



Application of Technology Products of Lake Tondano Sediment and Organic Manures (Green Manure and Compost of Water hyacinth (*Eichornia crassipes*), and Poultry Manure) toward the Growth and Yields of Nut Plants

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Abstract : Research has aimed to: 1)determine the composition of Lake Tondano sediment and organic manure as technology products, 2)apply those products as the effort of local resources management fulfilled the requirements for plant, 3)measure the growth and yield of nut plants toward the given organic manures.

This research was conducted on Pot Experimental with application of technology product of Lake Tondano sediment as the mixture of planted media for growth and yield of nut plants (peanut and green pea) by given the organic manures (compost and green manure of water hyacinth, and poultry manure) in the method of Block Random Design. Using the sediment, water hyacinth and poultry manure was focused on this research in order to apply the technology product as the application of science and technology based local policy as the conservation effort to Lake Tondano in North Sulawesi province, Indonesia.

Results showed that: 1)nutrient contents of Lake Tondano sediment for N,P,K were medium and C-organic content was very high and pH was neutral, 2)organic manures (compost and green manure of water hyacinth, and poultry manure) has variation and very high ratio of C/N, and the nutrient contents were fulfilled the requirements in using to apply as technology products, 3)given the organic manures on the mixture of Lake Tondano sediment gave significant effect on the growth and yield of nut plants (peanut and green pea), i.e.: variation doses of organic manures (green manure of water hyacinth of 10 ton/ ha + compost of water hyacinth of 10 ton/ ha + poultry manure of 10 ton/ ha) gave highest value on Pot Experiment. Height of plant and number of leaves increased with the extent of variation doses of organic manures. This experiment could be applied in further Field Experiment planning.

Key words : lake sediment, organic manures, technology products, nuts plant.

Introduction

Using organic manures as the substituent of chemical fertilizers was mostly needed, because the product was resulted by the organic characterized and friendly in environment. Some government programs in developing the horticultural and foodswere hoped some problems about decreasing of artificial fertilizers could be solved by using some remains plants and another local-organic materials through the organic manure technology. Application of this technology used water hyacinth (*Eichornia crassipes*) as the green manure and compost and hen fesses as the manure. However, Lake Tondano sediment used as the mixture material of soils, was derived from sedimentation process and occurred surrounds Tondano Lake. This sediment in preliminary just as a waste product, but it could be used as planted media.

Some activities have done in Tondano Lake, such as: Pakcoy yields which has planted in small pots gave good responses on its growth when had given the mixture of water hyacinth compost on the Lake Tondano sediment¹, and also the green manure of water hyacinth on the seasonal plants². It was therefore, Sinolungan has found the technology product of Tondano Lake sediment as planted media in 30 tons/ha was the best value of doses^{1,2}; however the research about how to apply the lake sediment for the nuts' growth and yield by giving the organic manures in some treatments has still not done, yet. It was therefore, this research needed to apply.

Tondano Lake was one of the important natural resources in Minahasa Regency, North Sulawesi Province of Indonesia and had some problems, such as: sedimentation and lake shallowing, due to land erosion in the catchment area and some activities in lands surround the lake accumulated by sediment itself³. The lake was covered by water hyacinth so that occur eutrophication. It was therefore needed some efforts, such as managing the Tondano Lake sediment and water hyacinth as the green manure/compost and hen fesses as the poultry manure. These problems were focused in this research in order to apply the technology products as the form of scientific and technology application based on local policy as one of the best fields of Sam Ratulangi programs and the conservation effort to Tondano Lake.

Nut plants such as peanuts (*Arachis hypogaea* L.) and green pea (*Vigna radiata*) were chosen in this research due to these plants were easily in growth in some conditions and some places, besides these had some benefits for people's life, whether prefer to consumed by the people as food sources, or managed by the people to sell in order to increase the people welfare.

Experimental

The research was conducted: a) Sampling the sediment in Talikuran Village Remboken Sub-district, b) Analyzed the physical and chemical soils and the chemicals of compost, green manure and poultry manure in Laboratory of Physical/Conservation, and Laboratory of Chemical/Soils Fertility, Soil Dept, Agriculture Faculty, c) Planting the Pot Experiment in the field of Winangun Dua Village, Manado. This was conducted in 2018. The materials were used, such as: peanut, small green pea, sediment, sand, water hyacinth, and poultry manure.

