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Study of Several Soil Properties which Managed Conventionally and by Organic Systems in Naga Timbul Village, Bonatua Lunasi Sub-District of Toba Samosir District

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ABSTRACT

The current agricultural system is generally carried out conventionally depending on the use of chemical fertilizers. But long-term use will have a negative impact because it can acidify the soil. This study aim was to determine several physical and chemical of soil properties which managed by conventional agriculture and organic systems in Naga Timbul Village, Bonatua Subdistrict, Toba Samosir District. The method used was purposive sampling which was carried out compositely on 4 sample points by the zigzag method, 2 points on conventional agricultural land and 2 points on organic agricultural land, at a depth of 0-20 cm and 20-40 cm. The research started from June to November 2017. The parameters observed were soil physical properties (bulk density, total pore space, and water content) and soil chemical properties (soil pH, organic C, P-available, and P-total). The results showed that the newly managed organic farming system for 3 years had a bulk density value (1.37 g / cm3) 9.67% lower compared to conventional farming systems (1.52 g / cm3); total pore space (48.34%) 11.45% higher compared to conventional farming systems (42.81%); and water content (45.44%) 40.53% higher than conventional farming systems (27.02%). The pH value around (5.13) 3.71% higher compared to conventional agricultural land (4.94); C-Organic (0.55%) 31.25% lower compared to conventional farming systems (0.80%); P-available (25.83 ppm) 28.62% lower compared to the conventional system (36.19 ppm); and the P total value (135.09%) 44.44% lower compared to conventional farming systems (243.15%).

Keywords: conventional agriculture, organic agriculture, physical properties, chemical properties

INTRODUCTION

The current management of agricultural land is more / generally done conventionally. Conventional agriculture creates a high dependence on farmers for the use of chemical fertilizers and pesticides. In addition to creating high dependency, chemical fertilizers and pesticides that are used continuously cause significant damage to the environment. The impact of using a large amount of chemical fertilizers for a long time can have a negative impact, such as: (1) Soil conditions become more acidic; (2) Decrease in soil productivity because in acidic conditions macronutrient availability is reduced; (3) The number of macrofauna populations decreases; (4) The decreasing quality and health of food ingredients; (5) Human health and safety risks arise (Suwantoro, 2008).

The history of organic farming has long been known, since the science of farming is known to humans. The dangers awareness of factory-made chemicals in the long term began to be realized hence it is necessary to look for an alternative farming method which can produce products that are free of contamination from factory-made chemicals and maintain a healthier environment. Since then, the method of natural agriculture (back to nature) has begun to be looked back at (Nurhidayati, et. Al., 2008).

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Organic Farming is an agricultural system using organic fertilizer. But it does not mean that it does not use inorganic fertilizers except the usage is reduced and replaced with organic fertilizers obtained from previous crop residues. There are several advantages in using organic fertilizer, namely; improve soil physical and chemical properties, complex adsorption and retention can be increased, nutrient reserves increase, reduce the risk of drought, improve drainage, reduce erosion, pH controlled, reduce hardening, and increase ion exchange capacity (Arinong, 2012).

The area available for organic farming in Indonesia is very large. 39 million hectares of land that can be used for agricultural businesses, only around 25.7 million ha are processed for fields (paddy field etc) and plantations (BPS / Statistics Indonesia, 2012). Organic farming requires that the land used is not or has not been contaminated with factory-made chemicals and has high accessibility. Quality and area are considered in the selection of land. The unpolluted land is land that has not been cultivated, but in general such land is not fertile. Fertile land generally has been cultivated intensively by using chemical fertilizer and pesticide materials made in factories. Land use like this requires a long conversion period, which is around 2 years (Nurhidayati, et al., 2008).

Naga Timbul Village is one of the villages in Bonatua Lunasi Subdistrict of Toba Samosir District with an area of 3.07 km2 and 164 ha of paddy fields, where agriculture is the main livelihood of its people. Agriculture adopted in general is a conventional farming system but there are farmers who have adopted agriculture without artificial fertilizers since 2013. One type of soil there is Inceptisol soil which has physical, chemical and biological properties that are not good for farming. Therefore, the economic conditions in Naga Timbul Village have not been maximized. Whereas in Naga Timbul Village has the potential of the region in the form of agricultural areas (Yosephine, 2012).

