



## Improved Growth and Yield of Pakchoy (*Brassica Rapa L.*) with Organic Fertilizer plus Vitamin-B1 and Auxin

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**Abstract:** The purpose of this study is to determine the effect of POC Plus concentration on mustard growth and yield. The method used is Group Randomized Design, with 1 (one) factor of POC Plus concentration (Liquinox start) including 8 levels of treatment and 3 replicates. There is significant effect of POC Plus concentration treatment to increase the growth and yield of pakchoy in all parameters of observations compared to the control treatment. The highest gross weight per plant is achieved by treatment L7 at the age of observation 35 days after planting by 338.36%. The highest growth and yield is achieved by treatment L7 by using 17.5 ml per liter of water POC Plus. However, statistically the best value is achieved by treatment L6 with concentration of 15 ml per liter of water POC Plus as there is no significant difference with L7 treatment in all parameters of observations including plant length, leaf number and fresh weight per plant at the age of 35 days after transplanting.

**Keywords:** Liquinox Start Concentration, Pakchoy

### I. INTRODUCTION

Mustard is a type of vegetable that favored by the Indonesian community with its consumers ranging from the lower class to upper class community group and with a very bright prospect, as mustard has a good market. Its market covering local, inter-island and even exported to (Sutiyoso, 2003).

Mustard is good for relieving itching in the throat in cough sufferers, headache healer, blood cleanser, improving kidney function, and smoothing digestion. It contains protein, fat, carbohydrate, Ca, P, Fe, Vitamin A, Vitamin B, and Vitamin C (Dani, 2010). Furthermore, according to Eko Susanto (2010), it contains vitamins and minerals. Its contents of vitamin K, A, C, E, and folate are in the category of excellent. Manganese and calcium in mustard are classified in excellent category is. In addition, it is also excellent in terms of the amino acid tryptophan and fiber food (*dietary fiber*).

Mustard optimal production needs nutrients. It needs loose and fertile soil. To make the plants grow well, effectiveness of fertilizer absorption, both organic and non-organic fertilizer is necessary. One effort that can be taken to overcome it is by the application of POC Plus technology which greatly help improve the soil or media plants with low fertility. It



contains Vitamin B-1 in addition to active hormone to maximize the effectiveness of nutrients absorption contained in the soil or growing media.

Liquinox Start usage as a material containing combination products of vitamin B-1 (*Thiamine HCl*) and NAA (*Naphtalene Acetic Acid*) auxin group root growth regulator are useful as an anti-stress and stimulant of plant roots. Vitamin B-1 plays a role in the metabolism of plants by converting carbohydrates into energy to move the activity in plants, thus plants that experience stress due to the condition bare root (delivery without media) or due to transfer of plants to new media, can immediately perform activities metabolism to adapt to the new environment or media. Meanwhile plant NAA (*Naphtalene Acetic Acid*) growth regulator is from auxin group, which has a role in stimulating the growth of roots lateral/side. The selection of NAA is due to its strong and stable root stimulants (Anonymous, 2010).

Liquinox start is also a liquid growth regulating substance that can be used to reduce stress on plants caused by environmental stress. Liquinox start is formulated to help reduce stress during transplanting and stimulate root growth. Liquinox start is effective to be applied to all types of plants in planting such as seeding, planting cuttings, rooting on roses, barrier plants etc.

Liquinox Start-Vitamin B1 is also a liquid fertilizer to produce maximum results when transplanting or moving/planting new crops and to nourish all types of plants. This fertilizer has a very high ability to stimulate the roots and stimulate the roots to immediately become healthy and soon grow, thus reducing to the maximum extent possible damage caused by transplanting and moving in plants. Liquinox Start is helpful in improving soil or plant media. Liquinox start acid levels is very high by 1.9 with its substances include vitamin B1, iron, pospat and yucca extract.

#### a . Vitamin B1

Vitamins are one of the organic substances synthesized by plants and are active in relatively small quantities. Vitamin B1 is also known as Thiamine. The term *thiamine* states that this substance contains sulfur (tio) and nitrogen (amine). Thiamine belongs to a water-soluble vitamin class. Thiamine is synthesized on the leaves and is trans located to meristematic areas of roots and buds.

