylla* extract was given 1 MST and the next administration was given at intervals of 1 week for 3 times the dose that was determined in each experimental unit by spraying all parts of the plant until it was wet then the rest was splashed to the ground with the same volume of planting. While urea treatment was given 1 MST as much as 75% and 3 MST as much as 25% of the treatment dose in Portugal around the plant.

### **2.1.7. Maintenance**

#### **2.1.7.1 Stitching**

Stitching is done in the afternoon. Stitching is done at the age of 5 DAP. Replanting is done for dead pakchoy plants or plants that have poor growth. Embroidery plants used are backup plants according to treatment.

#### **2.1.7.2. Sprinkling**

Watering is done twice a day, ie morning and evening. Watering is carried out until the field capacity with the volume adjusted to the growth phase by using a fan.

#### **2.1.7.3 Fertilizing**

The fertilizer given was SP-36 with a dose of 0.35 g / polybag and KCl 0.55 g / polybag. Giving fertilizer by tugal as deep as 3 cm, and 5cm distance from the plant. Giving fertilizer only once, namely at planting time.

#### **2.1.7.4 Pest Control**

Control of pests and diseases is carried out preventively by using vegetable pesticides made from raw materials of garlic. Control is done 1 week after planting with intensity twice a week by spraying.

### **2.1.8 Harvest**

Harvesting is done when the plant has entered the harvest criteria, with characteristics - the lowest leaves touch the ground, yellowing and the plants have not flowered. Crops are harvested when it reaches 75% of the total population experiences harvest criteria. Harvesting is done by watering first, then carefully dismantled.

### **2.1.9 Observations**

Observations were made at the end of the study. Some parameters observed are as follows.

**2.1.9.1. Plant Height (cm)**

Plant height is measured from the base of the stem to the tip of the highest leaf part perpendicular to the stem using the meter.

**2.1.9.2. Rod Diameter (cm)**

The diameter of the stem is measured at the largest part of the stem from the base of the stem using the calipers

**2.1.9.3 Number of Leaves (strands)**

The leaves that are counted are all the leaves that have opened perfectly.

**2.1.9.4 Fresh Weight (g)**

After the pakchoy plant is removed from the polybag by tearing the polybag, the plant is cleaned. The whole plant organs including roots are weighed with analytical scales.

**2.1.9.5. Consumption Weight (g)**

Observation of consumption weight is done after weighing fresh plant weight. Plant roots are cut and discard leaves that are not suitable for consumption, then weighed with analytical scales.

**2.1.9.6. Dry Weight (g)**

Calculation of dry weight is done by weighing pakchoy plants, then dried for 2 x 24 hours in an electric oven with a temperature of 80o C then weighed again until it reaches a constant weight.

**III. RESULTS AND DISCUSSION****3.1. Results****1. Plant Height (cm)**

The average observations of pakchoy plant height after analysis with variance due to the administration of Azzola microphylla and urea extracts gave a significant effect. Results of DNMRT follow-up tests of 5% are presented in Table 1.

**Table 1:** Average Height of Pakchoy Plant (cm) due to the administration of Azolla microphylla and Urea extracts

Treatment	Average
A <sub>0</sub> = Control (without treatment)	16,33 a
A <sub>1</sub> = Azolla microphylla extract 100 ml / l water + Urea 0.25 g/plant	18,41 b
A <sub>2</sub> = Azolla microphylla extract 80 ml/ l air + Urea 0,5g/ plant	18,44 b
A <sub>3</sub> = Azolla microphylla extract 60 ml/ l air + Urea 0,75 g/ plant	19,38 b
A <sub>4</sub> = Azolla microphylla extract 40 ml/ l air + Urea 1 g/ plant	19,46 b

The numbers followed by the same lower case indicate no significant difference according to the DNMRT test at the 5% level.

Table 1 shows that there was an increase in growth in plant height parameters due to administration of *Azolla microphylla* extract. Further test results between treatments showed that A0 was significantly different from A1, A2, A3, and A4. The efficiency of urea on the treatment of *Azolla microphylla* extract was found in treatment A1 (*Azolla microphylla* extract 100 ml / 1 water + Urea 0.25 g / plant). But the numbers show a tendency to increase crop yields.

