

Nutrient Analysis of Plant Mantangan and its Potential as the Organic Fertilizer in Supporting Plant Physiology Courses

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Article Info

International Journal of Advanced Information and Communication Technology

(https://www.ijaict.com/journals/ijaict/ijaict_home.html)

<https://doi.org/10.46532/ijaict-202108012>

Received 12 January 2021; Revised form 10 February 2021; Accepted 08 March 2021; Available online 05 April 2021.

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Abstract - Plant physiology is one of the subjects in higher education, where the material and the subjects studied in this course is implemented in daily life related to human needs that have the opportunity to be developed into business capital by modifying it according to needs, because the nutrient content and the secondary metabolites possessed by green plants studied in plant physiology courses are very useful for the growth and development of the plant itself. Plant of Mantangan (*Merremia peltata* (L) Merril.) is a plant that is classified as an Invasive Alien Species which grows and develops well although it is not in its natural ecosystem. The effort to prevent Mantangan at this time is still very minimal so that it is necessary to find the right way to anticipate the speed of growth and development of these plants such as by utilizing these invasive plants as ingredients for organic fertilizer for plants. Plants that are considered detrimental such as Mantangan turned out to have great potential to be used again as ingredients that have value and are very useful for human life. This research was conducted to analyze the nutrient content of the plant Mantangan (*Merremia peltata* (L) Merr.) and its potential as organic fertilizer in supporting the subject of plant physiology. The study was conducted at the Laboratory of the Agricultural Technology Study Center in East Kalimantan from March 27 to May 19, 2018. The results of the study show that the leaves, stems and flowers of the plants of Mantangan have the potential to be used as organic fertilizer. This can be seen from the nutrient content of Mantangan leaves, namely 10.25 water content, 44.87 C-organic, 1.68 N total, P 0.15, and 5.14 K. Stems of Mantangan have a water content of 15.18, C-Organic 42.91, N Total 1.19, P 0.18, K 2.54. Mantangan Flowers have 15.78, C-organic 39.35, N total 1.58, and K 2.11. The potential of the plant as an organic fertilizer can support plant physiology courses because the procedure for making organic fertilizer is contained in a Student Activity Sheet which can be done by students themselves.

Keywords - Plant of Mantangan (*Merremia peltata* (L) Merr.); Organic Fertilizer; Plant Physiology.

1. Introduction

Plants are organisms that produce chlorophyll which have an important role in the survival of life in nature. It is the producers of oxygen and other important elements that are

needed by other living things including humans. Plants that grow in places that are not desired by humans because they can harm the cultivated plants, as well as have a growth speed and a long-life cycle. They can be classified in disturbing plants or called weeds.

Weeds tend to have certain characteristics that enable them to spread out easily and are capable of causing loss and disturbance, so they need to be destroyed. Especially for farmers, weeds are treated as plants that must be destroyed because they can harm them and reduce the production of cultivated plants because if the weeds grow together with cultivated plants there will be competition in the absorption of nutrients in the soil, light and living space together. Although the weeds detrimental to cultivated plants, just like plants in general plants that are considered as weeds still have a role and potential in maintaining the balance of the ecosystem and can be utilized by humans in their lives. Some types of plants that are classified as weeds are used by humans widely for animal feed and the treatment of various types of diseases. Research on multiple types of weeds reveals its role in curing various human diseases [1], potential weeds as a fodder and land cover or mulch [2], as well as several types of widespread weeds that are highly potential as standard ingredients for pellet compound fertilizer [3].

This shows that plants that are classified as weeds have the potential to be used by humans in their life activities so that they can be used as useful plants for humans. Utilization of plants that are considered harmful, such as weeds turned out to have great potential to be used again as valuable materials and very useful for human life. This study was conducted to analyze the nutrients contained in plants including weeds, *Merremia peltata* (L.) Merril. to be used as an organic fertilizer that has economic value, and is useful for the growth of cultivated plants.

