Akta Agrosia

Growth Response and Yield of Pakcoy (*Brassica rapa* L.) on Various Concentrations of Liquid Organic Fertilizer of Jering Pods

Peri Hardiansyah, Uswatun Nurjanah*, and Widodo
Department of Crop Production, Faculty of Agriculture, University of Bengkulu
Jl. WR Supratman, Kandang Limun, Bengkulu 38120, Indonesia

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*Corresponding author:
E-mail:
uswatun.nurjanah@gmail.com

ABSTRACT

Pakcoy (*Brassica rapa* L.) is a vegetable crop and important to human body because it contains good nutrition. Productivity of pakcoy is still low in Indonesia for some reasons, such as cultural technology. One of the efforts to increase the production of pakcoy is the application of liquid organic fertilizer (LOF) from jering pods. LOF can be absorbed by plants faster than solid organic fertilizers and it does not damage soil structures as synthetic chemical fertilizers did. This study was aimed to determine the optimum concentration of LOF of jering pods on growth and yield of pakcoy. The research was conducted at the greenhouse and Laboratory of Agroecotechnology, the University of Bengkulu. The research was organized in Completely Randomized Design (CRD) with a single factor and repeated 5 times. The LOF concentration consisted of 5 levels included LOF 0% (Control), LOF 25%, LOF 50%, LOF 75%, and LOF 100%. The result showed that the concentration of LOF 100% produced the best growth and yield of pakcoy and has the longest shoot, the highest number of leaf, the widest leaf area, the heviest fresh weight of shoot, the highest weight of dried biomass, the highest greenish leaves, and the haviest weight of dried roots.

INTRODUCTION

The pakcoy plant (*Brassica rapa* L.) is one type of vegetable plant that belongs to the Brassicaceae family. Historically, pakcoy plants are belonging to the Chinese vegetable family, and until now the pakcoy plant has been developed and cultivated in several Asian countries such as the Philippines, Malaysia, Thailand and especially has also been widely cultivated in Indonesia (Yogiandre et al., 2011). Fahrudin (2009) stated that the nutrients of pakcoy included calories, protein, fat, carbohydrates, fiber, Ca, P, Fe, Vitamin A, Vitamin B, Vitamin C and contain very high beta-carotene and are beneficial for health.

BPS data and the Directorate General of Horticulture (2015) showed that pakcoy production in Indonesia decreased from year to year. In 2013, 2014, and 2015 the production was decreased from 635,728, 602,478, and 600,200 tons / year. Meanwhile, in Bengkulu data showed that the level of production of pakcoy has also decreased since 2013 to 2015. In 2013, the production was 35,919, in 2014 was 35,585, and in 2015 was 33,943 tons/ year. Based on these data, there is still need to increase the level of production of the pakcoy so that its productivity can meet the Pakcoy's needs in Indonesia, especially in Bengkulu.

One of the main causes of the decline in production of pakcoy plants from 2013 to 2015

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is the lack of sufficient nutrient required for the pakcoy plant itself. To overcome this problem, it is necessary to provide fertilizer that is suitable for pakcoy plants. Fertilizing can be done in two ways, using synthetic chemical fertilizers and natural (organic) chemical fertilizers. Synthetic chemical fertilizers will have a negative impact on the environment especially can damage and pollute the soil and the environment. Therefore it is necessary to look for other fertilizing alternatives, namely using natural or organic fertilizers. In general, organic fertilizer can help to fertilize the plants, not damage the soil and also not even damage to the environment (Hadisaputo et al., 2008).

