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"Application of Effective Microorganism for Sustainable Crop Production"

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The concept of EM (Effective Microorganism) was developed by me in the 1980s, after conducting research on overcoming hazards of continued cropping and the preservation of quality in horticultural crops. Thus, from the 1970s, on the basis of the historical significance of microorganisms in Japanese agriculture, I experimented with mixtures of microbes, with no anticipated results for over a period of 10 years.

I must emphasize at this point that EM does not contain any special set of microbes. Neither does it have any genetically engineered organisms. Thus, EM has only a combination of specially selected microorganisms capable of producing multiple benefits. All these microbes are present in nature. If anyone wishes to test it - this could be done easily by incubation EM with sterilized organic matter under sterile conditions. Within a few days, one would be able to detect many kinds of microorganisms that are seen in all natural ecosystems.

Modern agriculture using chemicals have produced definite results. These systems have been able to produce high yields as evidenced by the green revolution, but at a cost. Recent reports from the International Rice Research Institute of the Philippines clearly illustrate this. Yields of plots that have been supplied with agrochemicals continuously for a long time are declining rapidly. Similar reports are found in the developing world where farmers use agrochemicals without caution. I am sure that there are a significant number of similar examples in Europe, which has a long history of agriculture. All these systems show a special common feature - they are not sustainable.

Analysis of the reasons for this phenomenon show one common characteristic - The soils of these systems do not contain natural fauna and flora - which in other words mean - that the soils are dead. EM reverses this situation by developing a more conducive environment for the crops. Thus, EM works in harmony with nature, mobilizing the energy from the sun and earth, but the exception is that it accelerates the process.

Numerous books and papers have been written by me on this subject, although some specialists do not accept this principle. I am not disappointed by this scientists generally wish to test this concept before acceptance. However, I am pleased to note that the technology has spread across several countries and continents and the beneficial effects are being reported from a diverse range of environments under both laboratory and field condition. Some countries are adopting the technology as a part of their national agricultural policy.

The basis of action of EM can be related to a general method of classifying microorganisms. This can be classified as Reviving, Neutral or Disintegrating types. The microorganisms found in EM are also found in nature and can be classified as the reviving types. They act harmoniously to develop a more productive and sustainable system of agriculture. For example, the reviving types enhance the soil biological, chemical and physical properties, while acting as synergists. The reviving types could also change the neutral types to beneficial types. All of these decompose organic matter to produce growth requirements of crops and reduce pollution. In contrast, the disintegrating types cause diseases. EM can suppress these disintegrating types.

The action of EM does not occur in isolation. The microorganisms in EM also need food - Thus the effectiveness of EM is best obtained with organic matter. The microbes have the ability to breakdown the organic matter thus releasing beneficial soluble substances such as amino acids, sugars, alcohol, hormones and similar organic compounds. These are absorbed by plants, and thus growth is enhanced. In animal husbandry, EM promotes the breakdown of manures rapidly, thus eliminating foul odors, while producing good quality organic manures. In this process EM suppresses disease causing organisms. Thus, EM can be best described as a methodology capable of providing solutions to the problems of food, diminishing resources, environmental pollution and health. It is a very good solution to the problems of modern agriculture, as it is capable of supporting the basis of food production - the soil and the environment, by transforming a disease inducing system to one of continuing productivity.

The developments of EM do not end here. The more recent developments include the use of EM in health and sanitation programs in Japan and several Asian countries. We are in the process of deriving EM products for industry as well.

Beneficial bioactive substances produced by microbes have one common aspect - They are antioxidants. The effect of these substances is via the prevention of oxidation of matter and living bodies, a concept known for a long time. Thus they play an important role, as all types of matter on earth, both living and non living, deteriorate through the process of oxidation causing malfunctioning of bodies of organs.

Antioxidant substances generated by Effective Microorganisms and the antioxidative emissions of waves that accompanies such processes have the strength to suppress harmful effects of oxidation. This phenomenon also has the capacity to transform oxidized matter to its original condition, regardless of its state of disintegration.

The process of antioxidation where reduction takes place, has been identified as one of entropy. This causes a difference in the activity of SOD (a free radical deionizing enzyme or super oxide dismutase) of living bodies, a term used in medical sciences. With the bioactive substances generated by EM, some of which do not activate the SOD, remarkable results have been observed, This is due to the deactivation of free radicals that occur in materials and living organisms.