This research used method of Purposive Sampling for sampling sediment, water hyacinth, poultry manure; and used method of Block Random Design with eight treatments and three repetitions, as below:

A = 0 ton/ha (mixture sediment/control)

B = mixture of sediment + green manure of water hyacinth of 30 tons/ha

C = mixture of sediment + compost of water hyacinth of 30 tons/ha

D = mixture of sediment + poultry manure of 30 tons/ha

E = mixture of sediment + green manure of water hyacinth of 15 tons/ha + poultry manure of 15 ton/ha

F = mixture of sediment + green manure of water hyacinth of 15 tons/ha + compost of water hyacinth 15 ton/ ha

G = mixture of sediment + compost of water hyacinth of 15 tons/ha + poultry manure 15 ton/ha

H = mixture of sediment + green manure of water hyacinth of 10 tons/ha + compost of water hyacinth of 10 ton/ha + poultry manure of 10 ton/ha.

Results and Discussion

1. Nutrients contents of Lake Tondano sediment and organic manures (compost and green manure of water hyacinth and poultry manure)

Analysis result of nutrient contents of Lake Tondano sediment listed in Table 1.

Table 1. Nutrient Contents of Lake Tondano Sediment

Kinds of analysis	Results	Methods of analysis	Remarks
pH H ₂ O	6.75	pH meter	Neutral
C-org (%)	8.23	Walkey and Black	Very high
N-total (%)	0.48	Kjeldhal	Medium
P-available (ppm)	23.24	Bray 1	Medium
K-available (ppm)	16.17	Bray 1	Low
KTK (me/100 g soils)	24.36	NH ₄ Ac	Medium

Table 1 showed that the nutrient contents of N and P-available were medium, whereas K-available was low, C-organic was very high, and soil pH was neutral. The highest content of C-org and N due to the sampling location was growth of so many water hyacinth, which some were decayed then deposited. This deposit might be caused by some people activities surround the lake which made the lake as a place of rubbish. However, the physical composition of sediment was dominated by the grain size of clay and silt so that the texture was silty clay.

Nutrient contents of organic manures consisted of compost and green manure of water hyacinth and poultry manure were listed in Table 2.

Table 2. Nutrient Contents of Organic Manures

Kinds of manures	N(%)	P (%)	K(%)	pH	C-Org
Compost of water hyacinth	1.56	0.22	0.29	6.1	22.01
Green manure of water hyacinth	1.67	0.24	0.26	6.3	25.60
Poultry manure	1.3	1.5	0.78	6.5	30.67

Nutrient contents of those kinds of manures were varied, could be seen on the contents of N,P, K, pH and C-organic. Ratio of C/N was also vary and very high value (compost of water hyacinth = 14.11, green manure = 15.33, and poultry manure = 23.59).

2. Growth of Peanut and Green Pea

Measuring the growth of plants was: height of plant and number of leaves of both peanut and green pea.

a. Peanut

Height of plant

The measuring result of mean of plant height of peanut at 5WAP (weeks after planting) was listed in Table 3.

Table 3. Mean of Plant Height of Peanut at 5WAP

Treatments	Height of plant (cm)
A	21,33
B	21,16
C	21,00
D	22,33
E	21,66
F	21,00
G	19,66
H	20,66

Analysis results showed that given the organic manures, such as compost and green manure of water hyacinth and chicken manure were not significantly affected on height of plant at 5WAP. This showed the nutrients in sediment were still enough extent to grow the peanut, although not gave the organic manures. The sediment nutrients could support the growth of plant height.

The same growth of plant height was not determined the same yield, yet. There was the same height of plant, but the yield was different. This might be the needed nutrients were not extent for plant, yet. When the poultry manure was deposited into the soils it decayed by microorganism to be simple forms⁴. The microorganisms were: bacteria, fungi, actinomycetes and protozoa, then finally to free some kinds of plant nutrients⁵. The nutrients were: C, H, O, N, P, S, K, Mg, Ca, Zn, and Mn⁶. These nutrients were needed by the plant in growth processing, included plant height.

Number of leaves

Measuring the number of leaves of peanut at 5WAP listed in Table 4.

Table 4. Mean of Number of Leaves of Peanut at 5WAP

Treatments	Number of Leaves
A	103 a
B	139 b
C	142 b
D	135 b
E	173 c
F	213 d
G	206 d
H	194 d

Analysis results showed that there was significant effect of given the compost and green manure of water hyacinth and poultry manure on the number of leaves of plant. The results showed organic manures gave some nutrients for plant. The organic manures include poultry manure has the ability in increasing the soils fertility because it could adding the nutrients, increasing the humus contents, improve soil structure and support the fine microorganism⁷.