Based on the problem description above, the authors studied several physical and chemical properties of the soil managed in conventional and organic agriculture.

MATERIALS AND METHOD

The research was carried out on the farmer's farm representing conventional land and organic land in Naga Timbul Village, Bonatua Lunasi Subdistrict, Toba Samosir District with an altitude of ± 1017 m above sea level. The research started from June to November 2017. The materials used in this study were soil samples taken randomly, label paper to label soil samples, insulation to close the ring sample tightly, chemicals used for analysis, administration map with a scale 1: 30000, map of soil type with a scale 1: 30000, and other supporting materials.

The tools used in this study were hoes to take soil samples, sample rings to take undisturbed soil samples, 2 mm soil sieves to sift soil samples, shaker machines to homogenize the soil, scale pipettes to take the solution, the test tube as a reaction container occurs, stationery to record data collection needs, GPS to find out sample coordinates, and other supporting tools.

The method used was purposive sampling method. Location of soil sampling in Naga Timbul Village, Bonatua Lunasi Subdistrict, Toba Samosir District wich done compositely on 4 sample points using the zigzag method, 2 points on conventional agricultural land and 2 on organic farms which have been managed for 3 years, around in the middle of 2013 - 2017. Soil samples were then analyzed to determine severals soil properties.

RESULTS AND DISCUSSION

Soil Physical Properties on Conventional and Organic Agriculture

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Based on research on bulk density (Table 1) at the study site, it was known that the bulk density value in organic farming systems (1.37 g / cm3) was 9.67% lower than conventional farming systems (1.52 g / cm3). This happens because the organic farming system gives a lot of organic matter to the soil. Soil organic matter is one of the soil aggregate forming materials, which has a role as an adhesive material between soil particles to unite into soil aggregates, hence organic matter is important in the formation of soil structures. This was in accordance with Margolang (2014) which stated that the role of organic matter in agricultural systems is to improve soil structure because organic matter can bind soil particles into a solid aggregate.

The organic farming system improves the value of the total pore space where the total pore space value in the organic farming system (48.34%) was 11.45% higher than the conventional farming system (42.81%). This can occur because organic matter can increase the total pore space in the soil. In coarse (sandy) soil, organic matter will increase the medium-sized pore and reduce the macro pore. This was in accordance with Atmojo (2003) which stated that adding additional organic matter will increase the total pore of the soil and will reduce the weight of the soil volume.

Based on research on the parameters of water content observation (Table 1), it showed that the water content in the organic farming system (45.44%) was higher 40.53% compared to conventional farming systems (27.02%). This increased can occur along with the increased in the total pore space of the soil which resulted in increasing of soil power to retain water resulting in an increased in the availability of water in the soil. This was in accordance with Atmojo (2003) that the addition of organic matter in the sandy soil will increase the water content in the field capacity, due to the increase of pore size and the decreasing of the macropore, hence the power to hold water increases, resulting in increased water availability for plant growth.

Soil Chemical Properties on Conventional and Organic Agriculture

Based on the observations of soil pH data (Table 2) the value of soil pH on organic farms was around (5.13) 3.71% higher compared to conventional agricultural land (4.94). This can occur because the application of organic matters can improve soil pH even though it is still in the sour category. Organic matter plays a role in maintaining soil pH stability. This was in accordance with (Afandi et al., 2015) which stated that the effect of organic matter application can improve soil pH.

Based on C-organic observation data (Table 2), the application of organic farming systems has an organic C-value of around 0.55%, lower by 31.25% compared to conventional farming systems (0.80%) and still very low. This can be caused by a lack of litter on the ground due to the land processing and the transport of the remaining crop out of the planting area. This was in accordance with Prabowo and Subantoro (2017) who stated that the value of C-organic on soils is classified as low due to the very lack of litter on the soil due to the intensity of the management carried out and the transport of leftovers from the planting area. Based on P available P observation data (Table 3), the organic farming system has an P available P value (25.83 ppm) which was 28.62% lower than the conventional system (36.19 ppm).

