Effective Microorganisms: A New Dimension for Nature Farming

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Good afternoon everybody. First I would like to express my sincere thanks and appreciation to the faculty and staff of Luiz de Queiroz College of Agriculture for hosting this Second International Conference on Kyusei Nature Farming and for the excellent arrangements they have made. I would also like to thank the Mokichi Okada Foundation, Sekai Kyusei Kyo, and the International Nature Farming Research Center for their support and cooperation which has made this conference possible.

The First International Conference on Kyusei Nature Farming was held in Khon Kaen, Thailand in 1989 with the cooperation of the Government of Thailand, Khon Kaen University, the International Nature Farming Research Center, Sekai Kyusei Kyo, the U.S. Department of Agriculture, and the U.S. Agency for International Development. The conference was attended by more than 200 participants from 15 countries of the Asia-Pacific Region.

A major accomplishment of the first conference was the creation of the Asia-Pacific Natural Agriculture Network (APNAN), an organization of scientists representing 15 countries of the Asia-Pacific Region who are conducting research on nature farming practices and technologies, including effective microorganisms (EM) which I will discuss later in more detail. As a result of our first conference, the Government of Thailand is actively promoting the development and implementation of Kyusei Nature Farming as a national policy. Similar actions have also been initiated in Korea, Taiwan, Indonesia, and Myanmar. Research reports from our APNAN countries will be presented during this second conference. Here in Brazil, our host country for this second conference, scientists have obtained excellent results from the application of nature farming practices and technologies as you have seen from exhibits in the entrance hall.

Some of you may already know that Kyusei Nature Farming is a method of farming that was first advocated by Mokichi Okada, a Japanese naturalist and philosopher, and founder of Sekai Kyusei Kyo. Okada's ultimate goal was to "create paradise on earth by eradicating disease, poverty, and conflict." Since then, it has gained the attention of many people as a new and potentially sustainable farming method. Thus, after more than five decades, Kyusei Nature Farming is being seriously considered as a conservation and production system that, indeed, can save the world as the word "Kyusei" indicates in Japanese.

There is a growing worldwide concern that environmental pollution caused by excessive use and misuse of chemical fertilizers and pesticides is directly or indirectly related to problems of human health. Consequently during the 1980s, many of the farmers in developed countries began to shift from chemical-based, conventional farming methods toward organic, alternative, or low-input/sustainable agriculture (LISA). Kyusei Nature Farming is not a farming method that leaves everything to nature. While it does have some similarities with organic farming, it goes considerably beyond organic farming, both conceptually and practically. It is a farming method which has a definite mission and goal, which is to enhance the quality of human life by eliminating hunger, disease, poverty and conflict. To achieve this goal, Kyusei Nature Farming advocates the following five requirements:

1. It must produce safe and nutritious food to enhance human health.
2. It must be economically and spiritually beneficial to both producers and consumers.
3. It must be sustainable and easily practiced by anyone.
4. It must conform to nature and protect the environment.
5. It must produce sufficient food of high quality for an expanding world population.

To satisfy all of these requirements, it is necessary that chemical-based conventional farming systems change dramatically to achieve a natural-based, self-sufficient agriculture. Such a conversion or transition is possible by integrating information on natural biological cycles into useful databases that can be applied effectively at the farmer's level. Chemical-based conventional farming methods are not unlike symptomatic therapy. They are based on direct and simplistic techniques, such as applying chemical fertilizers when crops express symptoms of plant nutrient deficiencies, and spraying pesticides when crops are attacked by insects and diseases. Since the heavy use of agricultural chemicals began in the 1950's and 1960's, farmers worldwide have been conditioned to respond accordingly. They seem to have forgotten that all living things are dependent on each other. Consequently, they have lost sight of the potential of natural biological systems and cycles to provide substantial amounts of plant nutrients, and to effectively suppress plant pests.

A fundamental approach to the transition of conventional agriculture to nature farming is that of controlling microorganisms that directly or indirectly affect the growth, health and yield of crops. We have to realize that agriculture has long been an economical enterprise that represents man's attempt to coexist with nature. However, conventional agriculture has traditionally relied on technologies such as chemical fertilizers and pesticides, and practices which produce rapid, tangible results. In so doing, it has neglected the vital importance of soil microorganisms, whose activity cannot be observed so easily.

I use the term "microorganisms" to refer to a very large and diverse group of microscopic organisms, many of which are known to be beneficial to the production and protection of agricultural and horticultural crops. However, some of these microorganisms are pathogenic to plants which can cause a wide array of destructive diseases.