## 2. Rod Diameter (cm)

The mean observations of the stem diameter of pakchoy plants after analysis with variance due to the administration of *Azolla microphylla* and urea extracts had significant results. Results of DNMRT follow-up tests of 5% are presented in Table 2.

**Table 2:** Average Stem Diameter of Pakchoy Plant (cm) Due to The Provision of *Azolla microphylla* and Urea extracts.

Treatment	Average
A <sub>0</sub> = Control (without treatment)	0,64 a
A <sub>1</sub> = <i>Azolla microphylla</i> extract 100 ml / 1 water + Urea 0.25 g/plant	0.67 a
A <sub>2</sub> = <i>Azolla microphylla</i> extract 80 ml/ 1 air + Urea 0,5g/ plant	0.63 a
A <sub>3</sub> = <i>Azolla microphylla</i> extract 60 ml/ 1 air + Urea 0,75 g/ plant	0.77 b
A <sub>4</sub> = <i>Azolla microphylla</i> extract 40 ml/ 1 air + Urea 1 g/ plant	0.79 b

The numbers followed by the same lowercase indicate no significant difference according to DNMRT further tests at the level of 5%.

Table 2 shows that an increase in growth in diameter parameters of plant stems due to the administration of *Azolla microphylla* extract. The results of further tests between treatments showed that A0 was significantly different from A3 and A4, but numerically it showed an increased tendency. The treatment of *Azolla microphylla* extract 60 ml / 1 water + Urea 0.75 g / plant as the best treatment.

## 3. Number of Leaves (strands)

The average observations of the number of leaves of pakchoy plants after analysis with variance due to the administration of *Azolla microphylla* and urea extracts gave significant results. Results of DNMRT follow-up tests at the 5% level are presented in Table 3.

**Table 3:** Average Number of Leaves of Pakchoy (strands) Due to administration of *Azolla microphylla* and Urea extracts

Treatment	Average
A <sub>0</sub> = Control (without treatment)	13,19 a
A <sub>1</sub> = <i>Azolla microphylla</i> extract 100 ml / 1 water + Urea 0.25 g/plant	13.89 ab
A <sub>2</sub> = <i>Azolla microphylla</i> extract 80 ml/ 1 air + Urea 0,5g/ plant	14.13 ab

A <sub>3</sub> = Azolla microphylla extract 60 ml/ l air + Urea 0,75 g/ plant	14.75 b
A <sub>4</sub> = Azolla microphylla extract 40 ml/ l air + Urea 1 g/ plant	14,88 b

The numbers followed by the same lowercase indicate no significant difference according to DNMRT further tests at the level of 5%.

Table 3 shows that there was an increase in growth in the number of leaf parameters due to the administration of Azzolla microphylla extract. The results of further tests between treatments showed that A0 was significantly different from A3 and A4, but numerically it showed an increased tendency. The treatment of Azolla microphylla extracts 60 ml / l water + Urea 0.75 g / plant as the best treatment.

#### 4. Fresh Weight (g)

The average observations of the fresh weight of Pakchoy plants after analysis with variance due to the administration of Azzolla microphylla and urea extracts gave a significant effect. The results of DNMRT follow-up tests at the 5% level are presented in Table 4.

**Table 4:** Average fresh weight of Pakchoy (g) due to administration of Azolla microphylla and Urea extracts

Treatment	Average
A <sub>0</sub> = Control (without treatment)	39.00 a
A <sub>1</sub> = Azolla microphylla extract 100 ml / l water + Urea 0.25 g/plant	55.64 b
A <sub>2</sub> = Azolla microphylla extract 80 ml/ l air + Urea 0,5g/ plant	54,40 b
A <sub>3</sub> = Azolla microphylla extract 60 ml/ l air + Urea 0,75 g/ plant	66.58 c
A <sub>4</sub> = Azolla microphylla extract 40 ml/ l air + Urea 1 g/ plant	71.77 c

The numbers followed by the same lowercase indicate no significant difference according to DNMRT further tests at the level of 5%.