Mantangan (*Merremia peltata* (L.) Merril.) is one of Convolvulaceae (water spinach) nation's invasive plant species. Mantangan is the most destructive plant in Indonesia, losing habitat generatively reproducing using

seeds and vegetation through the plant roots and stems [4]. Mantangan is one of the Invasive Alien Species (IAS) listed plants which is a species that grows and evolves very well in an environment that is not a natural ecosystem. The IAS will disturb the ecological equilibrium and is dangerous to animals, plants and even humans, the negative impacts that occur will be greater than the positive impacts [5].

The facts regarding this Mantangan make invasive plants need to be dealt with seriously so that it cannot damage the ecosystem and even cultivated plants [6].

2. Research Methods

The current prevention efforts are still very minimal because the information about the morphology and physiology of Mantangan is still lacking, so it is necessary to find appropriate ways to anticipate the speed of growth and development of Mantangan plants, among others are by utilizing this invasive plant as an ingredient for organic fertilizers, as the purpose of this study. The utilization of the Mantangan plant to be used as an organic fertilizer has never been done, so it is interesting to try [7]. In addition to being cheap and widely available organic fertilizers from plants do not leave harmful residues in cultivated plants which are cultivated by farmers, so organic fertilizers are safe to use, inexpensive, as well as easy to obtain.

The Mantangan plant (*Merremia peltata* (L.) Merrill.) which is an invasive weed and often found in the Samarinda region was analyzed and packaged into organic fertilizer, so that organic fertilizer products that have economic value and can be utilized by the community [8]. The utilization of the Mantangan plant as organic fertilizer begins by examining the nutrient content of Mantangan plants through laboratory work which can be done by students in plant physiology courses.

Plant physiology is one of the courses in college that studies the functions and processes that occur in plants, as well as the relationship between these processes with the environment. The material and subject matter studied in plant physiology if implemented in daily life that relates to human needs, so it has the opportunity to be developed into business capital, one of which is by involving students in processing and making organic fertilizers derived from Mantangan plants [9]. Thus, students are trained and prepared to have more skills than just understanding the concepts of growing physiology. These skills can be one of the provisions of students when they finish their education in college.

The procedure for making and processing Mantangan into organic fertilizer is used as a practical guide in the course of plant physiology, specifically the subject of soil and plant nutrition, as well as plant growth and development. So that the students in the lecture process, especially in the practicum of plant physiology courses, students are trained to analyze, process and make organic fertilizers from the Mantangan plant. Thus, students have

the skills in formulating Mantangan plants (*Merremia peltata* (L.) Merrill.) into organic fertilizers [10]. This is the provision of students to work in the same way in other plants, to obtain results that have economic value. The skill to make organic fertilizer can be a provision for students and try it independently to earn income when graduating from college.

The problem of this study is formulated as follows: (1) What is the nutrient content in the *Merremia peltata* (L.) Merrill plant, and it is potential as organic fertilizer in supporting plant physiology courses? (2) How is the effectiveness of organic fertilizers as a result of the formulation of *Merremia peltata* (L.) Merrill plants in supporting plant physiology courses?

The objectives of this study are described as follows: (1) To study the nutrient content of *Merremia peltata* (L.) Merrill plants and their potential as organic fertilizer in supporting plant physiology courses. (2) To study the effectiveness of organic fertilizers as a result of the formulation of *Merremia peltata* (L.) Merrill plants in supporting plant physiology courses.

The benefits of this research include: (1) As an input for the community, especially farmers to use weeds as organic fertilizer for plants. (2) As innovation in lectures on plant physiology. (3) As input for colleagues to be creative and to look for opportunities to support entrepreneurship by the subjects taught. (4) In addition to knowledge for other researchers to carry out similar research.

The urgency of this study is: (1) Unwanted plants (weeds) which are very fast-growing and their spread can be controlled by more creative ways and which can produce economically valuable works. (2) The course of plant physiology is one of the abstract subjects, so creativity is needed to modify the lecture process so that students can develop a spirit of entrepreneurship through the course of plant physiology. (3) Synthetic fertilizers which often because residues can be replaced by utilizing environmentally friendly organic fertilizers.