The disintegrating types of microorganisms act in a complete opposite manner to that of the reviving types. These disintegrating types generate substances that promote oxidation, either directly or indirectly, and give rise to free radicals that cause the process of oxidation.

The neutral types of microorganisms consist of non dominant intermediate groups. These can be considered opportunistic as they can transform into reviving or disintegrating types on the basis of the atmosphere surrounding them. Thus in the reviving atmosphere, they transform into the antioxidating or reviving types.

The destruction of agricultural lands and the deterioration of the environment could also be viewed as a process of oxidation. Within this concept, diseases in all living organisms could also be considered a process of excessive oxidation.

I must emphasize that the scope of the recent developments in EM and its technology is not limited to a narrow field of agriculture alone. Due to the ability of classified as microorganisms with a multiple uses.

The agricultural systems of today are undergoing much hardships at the present time. The solutions to these problems are not readily available through conventional systems of agriculture, nor are solutions in sight through this pathway. Hence problems of food scarcity looms in the future, while most countries are hoping to achieve self sufficiency and food security. The concepts and reality are getting further apart, rather than closing the gap.

Looking at solutions to this problem, one could easily identify that the maintenance of soil fertility and quality are two basic concepts that have been considered vital in achieving sustainability of tropical food systems. The conventional technologies of chemicals do not offer a clear solution, as the excessive use of agrochemicals have brought us to this situation. Hence one has to look at organic matter as a source of alterative nutrients.

Most farmers in the past have relied upon the forests and surroundings of crop fields or livestock to provide organic matter. However, these sources are fast drying up. Therefore, one has to look at non-traditional sources of organic matter. Studies done in many done in many parts of this world show that wastes, such as urban and even kitchen or industrial wastes could be developed into quality fertilizers, through the use of EM. Studies carried out at both homestead and urban levels clearly present this phenomenon. One could easily cite examples from many countries in the region. This system of using organic wastes for maintaining productivity not only supplies nutrients, but brings multidimensional benefits to the soils and plants, while cleaning up the environment and protecting nature.

The conventional agriculture practiced by most nations today are causing further problems. Industrialization is adding fuel to the fire. The excessive use of agro-chemicals and the application of chemical wastes to soils leave residues that kill the living organisms in soils. These not only kill the micro-fauna and micro-flora, but leave substances such as dioxin and PCBs. The problems have been identified and have been accepted as being more serious than originally expected. This problem has been compounded further as incurable diseases such as cancer, allergies, damages to the genetic structure of humans, animals and plants have been traced to these toxic substances. In the recent past, the residues of

agro-chemicals have been associated with illnesses which are commonly referred to as being caused by hormone disrupting substances. These facts have further been compounded due to phenomena such as acid rain, which are caused by chemicals and toxic chemical residues. These phenomena makes toxic heavy metals easily soluble, thereby affecting animal life, which results in problems that we hear about in our daily lives today.

The question is - How do we overcome these problems - to make this world a better place for humankind while maintaining, and more importantly, increasing agricultural productivity?

There are many options available to us. We could use very expensive machinery and technologies to overcome these problems. However, new innovations and technologies take time to develop, are very costly, and therefore beyond the reach of most developing countries which face these problems to the greatest extent.

The other option is the effective use of nature to do this work for us. Our environments are abound with microbes which have been doing all the cleaning for us. However, with the passage of time and with developments, we have neglected our basics and those little unseen microbes, who have made this world habitable for us. This could be identified as one of the primary causes of the problems today.

What is the solution to this? It is very simple since we can easily go back to the systems to develop the microbial life in our environments. However, nature is slow and the rate at which pollution is produced will not facilitate redevelopment.

