Effective Microorganisms: Their Role in Kyusei Nature Farming and Sustainable Agriculture

Dr. Teruo Higa
College of Agriculture University of the Ryukyus
Okinawa. Japan

Good morning ladies and gentlemen. First I would like to express my sincere thanks and appreciation to the staff of the Nature Farming Research and Development Foundation for hosting this Third International Conference on Kyusei Nature Farming and for the excellent arrangements they have made. Also, I would like to thank 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. Some of you have perhaps now received a copy of the Proceedings of this Conference.

A major accomplishment of the First Conference was the founding of the Asia Pacific Natural Agriculture Network (APNAN), an organization of scientists from 15 countries in the Asia Pacific Region who are conducting research on nature farming practices and technologies, and particularly on the use of Effective Microorganisms (EM), which I will discuss later, in the transition from conventional farming to Kyusei Nature Farming. A number of research reports from the APNAN countries will be presented during this Third Conference.

The Second International Conference on Kyusei Nature Farming was held in Piracicaba, Brazil in 1991 and hosted by the University of Sao Paulo's Luiz de Queiroz College of Agriculture in cooperation with those same sponsors who supported our First Conference. A significant result of this Second Conference was the creation of the South American Natural Agriculture Network (SANAN) which like APNAN is conducting research in various countries of that region on low-input farming systems and the use of EM to facilitate the transition from agrichemical-based agriculture to nature farming. SANAN scientists will also be reporting their research results during this Third Conference. The Proceedings of the Second Conference are now in press and will soon be available for distribution.

Kyusei Nature Farming

As some of you perhaps know, the principles of Kyusei Nature Farming were introduced almost 60 years ago by Mokichi Okada, a Japanese naturalist and philosopher, and founder of Sekai Kyusei Kyo. Even then, Okada was concerned about the increasing world population, the diminishing natural resource base, environmental pollution, and the ability of nations to produce sufficient good quality food for their people. Thus, his teachings have had a significant impact on current thinking relative to food production, natural resource conservation, environmental quality, and sustainable agriculture. Okada's ultimate goal was to "create paradise on earth by eradicating disease, poverty, hunger, and conflict." He was one of the first contemporary philosophers to advocate soil quality as the basis for healthy crops which he believed was a vital requisite for healthy people. He promoted Kyusei Nature Farming which has evolved as a farming system that seeks to avoid the use of chemical fertilizers and pesticides; utilizes natural systems and biological cycles to ensure healthy, productive soils; utilizes on-farm resources; conserves energy and is cost-effective; produces healthy, nutritious, and uncontaminated food; and revitalizes the productivity of degraded agricultural soils. The word "Kyusei" in Japanese means "saving" or "conserving," and broadly interpreted, Kyusei Nature Farming means saving the world and mankind through natural farming methods.

I would emphasize here that Kyusei Nature Farming does have some similarities with organic farming. However, it goes considerably beyond organic farming, both conceptually and practically. The principles of Kyusei Nature Farming are based on 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.
4. It must conform to nature and protect the environment.
5. It must produce sufficient food of high quality for an expanding world population.

Thus, it would appear that Kyusei Nature Farming offers a viable alternative to chemical-based, conventional agriculture, and it provides a practical approach for making a successful transition to a more sustainable agriculture for future generations.

Recent Initiatives on the Use of Pesticides

There has been a growing awareness, worldwide, that exploitive and intensive agricultural practices, including the excessive use of chemical fertilizers and pesticides, have resulted in soil degradation and the loss of productivity, environmental pollution, increased risk to food safety and quality, and problems of human health. This has been particularly true in developed countries such as the United States and Japan, and in Western Europe where consumer and environmental movements gained momentum during the 1980's. This has caused many farmers to shift from chemical-based, conventional farming methods toward organic, alternative, or low-input/sustainable agriculture (LISA). There is also increasing interest in LISA-type agriculture and natural farming systems in many developing countries as evidenced by APNAN and SANAN participation.

There have been two recent significant events with respect to the use of pesticides in U.S. agriculture that are noteworthy for this Third International Kyusei Nature Farming Conference. First, in June 1993, the National Academy of Sciences (NAS), National Research Council, released a report on "Pesticides in the Diets of Infants and Children," which indicates that these individuals could be at risk from ingestion of fruits and vegetables containing pesticide residues. The report urges that tolerance levels for regulating permissible concentrations of pesticides in food be based primarily on health considerations rather than on agricultural practices.

