



Study of Application of Appropriate Technology on the Cabbage Plants (Study of Utilization of Liquid Organic Solution in Cabbage Plants in Pattapang Village, Tinggimoncong District, Gowa Regency)

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Abstract

The quantitative experimental research entitled "Study of application of appropriate technology on cabbage plants (study of utilization of liquid organic solutions in cabbage plants in Pattapang village, tinggimoncong district, gowa regency)" is important as an effort to utilize biological natural resources to overcome the threat of pests, increase the productivity of eco-friendly agriculture. The goals that are expected to; 1) increase the efficiency in the utilization of liquid organic solution (loc) by cabbage farmers in the pattapang village, tinggimoncong district, gowa regency , 2) designing manufacturing techniques and describing the application of liquid organic solution (loc) to liquid organic fertilizer (poc) by cabbage farmers in pattapang village, tinggimoncong district, gowa regency, 3) describe the dual benefits of liquid organic fertilizer (poc) on cabbage by cabbage farmers in the pattapang village, tinggimoncong district, gowa regency. The theories referred to in this research are the theory of sustainable development, the theory of polarity of compounds, the theory of element stability, the theory of chemical bonds and the theory of environmental balance. The objects of this research are liquid organic fertilizer, brassicaceae family and their pests, and the informants are farmers. The research design will be carried out with a quantitative experimental method because before laboratory tests are carried out to determine the metabolic secondary compounds in various liquid organic fertilizer mixtures and nutrient content in the planting medium, as well as a field survey to determine the empirical conditions that occur in cabbage farmers. The output obtained is the known level of efficiency in the utilization of liquid organic solution, namely availability, access facilitation, affordability, compounding facilitation, ease of use and low levels of risk of equipment and materials. Poc is formulated from various organic materials that can be used to maximize the productivity of cabbage plants. Ideal concentration required for an area of 100m² to 168 units of cabbage is 1.25 liters of poc per 15 liters of water to produce a cabbage weighing 800gr/yield. The parameters proven are the number of leaves, the length of the leaf diameter, the weight of the crop and the length of the diameter of the crop so that at the age of 8 weeks of harvest it will be

able to produce cabbage with an average weight of up to 800gr/yard or 200 grams heavier than the ideal standard weight of cabbage, which is 600gr/yard. The poc is capable of improving the quality of cabbage which avoids the threat of inorganic compounds, is large and heavy and does not pollute water, soil, air and is not a risk to work safety.

Keywords: *Pests; Cabbage; POC; Eco-Friendly*

Introduction

Sustainable agricultural systems must meet the safe criteria according to environmental insight, namely maintaining the quality of natural resources and the overall vitality of the agroecosystem by managing soil and plant prosperity as well as human and animal life through natural biological processes (Reijntjes, 2006). The use of technology in the scope of modern agriculture has an impact on the destruction of natural resources and the environment so that in its application it is always expected to be of use value with appropriate technology standards. The success of increasing agricultural production and productivity due to the use of chemical fertilizers which have an impact on land destruction and depletion as well as the biotic and abiotic environment that exceeds the ability of the ecosystem meant to recover itself (Wiwik et al., 2015).

Benefits of POC for soil fertility management in this system only emphasizes nutrient replacement through the addition of excessive inorganic fertilizers without any effort to maintain overall soil fertility, which includes physical, chemical and biological soil fertility, so it takes TTG in the form of Liquid Organic Fertilizer (POC) which nutrients are in the form of a very fine solution so that it is easily absorbed by plants, even by the leaves or stems (Murtlaksono & Anwar, 2014).

The context of nutritional balance for strengthening food security of the community requires not only protein and calories from crops but also the need for vitamins and minerals obtained from vegetables and fruits. Changes in lifestyle have an impact on the consumption patterns of society so that commodities of vegetables and fruits are required to improve nutritional quality which has implications for health. The interest in health by reducing the role of chemical fertilizers and pesticides in foodstuffs will cause residue (contamination) so that the alternative way is to choose the types of vegetables and fruits that are developed in a process that is healthier in biology, physics and chemistry (Maria & Cristina, 2014).

