

Royal Agricultural College, Cirencester, UK

Research Activities

THE TECHNOLOGY OF EFFECTIVE MICROORGANISMS – CONCEPT AND PHILOSOPHY

Professor Teruo Higa

University of the Ryukyus, Okinawa, Japan

ABSTRACT

The concept and technology of Effective Microorganisms (EM) was developed by Professor Dr. Teruo Higa, at the University of Ryukyus, Okinawa, Japan in 1970s. The fundamental principle of this technology was the introduction of a group of beneficial microorganisms to improve the soil condition, suppress putrefying (disease inducing) microbes and improve the efficacy of organic matter utilization by crops.

EM is a fermented mixed culture of beneficial microorganisms. These are Lactic acid bacteria, Phototropic bacteria and Yeast. These microorganisms exist in nature and are utilized for food processing and probiotic for livestock. The culture of EM contains these species, in an acidic medium. This solution does not contain any genetically modified microorganisms.

Research and field studies in all continents have shown that the inoculation of EM culture to the soil/plant ecosystem can improve soil quality, soil health,

and the growth, yield, and quality of crops. Similar benefits have also been reported when EM is used in animal production systems.

EM can significantly enhance the beneficial effects of soil and crop management practices, especially in organic farming systems. The solution will help the decomposition process of organic materials through fermentation, and produce beneficial organic acids, bioactive substance and vitamins. A key ingredient in this process is organic matter, which is supplied by recycling crop residues, green manures and animal manure. In addition this process leads to increased humus in the soil.

The use of EM is not restricted to the production of food. It is used extensively in waste management with very good results as shown by numerous studies and field applications in many countries. In the recent past, antioxidation effects of EM have been reported, which could improve immune system of plants and animals. The presentation highlights the development and current uses of EM in a global context.

INTRODUCTION

As we enter the new millennium, the scene we see around is not pleasing to the eyes of humankind. There are both natural and human originated disasters all over the world. Some even believe that these calamities could culminate in the destruction of mother earth!

Under such circumstances, can we, the human race not develop some mechanism to surmount these problems? The answer is simple - WE CAN!

The first problem that humans must solve is of food. The second is of the environment. How we do this? It is strongly believed that the concept lies in the feature of treating the earth and its ecosystems in a holistic matter – by considering the entire ecosystem. Looking back at the developments made in the latter half of the last century, we see one significant phenomenon. The thrust was to increase food production. This was done very successfully using all the resources that one could see with the naked eye. All the rest were forgotten. This was the root to all problems. While the humans, in their endeavor to increase food production at any cost,

forgot or ignored the vital link in all ecosystems – the Microorganisms. These small living organisms link the detritus and grazing food chains and keep the energy and nutrient flows moving through the ecosystems and its living beings

The recognition of this factor dawned on me in the 1970s while working with chemical fertilizers and pesticides. Thus, while researching on microbes in our University, I accidentally discovered that a microbial mixture thrown aside had a significant impact on a patch of grass!! This paved the way for the development of the Technology that I termed Effective Microorganisms (EM) in the late 1979's.

THE TECHNOLOGY OF EFFECTIVE MICROORGANISMS

At the inception of my studies, 80 species were used to develop the solutions of Effective Microorganisms (EM). This selection was done from over two thousand species of microbes found in all environments. The species selected were all commonly utilized in the food and fermentation industries. However, this was a very complex process for a simple and environmentally friendly technology such as that of EM. Thus studies were carried to simplify the process of developing EM in all environments.

Today, EM is developed using three principal organisms, namely Phototrophic bacteria, Lactic acid bacteria and Yeasts. These three types are indispensable for EM and even if other species were not included, these would develop coexisting forms with other beneficial organisms in the environment. This happens, as EM is not made under sterile conditions, but using simple technology in many difficult environments. Thus, the EM of today consists of these three principal types, which is subsequently enriched naturally by other species such as filamentous fungi and Actinomycetes. The fundamental principle is that the three principal species must be abundant in EM and the pH of the solution must be below 3.5. This is the technology and if this combination is found, that solution, made anywhere will develop the beneficial effects of EM.

I would also like to emphasize one aspect that troubles all when we speak of microorganisms. This is the concern about genetically modified organisms.