The research outputs or innovations are: (1) Organic fertilizer products developed from invasive weed formulations of *Merremia peltata* (L.) Merrill which have economic value. (2) Teaching materials in the form of practicum guides in the field of plant physiology, the subject of soil and plant nutrition, as well as plant growth and development.

This research is a Phase I study which was carried out in stages for 2 years as shown in the following Fig 1:

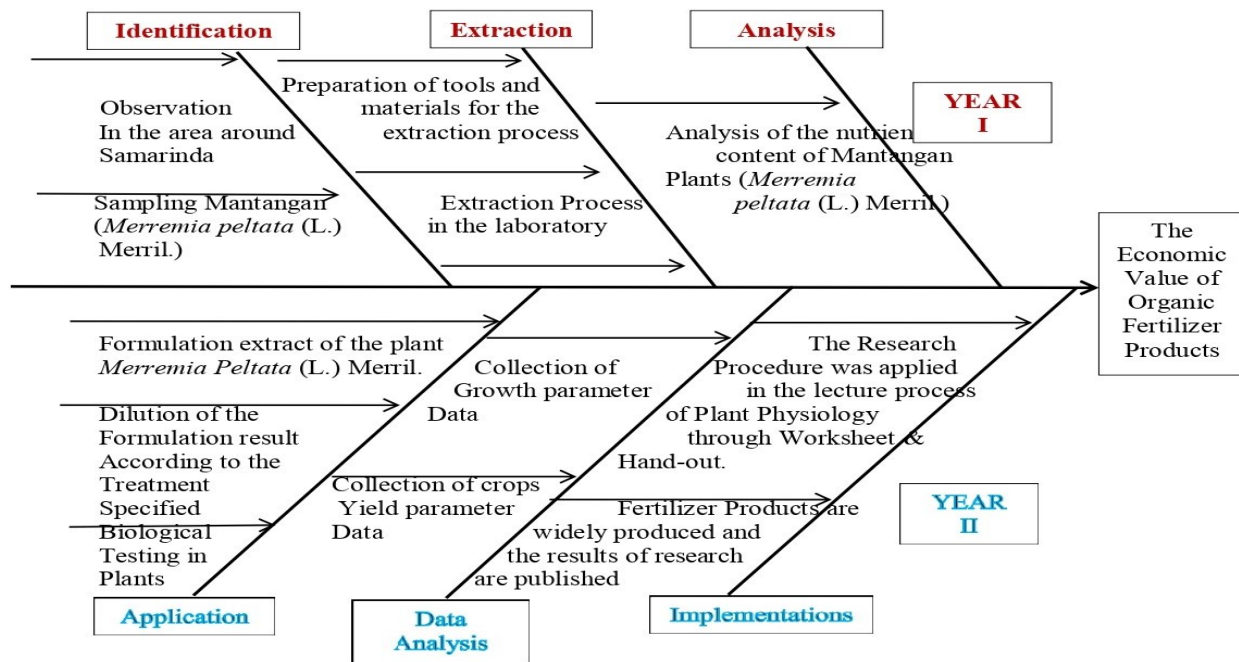


Fig 1: Chart of Research Flow

2.1 Time and Place of Research

The research for the first year was held from March 27th, 2018 to May 19th, 2018 at the Laboratory of Agricultural Technology Research Institute, East Kalimantan Jl. P.M. Noor Sempaja Samarinda.

2.2 Population and Research Samples

The population in this study was the Mantangan plant (*Merremia peltata* (L) Merr obtained in the area around Samarinda. The sample of this study consisted of leaves, stems, and flowers of the Mantangan plant.

3. Research Design

This research was compiled based on Complete Randomized Design consisting of 3 treatments which were repeated 3 times so that obtained 9 units. Each treatment is 5 grams of dry powder Mantangan leaves (L), 5 grams of powder Mantangan stem (S), and 5 grams of Mantangan flower powder (F).

3.1 Data Collection Technique

The data collection technique was carried out by analyzing the nutrient content of each study sample, namely the leaves, stems, and flowers of the Mantangan plant. The

data from nutrient analysis results are included in the table prepared,

3.2 Data Analysis

The data analysis was carried out descriptively qualitatively by describing the nutrient content of Mantangan plants.