One type of vegetable crop that is directly consumed and popular with people which are susceptible to the spurt of pest and disease is the cabbage plant (*brassicaceae* family) as it was developed massively in Gowa Regency with a harvest area of 2,036 hectares. Its productivity reaches 50,674 tons per year which is allocated to meet the needs of horticulture in several districts/cities around it, including Makassar City. The higher market demand for cabbages can reduce production because its orientation is to meet market needs, while the quality of the products cannot be guaranteed biologically, physically and chemically so that it has an adverse impact on consumers. Another thing is the controlling of environment quality [soil, water and air] which has been used as a medium for cultivation, certainly will undergo quality degression so that the use of all forms of technology, equipment and production materials must meet the eco-friendly prerequisites. Regarding this substance, this research is urgent to provide solutions in the cultivation of cabbage, utilization of the potential of organic matter, ensuring public health and environmental quality for sustainable agriculture.

This research that has been conducted aims to; (1) Increase the efficiency in the utilization of Liquid Organic Solution (LOC) by cabbage farmers in the Pattapang Village, Tinggimoncong District, Gowa Regency, (2) Designing manufacturing techniques and describing the application of LOC to POC by cabbage farmers in Pattapang Village, Tinggimoncong District, Gowa Regency, and (3) Describe the dual benefits of POC on cabbage by cabbage farmers in the Pattapang Village, Tinggimoncong District, Gowa Regency. The POC produced is SNI standard after going through various experimental processes to

improve the quality of cabbage biologically, chemically and physically as well as being safe, easy and affordable in assembly and use. This condition has led this research to focus on the organic agricultural approach but also on environmental sustainability for its sustainability.

Literature Review

The literature used as a reference as well as a comparison in this assessment process is related to appropriate technology in the field of agriculture, eco-friendly agriculture, liquid organic solution, liquid organic fertilizer, and cabbage cultivation. The focus of the research leads to the criteria for eco-friendly agriculture (Soetanto, 2002) are; (a) The maintained biodiversity and ecological balance of biota on the surface and soil layer, (b) The maintained quality of agricultural resources from a physical, hydrological, chemical, and microbial biological perspective, (c) Free of contamination from chemical residues, organic and inorganic waste which are harmful or disrupt the life process of plants, (d) The preserved genetic diversity of cultivated plants, (e) No accumulation of toxic compounds and heavy metals that are harmful or exceed the safe threshold, (f) There is an ecological balance between pests and their natural enemies, (g) Stable and sustainable land productivity, and (i) Production of high quality and safe crops for food or feed.

POC is a fertilizer derived from organic matter with a non-solid liquid form that dissolves easily in the soil and carries essential elements for plant growth. POC has many advantages, including containing certain substances such as microorganisms rarely found in solid organic fertilizers in dry form. The final form of POC is a solution derived from the decomposition of organic matter in the form of plant residues, animal waste, and human waste which contain more than one element of nutrients. POC can quickly be used to overcome nutrient deficiencies, prevent nutrient leaching, and provide nutrients quickly. The positive impact obtained due to the use of eco-friendly POC has led to this fertilizer being widely developed in the community (Santoso, 2004).

Organic pesticides are medicinal compounds to control pests and plant diseases made from natural ingredients. The ingredients for making organic pesticides are taken from plants, animals and microorganisms. Made from materials found in nature, this type of pesticide is more eco-friendly and safer for human health. Plant parts taken for organic pesticides usually contain active substances from secondary metabolite groups such as alkaloids, terpenoids, phenolics and other chemical substances. These active ingredients can affect pests in various ways, such as *repellents*, *anti-feedants*, *growth regulators*, *attractant* and as deadly toxins. Organic pesticides made from animal parts usually come from urine, and some microorganisms are also known to control pests that can be used to make pesticides (Rukmana, 2000).

Cabbage (*Brassica oleracea* or *B. oleracea* var. *capitata*, var. *tuba*, var. *sabauda* or var. *acephala*) is a member of genus of *Brassica* and the family of mustard, Brassicaceae. Several other cruciferous vegetables (sometimes known as *cole plants*¹) are considered cultivars of *B. oleracea*, including broccoli, collard greens, brussels sprouts, kohlrabi and broccoli sprouting. Cabbage has the characteristic of forming a crop, which early growth is characterized by normal leaf formation but as they mature the leaves begin to curve upwards until they grow very tightly. In this condition, farmers usually cover the crop with leaves underneath so that the color of the crop is paler. When the crop size is sufficient, the cabbage is ready to be harvested. Cabbage is a seasonal commodity but is categorized as *biennial* so it requires vernalization for flowering (Pracaya, 2001).

Methodology

The research carried out is a quantitative research with an experimental approach because in its implementation it will be more focused on testing on the demonstration plot then tested in the laboratory and tested the residue in the experimental garden. The initial stage is the assembly of the LOC which will

be tested for chemical content feasibility, but to prove the accuracy of the function, an initial trial is carried out and is considered representative for physical testing in the experimental garden.