Thiamine in plants is present in free form and as thiamine phosphate (Khrishnamoorthy, 1981). Vitamins function as co-enzymes in the enzyme reactions. Thiamine pyrophosphate



is an active part of the carboxylase enzyme. Because thiamine synthesis process occurs in the leaves, light is required for synthesis and translocation (Khrisnamoorthy, 1981).

b. NAA (*Napthalene Acetic Acid*)

NAA is a synthetic compound of auxin which has a function as one of growth regulator substances in plants. Auxin plays a role in many aspects of plant growth and development. The role of auxin includes cell enlargement, inhibition of side shoots, and abortion of leaves, cambium activity, and root growth. Auxin in plants can affect the process of opening and closing stomata (Klingman, 1973). Synthetic auxin activity is influenced by the ability of these compounds to penetrate the cuticle, the nature of the translocation within the plant, auxin binding to inactive compounds, interactions with other plant hormones, plant species, stage of growth, and environment (Wattimena, 1988).

c. YUCCA Extract

Yucca plant is included in the Liliaceae family. Yucca plants contain steroid saponins. The use of steroidal saponins as anti-stress in plants is now widespread. Results of previous studies shows that plants receive extracts of yucca plants have good resistance to arid environments.

d. Iron Substance

Iron is a micro mineral. Iron has several important functions in plants as a means of oxygen transport, conveyance of electron in the cell, the catalyst the formation of chlorophyll, and plays a role in enzyme reactions in the body of the plant.

e. Phosphoric acid

Phosphoric acid has an effect on plant growth. Phosphoric acid can stimulate root growth, flowering, and helps in forming seeds and is very important for germination (Gardner, Pearce, and Mitchell, 1991).

## 2. METHODS

This research uses randomized block design (RAK) with 1 (one) factor of POC concentration Plus (Liquinox start) with 8 levels of treatments and repeated 3 times. The treatment are  $L_0 = 0$  ml;  $L_0 = 2.5$  ml;  $L_0 = 5.0$  ml;  $L_0 = 7.5$  ml;  $L_0 = 10$  ml;  $L_0 = 12.5$  ml;  $L_0 = 15.0$  ml;  $L_0 = 17.5$  ml per liter of water. Plant observation is carried out through growth and yield variables, starting from plant transplanting. Observation of plant growth was carried out at days of 7, 14, 21, 28, and 35 days after transplanting.



### 3. RESULTS AND DISCUSSION

#### 3.1. Plants length

Statistical analysis showed that the concentration of liquid organic fertilizer (POC) Plus provides highly significant effect ( $F_{count} > F_{1\%}$ ) on variable of plants length at 14 days, 21 days, 28 days and 35 days after transplanting. The average length crop observations are presented in Table 1.

Table 1. Average of Pakchoy length (cm) on various age of observations (day after transplanting)

Treatment	Average Long Plants				
	7 HST	14 HST	21 HST	28 HST	35 HST
L0	5.00 a	8.17 a	12.00 a	16.50 a	20.17 a
L1	5.83 ab	10.17 b	13.67 ab	17.67 ab	22.17 ab
L2	5.67 ab	11.33 bc	15.50 bc	19.50 bc	24.00 bc
L3	6.33 ab	12.33 cd	16.50 CD	20.50 c	24.83 bc
L4	7.17 bc	12.67 cd	17.17 CD	21.67 c	26.50 cd
L5	7.33 bc	14.17 de	18.33 de	22.83 c	28.50 de
L6	8.17 c	14.67 ef	19.00 ef	23.50 c	28.67 de
L7	8.67 c	16.17 f	20.67 f	24.33 c	29.67 e
BNT 5%	1.72	1.98	2.11	2.76	2.96

*Description: The figures followed by the same letters, the same column showed no significant difference (LSD 5%).*

Table 1 shows that treatment L7 provides the highest value by 29.67 cm at the end of the observation age of 35 days after transplanting, yet statistically it shows no significant difference compared with L5 and L6 respectively by 28.50 cm and 28.67 cm. The results of calculation the percentage increase in the plant length of control treatment indicates due to treatment concentration of Liquinox Start Plus Vitamin B-1 and PGR with treatment L7 gives the highest increase of 47.09% to control treatment and the increase is higher than other treatments. Table 1 show there is no significant difference with L5 and L6 treatments at observation at 35 days after transplanting respectively by 41.29% and 42.15%. The average percentage increase in the length of pakchoy to control treatment are presented in Table 2.