Table 4 shows that an increase in growth in the fresh weight parameters of plants due to the administration of Azzolla microphylla extract. The results of further tests between treatments showed that A0 was significantly different from A1, A2, A3, and A4, but numerically showed an increasing trend. The treatment of Azolla microphylla extracts 60 ml / l water + Urea 0.75 g / plant as the best treatment.

#### 4.1.5. Consumption Weight (g)

The results of observations of the weight consumption of Pakchoy plants after analysis with variance due to the administration of Azzolla microphylla and urea extracts gave a significant effect. Results of DNMRT follow-up tests at the 5% level are presented in Table 5.

**Table 5:** Average Weight of Consumption of Pakchoy (g) Due to the Administration of Azolla microphylla and Urea Extracts

Treatment	Average

A <sub>0</sub> = Control (without treatment)	34.14 a
A <sub>1</sub> = Azolla microphylla extract 100 ml / l water + Urea 0.25 g/plant	43.78 a
A <sub>2</sub> = Azolla microphylla extract 80 ml/ l air + Urea 0,5g/ plant	44.36 ab
A <sub>3</sub> = Azolla microphylla extract 60 ml/ l air + Urea 0,75 g/ plant	56.11 b
A <sub>4</sub> = Azolla microphylla extract 40 ml/ l air + Urea 1 g/ plant	58,34 b

The numbers followed by the same lowercase indicate no significant difference according to DNMRT further tests at the level of 5%.

Table 5 shows that there was an increase in growth in weight parameters of plant consumption due to administration of Azzolla microphylla extract. The results of further tests between treatments showed that A<sub>0</sub> was significantly different from A<sub>3</sub> and A<sub>4</sub>, but numerically it showed an increasing trend. The treatment of Azolla microphylla extract 60 ml / l water + Urea 0.75 g / plant as the best treatment.

### 3.1.2. Dry Weight (g)

The mean observation results of the dry weight of Pakchoy plants after analysis with variance due to the administration of Azzolla microphylla and urea extracts gave a significant effect. The results of DNMRT follow-up tests at the 5% level are presented in Table 6.

**Table 6:** Average Dry Weight of Pakchoy (g) Due to the Administration of Azolla microphylla and Urea Extracts

Treatment	Average
A <sub>0</sub> = Control (without treatment)	3.20 a
A <sub>1</sub> = Azolla microphylla extract 100 ml / l water + Urea 0.25 g/plant	3.63 a
A <sub>2</sub> = Azolla microphylla extract 80 ml/ l air + Urea 0,5g/ plant	4,18 ab
A <sub>3</sub> = Azolla microphylla extract 60 ml/ l air + Urea 0,75 g/ plant	5,11 b
A <sub>4</sub> = Azolla microphylla extract 40 ml/ l air + Urea 1 g/ plant	5,31 b

The numbers followed by the same lowercase indicate no significant difference according to DNMRT further tests at the level of 5%.

Table 6 shows that there was an increase in growth in plant dry weight parameters due to the administration of Azzolla microphylla extract. The results of further tests between treatments showed that A<sub>0</sub> was significantly different from A<sub>3</sub> and A<sub>4</sub>, but numerically it showed an increasing trend. The treatment of Azolla microphylla extracts 60 ml / l water + Urea 0.75 g / plant as the best treatment.



#### IV. DISCUSSION

The results of variance showed that the combination treatment of *Azolla microphylla* extract was able to streamline the administration of urea fertilizer on parameters of plant height, stem diameter, number of leaves, fresh weight, consumption weight and dry weight of pakchoy plants. All parameters observed showed that the A0 (Control) treatment was the treatment that produced the lowest growth and crop production compared to the other treatments. It is suspected that the nutrient content is low in the research media which causes suboptimal growth and crop production. The medium used is FMD soil with a low content of organic matter and nutrients, this results in low growth and production without administration of *Azolla microphylla* extract. A4 treatment for all observational parameters was not significantly different from treatment A3. The best treatment is in A3 treatment, namely the administration of *Azolla microphylla* extract 60 ml / l water + Urea 0.75 g / polybag, which means that *Azolla microphylla* extract can make efficient use of urea fertilizer up to 25%. It is suspected that the nutrient content of N in *Azolla Microphylla* extract which is applied to pakchoy plants can be well absorbed.