The fertilization aims were to replace lost nutrients and increase the nutrient supply needed by plants to increase crop production and quality. This was in accordance with Dewanto et al. (2013) which stated that fertilization aims were to replace lost nutrients and increase the nutrient supply needed by plants to increase crop production and quality.

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Table 1. The Average Rate of Soil Physical Properties of Conventional and Organic Farming

Sample Code	Bulk Density (g/cm3)	Total Pore Space (%)	Water Content (%)
O1DA	1.37	48.34	45.44
O1DB	1.27	52.21	60.32
O2DA	1.45	45.21	44.20
O2DB	1.45	45.29	33.16
K1DA	1.52	42.81	27.02
K1DB	1.54	41.86	34.75
K2DA	1.52	42.59	38.00
K2DB	1.54	42.02	34.39

Des: K1: Conventional Location 1 O2 : Organic Location 2
K2 : Conventional Location 2 B : Bottom Location
O1 : Organic Location 1 A : Upper Location

Table 2. The Average Rate of pH and C Organic Observation Parameters

Sample Code	pH H_2O	Criteria	C-Organik (%)	Criteria
O1DA	4.64	Sour	0.55	Very Low
O1DB	5.13	Sour	0.58	Very Low
O2DA	5.19	Sour	0.75	Very Low
O2DB	4.76	Sour	0.40	Very Low
K1DA	4.67	Sour	0.80	Very Low
K1DB	4.94	Sour	0.83	Very Low
K2DA	4.86	Sour	0.53	Very Low
K2DB	5.02	Sour	0.80	Very Low

Des: K1: Conventional Location 1 O2 : Organic Location 2
K2 : Conventional Location 2 B : Bottom Location
O1 : Organic Location 1 A : Upper Location

The P total observation parameter (Table 3) showed the P total value in the conventional farming system (243.15%) was 44.44% higher than the organic system (135.09%). This can be caused by the more P fertilizer application in conventional farming systems hence it increases the P total P value in the soil. This was in accordance with Dewanto et al. (2013) which stated that fertilization aims were to replace lost nutrients and increase the nutrient supply needed by plants to increase crop production and quality.

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Table 3. The Average Rate of P available and P total Observation Parameters

Sample Code	P Available (ppm)	Criteria	P Total (%)	Criteria
O1DA	25.83 ()	Moderate	135.09	Very High
O1DB	26.09 ()	High	166.72	Very High
O2DA	23.92 ()	Moderate	177.44	Very High
O2DB	14.53 ()	Low	208.97	Very High
K1DA	36.19 ()	Very High	243.15	Very High
K1DB	30.39 ()	High	246.95	Very High
K2DA	25.26 ()	Moderate	230.47	Very High
K2DB	23.73 ()	moderate	346.40	Very High

Des: K1 : Conventional Location 1 O2 : Organic Location 2
K2 : Conventional Location 2 B : Bottom Location
O1 : Organic Location 1 A : Upper Location

CONCLUSION

Land managed by organic farming systems has a value of physical bulk density (1.37 g / cm3) lower 9.67% compared to conventional farming systems (1.52 g / cm3); the total pore space value was 48.34% higher 11.45% compared to conventional farming systems (42.81%); and the value of water content 45.44% higher 40.53% compared to conventional farming systems (27.02%). Low bulk density makes the soil more manageable and increases root penetration.

Land managed by an organic farming system has a chemical property of pH (5.13) around 3.71% higher compared to conventional agricultural land (4.94); C Organic (0.55%) 31.25% lower than conventional farming systems (0.80%); P-available (25.83 ppm) lower by 28.62% compared to the conventional system (36.19 ppm); and the P total (135.09%) was lower by 44.44% compared to conventional farming systems (243.15%).

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