4. Research Procedure

The procedure of the study was carried out based on the flow chart of Phase I research which included identification, extraction and analysis activities. All activities are carried out in the East Kalimantan BPTP laboratory.

5. Research Result

This research was carried out by examining the nutrients contained in the Mantangan plant which has the potential to be used as organic fertilizer for cultivated plants. The results of the analysis were carried out in the BPTP laboratory by analyzing the leaves, stems and flowers of the Mantangan plant tissue. The results of the analysis are listed in Table 1.

Table 1: The results of the Analysis of Mantangan Plant Nutrients (*Merremia peltate* (L) Merr.)

No.	Nutrient	Tested Samples			Average
		Leaf	Stem	Flower	
1.	Water Content	10,25	15,18	15,78	13,73
2.	C-Organic	44.87	42,91	39,35	42,37
3.	N-Total	1.68	1,19	1,58	1,48
4.	P	0,15	0,18	2,54	0,95
5.	K	5.14	0,23	2,11	2,49

Source: Research Result (2018)

Table 1 shows that the leaves, stems, and flowers of Mantangan plants have nutrient elements of water, C-organic, N-total, P, and K. The most average abundant nutrients contained in the Mantangan plant are elements C of 42.37. The average nutrient content that was least contained by the Mantangan plant was the P element of

0.95. The average N nutrient is 1.48, K nutrients are 2.49 and the average water content is 13.73. The nutrient content of the Mantangan plant according to the results of the analysis in the laboratory shows that this plant can be used as organic fertilizer for cultivated plants [11]. This needs to be proven again through biological testing on cultivated plants to determine the effectiveness of the organic fertilizer Mantangan plant, which will be carried out in the 2nd year study.

6. Discussion

The results of this study are a series of studies conducted to assess the nutrient content of Mantangan plants (*Merremia peltata* (L) Merril.), A type of plant that is considered an invasive weed that severely damages cultivated plants, even other plants, so it needs to be destroyed even though it is very difficult to do because of the rapid growth and development of this plant. Mantangan has included an invasive plant because it can cause habitat damage, dominate the ecosystem, and cause losses to other plants. In line with [12] states that the dominance of invasive plants is generally indicated by rapid growth, wide distribution, and efficient use of nutrients and photosynthates. Although it is said to be an invasive plant, it turns out that Mantangan is used as a medicinal plant. By [13] that some local communities in Indonesia use Mantangan leaves as traditional anti-cancer drugs (especially breast cancer), diarrhea, abdominal pain, cough, eye pain, wound medicine, inflammation, and wound compression, also used to help the process birth. Added by [14] that Mantangan plants have biological activities as anti-HIV-1 (EC 31.3 μg / mL). Other studies have shown that the Mantangan plant acts as an anti-bacterial at a concentration of 500 ppm.

The utilization of the Mantangan plant as an organic fertilizer has never been done, although it turns out the results of the analysis of nutrient content in the Mantangan plant show that this plant has the potential as one of the plants that can fertilize the cultivated plants. So, by knowing the nutrient content of the Mantangan plant, it can also be seen the potential of this invasive plant to be used as organic fertilizer, as the purpose of this study. The utilization of organic fertilizers is currently increasing rapidly along with farmers' awareness to maintain the health of the soil and the increasingly expensive inorganic fertilizers. [15] stated that the nature of organic fertilizer is to improve the physical and chemical conditions of the soil so that it is conducive for plant growth.

The results showed that the nutrient content in the Mantangan plant turned out to be a macronutrient needed by plants in relatively large amounts in the process of growth and development. This shows that even though it is an invasive weed, it turns out that the Mantangan plant has the potential as an organic fertilizer and can also be used as a plant that can fertilize other plants [16],[17]. This can be seen from the results of the analysis in the laboratory regarding the nutrient content present in Mantangan plants

which shows that this plant has the potential to be used as organic fertilizer for cultivated plants, which is planned to be carried out in research in the second year to prove its effectiveness.