Organic fertilizers can applied in form of solid organic fertilizers (SOF) and can also be applied in the form of liquid organic fertilizer (LOF). LOF is easily absorbed thoroughly by plants compared to SOF. LOF is mostly applied through leaves as foliar liquid fertilizer. One of the advantages of LOF is that it is able to supply nutrients quickly. Compared with inorganic fertilizers, the liquid fertilizer will not damage the soil even though its is repeatedly applied (Hadisuwito, 2012). One source of organic material that can be used as liquid organic fertilizer is the waste of jering pods or jengkol pods. Pitojo (1995) described that jering fruit pods contains essential oils, saponins, alkaloids, terpenoids, steroids, tannins, glycosides, proteins, carbohydrates, calcium (Ca), phosphorus (P), and vitamins. Gusnidar et al. (2011) stated that the provision of organic fertilizer from the pods of jengkol fruit can be very useful in increasing soil fertility. Jengkol fruit skin can fertilize the soil because it contains N-total 1.82%, P-total 0.32%, K-total 2.10%, Ca-total 0.27%, Mg-total 0.25%, C- a total of 44.02% and C / N 24.19%. This objectives of this study was to determine the optimum concentration of LOF on the growth and yield of pakcoy plants.

MATERIALS AND METHODS

This research was conducted in 3 months, started in September to November 2017. This study was done in the greenhouse and Laboratory of the Dept. of Agroecotechnology, the University of Bengkulu. The research was organized in Completely Randomized Design (CRD) with one treatment factor and repeated 5 times. The treatment factor was concentration of liquid organic fertilizer (LOF), which was 5 levels: T0 = 0%, T1 = 25%, T2 = 50%, T3 = 75%, and T4 = 100%.

The tools used in this study were hoes, meters, SPAD, digital scales, buckets, plastic barrels, and polybags. The materials used were jengkol fruit peel, palm sugar, cow manure, top soil, water, EM4, and pakcoy plant seeds.

Liquid organic fertilizer derived based on Fahrurozi (2016) method used was made using 10 kg of wet jengkol rind, and EM4 solution. Preparation of EM4 solution was by mixing 20 ml of EM4 plus 2 kg of palm sugar and 20 liters of water stirred until dissolved. POC was made by chopping wet jengkol fruit skin by ± 1 cm. Then the seed coat of the jengkol wet fruit was put into a plastic barrel that has been filled with EM4 solution, stirred thoroughly and then covered and stored for ± 1 month. This POC is still considered and is stirred every 4 days. After 1 month of POC is observed, if the POC is yellow and the odor was not too strong, it means that the POC was ready to be filtered using a filter cloth and ready to be applied.

Data observed included the greenish level of leaf, shoot length, number of leaf, area of leaf, shoot fresh weight, shoot dried weight, root dried weight, and total biomass dried weight. The data of the observations were analyzed using Analysis of Variants (ANOVA) based on the F test level at 5% and if there were significant differences then continued with further tests of Polynomial Orthogonal.

RESULTS AND DISCUSSION

The application of LOF from jengkol pods affected all observed variables significantly. Further evaluation was using Orthoghonal Polynomial. Table 1 was presented a summary of F-values due to the the effect of LOF extracted from jengkol fruit skin on the growth and yield of pakcoy plants.

Based on Table 1, there are significant effects of the treatment of jengkol fruit pods concentration to variables of greenish of leaf, shoot length, number of leaf, area of leaf, shoot fresh weight, total biomass dried weight, and root dried weight. The application of LOF gave significatnt effects on the growth and yield of pakcoy, because the application of different POC concentrations influences the nutrient availability for pakcoy plants (Gerald, 2014).

Table 1. Summary of Analysis of Variance (ANOVA)

Variable Observed	F-Table	F-calculated
Greenish of leaf	2,86	9,67*
Shoot length	2,86	34,94*
Number of Leaf	2,86	20,76*
Area of leaf	2,86	22,78*
Shoot fresh weight	2,86	53,25*
Root dried weight	2,86	25,47*
Weight of dried biomass	2,86	45,05*

Notes : *= significantly different

Based on the results of the orthogonal polynomial test it can be explained that the optimum concentration of LOF from jengkol fruit peel has not been obtained for growth and yield of pakcoy plants, so orthogonal polynomial graphs of shoot growth, leaf number, leaf area, shoot fresh weight, total biomass dried weight, leaf greenish and dried weight of roots are still linear. Analysis of nutrient content of LOF extracted from jengkol pods at 100% concentration were 0.127 grams N. In this experiment the need for N were also supplied from inorganic fertilizers and from cow manure which were 0.2 and 1.785 grams, respectively. Therefore, the actual needs of N for pakcoy plants has been fulfilled, but in fact the data observed such as shoot length, leaf number, leaf area, shoot fresh weight, total dried weight, leaf greenish, and root dried weight were not responded to the supplied N. When pakcoy plants need N elements for growing, the N from cow manure which is relatively large cannot be absorbed by plant roots because it was not yet available. It needs time to be mineralized, and N given from NPK fertilizer was leached so that it cannot be absorbed by the roots of the pakcoy plant.

