Influence of EM on Organic Matter Decomposition in Soil Under Controlled Conditions

S. Z. Filho, R. R. Medeiros and S. Kinjo
Center for Development of Kyusei Nature Farming, Mokichi Okada Foundation, lpeúna, SP, Brazil

Background

Nature farming depends upon the recycling of organic amendments (i.e., crop residues, animal manures, green manures, bokashi, various composts, and municipal wastes) to maintain soil tilth and to sustain the nutrient requirement of crops. Organic amendments are decomposed by soil microorganisms that derive carbon and energy in the process. During decomposition, mineralization occurs whereby plant nutrients are transformed from complex organic compounds (e.g., complex carbohydrates and proteins) to simple organic molecules (e.g., sugars and amino acids), and further to inorganic nutrients (e.g., N, P, K and S in simple forms). Thus, the process of decomposition provides progressively simple organic molecules and inorganic elemental forms of nutrients that can be absorbed and utilized by plants for their growth and metabolic functions.

A major concern in nature farming is whether the existing soil microflora will be able to decompose the various organic amendments at rates fast enough to keep pace with the crop's nutrient requirements. A laboratory study was conducted under controlled conditions to determine if EM could accelerate the decomposition of organic amendments (i.e., an organic fertilizer) and enhance the recycling and availability of plant nutrients.

Experimental Procedure

Organic matter decomposition was conducted in cylindrical, 2-1iter incubation chambers constructed of clear plastic. The chambers were fitted with ports at the top for introduction of solutions and suspensions; on the side to facilitate continuous aeration, collection of evolved gases, and withdrawal of soil samples; and at the bottom for periodic collection of leachate. The chambers were hermetically sealed throughout the study. Ammonia (NH_3) exhausting from the chambers was trapped in standard HCl for analysis and carbon dioxide (CO_2) was absorbed in standard NaOH. Other relevant chemical and physical parameters were determined as noted

The soil used in this study was a lithosol of medium texture that had been farmed traditionally to corn and sugarcane with inputs of chemical fertilizers. Soil was collected from the 0 to 0.2 m depth. Each chamber received 900 g of soil with the following treatments applied prior to the start of incubation:

1. *Chemical Fertilizer* - Additional phosphorus was added to supplement the soil P-level
2. *Organic Fertilizer* - The soil was amended with a dry mixture of 3.84 g Bengal velvet bean (*Stizolobium aterdmum*); 1.97 g Guinea grass (*Panicum meximum*); and 0.81 g mixture of rice bran, castor bean oil cake, soybean oil cake, and fish meal.
3. *Organic Fertilizer + EM* - Same amendments were added as in treatment 2 plus two applications of EM (3 ml each) on days 1 and 30 of the experiment.

Water was added to the treated soils and maintained near the maximum water-holding capacity. Each treatment was replicated three times (i.e., 3 chambers for each treatment).

Results

While the results of this study are somewhat preliminary, the following observations and data are indicative of the effects of EM

1. Soil pH increased with the addition of organic amendments compared with the chemical fertilizer treatment. The addition of EM caused a further increase in soil pH.
2. The electrical conductivity (EC) of the soil leachate increased significantly with the addition of organic matter compared with the chemical fertilizer treatment. This indicated that the higher rate and extent of decomposition and mineralization from microbiological activity of the organic fertilizer treatments provided soluble salts which, in turn, increased the EC. The organic fertilizer + EM treatment resulted in a slightly higher EC compared with the organic fertilizer alone.

3. The organic fertilizer + EM treatment resulted in the highest concentration of ammonium nitrogen (NH_4+) compared with organic fertilizer alone. This indicated a more rapid rate and extent of decomposition and subsequent hydrolysis and ammonification of proteins and amino acids due to EM.
4. The organic fertilizer + EM treatment resulted in the highest concentrations of soluble organic matter and soluble sugars such as glucose compared with organic fertilizer alone. This indicated a more rapid rate of decomposition due to EM.
5. There was some indication that the organic fertilizer + EM treatment had improved certain soil physical properties including soil aggregation, drainage, and water-holding capacity, compared with organic fertilizer alone. This suggests that EM accelerated the decomposition process and possibly had enhanced the production of polysaccharides that are the "binding materials" needed to promote aggregate formation.
6. Perhaps the most reliable parameter of organic matter decomposition in soil is the associated rate and extent of CO_2 evolved from the growth and activity of the soil microflora. After 9 weeks of incubation, the total amounts of CO_2 evolved from soil treated with chemical fertilizer, organic fertilizer, and organic fertilizer + EM were 316, 4158, and 4545 mg., respectively. While the amounts of CO_2 evolved from the organic fertilizer treatments were not significantly different, there was a definite trend which indicated that EM enhanced the extent of organic matter decomposition.

Conclusions

These preliminary results indicate that EM accelerated the decomposition rate of organic amendments applied to soils, improved certain soil chemical and physical properties, and enhanced the mineralization and availability of plant nutrients. Experiments will continue to confirm these results and to determine the mechanisms more precisely.