Moreover that good soil structure could support the growth acceleration included number of leaves and plant yields. The nutrients of N, P, and K in organic manures could be available for plant but it must be occurred decomposition first in the soils⁸. The organic manures were the primary source, such as N,P,K, S and micro essential nutrients for growth and developing plant⁹.

b. Green Pea

Height of plant

Measuring result of mean of height plant of green pea at 5WAP (weeks after planting) was listed in Table5.

Table 5. Mean of Plant Height of Green Pea at 5WAP

Treatments	Plant Height (cm)
A	26.66 a
B	29.66 b
C	30.21 b
D	31.45 b
E	31.66 b
F	30.83 b
G	31.15 b
H	35.66 c

Analysis results showed that given the organic manures (compost and green manure of water hyacinth, and poultry manure) gave significant effect to the height plant of green pea at 5WAP. This has shown the given organic manures on sediment could give some needed nutrients to growth and developed plant. The treatments of 10 ton/ha of compost of water hyacinth, 10 ton/ha of green manure, and 10 ton/ha of poultry manure showed the highest value of plant height and significant different to another treatments. These showed that the plant absorbed some extent nutrients and available to the plant.

The plant highly needed the enough nutrients at the beginning stage of growth. Decreased of N in soil caused dwarfish growth and limited root growth. N was highly needed in the beginning growth of plant. The enough N could increase the plant height so that the plant grows optimum¹⁰. The content N in sediment was medium, but not maximum in giving the nutrients to the plant so that needed addition nutrients in the form of manure.

The results gave a clue that giving the organic manures could give some nutrients, whether macro nutrients of N, P, K, Ca and Mg, and some micro nutrients which needed the plant for growing optimum.

Compost and poultry manure used in this research had occurred some reactions and changed form from complex composed to the simple one through enzymatic process by microorganisms¹¹. Thus, both compost and green manure could yield the needed nutrients so that could absorbed by the plant. This element was used in metabolism process in supporting the process of cell splitting then occur the growth of plant height.

Compost of water hyacinth played some roles on physical, chemical and biological soils¹². The role of organic manure to the physical soils was improved soils structure. Improving the chemical soils, it gave the nutrients into the soils and increased cation exchange capacity (CEC) of soils. However, the biological soils brought the benefit fine-microorganisms to the physical and chemical soils, and then gave positive effect to the growth and yields.

Number of Leaves

Measuring result of number of leaves of green pea at 5WAP was listed in Table 6.

Table 6.Mean of Number of Leaves of Green Pea at 5MST

Treatments	Number of Leaves
A	27
B	27
C	28
D	28
E	28
F	27
G	29
H	29

Analysis result showed that there was no significant effect to the given compost and green manure of water hyacinth, and poultry manure on the number of leaves. This might be caused by the nutrients on plant were not totally used for the growth of number of leaves, but roots, stem and diameter of plant at beginning stage (vegetative) were highly needed the nutrients in forming the tissues.

N has functioned in accelerating the vegetative growth and as the source of protein. Protein was used in forming protoplasm of plant cells and was occurred cell split. This affected to add the number of leaves¹⁰.

The plant needed some nutrients for the beginning growth of plant. Nitrogen was highly needed on that stage. When plant decrease of Nitrogen, the vegetative growth included the number of leaves was inhibited. Otherwise, P and K were needed in forming the protein, carbohydrate, and developing the plant's root. Roots plant in good developed causing good absorption of nutrients and water, and then effected good growth of plant. Ca was useful to form cell wall, cell split and to growth (*elongation*). When N decreased, bud and root couldn't grow due to the cell split was inhibited¹⁰.

3. Yields of Plant

Measuring the plant yields were: number of peas and weight of seed from both kinds of nuts, peanut and green pea.

a. Peanut

Number of Peas

Measuring the number of pea of peanuts listed in Table 7.

Table 7.Mean of Number of Pea of Peanut

Treatments	Number of Pea
A	6 a
B	9 b
C	10 b
D	10 b
E	11 b
F	10 b
G	11 b
H	11 b

Analysis results showed that a significant effect of given compost and green manure of water hyacinth, and poultry manure on number of pea of peanut. Smallest Significant Different Test of 5% showed significant differentiation between treatments, i.e.: without and with organic manures. Organic manures given on sediment responded on peanut. Peanut without manure yielded small pea and less number compared with the manured plant. Preliminary analysis results showed that organic manure contained some important nutrients for growing.

