Entisol Chemical Properties on the System Organic Agriculture

Renaldo Olivier
Centre of Philippines Land Agriculture
Email: renaldo_olivar49@gmail.com

Abstract

Agricultural systems based on high input energy materials (fossil materials) such as chemical fertilizers and pesticides can damage soil properties and will ultimately reduce soil productivity in the future. Alternative agricultural systems that use low input energy (low input energy) are believed to be able to maintain soil fertility and environmental sustainability while at the same time maintaining or increasing soil productivity. Organic farming systems prioritize the use of organic materials and waste recycling. This research reveals how changes have taken place in the physical and chemical properties of soils that have carried out organic farming systems for several times. The study uses a sampling method on farmer's land that has been studied to treat organic and non-organic farming systems. Two soil samples were taken from 2 different locations to represent soil organic farming systems and 4 soil samples were taken from 4 different locations representing non-organic farming systems. Soil sampling was carried out at a depth of 20 cm. The results showed significant differences in the chemical properties of the soil (CEC, pH H_2O, available P, available K, total N, carbon content, humic acid and fulfat) between the soil with organic and inorganic farming systems which showed better values in the agricultural system organic

Keyword*: Organic Farming, Soil Chemical Properties, Entisol.*

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A. INTRODUCTION

Entisol soil is a relatively less profitable land for plant growth, so it needs efforts to increase its productivity by fertilizing. The conventional farming system so far has been using chemical fertilizers and pesticides which are getting higher doses. This increase in dose causes accumulation of nutrients derived from fertilizers / pesticides in water and ground water, thus resulting in environmental pollution. The land itself will also experience saturation and damage due to high-tech input. Against this background, organic farming systems began to be developed which had long been practiced by our ancestors. Some farmers in Lemery, Batangas have done it, while others have not been interested because they do not know the benefits, especially for improving soil properties. After a number of times doing this farming system needs to be studied changes in chemical properties that occur.

Organic Agriculture System

Increasing the use of artificial fertilizers and pesticides can cause serious environmental problems. As awareness of sustainable agriculture grows, the importance of organic matter utilization in nutrient management in the soil is

increasingly being realized. The use of organic material into the soil is believed to improve the physical, chemical and biological properties of the soil (Engelstad, 1991)

Organic material is not absolutely needed in plant nutrition, but for efficient plant nutrition, its role should not be negotiable. The contribution of organic matter to plant growth has an effect on the physical, chemical and biological properties of the soil. They have a chemical role in providing N, P, and S for plants, a biological role in influencing the activity of microflora and microfauna organisms, and physical roles in influencing soil structure and others.

Organic farming or organic cultivation can be interpreted as a crop production system that is based on biological recycling. Nutrient recycling can be done through plant and livestock waste facilities, as well as other wastes that can improve fertility status and soil structure. Nutrient recycling is a traditional technology that has been around for a long time. Western agricultural experts refer to it as a system that seeks to return all types of organic matter into the soil, both in the form of crop and livestock waste which subsequently aims to feed the plants (von Uexkull and Beaton, 1991). Organic farming or cultivation system is one alternative solution to limit the possibility of negative impacts caused by chemical cultivation (Sutanto, 1992).

Based on the definition of a low technology input farming system, there are two objectives to be achieved, namely:

1. Trying to optimize the management and use of production inputs from in-farm resources, so that adequate and economically profitable agricultural and livestock products are obtained. This approach focuses on crop management, such as crop rotation, recycling agricultural waste, utilizing manure or livestock manure, soil management based on conservation to prevent erosion and nutrient loss, and maintaining and increasing soil productivity.
2. Limiting agricultural dependence on off-farm resources, such as factory fertilizers and pesticides, reducing production costs as much as possible, avoiding pollution of surface and ground water, limiting pesticide residues in food, limiting all risks faced by farmers, and increase farm profits for the short and long term.
3. This agricultural system still utilizes modern technology, such as labeled hybrid seeds, carries out soil and water conservation, soil management that is conservation based. Limiting the use and needs originating from outside farming such as factory fertilizers and pesticides, by developing crop rotation, developing integrated crop and livestock management, recycling agricultural waste and manure to maintain soil productivity.

Land of Entisol

In Phillipine, the land of Entisol is mostly cultivated for rice fields, both technical and rainfed in lowland areas. This soil has loose consistency, low aggregation rate,

sensitive to erosion and low nutrient content. The potential of soil derived from volcanic ash is rich in nutrients but not yet available, weathering will be accelerated if there is sufficient activity of organic material as a provider of acids organic (Tan, 1986). Organic farming systems prioritize the use of organic materials as one of the requirements in farming activities. The use of organic material is expected to improve the physical and chemical properties of Entisol so as to support better plant growth. Research on changes in soil properties after several organic farming systems needs to be carried out to determine the benefits of this system for improving soil properties to ensure continued use.