The types of data collected are secondary data and primary data obtained from interviews with farmer groups at the research location and measurement of the propagation process of cabbage plants as a result of the experiment. Collecting data are through interviews, field observations, laboratory tests and limited discussions with trusted sources to get input from various experiments. Measurement of the efficiency level of LOC utilization through qualitative descriptive analysis of the equipment and types of materials used, namely; (a) level of availability, (b) access facilitation, (c) affordability of purchase price, (d) compounding process facilitation, (e) ease of use, and (f) risk level of utilization. The first part of this is an attempt to test the soil chemically and the types of compounds contained in the LOC material.

The next part is the process of LOC testing in experimental gardens to ensure quality accuracy with 9 concentrations and 3 repetitions as well as 3 controls. The initial step is the process of land preparation and seed seeding, then intervening with intensive watering at a period that is conditional during the propagation phase until just before harvesting. The whole stages was observed and recorded on the parameters of [a] number of leaves, [b] leaf diameter, and [c] crop weight. The data from each parameter was then performed a statistical test of analysis of variance or ANOVA with the help of SPSS 16 to obtain the ideal concentration for the four parameters referred to. The field test results were then confirmed against the assessment of the POC feasibility standard according to the SNI standards to get the ideal concentration using the advanced tests of *Duncan Multiple Ranges Test* (DMRT). The second stage of this analysis is to determine the physical changes of cabbage due to intervention using POC with a certain concentration.

The third part is measuring the biological quality of cabbage that has received POC intervention in the form of ideal cabbage shape and its durability after harvesting. The quantity aspect is known through the productivity range per hectare which is influenced by the number of pieces and the average weight per piece. The next aspect is environmental sustainability which can be ascertained through laboratory test results of changes in soil quality and qualitatively irrigated from the results of the water and air quality, and closed with an analysis of work safety insurances since the POC compounding stage, field and laboratory testing as well as during the process of using POC.

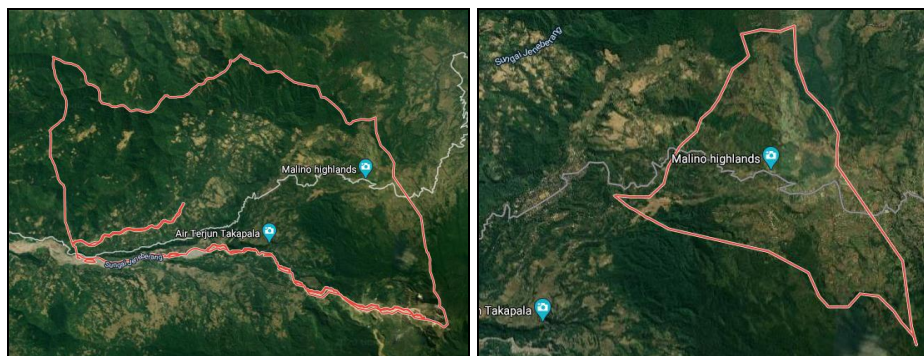


Figure 1. Tinggimoncong District Map and Pattapang Village (Gowa Regency)

Results and Discussion

The analysis stages are grouped into 3 (three) parts, all of which are interconnected, namely; *first*; measuring the efficiency level of LOC utilization, *second*; describes the manufacture, compounding and application of POC, *third*; described the dual benefits of POC as an organic insecticide. The results and discussion of the three objectives are presented in the following explanation;

1. Efficiency level of LOC utilization

Making LOC requires a variety of simple equipments that are easily obtained because they are available around the users including; drum, *hand sprayer*, hoe, machete, paranet, bamboo, pipe ¼ inch, hose ¼ inch, and measuring ruler. Meanwhile, complementary equipments in this assessment process include a name board, stationery, cameras and soil pH, including a tractor for further land processing. The types of materials needed for LOC compounding and further processing include turmeric, curcuma, galangal, gadung, betel leaf, young coconut water, palm sugar, EMA, cow urine, chicken manure and cabbage seeds for further cultivation process. The various types of equipment and materials referred to can be easily obtained in the surrounding environment, even if they are not available, it can be solved with other types of equipments that can be used in part of the process. The availability of these various equipment and materials makes it easier for farmers to access them and the substitute equipment and materials can be easily found if not available.