The analysis in the laboratory shows that the Mantangan plant contains macronutrient nutrients that are needed by plants to live. The analyzed parts of the Mantangan plant organs show that there is an important nutrient content for the growth and development of a plant, this explains that the Mantangan plant is very potential to be used as the organic fertilizer because the organs of the plant like leaves, stems, and flowers have the nutrients that are important for the growth and development of cultivated plants. As stated by [18] that in the life process of a plant requires macronutrient and micronutrient nutrients, as well as other additional nutrients.

Carbon (C) is the basic element most needed by organisms including Mantangan plants. Organic carbon (C-organic) elements possessed by leaves, stems, and flowers of Mantangan plants are an important element and needed by plants to carry out electrochemical processes, structural functions, and catalysts, along with other essential elements needed by plants for their survival. In line with [19],[20] which states that the role of electrochemistry includes the process of balancing ion concentrations, stabilizing macromolecules, colloidal stabilization, neutralizing the charge, and other processes. The role of a structure is carried out by elements in their involvement in the chemical structure of biological molecules or used in forming structural polymers (eg: calcium in pectin, phosphorus in phospholipids). The role of elements in catalytic functions is to be involved in the active site of an enzyme.

Element C is the element possessed by Mantangan plants in addition to other basic elements such as Potassium (K), Nitrogen (N), and Phosphorus / Phosphate (P). This is following Bidwell (1979) which states that the portion of the most common element in plant tissues is the element Carbon (C) and Oxygen (O), each occupying around 45%. The next element is Hydrogen (H) as much as 6%, Nitrogen (N) as much as 1.5%, and Potassium (K) 1%. Other elements are below 1%. This is easy to understand because the elements C, O, H, and N are the main elements for the development of organic matter in the plant body.

The most abundant leaves of the Mantangan plants contain C elements, followed by stems, and plant flowers. It can be explained that element C which is also the main element needed by plants in the formation of more organic matter in the plant body in leaves due to leaves is the kitchen of a plant where photosynthesis takes place before photosynthate is formed channeled to all parts of the plant so that this results in the leaves of many elements C and other macronutrient elements. Salisbury and Ross (1995) state that photosynthesis is a process of forming organic matter from inorganic materials (CO_2 , H_2O , H_2S) with the help of sunlight and chlorophyll. All life on this earth depends on photosynthesis both directly and indirectly. Photosynthesis provides both carbon and energy for living organisms and produces oxygen in the atmosphere that is important for all aerobic life forms, including humans.

Potassium (K) is a nutrient that is also possessed by leaves, stems, and flowers of the Mantangan plant. Although only a small number is an average of 2.49%, this

element is one of the main elements needed by plants in large quantities. This is in line with [21] which states that plants require large amounts of potassium, and deficiencies in these elements often occur in sandy or sandy soil, because of their high solubility, so they are easily washed away. Potassium is a common cation in plants and is involved in maintaining ionic balance in cells. Potassium elements have no role in supporting plant structures, but many acts as catalysts. Many enzymes involved in protein synthesis do not work efficiently if there is no potassium. Potassium is needed in large quantities, exceeds magnesium requirements, and acts to activate free enzymes. Potassium is bound in ionic form to the enzyme pyruvate kinase, which is important in respiration and carbohydrate metabolism, so potassium becomes very important for the overall metabolism in plants.

The next element which is known is in the leaves, stems and flowers of Mantangan are Nitrogen, each 1.68% in leaves, 1.19% in stems, and 1.58% in flowers. Nitrogen has a special place in plant nutrition, not because plants are needed in large quantities, but this nitrogen is hardly found in the host rock from which the soil originates. The presence of nitrogen in the soil is almost entirely biological work, artificial enrichment, or natural fertilization (the result of lightning during rain). Nitrogen is very important in plants because it is a component of proteins, nucleic acids and many other important ingredients.

The presence of N elements in the leaves, stems, and flowers of the Mantangan plant makes it clear that this plant can be used as organic fertilizer for other plants, especially in supplementing the elements needed by plants during its vegetative growth. The need for N elements for the formation of leaves and other important vital organs in the vegetative phase of plants can be fulfilled by the presence of the elemental N present in the Mantangan plant.

