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ECHO Development Notes

Highlights from Higa and Parr's Document: "Beneficial and Effective Microorganisms for a Sustainable Agriculture and Environment."

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Higa, Teruo and James F. Parr. 1994. "Beneficial and Effective Microorganisms for a Sustainable Agriculture and Environment." International Nature Farming Research Center, Atami, Japan.
Because the approach outlined by Higa and Parr in this paper is so different from what I (DRB) have previously read on the subject of soil microorganisms, I thought I would summarize some key points. If you would like more details, I encourage you to read the paper.

The Case for Beneficial Microorganisms. Moving from conventional to organic agriculture can be risky for the first several years, with potential for lower yields and increased pest problems. Beneficial microorganisms can help ease the transition. Microbial methods can also help address environmental problems resulting from agriculture (e.g. fertilizer and pesticide runoff; animal wastes; erosion), which are often targeted using chemical and physical methods.

The organisms in Higa's EM-1 solution are mutually compatible. "The ultimate goal is to select microorganisms that are physiologically and ecologically compatible with each other and that can be introduced as mixed cultures into soil where their beneficial effects can be realized."

You need high initial populations of microorganisms for inoculating. "The most reliable approach is to inoculate the beneficial microorganism into soil as part of a mixed culture, and at a sufficiently high inoculum density to maximize the probability of its adaptation to environmental and ecological conditions."

Plants generally use less than 5% of available solar energy! Lots of visible light and infrared radiation are unused.

In agriculture, "the farmer attempts to integrate certain agroecological factors and production inputs for optimum crop and livestock production."

Application of single-culture microbial inoculants is problematic. "…there is a greater likelihood of controlling the soil microflora by introducing mixed, compatible cultures rather than single pure cultures." In a natural ecosystem, "the greater the diversity and number of the inhabitants, the higher the order of their interaction and the more stable the ecosystem."

The majority of microorganisms in any particular soil are harmless to plants. But harmful microorganisms can quickly multiply under certain conditions (e.g. monoculture; lots of chemical fertilizers and pesticides). Conventional (chemical-based) farming tends to treat symptoms.

Changes in farming practices may be required along with use of EMs.

Classification of Soils. One interesting suggestion made in the paper is to classify soils based on activities and functions of the predominant microorganisms. Higa and Parr wrote, "Most soils are classified on the basis of their chemical and physical properties; little has been done to classify soils according to their physicochemical and microbiological properties. The reason for this is that a soil's chemical and physical properties are more readily defined and measured than their microbiological properties. Improved soil quality is usually characterized by increased infiltration; aeration, aggregation and organic matter content and by decreased bulk density, compaction, erosion and crusting. While these are important indicators of potential soil productivity, we must give more attention to soil biological properties because of their important relationship (though poorly understood) to crop production, plant and animal health, environmental quality, and food safety and quality.…

"The basic concept here is not to classify soils for the study of microorganisms but for farmers to be able to control the soil microflora so that biologically-mediated processes can improve the growth, yield, and quality of crops as well as the tilth, fertility, and productivity of soils. The ultimate objective is to reduce the need for chemical fertilizers and pesticides.”

Higa and Parr suggest four classifications:

1). Disease-inducing soils. “In this type of soil, plant pathogenic microorganisms such as Fusarium fungi can comprise 5 to 20 percent of the total microflora. If fresh organic matter with a high nitrogen content is applied to such a soil, incompletely oxidized products can arise that are malodorous and toxic to growing plants. Such soils tend to cause frequent infestations of disease organisms, and harmful insects. Thus, **the application of fresh organic matter to these soils is often harmful to crops. Probably more than 90 percent of the agricultural land devoted to crop production worldwide can be classified as having disease-inducing soil**. Such soils generally have poor physical properties, and large amounts of energy are lost as “greenhouse” gases, particularly in the case of rice fields. Plant nutrients are also subject to immobilization into unavailable forms.”

2) Disease-suppressive soils. These soils contain many beneficial microorganisms that produce antibiotics. Plants tend to experience few diseases or pests. The soil has excellent physical properties.

3) Zymogenic soils. Beneficial microorganisms in these soils carry out useful fermentations. Soil has a pleasant odor and good properties; lots of inorganic nutrients are available; there is low incidence (<5%) of Fusarium; and low production of greenhouse gases, even from flooded rice.

4) Synthetic soils. Fix N and C. These soils need little extra organic matter. They have low levels of Fusarium; are often disease-suppressive; and produce few greenhouse gases.

Higa and Parr concede that the types of soils will not always be so clearly defined. A mix of 2, 3 and 4 is most desirable.

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