Nutrients N, P, and K are nutrients that are needed by plants at the initial stage of growth, especially at plant height. Element N contained in *Azolla microphylla* extract and urea fertilizer can increase the amount of organic matter and is directly proportional to the improvement of plant growth environment and available nutrients also increase, so that nutrient availability can be utilized optimally to support height growth of pakchoy plants.

Wibisono and Basri (1993) stated that plants will be able to grow and produce perfectly if sufficient nutrients are needed. According to Lingga (2007) nitrogen in sufficient quantities plays a role in accelerating overall plant growth, specifically stems and leaves. Increased photosynthate in the vegetative phase leads to cell division, extension, and differentiation (Lakitan, 2000).

The combination of *Azolla microphylla* extract 40 ml / l water / plot + urea fertilizer 1 gr / plant has the most number of leaves which is 14.88 strands, this is related to plant height parameters where by giving *Azolla microphylla* extract 40 ml / l water / plot + fertilizer urea 1 g / plant showed the highest height of pakchoy plants, so that it produced the most leaves. This is consistent with Fahrudin's statement (2009) that the number of leaves is very closely related to plant height, because the higher the plant, the more leaves will be formed. Besides, the number of leaves is influenced by nutrients N, P, and K that are in the soil.

The efficiency of urea fertilizer was obtained in treatment A3. Nutrient N from the combination of *Azolla microphylla* extract with urea fertilizer is available in leaf formation, where the N element helps the process of cell division and enlargement which causes young leaves to reach their perfect shape faster.

Nyakpa et al. (1988) state that the process of leaf formation is inseparable from the role of nutrients such as nitrogen and phosphorus available to plants. These two nutrients play a role in the formation of new cells and the main components of organic compounds in plants that affect the vegetative growth of plants, especially the increasing number of leaves.

Nutrients and water absorbed by plants are a reflection of the fresh weight of plants. Nutrients absorbed by plants through the roots with water will affect growth such as height, number of leaves and leaf area. The accumulation of height, number of leaves and leaf area will influence the fresh weight of Pakchoy plants. The better the growth of pakchoy plants, the fresh weight of the plant also increases. According to Lahadassy (2007)

to achieve optimal wet weight, plants still need a lot of energy and nutrients so that an increase in the number and size of cells can reach optimal levels and allow for an optimal increase in plant water content as well.

The weight of a suitable plant is a reflection of plant parts, such as stems and leaves without including yellowing roots and leaves. The amount of yield obtained from the weight of the plant consumed is due to the higher number of leaves produced and the nutrients absorbed by the plant.

The use of a combination of *Azolla microphylla* extract with urea fertilizer is important because it produces a higher content of organic matter and nitrogen when compared to the use of chemical fertilizers. Hakim et al. (1986) stated that nitrogen plays an important role in accelerating plant growth so that indirectly the fresh weight of plants suitable for consumption will also increase.

The administration of *Azolla microphylla* extract has a significant influence on the dry weight of pakchoy plants. In the A4 treatment the average dry weight tends to be higher than other treatments, because the treatment-experienced the best growth with total plant height, fresh weight, heavy consumption and the highest number of leaves so that the nutrients present in *Azolla microphylla* extract are sufficient for plant needs and the process of photosynthesis can take place quickly. The results of photosynthesis can be stored in plant organs, there is more accumulation in the stem so that the dry weight of the plant increases.

According to Lakit (1996), the dry weight of plants reflects the accumulation of compounds successfully synthesized by plants from organic compounds, especially water and carbon dioxide as well as nutrients that have been absorbed by the roots to contribute to the increase in plant dry weight.

## V. CONCLUSION

Based on the results of research that has been carried out that is the combination of *Azolla microphylla* extract with urea fertilizer on the growth and production of pakchoy (*Brassica rapa* L) plants, the following conclusions can be drawn:

1. The administration of *Azolla microphylla* and urea extracts significantly affected the parameters of plant height, stem diameter, number of leaves, fresh weight, consumption weight and dry weight of pakchoy plants (*Brassica rapa* L).
2. Treatment of A3, namely the administration of *Azolla microphylla* extract 60 ml / l water + Urea 0.75 g / plant is the best result on the growth and development of pakchoy plants (*Brassica rapa* L).

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