Increasing the LOF concentration of jengkol fruit pods was able to increase the greenish of plant leaves as indicated by the linear line equation Y = 0.0754x + 40.259 (R^2 = 0.9668) (Figure 1). Based on Table 1, there are significant effects from the treatment of LOF of jengkol fruit pods concentration to shoot length, leaf number, leaf area, shoot fresh weight, total dried weight, leaf greenish, and root dried weight. The application of LOF was significantly influence the growth and yield of pakcoy, because different LOF concentrations provided nutrient availability for pakcoy plants (Gerald, 2014).

Based on the results of the orthogonal polynomial test it can be explained that the optimum concentration of jengkol fruit pods has not been obtained for growth and yield of pakcoy plants, so orthogonal polynomial graphs of canopy growth, leaf number, leaf area, canopy fresh weight, total dry weight, leaf greenery and weight dried pakcoy plant roots are still linear. The results of the analysis of nutrient content of LOF of jengkol fruit pods at 100% concentration were 0.127 grams N, from 0.2 grams N from inorganic fertilizers and 1.785 grams N of cow manure means that N needs 2.11 grams, while N needs for pakcoy plants, which is equal to 0.5 gram of crop. Based on the results of the analysis, the actual N for pakcoy plants provided has been fulfilled, but in fact, nutrients are still needed for growth and yield of pakcoy plants. When pakcoy plants need N elements in their growth, N from cow manure which is relatively large cannot be absorbed by plant roots because it is not yet available or needs to be mineralized first, and N is given from the compound NPK fertilizer washed (leaching) so that it cannot be absorbed by the roots of the pakcoy plant.

Increasing the LOF concentration of jengkol pods was able to increase the greenish level of plant leaves as indicated by the linear equation Y = 0.0754x + 40.259 (R^2 = 0.9668).

This equation showed that increasing the LOF concentration of jengkol pods from 0 to 100% can increase the greenish level of pakcoy leaves by 0.075. Nitrogen (N) is one of the macro nutrients of crop production because nitrogen is an essential nutrient that functions as a constituent of amino acids, proteins, and chlorophyll which are important in the process of photosynthesis and the constituent components of cell nuclei (Sirappa, 2002). Furthermore, the results also showed that N can

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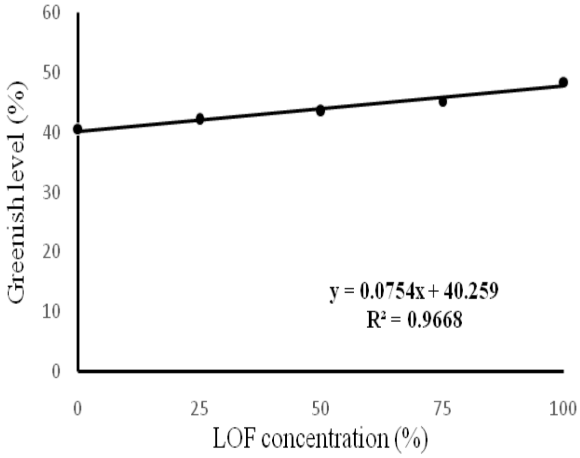

Figure 1. Graph of the relationship between LOF concentration and the greenish of leaves

increase the green color of leaves and also increase the yield variables such as shoot length, leaf area, and number of leaves. The length of the shoot is the result of increasing the size, elongation of cells and all activities of the meristematic tissue which actively divides and caused an increase in the length of the shoot of the pakcoy plant. The growth of shoot is strongly influenced by several factors including environmental conditions, soil conditions and the availability of nutrients for the pakcoy plant itself. The length of the shoot is also closely related to the greenish level of the leaves. The higher the greenish level of the leaves, the higher photosynthesis process and the growth of plant indicated in the length of shoot.