Water hyacinth, which was grew surrounded the lake, could be used as organic manures so that it was very useful in farming system. Nutrients on the manure of water hyacinth supported the growth and yields. This research figured that organic manure had yielded enough production on peanut. Compost of water hyacinth played the roles on the physical, chemical and biological soils¹². The role of physical soils was improved the soil structure. Improving the chemical soils, it gave the nutrients into the soils and increased cation exchange capacity (CEC) of soils. However, the biological soils brought the benefit fine-microorganisms to the physical and chemical soils, and then gave positive effect to the growth and yields.

Weight of Peanut Seed

Measuring result of peanut's seed listed in Table 8.

Table 8. Weight of Peanut Seed

Treatments	Seed Weight (g)
A	5.33
B	8.12
C	9.11
D	9.23
E	8.89
F	9.99
G	9.22
H	10.02

Analysis result showed significant effect in given compost and green manure of water hyacinth, and poultry manure to the weight of peanut's seed. Result of the Smallest Significant Different Test of 5% showed significant differentiation between the treatments, i.e. without manure and with manure. Organic manures on sediment gave good responds on the cultivation plant, peanut. Weight of seed increased with the given organic manures of mixture sediment and sand. Giving the sand in sediment was highly helped in peanut's growth. Peanut was well growth if the planting media was available and enough the nutrients for plant growth.

Table 8. Weight of Peanut Seed

Treatments	Seed Weight (g)
A	5.33
B	8.12
C	9.11
D	9.23
E	8.89
F	9.99
G	9.22
H	10.02

Major elements of N, P, K and another in compost, were taken and used by the plant, even used for plant metabolism. The extent nutrients helped to occur photosynthesis to yield the organic complexes which changed in ATP form when respiration occurred, and then the ATP helped the plant growth to increase the weight of plant seed.

b. Green Pea

Number of Pea

Mean result of number of pea of green pea listed in Table 9.

Table 9. Mean of Number of Pea of Green Pea

Treatments	Number of Pea
A	11 a
B	15 b
C	16 b
D	16 b
E	15 b
F	15 b
G	16 b
H	15 b

Analysis result showed that giving the organic manures (compost and green manure of water hyacinth, and poultry manure) gave a significant effect on the number of pea of green pea. Result of Smallest Significant Different Test of 5% showed significant different in giving the organic manure to the number of pea of green pea. This showed plant respond to the given organic manures on the mixture of sediment and sand. Nutrients contained in organic manure absorbed by the plant to grow and to yield so many numbers of peas, compared without organic manures.

When poultry manure has deposited into the soil, it would decomposed by microorganism into the simple forms⁴. The microorganism responsible its decomposition, were: bacteria, fungi, actinomycetes and protozoa, then omit some various nutrients of plant⁵. The nutrients were: C, H, O, N, P, S, K, Mg, Ca, Zn, and Mn⁶. These were needed by the plant in growth up to the good yield of plant.

Weight of Seed

Mean of weight of seed of green pea listed in Table 10.

Table10. Weight of Seed of Green Pea

Treatments	Weight of Seed (gr)
A	5,22 a
B	8.33 b
C	9.22 b
D	8.87 b
E	8.90 b
F	9.0 b 8
G	8.66 b
H	9.11 b

Analysis result showed that the given organic manures (compost and green manure of water hyacinth, and poultry manure) gave significant effect on the seed weight of green pea. Result of the Smallest Significant Different Test of 5% showed significant different in given the organic manures of seed weight of green pea. The seed weight increase with the given organic manure. This showed that nutrient contents in organic manures could be used by plant in growth up to form the seed.

The growth process of plant needed enough nutrients, whether in the beginning process of growth, or in the growth of flower and fruit. Adding compost might be existed Nitrogen needed the plant. Nitrogen has functioned in accelerating the vegetative growth of plant and as material forming protein¹⁰. The protein used in forming protoplasm of plant cells to occur the cell split. This even effected on increasing the weight of plant. Nitrogen contribution was an important element in increasing the plant growth of top soils, and widespread the root system¹³.

Other elements of plant need were P and K. Phosphor played some roles in developing the root, forming the flower, fruit and seed. Good developing the root might absorb the nutrients from the soils and plant fluently, and then the activity of physiology could occur smoothly. Kalium played role in translocation some nutrients to whole plant tissues. It was therefore if Kalium was not available, the nutrients translocation could not occur smoothly, too.

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