Phosphorus (P) is found in the leaves, stems, and flowers of the Mantangan plant. The P element is absorbed by plants in the form of phosphate ions. Like nitrogen, phosphorus is very important as an ingredient in many compounds that build plants, including nucleic acids and phospholipids. Besides, phosphorus plays an important role in energy metabolism. [22] states that plants need nutrients to grow and develop. Nutrients needed by plants consist of macronutrients, micronutrients, and additional elements. Macronutrients are also called basic nutrients consisting of elements C, H, O, P, K, N, S, Ca, Fe, Mg. Micronutrients are also called complementary nutrients, consisting of elements of Mn, B, Cu, Zn, Cl, Mo which are needed by plants in relatively low amounts. Both groups of elements are essential elements needed by plants, one of the elements must not be absent in plant nutrition. If one does not exist, it will cause growth and metabolism in plants to be disrupted, even causing death for these plants. That is why the Mantangan plant is one of the plants that have the potential to supply nutrients for cultivated plants because the content possessed by the Mantangan plant includes elements that are needed by cultivated plants. If it is processed into organic fertilizer, this invasive plant can be more easily controlled and the balance of the ecosystem can be conserved without the need to always destroy the Mantangan plant [23].

The procedure for processing Mantangan plants into organic fertilizer is done by following the procedure outlined in the Student Activity Sheet (LKS) that has been prepared based on previous research experience. The procedure that is packaged in this LKS is intended to be carried out by students through practicing activities in Plant Physiology courses especially on the appropriate subject matter. The topics chosen are Land and Plant Nutrition, as well as the subject of Plant Growth and Development. It can be explained that the process of processing Mantangan plant into organic fertilizer is packaged in LKS for students to do on the subject chosen, the aim is to train students to skillfully process Mantangan plants into organic fertilizers. The experience of doing the processing of Mantangan plants into organic fertilizer is a learning process that students will not forget until they finish their studies in college. So that if the situation requires them to process Mantangan plants, other plants, or other materials that will be processed into organic fertilizer, they can do it again in the same way. The skills obtained by these students can be their provision to become entrepreneurs in the future.

The skill to process Mantangan plants as an ingredient for making organic fertilizer with economic value is one way to prepare students to become entrepreneurs. This is because organic fertilizers are needed by farmers and are cheaper than inorganic fertilizers, and are safer to use because they do not leave harmful residues for cultivated plants or consumers. Thus, the selling power of organic fertilizers will not lose compared to synthetic fertilizers, as consequently, the organic fertilizers can provide benefits for those who sell them, so that those who process and cultivate them can take advantage. This thinking is the basis of this research so that the processing of Mantangan plants into organic fertilizer is carried out through lectures on plant physiology that is able to support student entrepreneurship.

7. Conclusion and Recommendation

7.1 *Based on the results of research and discussion it can be concluded that*

- Mantangan plant (*Merremia peltata* (L.) Merrill.) has nutrient content in each leaf consisting of moisture content 10.25%, C-organic 44.87%, N-total 1.682%, P 0.152% and K 5.14%. The nutrients in the stem of the Mantangan plant consist of moisture content 15.18%, C-organic 42.91%, N-total 1.197%, P 0.188%, and K 2.54%. The nutrients in the Mantangan plant flower consists of 15.78% moisture content, 39.35% C-organic, total N-1.580%, P 0.229%, and K 2.11%.
- Mantangan plant has the potential as an organic fertilizer to support student entrepreneurship in plant physiology courses according to the nutrient content of the Mantangan plant and the processing procedures as outlined in Student Activity Sheets (LKS) is prepared based on previous research experience.

7.2 *Based on the results of research and discussion, it can be suggested as follows:*

- To control the rapid spread, the Mantangan plant does not need to be always destroyed, but it can

be processed into organic fertilizer for cultivated plants.

- The results of this study need to be continued to determine the effectiveness of the nutrient content of the Mantangan plant as an organic fertilizer on test plants in the field.

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