The increase in LOF concentration of jengkol pods was able to increase the shoot length of the pakcoy plant as indicated by the linear equation Y = 2.478x + 9.2727 (R^2 = 0.9884). The following graph descred the effect of giving some LOF concentrations of jengkol fruit peels to the shoot length of plants (Figure 2).

From this equation, it can be explained that every 1% increase in LOF concentration of

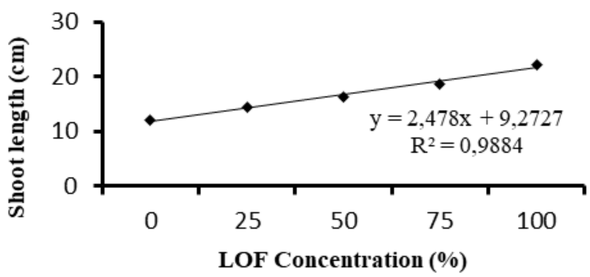

Figure 2. Graph of the relationship between LOF content and shoot length of pakcoy plant

jengkol fruit pods from 0 - 100% can increase pakcoy plant shoot length by 2.478 cm. Gerald (2014) explained that liquid organic fertilizer can increase shoot length and number of leaves in mustard plants. The shoot length of the pakcoy plant is closely related to the number of leaves of the pakcoy plant. The better growth of the shoot length of the pakcoy plant can be assumed that the number of leaves is also increasing.

Leaves are very important organs of plants. Leaves are a place for photosynthesis in plants because chlorophyll is used as a tool to synthesize food for plants by the energy of sunlight. Increasing the LOF concentration of jengkol fruit pods was able to increase the number of leaves as indicated by the linear line equation Y = 2.0733x + 5.0467 (R^2 = 0.9853). The graph of the effect of giving LOF concentrations of jengkol pods to the number of leaves during the study is presented in Figure 3.

From this equation, it can be explained that every 1% increase in LOF concentration of

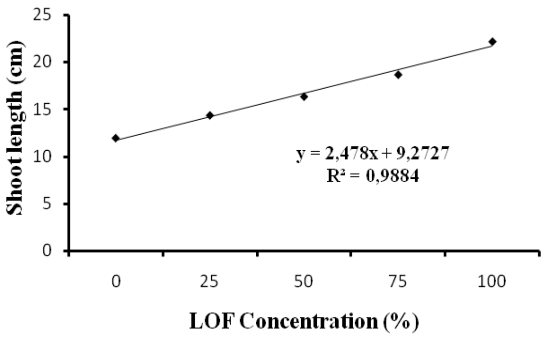

Figure 3. Graph of the relationship between LOF Concentration and the number of leaves

jengkol fruit pods from 0-100% can increase the number of pakcoy leaves by 2,073 strands (Figure 4). Hakim et al. (1986) stated that the N nutrient is very important to pakcoy growth so that the plant growth is better. Prihmantoro (2007) described that nitrogen is needed by plants to stimulate plant growth, especially stems, branches, and leaves. According to Ohorella (2012), liquid organic fertilizer contains nutrients which play an important role in every plant metabolic process. The number of leaves of the pakcoy plant is closely related to the leaf area of the pakcoy plant. The better the growth of the number of leaves of the pakcoy plant, it can be assumed that the existing leaf area is also getting better because

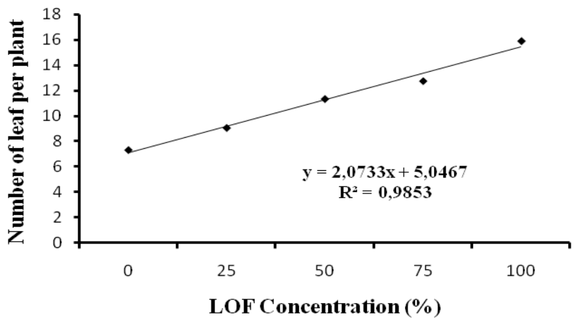

Figure 4. Graph of the relationship between LOF concentration and leaf area of pakcoy plants

the photosynthesis process is done optimally.

