Effective Microorganisms: Concept and Recent Advances in Technology

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Honorable Guests
Distinguished Colleagues
Ladies and Gentlemen,

During the last several days, you have heard many examples of the beneficial effects of EM when applied toward agricultural and environmental problems. As we conclude this Fourth International Conference on Kyusei Nature Farming I would like to review briefly the concept of Effective Microorganisms (EM) and some recent advances in EM technology that transcends its applications to agriculture and the environment.

Effective Microorganisms or EM is a mixed culture of beneficial microorganisms that can be applied as inoculants to shift the microbial diversity of soils and plants in ways that can improve soil quality, and the growth, yield and quality of crops. The microorganisms comprising EM are neither exotic nor engineered types; but are naturally-occurring species that have been isolated from natural environments worldwide and selected for their specific beneficial effects and compatibility in mixed cultures.

My research on the concept and use of EM began in the late 1960's, 30 years ago, and has been directed largely toward resolving the problems associated with soil degradation, declining productivity and crop yields, and the intensive use of agricultural chemicals in monoculture cropping systems. Interest in the concept increased steadily and by 1982 EM had become a marketable product and considerable on-farm testing had been done to demonstrate its merits. During the past decade the agricultural, environmental, and consumer organizations in many countries have expressed an interest in EM as a possible means of reducing the use of chemical fertilizers and pesticides in their food production systems. EM has allowed many farmers to make a successful transition from chemical-based conventional agriculture to non-chemical, organic farming systems, and with considerably less risk. Consequently, there are now more than 60 countries that are using EM to achieve a more sustainable agriculture and environment. Some countries have incorporated EM technology into their national agricultural research and development policies and agendas.

Among the most predominant types and numbers of microorganisms that comprise EM cultures are lactic acid bacteria, yeasts, actinomycetes and photosynthetic bacteria. Lacto-bacillus spp. and yeasts have long been used for processing fermented foods and beverages for human consumption, while actinomycetes have been used extensively in the production of antibiotics for control of certain diseases and infections in humans and livestock. It follows then that EM technology provides direct applications of beneficial microorganisms to agriculture, fisheries, forestry and the environment; and indirect applications of EM metabolites or by-products to food processing, sanitation, medicine and health. A number of countries have now granted permits for the production and registration of EM including the United States, and particularly California which has very stringent standards in this regard.

Microorganisms can be broadly classified into three types depending on their principal functions, i.e., synthesizing, decomposing and neutral types. Effective Microorganisms are considered to be mainly of the synthesizing type which impart beneficial effects to agricultural and the environmental processes by generating a wide array of bioactive substances. Many of these substances produced by EM cultures can function as antioxidants.

During normal metabolic reactions in living systems, oxygen atoms may lose electrons, thereby becoming free radicals; these are highly oxidative entities that can cause degradative reactions in cell tissues and membranes of both plants and animals. The usual defense against free radicals is the enzyme superoxide dismutase (SOD) which restores lost electrons and transforms free radicals back to normal oxygen atoms.

Antioxidants produced by EM greatly enhance the effectiveness of SOD by serving as electron donors and thereby providing a more efficient system for preventing the generation of free radicals and their degradative effects. Common antioxidants include vitamins A, C, E and selenium.

Decomposing types of microorganisms function quite the opposite from synthesizing types. That is, they generate substances that promote oxidation and the production of free radicals. Neutral types of microorganisms are pivotal and can be transformed into synthesizing or decomposing types depending on the specific environmental conditions. In essence, the degradation of agricultural lands from erosion and the intensive use of chemical fertilizers and pesticides, as well as most diseases are associated with oxidative processes.

Recent developments in EM technology indicate that the beneficial effects of EM can be extended considerably beyond agriculture and the environment largely because of the antioxidant potential of EM cultures. Based on research and development activities in many countries, EM is increasingly viewed as a means of providing solutions to problems of food production, depletion of natural resources, environmental pollution, food safety and nutrition, and human and animal health.

For example, EM inoculants have been used successfully to 1) improve soil quality and the growth, yield and quality of crops; 2) suppress malodors associated with livestock production; 3) enhance the growth and market weight of swine and poultry when used as a feed additive; 4) improve the quality and shelf-life of fruits and vegetables; 5) improve the process technology for sewage treatment and water purification; 6) improve the process technology for composting municipal solid waste (i.e., garbage) into a high quality soil conditioner and biofertilizer; 7) improve the process technology for recycling other waste materials including plastics, paper, rubber and textiles ; 8) enhance human and animal health through the use of EM by-products and metabolites; 9) improve the process technology and quality of ceramics produced from waste materials, particularly ash from various combustion systems; and 10) improve the control of insect pests in both rural and urban communities. I might add that all of these applications of EM technology have been cost-effective and acceptable to environmentalists and consumers.

In conclusion let me say that it may seem incredible that EM technology could be extended successfully to all of these applications. However, I can assure you that these conclusions are based on scientific research, validation and testing. Thus, I am most happy that you have attended this conference and have been exposed to the concept and diverse utility of EM technology. Many of us are very confident that this technology offers environmentally-sound, economically-viable, and cost-effective solutions to problems of agriculture, the environment, industry, natural resources conservation, food safety and quality, and human and animal health that are now facing countries worldwide.

Thank you and have a safe journey home.