Test research of different material made garbage enzyme’s effect to soil total nitrogen and organic matter

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Abstract: Garbage enzyme is made from fruit and vegetable wastes. Apple peel, dragon peel and eggplant peel are selected as to ferment for 6 months. The product has many active enzymes and microbiology flora. To research the effect of garbage enzyme to improve soil nutrient, self-made garbage enzyme is diluted in the ratio of 1:800 and irrigated to soil of flowerpot. Soil is irrigated by dilution once in two days for four weeks. Total nitrogen and organic matter are detected once per week. Test method of total nitrogen and organic matter is respectively Kjeldahl method and potassium dichromate method. Total nitrogen and organic matter background are respectively 1.61 g/kg and 24.32 g/kg. The results illustrate that garbage enzyme gradually increase soil total nitrogen and organic matter with the increase irrigation time. Soil sample’s total nitrogen of apple peel, dragon peel and eggplant begin to increase gradually and respectively peaked at 3.17 g/kg, 4.13 g/kg and 4.27 g/kg after 4 weeks irrigation. The content of total nitrogen is classified as the first level (>0.20 g/kg). After 4 weeks irrigation of dilution of garbage enzyme made from eggplant peel, the sample’s organic matter begins to increase gradually and peaked at 49.33 g/kg after 4 weeks. The content of organic matter is higher than background (24.32 g/kg) and classified as the first level (>40 g/kg).

1. Instruction
Dr. Rosukon Poompanvong researched garbage enzyme for 30 years. Garbage enzyme is made from fermenting fruit and vegetable wastes [1]. It has many active enzymes and microbiology flora [2]. The making method is simple and easy. Garbage enzyme has widely used in domestic environment, especially in Southeast Asia and Japan [3]. It is economical and environmentally friendly to make the enzyme by kitchen garbage.

There are reports about the effect of garbage enzyme to soil effective nitrogen, total nitrogen, organic matter and kalium [4,5]. Residual pesticides is degradable by garbage enzyme is researched [6]. Garbage enzyme enhances soil fertility is also reported. There are more earthworms found in the test soil, which shows that garbage enzyme is good for the improvement of soil quality [7-9].

Soil total nitrogen includes organic nitrogen and inorganic nitrogen. The 5 percentage of total nitrogen is inorganic nitrogen absorbed and metabolized by plant. Most of total nitrogen is organic nitrogen, which need to be mineralized to be used by plant. Organic matter mainly comes from organic fertilizer, humus and microorganism, including cellulose, lignin, starch, sugar, lipid and protein. Organic matter is important index of soil nutrient. It provides abundant nutrient ingredient (carbon, hydrogen, oxygen, sulphur and microelement) for plant to grow and regulate soil’s physical performance and chemical performance.
Soil fertility is the ability to continuously provide effective nutrient and water for plant in its growth and development process and also the ability of automatically regulate soil to have appropriate air and temperature. The impact factors of soil fertility are nutrient factor, physical factor, chemical factor and biological factor [10].

Soil nutrients are the nutrient elements provided to plant’s growth, which include soil nutrient storage, soil strength factor and soil capacity factor. They depend on the quantity and composition of soil mineral matter and organic matter. Soil nutrient includes organic matter, nitrogen, phosphor, Potassium, sulphur, iron, magnesium, etc. [11,12]. As the growth condition for plant’s growth, soil fertility is the basic attribute of soil. It is the function representation of material constitution, structure, property and the relation with outside environment. Soil fertility consists of nutrient factor and environment factor.

2. Research method

2.1. Garbage enzyme and diluent making
Kitchen waste (fruit and vegetable peel) are chopped into bite-sized pieces. Mix these pieces with brown sugar and distilled water in a container with a weight ratio of 3:1:10 and then ferment for 6 months. Apple peel, dragon peel and eggplant peel are selected to be raw material. Garbage enzyme is made after 6 months. The finished product is no unpleasantly smell, the liquid is clear and raw materials are settled in the bottom without decomposition.

