Master Thesis Abstract:

EFFECT OF ZEOLITE ON THE DECOMPOSITION RESISTANCE OF ORGANIC MATTER IN TROPICAL SOIL UNDER GLOBAL WARMING

Mai Thanh Truc
Ibaraki University, Japan. 2010

It is recognised that global warming and increasing CO_2 levels in the atmosphere can affect plant growth, which in turn could provide more organic matter for the soil. On the other hand a rise in air temperature and that of the soil would be consistent with an increase in decomposition and loss of soil organic matter. Especially, tropical soils is more influenced than temperate soils under global warming condition. According to IPCC in 2001, the global mean temperature could increase yet for another 1.1 to 6.4 °C (2.0 to 11.5 °F) by 2100. Therefore, if we do not have any method to conserve soil organic matter under global warming condition, the soil's ability to provide nutrients for sustainable plant production will be limited. This may lead to lower yields and affect food security in future. That is the reason why SOM must be conserved at a level necessary to maintain soil fertility. There are many methods to conserve organic matter in the soil and the application of zeolite in the soil is a choice of this research. Zeolite are known as a material with ability to exchange cations, it does not break down over time and remains in the soil to improve nutrient retention capacity and increase their E.C. In reviewing the study being done, the author used zeolite as one of the measures to conserve soil organic matter is performed in order to evaluate its effect on the resistance of the organic matter decomposing ability on the tropical soil. The research carried out with two kind of soils from Philippines (Tagaytay soil – A horizon and Tagatay soil – B horizon) and one kind of soil from Paraguay (Itapúa area). Japan, a subtropical country, is also chosen with two kind of soils (Japan soil – A horizon and Japan soil – B horizon) at Shizuoka area.

Different doses (5%, 15%) of Ca-zeolite type in conjunction with 25% organic manure was applied to soil samples. The incubation was carried out in a soil flask for a durations of 1, 3 and 6 months all with a temperature of 40^{o}C and relative humidity of 65 to 70%. During the incubation period, soil treatments were irrigated every three days

depending on the vapo-transpiration value which was measured gravimetrically. Soil samples were collected after 1, 3 and 6 months incubation to evaluate the effect of zeolite on the changes of soil organic matter composition through C/N ratio, humic substances characteristics, elementary composition of humic acid, cation exchange capacity and exchangeable bases.

Results showed that following zeolite rates increase, the C/N ratio of all soils studied are higher than untreated soil samples during incubation, indicating that the application zeolite effected on the resistance of the organic matter decomposing ability. The carbon content of humic acid (HA) increased and fulvic acid (FA) decreased with the increase of zeolite rates. A larger the relative color intensity (*RF*) value and a lower of color coefficient ($\Delta \log K$) value following increasing zeolite rates indicates a higher degree of humification of HA. Besides, the increase in the aromatic condensation of HA after incubation, as indicated by the reduction of H/C and O/C ratios of HA, resulted in a slow decomposition of organic matter. The degree of unsaturation (DUS) had increased with increasing zeolite rates at all treatments after 6 months of incubation, indicating humic acid were condensed by zeolite combines with humic substances and there were a difficulty in cut humic acid structure during decomposition process of humic substances. The content of calcium, magnesium, sodium and potassium were gradually accumulated in the soil by the application of 5% zeolite and zeolite combined with organic manure that leads to increasing cation exchange capacity. It means that soil can hold more cation nutrients that can promote formation of soil aggregates. Besides that the more cation in soil the more water holding that soil can stand under drought or high temperature condition.

In summary, we found out that the carbon accumulation of humic fractions as well as the degrees of humification and acromaticity of HA had increased by the application of Ca-zeolite in the soil. These results affirmed that there are a complexation between oxy of zeolite components and organic acid that take form organo-metallic that make the humus decomposition process will happen slower than the humus decomposition process of the soil unapplied zeolite under high temperature.