Table 2. Average of pakchoy length improvement (%) in various age of observation compared to Control Treatment.

Treatment	The mean length of crop improvement percentage (%)				
	7 HST	14 HST	21 HST	28 HST	35 HST
L0	0.00	0.00	0.00	0.00	0.00
L1	16.60	24.48	13.92	7.09	9.02
L2	13.40	38.68	29.17	18.18	18.99
L3	26.60	50.92	37.50	24.24	23.10
L4	43.40	55.08	43.08	31.33	23.89
L5	46.60	73.44	52.75	38.36	41.29
L6	63.40	79.56	58.33	42.42	42.14
L7	73.40	97.92	72.25	47.45	47.09

Use of manure in growing media also aims to improve the physical and biological properties of soil as well as to absorb the nutrients contained. Nitrogen in manure can be provided for plant after nitrification process, a process of oxidation of ammonia into nitrite by nitrosomona bacteria. Nitrite is converted to nitrates with the help of nitrobacter. NAA (*Naphtalene Acetic Acid*) is frequently used Liquinox Start as a material containing combination products of vitamin B-1(*Thiamine HCl*) and root growth regulator of auxin group is which is useful as an anti-stress and stimulant for plant roots. Vitamin B-1 has a role in plant metabolism in terms of converting carbohydrates into energy to drive activity in plants; meanwhile Plant growth regulators NAA (*NaphtaleneAcetic Acid*) is a group of a group of plant growth regulator auxin, which has a role in stimulating the growth of lateral/side roots. According Kusumo, (1984), auxin can be used to stimulate rooting and increase germination, stimulate the development/encourages growth of leaves, shoots extension.

### 3. 2. Leaf Amount

The result of statistical analysis shows that concentration of liquid organic fertilizer (POC) plus Vitamin B-1 and ZPT gave a very significant effect ( $F_{Count} > F_{1\%}$ ) to the observed variation of the leaves of pakchoy mustard plant at 14 days, 21 days, 28 days and 35 days after transplanting. The average observation number of leaves is presented in Table 3.



Table 3. Average number of Pakchoy (cm) on various age observations (Day After Transplanting).

Treatment	Average Number of Leaves				
	7 HST	14 HST	21 HST	28 HST	35 HST
L0	2.00 a	4.17 a	6.67 a	9.33 a	12.67 a
L1	2.67 b	5.17 b	8.00 b	10.67 b	14.17 b
L2	3.00 bc	5.67 b c	8.33 b	11.00 bc	14.67 b
L3	3.00 bc	5.67 b c	8.17 b	11.33 bc d	15.33 bc
L4	3.00 bc	5,83 c	8.50 bc	11.33 bc d	15.33 bc
L5	3.00 bc	5,83 c	8.67 bc	11.83 c d	16.00 c d
L6	3,17 c	6,17 c	9.17 c	12.00 c d	16.17 c d
L7	3,33 c	6,17 c	9.17 c	12.33 d	16.67 d
BNT 5%	0.46	0.54	0.68	1.14	1.31

*Description: The figures followed by the same letters in the same column shows no significant difference (LSD 5%).*

Table 3 above shows that treatment L7 provides the highest value of 16.67 at the end of the observation age of 35 days after transplanting but statistically shows no significant difference compared with treatment of L5 and L6 respectively by 16,00 and 16,17. Table 4 shows the increasing number of leaf to control treatment as an impact of POC Plus Vitamin B-1 and PGR. Treatment L7 gives the highest increase of 31.57% to control treatment and the increase is higher than other treatments. In table 3 there is no significant difference in L5 and L6 on the observation age of 35 days after transplanting respectively by 26.28% and 27.62%. The average percentage increase in the number of plant leaves of pakchoy to control treatment, are presented in Table 4.