In contrast, we could use mixtures of useful microbes to accelerate the process. This is what EM does. The microbes found commonly in all ecosystems and are extensively used in the food industry are blended together to form EM. This can effectively reduce pollution. The most recent research highlights that EM helps overcome problems of dioxin and PCBs. The use of EM in controlling conventional pollutants such as animal wastes, household, and city wastes including sewage is now in practice in many countries. I will not steal the presentations of this afternoon to illustrate the successes - You will hear from the users of the success in all continents of the world. The success is shown in the developed and developing nations, and EM is moving, I assure you of this. The secret of this success is what was told by me earlier - the technology is simple, low cost, highly efficient and safe. It uses microbes from the respective environments and does not contain genetically engineered organisms. Such modified organisms will not live in these diverse environments and no one will offer them freely as we do EM. Hence, I assure you a more safe place for humankind while maintaining, and more importantly, increasing food production, a concept that is advocated in Kyusei Nature Farming.

I do not want to explain the developments of Kyusei Nature Farming and EM in all countries. The presenters will do that - and I do not want to steal their show. Please be informed that at least five countries have adopted EM in their national programs and in many others prominent organizations are actively using EM in agriculture and environmental control.

However, I wish to take an example from a country that is always in the news at the present time, due to the publicity given by the international media on food problems in that nation.

The country is the Democratic People's Republic of Korea. This country, which is being shown as one filled with people without sufficient food is actually a front runner in using EM. They adopted EM in 1996, and applied 100,000 tons of EM in 1997. The results are so promising that the governmental officials are very confident that they have finally sought an answer to their food crisis.

I visited this country in October, 1998 and found that governmental officials are very happy and confident, and have projected a grain yield of 5 million tons. The country is happy if they could produce 4 million tons, which will protect its people form famine. Hence this target of 6 million is indeed a very good omen and you can realize the impact it would have - to produce 1 million tons of grain in excess of requirements. Therefore, they hope to use 200,000 tons of EM next year. This is a very good example of the benefits of this way of farming and that of EM.

I do not state that EM is the answer to all problems. Various other methods have been advocated in the past, and will be done in the future as well. However, at the present time, when problems of modern agriculture and environment has become the current theme, EM technology offers a multitude of answers to develop a sustainable basis for food production and preserve our environment.

In conclusion, I wish to state that you may not believe that the application of solutions of Effective Microorganisms can be extended to every field of human activity - However, all what I have stated is based on facts and experimentation in Japan, other Asian countries and also from the Americas. Further evidence will be forthcoming even from very conventional research institutes of the world, where this technology is undergoing rigorous testing.

We assure you of all possible assistance. I also hope that this lecture will enlighten you on the numerous possibilities of the technology of Effective Microorganisms to enhance the productivity of ecosystems, to ascertain the development of a sustainable agriculture and environment.

Thank you.

A. General Information on EM

1. What is EM?
   EM stands for Effective Microorganisms. It was developed by 1980 and has been put to use for 18 years now.

2. Types of Microorganisms in EM
   EM is a multi-culture of major microorganisms such as photosynthetic bacteria, lactic acid bacteria, and yeasts with those found in nature and capable of coexisting with other major microorganisms. Microorganisms in EM, therefore, are found in nature in just about any part of the world; they are not genetically engineered.

3. Non-toxicity of EM - or - Bio-safety of EM
   Microorganisms in EM are limited to those used in food-processing or silage making and are confirmed in its non-toxicity by an accredited institution in Japan. In Japan, EM has been adopted widely in the producton of fermented products such as pickles, soy bean paste, yogurt, etc., or for maintaining the freshness of produce. There are even many who ingest EM for their health. To date, there are no cases of bad incidents with EM in the past 18 years.

4. Quality control
   The quality of EM is maintained by the following factors:

a. pH level:	Below 3.5
b. Smell:	Sweet-sour aroma (must not be used when it smells strongly irritating or malodorous)
c. Microbial count:	Over 10^3 per ml for each of photosynthetic bacteria, lactic acid bacteria, and yeasts (less effective if any is less than that count). As for the other group, it can be said that the higher the counts are the better the quality of EM is, but that no count is required on these for quality control.

B. The Application of EM to Agriculture

1. Expanded adoption by Nature Farming advocates to conventional farmers.
EM has been adopted first by those who supported Nature Farming with its emphasis on "no pesticides and no chemical fertilizers." Recently, however, as its ability to decompose pesticide residues and toxins in the soil has become widely known, it started being adopted by those practicing conventional farming.