It is also widely known that certain beneficial microorganisms can suppress the growth and activity of the plant pathogenic organisms. Thus, for many years microbiologists have tried to culture these beneficial organisms for use as soil inoculants to overcome the harmful effects of pathogens. Such attempts have mostly been unsuccessful, mainly for two reasons. First, to culture these beneficial microorganisms we must thoroughly understand their individual characteristics, including their nutritional and environmental requirements. Second, we must understand their ecological relation-ships and interactions with other microorganisms.

To control soil microorganisms ecologically, it is important to know what effect or influence a specific organism, or mixed culture of organisms, has on the growth and health of a particular crop. Ecological relationships in nature are based on a balance between integration and disintegration. Categorizing microorganisms on the basis of their functions depends on whether their presence in mixed cultures tends toward integration or disintegration. Research has shown that different microorganisms can coexist if they are mutually complementary. If they are not, they will oppose and impede the functions of one another which will ultimately lead to disintegration.

Beneficial microorganisms that can integrate the soil-plant microbiological equilibrium include lactic acid bacteria, photosynthetic bacteria, actinomycetes and mycorrhizal fungi. Through useful fermentation these organisms produce organic acids, plant hormones (e.g., auxin, gibberellin, and cyio-kinin), vitamins and antibiotics. These products of microbial metabolism can benefit the growing plant by a) solubilizing nutrients of limited solubility, e.g., rock phosphate, b) complexing heavy metals to limit their uptake by plants. c) providing simple organic molecules such as amino acids for direct uptake, d) protecting the plant from soil-borne pathogens, insects and diseases, e) stimulating plant growth and increasing the yield and quality of crops, and f) improving the chemical and physical properties of soils. When all of these beneficial effects of microbial metabolism are integrated it can optimize soil productivity and crop production without the use of chemical fertilizers and pesticides.

There are also harmful microorganisms that tend to disintegrate the beneficial microbiological balance just described. These microorganisms often produce chemically-reduced, malodorous substances such as ammonia, hydrogen sulfide and mercaptans. Such compounds can cause direct toxic effects on growing plants; inactivate and immobilize plant nutrients; enhance the availability and absorption of heavy metals; and adversely affect soil structure and productivity. These microorganisms may also produce compounds such as abcisic acid and ethylene which can adversely affect plant growth; reduce the plant's photosynthetic capacity; reduce nutrient uptake; and inhibit the plant's energy-yielding metabolism. Consequently, if these microorganisms become

dominant in an agricultural soil, they can significantly reduce the growth and yield of crops, and increase the incidence of soil-borne diseases.
Certainly, soil microorganisms can be classified in this way from the standpoint of their potentially beneficial and harmful effects on plant production and plant protection. In reality, however, these two groups of microorganisms coexist in nature and the predominance of either one at any time depends mainly on environmental conditions. Thus, it is not surprising that soil microbiologists have attempted to culture these known beneficial microorganisms and inoculate them into agricultural soils where, hopefully, they would adapt to environmental stresses and become the dominant species. However, most of these attempts were unsuccessful for the reasons stated earlier.
For a number of years now I have conducted extensive research studies with the ultimate goal of developing mixed cultures of compatible beneficial microorganisms for inoculating soils. The ultimate goal is to shift the soil microbiological equilibrium (i.e., the population balance) and create an environment that is favorable to the growth and activity of these introduced organisms, and to enhance their beneficial effects on the growth and health of crop plants. Our research has shown that we have successfully achieved this goal through the use of mixed cultures of effective microorganisms now referred to as EM. In effect, EM technology provides a) a means of controlling soil microorganisms to the advantage of the plant, and b) an added dimension that enhances the probability for successful transition from conventional to nature farming methods. Some of our research results with EM will be reported at this conference by APNAN scientists.
I would also like to mention that EM technology has a considerably broader application than just plant production and protection. Research has shown that EM is highly effective in purifying waste waters and sewage effluents; promoting soil structure and aggregation; suppressing malodors in livestock and poultry buildings; and enhancing the conversion efficiency of animal feeds. Such a widespread application of microorganisms vastly increases the probability of developing an economically-viable, energy-efficient, and environmentally-sound system of nature farming for mankind both today, and for future generations. I believe that many of the basic problems related to agriculture, the environment, and human health can be solved to a considerable extent by the application of EM technology.
Finally, may I express my hearty congratulations to the faculty, staff and students of the Luiz de Queiroz College of Agriculture on the 90th anniversary of the founding of this outstanding institution. Again, I would like to extend my sincere thanks and appreciation to everyone who worked so hard to make this Second International Conference on Kyusei Nature Farming such a great success.
Thank you very much.