Artificial chemical fertilizers supply certain nutrients in the form of high concentration and soluble inorganic compounds. Provision of repeatedly can endanger the flora and fauna of natural soil, causing nutrient imbalance in the soil, and with the usual nutrient management system this time can cause pollution of water supplies, especially ground water. Organic fertilizers supply a variety of nutrients, mainly in the form of low concentrated organic compounds which do not dissolve easily. Because it supplies a variety of nutrients with low concentrations and does not dissolve easily, organic fertilizer will not cause nutrient imbalances in the soil, it can even improve the nutrient balance. The supply of organic matter can nourish the life of natural soil flora and fauna, which in turn can improve and maintain soil productivity.

B. METHOD

This research is a field trial followed by analysis in the laboratory. The method used is sampling location of soil sampling in Arumahan, Lemery, Batangas Province. 2 soil samples were determined to represent the soil with organic farming systems and 4 soil samples from non-organic farming systems. Each repeated 3 times.

Soil Entisol is taken from the location of organic and non-organic farming systems, Lemery, Batangas (data according to local Agriculture Department sources) and soil samples from land that does not carry out organic farming systems. In addition, secondary data was collected on land conditions (fertilizer history, measurements, climate data, etc.). Work in the laboratory includes analysis of the physical and chemical properties of the soil. Examples of 0-30 cm deep soil from paddy fields. Soil sampling was carried out in a composite of 5 points per rice field plot using the zigzag method.

A set of tools for analyzing physical and chemical properties is prepared, as well as chemicals for analysis as follows: determination of organic material according to the method developed by Walkey & Black (1987), total soil N content of the Kjehdal method (Tan, 1996), the content of available P soil is the Bray I method (Tan, 1996), the K content is available soil (Tan, 1996), the content of humic and fulfat acids (Tan, 1996), soil cation exchange capacity with saturation of Ammonium acetate pH 7.0 (Tan, 1996).

Data analysis was then performed to determine the differences between organic and non-organic farming systems on the parameters of physical and chemical soil characteristics at the 5% level of myrtle.

C. RESULT AND DISCUSSION

Table 1. Effect of Treatment on Available P, Cation Exchange Capacity, pH H2O, pH HCl, and Organic C Content

No	Treatment	P Available	CEC (me/ 100 g)	pH H2O	pH HCl	C Organic (%)
1	Organic Farming 1	8,36[b]	25[c]	5,52[c]	4,83[a]	2,94[c]
2	Organic Farming 2	8,39[a]	22[d]	5,75[e]	4,80[a]	3,09[a]
3	Non Organic Farming 1	7,22[d]	33[ab]	6,51[f]	4,81[a]	2,96[b]
4	Non Organic Farming 2	8,26[c]	25[c]	5,56[d]	4,67[b]	2,07[f]
5	Non Organic Farming 3	6,71[e]	31[a]	5,27[d]	4,50[c]	2,33[d]
6	Non Organic Farming 4	6,58[e]	29[b]	5,46[b]	4,80[a]	2,28[e]

Note: Numbers followed by the same letter indicate no significant difference with the 95% level.

1. P available in Soil

The results of statistical analysis with DMRT (Duncan Multiple Range Test) show that there are significant differences between treatments. Organic cultivation markedly increases P available soils. This increase in available P can occur due to the release of P from added organic matter, also because of the indirect effect of organic material on P that exists in the soil sorption complex. Organic matter is known to reduce P sorption by iron oxide and Al and also colloidal clays present in this soil.

Pelapukan bahan organik menghasilkan asam-asam organik seprti asam humat dan fulfat yang bersifat polielektrolit. Kedua asam ini memegang peranan penting dalam pengikatan Al dan Fe sehingga P menjadi tersedia. Keefektifan pengikatan tersebut dipengaruhi oleh struktur bahan organik yang ditambahkan dan pH medium (Ruseel, 1978). Soepardi (1983) menyatakan bahwa adanya senyawa organik yang cukup memungkinkan terjadinya khelat yaitu senyawa organik yang berikatan dengan kation logam (Fe, Mn, Al). Terbentuknya khelat logam akan mengurangi pengikatan P oleh oksida maupun lempung silikat sehingga P menjadi lebih tersedia.

Hasil analisis menunjukkan bahwa terjadi peningkatan kandungan Karbon tanah, diikuti peningkatan kandungan asam humat dan fulfat yang merupakan hasil dekomposisi bahan organik. Dengan demikian dapat dikemukakan bahwa peningkatan P tersedia pada perlakuan budidaya organik juga diakibatkan pelepasan P dari kompleks jerapan oleh asam humat dan fulfat yang dihasilkan oleh pelapukan bahan organic.