Second, also in June 1993, and in conjunction with the NAS report, a joint statement was issued by the Secretary of Agriculture (USDA); the Administrator of the U.S. Environmental Protection Agency (USEPA); and the Commissioner of the U.S. Food and Drug Administration (USFDA) that their agencies are now officially committed to work with U.S. farmers to reduce their use and dependence on pesticides, and to promote the principles of sustainable agriculture. These are major events which other countries are sure to follow in the near future. It also underscores the principles and potential sustainability of Kyusei Nature Farming.

Effective Microorganisms: A New Dimension for Kyusei Nature Farming

There are many reports in the scientific literature which have shown that the application of organic amendments, such as animal manures, crop residues, green manures, and various municipal wastes, to soils can often, at least temporarily, suppress the growth and activity of soil-borne plant pathogenic microorganisms. The reason for this is that the amendments themselves introduce extraneous populations of microorganisms with a wide range of physiological capabilities. Many of these are what we call "beneficial" microorganisms that can actively control plant pathogens.

It is also known that in a relatively short time most of these introduced microorganisms tend to "die out," and once again the indigenous soil microorganisms become dominant. Consequently, many scientists over the years have attempted to inoculate soils with beneficial microorganisms to shift the soil microbiological equilibrium in ways that directly or indirectly enhance the growth, health and yield of crops. My interest in the concept of Effective Microorganisms (EM) began in the late 1960's when I was a graduate student. I recognized that for many years microbiologists have attempted to culture beneficial microorganisms for use as soil inoculants to overcome the harmful effects of pathogens. However, I also was aware that most of these attempts had been unsuccessful, mainly for two reasons. First, to culture these microorganisms in the laboratory we must thoroughly understand their individual characteristics, including their nutritional and environmental

requirements. Second, we must understand their ecological relationships and interactions with other microorganisms. These are not easy tasks. Moreover, it was readily apparent from the literature that most of the early work had been done using pure cultures of microorganisms with single inoculations.

My approach to the development of EM technology has been quite the opposite. While I have devoted most of my scientific career to the isolation and selection of various naturally-occurring microorganisms for their beneficial effects on soils and plants, my main objective was to find species that were physiologically compatible, and could coexist in mixed cultures. I have found that when these mixed cultures are introduced back into the soil environment from which they were isolated, their combined beneficial effects are often synergistic.

Among the beneficial microorganisms that can effectively integrate the soil-plant-microbiological equilibrium include lactic acid bacteria, photosynthetic bacteria, ray fungi (or actinomycetes), yeasts, and mycorrhizal fungi. It has been scientifically documented that these organisms in mixed cultures, and through fermentation reactions, produce organic acids, plant hormones (e.g., auxins, gibberellins, and cytokinins), vitamins, and anti-biotics. These products can benefit growing plants by a) solubilizing nutrients from materials of limited solubility, e.g., rock phosphate, b) complexing heavy metals to restrict their uptake by plants, c) providing simple organic molecules for direct uptake by plants, e.g., amino acids, d) protecting plants from soil-borne pathogens, insects, and diseases, e) stimulating plant growth, thereby increasing the yield and quality of crops, and f) improving the chemical and physical properties of soils. When all of these beneficial effects are integrated it can optimize soil productivity and crop production with minimal use, if any, of chemical fertilizers and pesticides.

Another effect of EM cultures that has now been documented is that they produce compounds that function as antioxidants in much the same way as vitamins A, C, and E in animal and human metabolism. Antioxidants are known to prevent oxygen (O_2) from forming free radicals that are associated with certain diseases.

Actually, EM cultures tend to simulate the “rotation effect,” a term used by agronomists to describe the regeneration of beneficial microorganisms and the suppression of harmful ones that often results when shifting from monocultures to crop rotations.

In closing, I would also mention that EM technology has now achieved a considerably broader application than soil improvement, and plant production and protection. Research has shown EM cultures to be highly effective in purifying wastewaters and sewage effluents; improving soil physical properties, particularly soil aggregation; and suppressing malodors in livestock and poultry buildings. Such a broad application of EM cultures has markedly enhanced the development of economically-viable. environmentally-sound, and energy-conserving systems of nature farming for mankind, both today and for future generations.

For more than 25 years I have conducted research with the ultimate goal of developing mixed cultures of compatible microorganisms that would function effectively as microbial inoculants to create a soil environment that would enhance the growth, health and yield of crop plants. Our research, including that of APNAN and SANAN, has shown that we have successfully achieved this goal through what is now referred to as EM technology. I would also point out that EM is not a requirement for Kyusei Nature Farming, but is an added dimension that provides a means for a) controlling soil microorganisms to the advantage of the plant and b) improving the probability for a successful transition from conventional to nature farming methods.

Finally, I would again like to express my sincere thanks and appreciation to everyone who contributed their efforts to ensure that this Third International Conference on Kyusei Nature Farming is a great success. My best wishes to all of the participants for a productive and informative Conference.