EM was developed initially at a time when genetic manipulations were a pipedream of many. Certainly in Okinawa, we did not have the technology for this. Hence it was impossible to use G M O's in EM. More importantly, EM is now made in all continents from the three species I mentioned earlier, which are isolated from the respective environments. Hence, I do assure you that EM does not contain any genetically modified organisms, nor does it contain microbes brought in from Japan.

The application of EM is easy and is harmless. However, the use of EM does not only enhance the microbes found in EM in that environment. It acts as a catalyst with a synergistic effect to promote all the beneficial microbes of that environment. When this happens, the microbes that develop harmful effects are excluded from that ecosystem, in a manner akin to human activity, where good people weed out the bad ones. Thus the soil microflora and fauna change from a disease inducing soil to a disease suppressive soil. With time and with EM and organic matter, such a soil has a capacity to develop into a zymogenic soil, which as we know is capable of sustaining production. The process enhances to increase the humus content of the soil and generally an infertile Oxisol would finally end up as a black fertile soil, capable of supporting bountiful yields. This has been well proven in many environments as reported at many international forums.

THE CONCEPT AND PHILOSOPHY OF EM TECHNOLOGY

The technology of EM is based on holding the three principal species together at a very low pH, when most species of microbes die. Many microbiologists have tried combining these species in laboratories and examining the functions and activities of EM in isolation. This does not work and they claim that EM is ineffective. However, I do assure you that EM works as shown by numerous examples every day. I do request the microbiologists to work with EM and organic matter in soils, where the activity really takes place.

Many have studied the mode of action of EM and interesting results have been reported. I presented some of them at the last conference two years ago. It was stated that EM helps produce antioxidant substances such as Inositol, Ubiquinone, Saponin, low molecular polysaccharides, polyphenols and Chelates of minerals. These antioxidant substances,

which are now proven to develop disease suppression even in humans, are formed with the application of EM. This in turn allows the multiplication of beneficial microbes, while inhibiting the harmful species.

The antioxidant substances formed by EM in the decomposition and fermentation of organic matter has the capacity of detoxifying harmful substances. They suppress harmful reactions by deionization of hazardous substances and also promote the chelation of heavy metals such as iron and induce microbes to secrete decomposing enzymes such as lignin peroxidase. Such enzymes have the capacity to decompose residual agrochemicals and even dioxin in soils. Thus, if EM is used with organic matter in soils, which have been heavily contaminated with pesticides or have high concentrations of dioxin, they are detoxified within 2 – 3 seasons. This has been proven in many environments.

The role of EM is also enhanced by the gravity wave resonance originating from the phototrophic bacteria. These waves have higher frequencies and lower energy than gamma and X rays. These waves are capable of transforming harmful energy forms in nature into beneficial forms through resonance. This is the technology of Effective Microorganisms.

FUNCTIONS OF EM

EM is something that is environmentally friendly and safe for use in all agricultural system. Its continuous use results in strengthening the vigor of plants. Research and farmer experiences present instances where crops grown with EM have withstood droughts, floods and temperature extremes. Use of EM has resulted in the increase of soil fauna such as earthworms. Such a phenomenon softens the soil, which in turns reduces the requirement of excessive tillage. Further examples of the benefits of EM include weed control with time. This is by spraying EM at dilutions of 1:500 or 1:100 and lightly cultivating soils. This process composts the weeds, and thus reduces weed populations with time. EM increases soil temperatures especially in the temperate regions, due to microbial activity. These are some of the many benefits of EM in Agriculture.

EM is also used in pest and disease management. Medicinal herbs and spices such as pepper, garlic and onions are blended with EM and fermented with molasses for 7 – 10 days. This solution not only prevents pest and disease incidence, but also promotes photosynthesis in plants and

enhances plant vigor.

The above examples show the multitude of benefits of EM, which have been well proven in many environments. Thus it is a holistic technology. All these benefits are due to the combined benefits of the wave resonance and antioxidant properties of EM. The negative effects are reduced and at times, the negative energy is transformed into developing positive effects. A clear example is the use of EM in mitigating radioactive contamination as that found in Belarus. These studies have also shown that continued use of EM has reduced contamination. This could be attributed to the development of gravity waves with very high frequencies and ultra low energies. Thus, EM and the gravity wave resonance produced by EM are used in areas such as energy saving technologies and mitigating the effects of dioxin.