2. Land Cation Exchange Capacity

Soil analysis results show that there are significant differences between treatments. According to the theoretical basis organic matter contributes to a very large

negative soil charge through its very high surface area so that the provision of organic material is expected to increase the cation exchange capacity. But the results of the study show that the capacity of cation exchange in soils that are cultivated with organic agriculture is lower than non-organic ones. It seems that 5 years is not enough to make the land increase its cation exchange capacity.

3. Soil H2O pH

The results of measurements of soil H2O pH showed that there were significant differences between treatments. Land that is not treated with organic cultivation shows a tendency to lower pH. The lower pH in inorganic agriculture is due to the use of factory fertilizers, especially urea which will increasingly acidify the soil. Organic matter has a large buffer capacity so if the soil contains enough of these components, the soil pH is relatively stable.

4. Soil KCl pH

The pH of KCl shows the amount of hydrogen that dominates the exchange complex and the soil solution. The results of statistical analysis showed that only 2 treatments of non-organic agriculture showed a real difference, while 4 others (2 organic agriculture and 2 non-organic agriculture) showed no significant difference. This is in accordance with the statement above that the 5 years has not been enough to affect the character of the dakhil soil, the most affected is the soil solution.

5. Soil C Content

Organic cultivation markedly increases soil carbon content. Carbon is the biggest component in organic matter, so giving organic material will increase soil carbon content. This high soil carbon will affect soil properties for the better, physically, chemically and biologically. Carbon is a food source of soil microorganisms, so that the presence of this element in the soil will spur microorganism activities thereby increasing the process of soil decomposition and also reactions that require the help of microorganisms, such as dissolving P, fixation N and so on

Table 2 Effect of treatment on Humic Acid, Fulfuric Acid, Total N, and K available

	Treatment	Humic acid (%)	Fulfat acid (%)	N Total (%)	K Available (mg/100 gr)
1	Organic Farming 1	0,33^{a}	0,35^{a}	0,23^{a}	1,78^{b}
2	Organic Farming 2	0.24^{d}	0,31^{b}	0,21^{cd}	1,17^{c}
3	NonOrganic Farming 1	0,16^{f}	0,22^{de}	0,22^{b}	2,12^{a}
4	Non Organic Farming 2	0,26^{c}	0,22^{de}	0,21^{cd}	0,83^{d}
5	Non Organic Farming 3	0,26^{c}	0,17^{f}	0,19^{e}	0,66^{e}
6	Non Organic Farming 4	0,17^{e}	0,25^{e}	0,17^{f}	0,60^{f}

Note: Numbers followed by the same letter indicate no significant difference with the 95% level.

6. The Content of Humic Acid and Soil Satisfat

In general, the composition of soil organic matter is dominated by the fraction of humin with a very large molecular weight, the fraction of humic acid with a moderate molecular weight, and the fraction of fulfat acid with a lower molecular weight. Humic acid is a fraction that dissolves in alakali but does not dissolve in acid or water. Humic acid is able to interact with metal ions, mineral oxides and hydroxides. This is because humic acid contains active functional groups such as carboxyl, phenol, carbonyl, hydroxide, alcohol, amino, quinone and methoxyl, as well as its porous shape so that it has a large surface area. This acid has a strong influence on soil absorption capacity (Stevenson, 1994). The analysis showed that organic cultivation markedly increased the humic acid content in the soil. This increase affects the water holding capacity (water holding capacity) and also improves soil structure through the addition of soil colloids. Folic acid has properties somewhat similar to fulfat, but its molecular weight is lighter and is soluble in acid.

7. Total N Content of Land (%)

Nitrogen is the main macro nutrient that is needed by plants. This element is called the primary macro element because it is most important in the life cycle of plants. The results of the measurement of total N soil show that land that is cultivated with organic agriculture contains more total N even though the increase is not striking. The increase in total N soil comes from the mineralization of organic matter added in organic agriculture, while in non-organic farming systems N is added in the form of N fertilizers. It turns out that the addition of N fertilizer in the soil does not necessarily have to be followed by an increase in total N content in the soil. This is because more N is lost transported by crops, or through leaching and evaporation.

8. K Available in Soil

Potassium is also a primary macro nutrient for plants. The existence of this element is very important for plant self-defense from pests and diseases and drought. Organic farming systems markedly increase the K content of available soils, although in non-organic farming systems there are locations that indicate higher available K, but it is likely this has happened because of newly cultivated KCl. Organic farming systems allow a better nutrition balance.

D. CONCLUSION

Organic farming systems significantly improve soil chemical properties by increasing available P, total N, available K, carbon content, humic acid, fulfat acid and maintaining soil pH stability. A deeper study of the organic farming system will be very useful for maintaining soil sustainability. It is necessary to study the types and sources

of organic materials used in organic farming systems and their effects on the physical and chemical properties of the soil**.**

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