The pH of product is 4.5. Escherichia coli and total coliform are not detected. Escherichia coli and total coliform are important index to test the sample not polluted. The self-made products are not polluted in the processing. Leuconostoc, Acetobacter, Lactobacillus are dominant bacteria floras. Hanseniaspora and Kazachstania are dominant fungi. They are normally bacteria and fungi in the fermentation procedure of food [2].

Take 0.5mL filtered liquid into 400 mL distilled water and the dilution ratio is 1:800. Test soil is sampled from garden in the university. Sampling method is grid method and with a sampling depth of 10 centimetre. The soil sample is dry in a shady and ventilated place after 2-3 days. Put soil sample into 6 garden pots with 8 centimetre long, 8 centimetre wide and 8 centimetre deep. The six pots are respectively numbered 0 to 5.

2.2. Research methods
No.0 pot’s soil is irrigated by distilled water as contrast group. The other three pot’s soil (No.1-No.3) is irrigated respectively by the dilution of garbage enzyme made from apple peel, dragon fruit peel and eggplant peel. These group’s soil samples are prepared for the testing of total nitrogen. At the same time, No.4 and 5’s soil is irrigated by distilled water and the dilution of garbage enzyme made from eggplant peel. The two group’s soil samples are prepared for the testing of organic matter. Soil is irrigated with 20 millimetre dilution once in two days for four weeks. Total nitrogen and organic matter are detected in a solid time per week.

Based on Soil quality-determination of total nitrogen-modified Kjeldahl method (HJ 717—2014) [9], test method of total nitrogen is Kjeldahl method. Total nitrogen is the total content of soil nitrogen, including organic nitrogen (protein, amino acids, nucleic acids, urea, etc.), nitrate nitrogen, nitrite nitrogen and ammonium nitrogen, also nitrogenous compounds such as nitrogen, azo and azide. Based on determination of soil organic matter (NY/T85-1988) [10], test method of organic matter is potassium dichromate method.

2.3. Instruments and chemicals
Kjeldahl method instruments include: grinder, glass mortar, soil sieve (mesh 60), analytical balance, digestion device, distilling apparatus, digestion bottle (50mL), acid burette (25mL), conical flask (250mL).
Kjeldahl method Chemicals include: non-ammonia water, concentrated sulphuric acid (superior pure), concentrated hydrochloric acid, perchloric acid, absolute ethyl alcohol, potassium sulphate, copper sulphate pentahydrate, titanium dioxide, Sodium thiosulfate pent hydrate, sodium hydroxide, boric acid, anhydrous sodium carbonate(standard reagent), sodium hydroxide solution (10mol/L), boric acid solution (2%), sodium carbonate standard solution (0.0500mol/L), methyl orange indicator (0.5g/L), hydrochloric acid standard solution (0.01mol/L), mixed indicator.

Potassium dichromate method instruments include: analytical balance, sand bath thermostat, grinded mouth triangle bottle (150mL), grinded air condenser, timer, burette(10.00mL,50.00mL), thermometer (200-300°C), copper wire sieve (mesh 60), porcelain mortar.

Potassium dichromate method chemicals include: potassium dichromate, sulphuric acid, ferrous sulphate, silver sulphate (powder), silica (powder), O-phenanthroline indicator, potassium dichromate-sulphuric acid solution (0.4mol/L), potassium dichromate standard solution (0.2000mol/L), ferrous sulphate standard solution.

3. Results and discussion

3.1. Results of total nitrogen

The total nitrogen background of test soil sample is 1.61g/kg. The results illustrate that total nitrogen of 3 kind’s soil sample increases with the increase of irrigation time except for contrast group (Fig.1 and 2). No.1, 2 and 3 soil sample’s total nitrogen begin to increase gradually from 1 week to 2 weeks irrigation, rise significantly in 3 weeks and respectively peaked at 3.17 g/kg, 4.13 g/kg and 4.27 g/kg after 4 weeks irrigation (Fig.1). On the basis of the second soil investigation in China, soil nutrient is divided to six levels. The content of sample’s total nitrogen is classified as the first level (>0.20 g/kg), whereas the background of total nitrogen is classified as the second level (0.15-0.20 g/kg).