In addition to being easy to obtain due to their availability, most equipment and materials type can also be obtained at relatively cheap and affordable prices even though only with a lease system such as a tractor for plowing the land. Equipment that is not used up for a single production process and can be obtained at traditional markets at affordable prices with a price range of <IDR 50,000, and can even be self-assembled from used goods in the surrounding environment. Meanwhile the most expensive equipment in the production process is the rental of a tractor for one planting season, around IDR 300,000.

The LOC compounding process begins with the preparation of the container and raw materials including; 2 kg of turmeric, 2 kg of curcuma, 2 kg of galangal, 2 kg of gadung, 1 kg of palm sugar, 5 liters of young coconut water, 1 kg of betel leaf, 1 bottle of EM 4 (1 ½ liters), and 10 liters of cow urine. The various ingredients are then thinly chopped and blended until smooth and fuzed then mixed with betel leaf water in 60 liters of water, while palm sugar is diluted by heating until it melts then mixed with EM 4 of 400 ml added to young coconut water (5 liters), then add the liquid palm sugar and stir until blended and add the herbs ingredients, add cow urine (10 liters) and stir evenly, collect in a bucket with a capacity of 60 liters. The assembly process can be carried out in open or closed spaces, but to speed up the fermentation process, the container containing the mixture is left stored in a shady room where the container has been tightly closed for 29 calendar days, afterwhich LOC can be used.

The LOC mixture referred to in the pretreatment is then sampled for laboratory tests to be confirmed of various dangerous substances that are suspected to appears in the assembly process but the results do not contain harmful compounds so it is relatively safe in the compounding process and its use but it is recommended to use a face mask and hand equipments to avoid contractions from outside into the POC. The dosage of materials with various treatment processes is then standardized to obtain the accuracy of the compounding process until it changes from LOC to POC after chemically confirmed from laboratory test results.

2. Compounding and Application of POC

The process of compounding LOC into POC has been obtained after going through laboratory tests and then testing the product in a demonstration plot. The beginning stage is the preparation of land covering an area of 350m² to 30 beds and seeding. Planting medium used for seeding are taken from the location of the laboratory experiment and then tested to make sure the initial conditions of pH less than 5.5. Making of beds begins with plowing the soil using a tractor and then proceed to build beds measuring 1 x 11m² with distance between beds 30cm and a thickness of beds up to 30cm. While the land preparation process is ongoing, the cabbage seeding process is also carried out in a shady location around the experiment location, the seeds are sterilized by soaking in a fungicide solution or in hot water for about 15 to 30 minutes then soaking for 12 hours to accelerate germination and sorting to obtain the best seeds.

The seeds are sown in polybags and left for 8 weeks with routine watering treatment every morning and evening until it gets an average of 5 seedling leaves, and after that it can be transferred to the

planting hole in the demonstration plot bed. The process of planting seedlings of cabbage planted with equipments to help in the planting hole as deep as 30cm, and the distance between the planting holes 30cm so that the average number of plant per plot reach 56 trees. The watering process is carried out every morning using manual equipments with different dosages for 9 POC concentrations, namely; treatment group 1 (0.25 liters, 0.75 liters and 1.2 liters), group 2 (0.5 liters, 1 liters, 1.5 liters), and the treatment group 3 (1.75 liters, 2 liters and 2.25 liters), each of which is mixed in 15 liters of clean water.

The observation process was continuously carried out along with the intensity of watering every day for 7 weeks of growing period, embroidery was also carried out for several trees that failed to grow, but in the experimental process there were no trees that failed to grow except for trees on control beds that had abnormal growth. The process of observing the four parameters is monitored from the start, but for ideal measurement, it is done at the final stage of harvesting, which is at week 8. The ideal concentration for the parameter of the number of leaves is 1.25 liters which have a consistency value of 19.08 b; while the parameter of the diameter of leaves (cm) is also a concentration of 1.25 liters with consistency value of 32.92 b. Meanwhile the crop weight (kg) parameter was controlled by concentration of 1.25 and 1 liters in a consistent value ranging from 1100 to 1141 a, while the crop diameter parameter (cm) is a concentration of 1.25 liters. Based on the statistical analysis range that have been further tested, the ideal POC concentration for 15 liters of water is 1.25 liters to ensure the four physical parameters of cabbage.

The results of the compound in a chemical approach through a biomass content test and then tested in a biological approach have obtained cabbage yield that is more than the average SNI standards set by the Ministry of Agriculture. The series of experiments, observations, measurements and analysis at this stage is an intervention of a biological approach to obtain quality cabbage.