Table 4. Percentage of Pakchoy average number of leaves (%) at various age of observation compared to Control Treatment.

Treatment	Increased Percentage Average Leaf Number (%)				
	7 HST	14 HST	21 HST	28 HST	35 HST
L0	0.00	0.00	0.00	0.00	0.00
L1	33.50	23.98	19.94	14.36	11.84



L2	50.00	35.97	24.89	17.89	15.79
L3	50.00	35.97	22.49	21.44	20.99
L4	50.00	39.81	27.44	21.44	20.99
L5	50.00	39.81	29.99	26.79	26.28
L6	58,50	47.96	37.48	28.62	27.62
L7	66.50	47.96	37.48	32.15	31.57

The content of NAA as a synthetic compound of auxin contained in Liquinox Start also has a role in the growth and development to the viability of the plant. Growing regulators are non-nutrient organic compounds that in small amounts can support, inhibit and alter the physiological processes of plants (Anonymous, 2010).

#### 4. 3. Gross Weight per Plant

Statistical analysis showed that concentration of liquid organic fertilizer (POC) Plus Vitamin B-1 and PGR provides a very real effect ( $F_{count} > F_{1\%}$ ) to variable observation of gross weight per mustard pakchoy at the age of 35 days after transplanting. The average of gross weight per plant in pakchoy at the end of the observation, are presented in Table 5.

Table 5. Average gross weight per plant of Pakchoy (G) and percentage of improvement compared to controls treatment at the age of 35 days after Planting.

Treatment	Average Gross Weight per plant	Average Percentage (%) Improved Treatment Of Control
L0	88.17 a	0.00
L1	149.93 ab	70.05
L2	173.63 b	96.93
L3	202.93 bc	130.16
L4	247.33 cd	180.51
L5	294.33 de	233.82
L6	329.00 e f	273.14
L7	386.50 f	338,36
BNT 5%	83.09	



*Description: The figures accompanied by the same letters in the same column showed no significant difference (LSD 5%).*

Table 5 above shows that of treatment L7 provides the highest value of 386.50 grams compared with other treatments, although statistically shows no significant difference with the treatment L6 by 329.00 grams at the age of 35 days of observation after transplanting. Calculation of increase in gross weight per plant to control treatments shows that L7 gives the highest increase by 338, 36% higher than other treatments, which is based on table 5 statistically the increase was not significantly different from the percentage increase of treatment L6 by 273.14% at the age of 35 days after transplanting.

Photosynthesis is producer of carbohydrates with an important role in the growth and formation processes of plant biomass. This statement is supported by Harjadi (1991), stating that Photosynthesis is a process in which carbon dioxide and water under the influence of light and the presence of chlorophyll or green leaves transformed into organic compounds that contain carbon and energy rich. The use of Liquinox Start as liquid organic fertilizer (POC) products containing a combination of vitamin B-1 (*Thiamine HCl*) and root growth regulator auxin is NAA group (*Naphtalene Acetic Acid*). According to Khrisnamoorthy, (1981), vitamins function as co-enzymes in enzyme reactions. Thiamine pyrophosphate is an active part of the enzyme carboxylase. Since the thiamine synthesis process occurs in the leaves then light is needed at the time of synthesis and translocation.

#### 4. CONCLUSION

There is significant effect on treatment concentration of liquid organic fertilizer (POC) Plus Vitamin B-1 and PGR to increased growth and yield of pakchoy on all observation parameters studied compared with control treatment, with the highest percentage rate on improvement is presented by treatment observation L7 at the age of 35 days after transplanting by 338,36%.

The highest value of growth and yield parameters is achieved by treatment L7 with concentration of 17.5 ml Liquinox Start (plus Vitamin B-1 and PGR) per liter of water. Statistically the best value is achieved by treatment of L6 with concentration of 15 ml Liquinox Start (plus Vitamin B-1 and PGR) per liter of water because it has no significant with treatment of L7 in all parameters of the observation including length of plants, number of leaves and gross weight per plant at the age of 35 days after transplanting.



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