After 4 weeks irrigation, the total nitrogen of No.3 has the highest total nitrogen (4.27g/kg). Subsequently No.2 has the second total nitrogen (4.13g/kg). The impact to soil total nitrogen of garbage enzyme made from eggplant peel is similar to that from dragon fruit. No.1 soil sample’s total nitrogen (3.17g/kg) is the lowest among the three soil samples, but is higher than the background (1.61 g/kg). The contrast group changes slightly and return to background (1.61 g/kg) after 4 weeks irrigation.

![Fig.1 Total nitrogen of soil irrigated by garbage enzyme dilution](image-url)
3.2. Results of organic matter
Based on determination of soil organic matter (NY/T85-1988), firstly the mass of soil sample is determined by the content of soil organic matter. Potassium dichromate method is used to test organic matter. According to the result (24.32 g/kg), the mass of soil sample is 0.2000 g. On the basis of the second soil investigation in China, soil nutrient is divided to six levels. The organic matter background of soil sample is classified as the third level (2-3 g/kg).

After 4 weeks irrigation of dilution of garbage enzyme made from eggplant peel, No.5 sample’s organic matter begins to increase gradually and peaked at 49.33 g/kg after 4 weeks (Fig.3). The content of organic matter is higher than background (24.32 g/kg) and classified as the first level (>40 g/kg). The contrast group’s organic matter changes slightly in 4 weeks irrigation.

4. Discussion
In the first week, total nitrogen (1.40 g/kg) of contrast group (No. 0) and organic matter (18.16 g/kg) of contrast group (No. 4) is respectively lower than background level (1.61 g/kg and 24.32 g/kg). Because irrigation leads to total nitrogen and organic matter run off to certain extent, both total nitrogen and organic matter of contrast group change slightly in four weeks irrigation. The change only depends on irrigation by watering effect. Garage enzyme has many active enzymes, such as hydrolase, amylase, lipase and protease. Microbiological floras are mainly yeasts, moulds and anaerobic bacteria [15, 16]. Garbage enzyme raises soil total nitrogen and organic matter only in a dilution ratio, because there are two opposite effect in soil [17].

Anaerobic bacteria of garbage enzyme have denitrification effect and ammonification effect which reduce total nitrogen. Denitrification reaction is that nitrate is reduced to nitrite, and then to ammonia by microorganisms. Ammonification reaction is that organic nitrogen is decomposed to ammonia by microorganisms. On the other hand, microorganism promotes mineralization to soil organic matter, which leads to the rise of effective nitrogen. Finally, total nitrogen of soil samples reaches the highest
level after 4 weeks irrigation. In the basics of two effects, only in a dilution ratio, garbage enzyme raises soil total nitrogen \(^{[17]}\).

Anaerobic microorganism of garbage enzyme diluent improves the synthetic action of humus to increase soil’s organic matter. On the other side, fungi decompose cellulose to reduce carbon which results in the drop of organic matter. Furthermore, Organic matter is mineralized by microorganism to inorganic compound and carbon dioxide. At last, organic matter of soil samples reaches the highest level after 4 weeks irrigation.

5. Conclusion
After continuously irrigation of dilution of garbage enzyme for four weeks, soil total nitrogen and organic matter rises with the growth of irrigation time. The garbage enzyme made from eggplant peel increase soil organic matter. And all the three kinds’ garbage enzyme increase total nitrogen. Among which made from eggplant peel and dragon fruit peel has nearly same effect to soil total nitrogen, which is higher than from apple peel. Self-made garbage enzyme ferment for 6 months. The product is a system of microbiological flora. In the processing, fruit and vegetable’s peel provide nutrient which is fermented to produce organic acid and various active enzyme, which result the increase of soil nutrient.

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