Gardner et al., (1991) stated that leaf area is the net result of assimilation process. Leaf area is an illustration of the ratio of leaf surface to the area of land occupied by plants. The usefulness of leaf area is used to describe the total content of leaf chlorophyll. The increase in LOF concentration of jengkol fruit pods was able to increase the leaf leaf area of pakcoy which was indicated by linear line equation Y = 16,275x + 9,2287 (R^2 = 0,8969).

From this equation, it can be explained that every 1% increase in LOF concentration of jengkol fruit pods from 0 - 100% can increase the leaf area of pakcoy plant by 0.980 cm (Figure 5). According to Hakim *et al.* (1986) the fulfillment of nutrients and radiation will make the photosynthesis process in plants run smoothly and plant growth will be better, thus, the production of plant will also increase. The results of the study by Hadisaputro et al. (2008) showed that N and K fertilizer can increase the activity of PEP carboxylase in leaves, the role of N in stimulating photosynthetic enzyme activity is more dominant than K. The shoot length, leaf number and leaf area of pakcoy plants are closely related to the fresh weight of shoot. The better the growth of shoot length, number of leaves and leaf area of pakcoy plants can be assumed that the fresh weight of the canopy is also getting better.

The canopy fresh weight is the weight of fresh plants obtained after harvest and then weighed immediately. According to Lakitan (2001) the fresh weight of plant canopy is a composition of 80-90% water content, and the remaining content is the dry weight of the plant itself. The fresh weight of shoot will be greater if the other variables are also getting bigger such as the length of the shoot and number of leaves. The increase of LOF concentration of jengkol fruit peel was able to increase the fresh weight of plant canopy as indicated by the linear line equation Y = 0.5522x + 4.424 (R^2 = 0.8879).

From this equation it can be explained, every

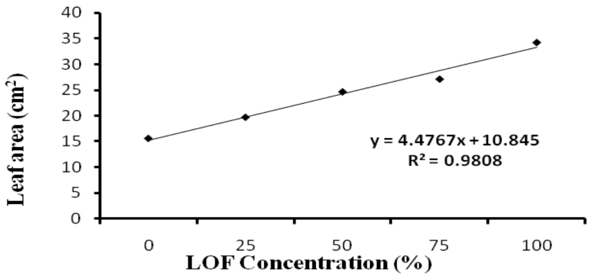

Figure 5. Graph of the relationship between LOF Concentration and the fresh weight of shoot

1% increase in LOF concentration of jengkol fruit skin from 0 - 100% can increase the fresh weight of pakcoy plant canopy by 0.552 grams. According to Irianto (2008) there was a significant difference in the fresh weight of kailan, presumably because of differences in the amount of water contained in plants. The amount of water that is different for each plant is due to the different doses of liquid fertilizer given to plants. This is in line with the secular nature of kailan (containing lots of water). Between 70 and 90% of the active growing part of the plant consists of water. Harjadi (1991) states that the availability of nutrients plays an important role as an energy source so that the level of nutrient adequacy plays a role in influencing the biomass of a plant. Plant growth can be disrupted if there is no additional nutrient derived from fertilizer which results in lower biomass. Organic fertilizers can increase the fresh weight of plants because they are easily decomposed and can provide nitrogen and other nutrients for plants. The fresh weight of pakcoy plant canopy is closely related to the total dry weight of pakcoy plants. The better the yield of the fresh weight of the produced pakcoy canopy, it can be assumed that the total dry weight produced is also getting better.

The dry weight of plants is the weight obtained after the plant through several stages such as the drying process until the weight is constant. The dry weight of plants is one of the parameters of plant growth. The dry weight of plants indicates the pattern of plants accumulating products from photosynthesis, besides that it is an integration with other environmental factors. The dry weight of plants will be greater if the other variables are also greater such as the length of the crop canopy, number of leaves and variable weight of fresh canopy plants. Increasing the LOF concentration of jengkol fruit peel was able to increase the total dry weight of plants as indicated by the linear line equation Y = 0.0506x + 0.9027 (R^2 = 0.8708) (Figure 6).