The above stated activities of EM are due to the phenomenon of **syntropy**, which is the opposite of entropy. This EM has the power to change the nature of things, where pollutants can be made into beneficial materials. This is well exemplified by the many integrated farms developed with EM in places such as Thailand and Indonesia. I also know of such units now being developed in South Africa, for research and testing purposes.

EM IN THE MODERN WORLD

Modern agriculture is heavily dependent on chemicals, which has caused tremendous problems of environmental degradation and human health. In addition, the inclusion of genetically engineered species has further aggravated the problems by causing imbalances in nature. Thus, Nature Farming is fast gathering momentum as an alternative way of life and productivity. However, nature or even the common organic farming systems are beset with problems, primarily of low yield and poor returns to investment. In addition, they require large quantities of good quality organic matter. This is the modern trend in agriculture.

EM can help these changes in Nature Farming significantly, to overcome its problems. This microbial solution can convert all wastes into very good fertilizers in a short time. It can enhance soil quality when used with organic matter. Many examples of this aspect have been presented over the past 10 years and again many will be stated over the next two days, and

you would see the results in the field as well. Thus EM technology can be considered an additive in agriculture that is safe, comfortable, low cost with a significant potential of producing high yields of good quality crops. Thus, the excessive use of energy and chemicals seen in modern agriculture could be replaced with EM, for greater profits through agriculture, using a lower quantum of energy. Thus EM is an alternative but very appropriate technology for the modern world.

EM FOR THE FUTURE

Agriculture and environments of the future must be self sustaining and sustainable. This is a very ambitious objective. However, this is possible EM. This system will ensure the best utilization of resources found in all ecosystems. It will ensure that all pollutants, that are problems today are converted into good organic fertilizers. This is vital for sustaining productivity and soil quality. The enhancement of photosynthesis by EM will ensure the entrapment of the solar energy and also reduce the problems of carbon dioxide increase in the atmosphere. EM can be used even in desert and sodic environments such as those in Pakistan, Egypt and Mongolia. These are not dreams as projects are already underway in these regions, which are showing very good results. EM would enable the cultivation of soils in cold regions as it increases soil temperatures by 2 – 3 degrees Celsius, due to microbial activity. EM can increase soil fertility, as shown by the high degree of success in the Democratic Republic of Korea, where wheat, rice and other crops have been cultivated in infertile soils under very low temperature conditions. In the United States, EM is also used for increasing yields of wheat and cotton in organic systems, with very low inputs. Thus it will be an ideal system of agriculture for the future, to ensure the sustenance of soils and maintenance of productivity, an aim that is being stated in all international fora discussing agriculture.

It is also important to note that most predictions state that the world will run short of good water for humans and farming in the next century. It is with happiness that I can state examples of wastewater treatment with EM, which has ensured recycling many times. This has been well proven in Japan, Indonesia, Egypt, United States and many other countries. Thus, again, EM technology is something that could help mitigate a crisis by purifying water for recycling. This would certainly avoid a crisis.

CONCLUSIONS

The agriculture of the world is facing many problems. They can be site specific or global. However, if one thinks diligently and with care, it would soon be realized that there are answers to these problems. Amongst the many types of solutions offered, EM technology has a very important role. This is not stated as a forecast, but with very successful experiences in all continents of this earth. Thus, in conclusion, I do wish to emphasize that EM is something worth trying – it is not heresy but a technology well tested and proven.

SUGGESTED READINGS

HIGA , T 1993. An earth saving revolution. Sunmark Publishing Inc, Japan.

HIGA, T 1994. An earth saving revolution II Sunmark Publishing Inc, Japan.

Proceedings of International Kyusei Nature Farming Conferences 1989 – 1997. INFRJ Japan or APNAN, Thailand.

Proceedings of IFOAM Conferences. 1994 – 2000. IFOAM, Germany.

[back to index](#)

[next paper](#)

Page managed by: [John Conway](#)

[Back to top...](#) Last updated: 08 July, 2002

© Royal Agricultural College, Cirencester, GL7 6JS

Tel. +44 (0)1285 652531 Fax. +44 (0)1285 650219