2. A wide range of adoption.
EM shows its effects only when it propagates enough and starts domination over the pathogenic microorganisms existing in the soil. The general method is to add to the soil EM treated organic matters, such as crop residue, weeds, animal excreta, and kitchen garbage after the fermentation is completed and the EM is well propagated. Household waste water, animal effluent, or waste water from food-processing factories of agro and aqua products, with EM propagated in it, will also bring about higher yields when irrigated to the field and rice-paddy. EM technology show the possibility for solving problems related with environment, water, and hygiene all at the same time.

3. As countermeasures to diseases and pests.
As EM increases its population in the soil, soil-borne diseases are rapidly reduced. In some cases two or three cropping with EM will make it possible to grow crops without pesticides and chemical fertilizers. For this purpose, EM and other EM fermented liquid materials are used in place of the pesticides. The users themselves can develop EM extended organic liquid and solid from EM stock.

4. Crop yields and quality.
Yield is expected to increase by 20% to 30% with the general use of EM and even by 50% to 100% when a high level of EM is maintained in the soil. Produce taste better, with higher content of vitamins C and E for some, show longer storage life, and show characteristics of general health products when consumed. Secondary products processed from these crops such as wine, juice, catchup, etc., also show better quality.

C.. Application of EM to Animal Husbandry
Application of EM through fermented feed (silaged), adding to drinking water, and spraying inside the animal barn will reduce bad odor as well as pests such as flies, maggots, etc., drastically.

The improvements in meat quality, egg-laying rate, and dairy production. Specially noted is the high quality of eggs and milk.

EM-X can be used together with EM, eliminating the use of antibiotics and other medicines altogether.

Excreta from animals treated with EM will have less odor and become a high quality organic fertilizer, which farmers are eager to receive nowadays. The urine also becomes a high quality liquid fertilizer. The overflow, which comprises of the clear parts of the effluent, will start cleaning the waters when led to the river, as well as make it healthier for water creatures to grow better.

D. Application of EM to Forestry

We can grow healthy seedlings in a shorter period of time with EM than without. EM used at the time of transplanting will improve the survival rate of the seedlings and their growth. A similar method applied to fruits is growing with success.

E. Integrated Farming (Systemic-Comprehensive Farming)

With EM it is possible to build an integrated farm with various practices for a farmer or for a community of farmers which themselves may be separate practices. That is, almost all industries not only the combination of cropping and livestock but also including aqua-culture, waste water and solid waste from food processing, of primary products, and sewage can be integrated into a system, which in turn provides opportunities for a wider range of industries to be integrated and recycled.
If such a system is adopted widely and firmly in the society, most environmental problems which are attributed to a large amount of kitchen garbage and organic wastes, sewage, and excreta from livestock, an be resolved, and finally we can establish a farming characterized with “low input”, “high productivity”, “high quality”, and “sustainable”.

F. The Application of EM to Environment Problems

1. Measure against kitchen garbage problems.
   EM can prevent bad odor from kitchen garbage in the urban area and turn them to organic fertilizer. And this practice is widely spread in Japan and Korea and is recognized as the most effective method for treating organic wastes at low cost.
2. Measure against animal waste problems.
   EM can prevent bad odor of animal excreta and turn them to something useful. In fact it can solve practically any problems associated with animal husbandry.
3. Measure against stained/polluted/contaminated water.
   When EM is applied and propagated at the source of pollution, such as toilets and a sewage treatment system, water will be cleaned enough for recycling for agriculture, aqua-culture, and even household uses.
4. Measure against incineration problems.
   The combination of EM and its ceramic will prevent dioxin from being produced in the incineration factory, even when it is incinerated at lower temperatures (around 700 degrees centigrade). Because of the lower temperature the factory enjoys a longer life as well as drastically reduce toxins in the incineration gas.
5. Measure against problems associated with energy consumption and solid wastes.
   EM and EM ceramics not only improve the efficiency of combustion engines including automobiles, boats, and farm machines, resulting in better fuel mileage and cleaner emission, but also protect them from aging, such as rusting, resulting a longer life. This helps us to reduce the consumption of energy, the pollution from exhaust gases, and reduce the waste of raw materials.

   Our civilization is filled with ever increasing industrial products, which comprise a large portion of solid waste which we must deal with. Currently numerous researches are undergoing for finding ways to recycle and reproduce them with EM.