From this equation, it can be explained that

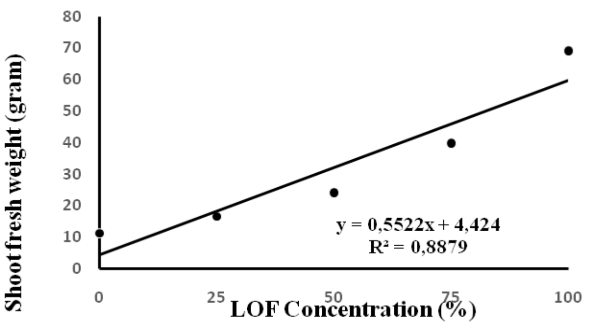

Figure 6. Graph of the relationship between LOF concentration and total biomass fresh weight

every 1% increase in LOF concentration of jengkol fruit pods from 0 - 100% can increase the total biomass dried weight of pakcoy plants by 0.050 grams (Figure 7). According to Ratna (2002) that if nutrients are available, the vegetative growth and dry weight of plants will increase, but if the conditions were lacking of nutrients, the plant will produce low dry weight. Sumarsono (2007) stated that dry weight of plants reflects the accumulation of organic compounds that were successfully synthesized by plants from inorganic compounds (water, CO_2 and nutrients) through photosynthesis.

The dry weight of roots is very dependent on root volume and the number of roots of the plant itself, so that the amount or volume of roots has a significant effect on the dry weight of the roots affected as well. The increase in LOF concentration of jengkol fruit peel was able to increase the dry weight of plant roots as indicated by the linear line equation Y = 0.0127x + 0.256 (R^2 = 0.9073) (Figure 8).

From this equation, it can be explained that

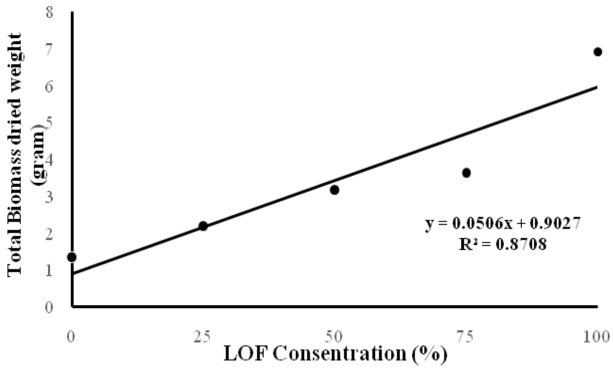

Figure 7. Graph of the relationship between LOF concentration and biomass dried weight.

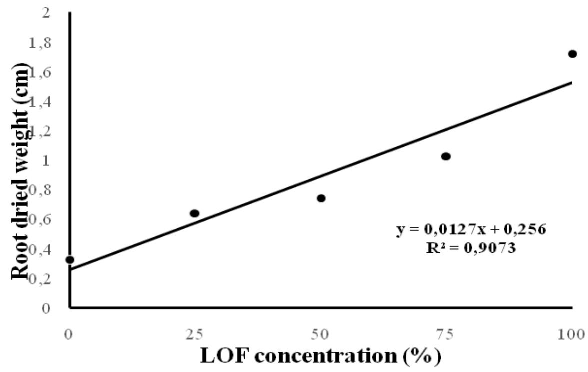

Figure 8. Graph of the relationship between LOF concentration and root dried weight

every 1% increase in LOF concentration of jengkol fruit skin from 0 - 100% can increase the dry weight of roots by 0.012 grams. According to Humadi (2007), if plants have certain limits on nutrient concentrations will cause plant growth to be hampered because less nutrients availabe for metabolic processes.

CONCLUSIONS

The optimum concentration of LOF that increase the growth and yield of pakcoy plants has not been obtained. Extraction of LOF of Jengkol fruit peel at a concentration of 100% resulted in the tallest shoot, the highest number of leaves, the best leaf area, the heaviest fresh weight, the heaviest total biomass dried weight, the highest greenish level and the heaviest root dry weight.

REFERENCES

BPS dan Direktorat Jendral Hortikultura. 2015. Data Produksi Sawi Nasional.