3. Benefits of POC as Organic Insecticide

The next stage is a physical approach in measuring the indicators of product neatness, covering aspects of cabbage quality, cabbage quantity, environmental sustainability, and work safety. Regarding the physical quality of cabbage, it is measured from the previous four parameters, namely the number and diameter of the leaves as well as the weight and diameter of the crop, where the four will determine the size and weight of the cabbage. The flawless smooth appearance of the cabbage on the second crop and its ability to last for a relatively long time are also indicators of the quality of cabbage products as a result of the ideal treatment of using POC according to the right dose and concentration. The results of observations and testing showed that the results of cabbage from beds that received treatment with a concentration of 1.25 liters of POC per 15 liters of water consistently produced cabbage based on the four parameters maximally, then physical observations and the ability to survive for more than 7 days in a relatively fresh condition as any other treatment are conducted.

While in terms of quantity, as measured by the standard, cabbage can be produced on 1 hectare of land to produce 6-8 tons, now in the use of formulated POC, the average weight per yield is 800 grams. This condition is above the ideal average weight of cabbage which is 600gr/yield so that the average total production of cabbage per hectare is 13 tons. Increased productivity is positively correlated with the weight and unit size of cabbage per yield so that if accumulated shows a significant increase.

The aspect of physical environmental sustainability is measured from changes in the quality of water, soil and air in the experimental location. This research is only concentrated in laboratory tests for the types of soil used which are tested before and after land use. The results of soil laboratory tests that measure various soil properties show a slight depression but the condition is still tolerable due to the possibility of such changes as a result of use residue and has not been reprocessed to return various substance contents to the original condition. Meanwhile, water and air observations carried out manually and directly confirmed to the surrounding community show that conditions are improving and can still be tolerated so that the threat of environmental damage and pollution cannot be proven.

The safety aspect is monitored from the initial process of selecting equipment and materials, compounding, testing and post-harvest processing, which shows that the mixers and the workers involved do not experience physical health problems. The work safety insurance is measured from the absence of hazardous chemical content, does not use high-risk technology and does not require special skills for its use so that the use of POC is not only able to improve the quality and productivity of cabbage but also to ensure environmental sustainability and work safety for the surrounding community.

Conclusion

The conclusions obtained from the research results are;

1. The use of LOC as an organic pesticide is an alternative in agricultural sector in order to improve crop quality and productivity. This effort is a form of innovation that is currently being developed in the agricultural sector because in addition to increasing crop productivity and quality, it can also minimize the impact of environmental damage caused by the use of organic pesticides.
2. The use of POC which is made with organic raw materials and simple, easy-to-obtain, and low-risk equipment can provide added value to the quality and productivity of cabbage plants compared to using inorganic fertilizers.
3. The ideal concentration of POC for 15 liters of water used for 168 trees in an area of 30m² is 1.2 liters of POC to obtain quality cabbage plants according to the parameters of number and diameter of leaves as well as weight and crop diameter for each yield which is consistent for 3 repetitions.
4. The results of the observations showed that the cabbage plant was perfectly propagated where not one plant experienced growth failure except for those in the control beds. The final measurement results for the four parameters of 9 concentrations show that the average net weight of cabbage is 800 gr/yield, or more than the ideal weight of 600 gr/yield so that productivity reaches more than 10 tons per hectare, or higher than the ideal productivity of 8 tons per hectares.
5. Utilization of POC for cabbage plants not only produces above standard quality cabbage but also ensures the quality of cabbage to remains fresh until the 7th day, and is very environmentally friendly, which is measured from the impact of environmental physical indicators [soil, water and air]. The safety aspect is guaranteed from the contraction of dangerous chemical compounds because it uses organic materials, simple equipment and ensures the work safety of the mixers and their users.

Suggestion

Referring to the conclusion above, the recommended suggestions are;

1. Farmers are expected to be intensified in utilizing the potential of biological and vegetable resources to be recycled into usable materials in their agricultural production processes such as making LOC from organic materials for POC.
2. The supply of organic raw materials must be increased for the provision of making POC which can be obtained anytime and anywhere in a stable condition so that problems in obtaining raw materials will not become a reason for farmers in compounding and using POC for the production process of horticultural crops.
3. The weakness of using POC is that the supply process is relatively long, so it is hoped that there will be restrictions on the supply of inorganic fertilizers in agricultural production areas as well as intensifying the circular use of POC by special producers who will be able to support the supply of POC materials for farmers.

4. Government policies can intervene in the distribution of organic fertilizers, intensify the community in empowerment programs so that they cultivate the use of POC, support the production aspects by providing production equipment, and provide large-scale inter-regional markets.

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