Fahrudin, F. 2009. Budidaya Pakcoy (*Brassica rapa* L.) Menggunakan Ekstra Teh dan Pupuk Kascing. Skripsi. Fakultas Pertanian. Universitas Sebelas Maret. Surakarta.

Gardner, F,P,. R,B. Pearche, dan R,L,. Mitchell. 1991. Physiology of Crop Plants (Fisiologi tanaman Budidaya, alih bahasa oleh Susilo, H). Universitas Indonesia. Jakarta. 428 p.

Gerald, S., M. A. Rahmi,. dan P. Astuti. 2014. Pengaruh Jenis dan Konsentrasi Pupuk Organik Cair Terhadap Pertumbuhan dan Hasil Tanaman Sawi (*Brassica juncea* L.) Varietas Tosakan. Jurnal AGRIFOR. 13 (1):33-40.

Gusnidar,Yulnafatmawati, dan R. Nofianti. 2011. Pengaruh kompos Asal Kulit Jengkol (*Phitecolobium jiringa* (Jack) Prainex King) terhadap ciri Kimia Tanah Sawah dan Produksi Tanaman Padi. Jurnal Solum. 8 (2):58-69.

Hadisaputro S, Rochiman K, Mirzawan PDN, Sukarso G, dan Sugiharto B. 2008. Kajian peran hara Nitrogen dan Kalium terhadap aktivitas Phosphoenolpyruvate Carboxylase di dalam daun tebu keprasan varietas M 442-51 dan Ps 60. Jurnal Ilmu Dasar 9(1):62-71.

Hadisuwito, S. 2012. Membuat Pupuk Organik Cair. Agromedia Pustaka. Jakarta.

Hakim, N., A. M. Lubis., S. G. Nugroho., M. A. Diha., G. B. Hong., dan H. H. Bailey. 1986. Dasar-Dasar Ilmu Tanah. Universitas Lampung, Lampung.

Harjadi SS 1991. Pengantar Agronomi. Gramedia. Jakarta.

Humadi, F.M. and H.A. Abdulhadi. 2007. Effect of different sources and rates of nitrogen and phosphorus fertilizer on the yield and quality of *Brassica juncea* L. Journal Agriculture Resources 7 (2): 249-259.

Irianto. 2008. Pertumbuhan dan Hasil Kailan (*Brassica albrograba*) pada Berbagai Dosis Limbah Cair Sayuran. Jurnal Agronomi .12(1):50-53.

Lakitan B. 2001. Dasar – dasar Fisiologi Tumbuhan. Raja Grafindo Persada. Jakarta.

Ohorella Z. 2012. Pengaruh dosis pupuk organik cair (POC) kotoran sapi terhadap pertumbuhan dan produksi tanaman sawi hijau (*Brassica sinensis* L.). Jurnal Agroforestri 7(1): 43-49.

Pitojo, S. 1995. Jengkol Budidaya dan Pemanfaatannya. Yogyakarta. Kanisius. 72 hal.

Prihmantoro. 2007. Memupuk Tanaman Sayuran. Penebar Swadaya, Jakarta.

Ratna, D.I. 2002. Pengaruh Kombinasi Konsentrasi Pupuk Hayati Dengan Pupuk Organik Cair Terhadap Kualitas Dan Kuantias Hasil Tanaman Teh (*Camellia sinensis* (L.) O. Kuntze) Klon Gambung 4. Ilmu Pertanian 10 (2): 17-25.

Sirappa, M.P. 2002. Penentuan batas kritis dan dosis pemupukan untuk tanaman jagung di lahan kering pada tanah typic Usthorthents. Jurnal Ilmu Tanah dan Lingkungan 3(2): 25-37.

Sumarsono. 2007. Analisis Kuantitatif Pertumbuhan Tanaman Kedelai (Soy Beans). Jurusan Nutrisi dan Makanan Ternak Fakultas Peternakan Universitas Diponegoro, Semarang.

Yogiandre et al., 2011, Budidaya Pakcoy, http://kios.tabloidtransagro.com/budidaya pakcoy, Diakses Februari 2017.