Achievements of EM Technology and Tasks in D.P.R. KOREA

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***Abstract**: Under the wise guidance of the great leader Comrade Kim Jong II, EM technology was introduced on a national scale in a short period of time and has successful results. The productive capacity of about 1,200 tons of EM stock solution was created in 4 years since 1995 when EM technology began to be introduced in the country. Moreover, more than 110 plants for EM secondary solution were built and formed a national network and EM fertilizer was applied to the arable land of about one million hectares this year. This paper represents the actual conditions that EM technologies are introduced in some areas including agriculture and environment conservation and their success and the tasks that should be solved in the future.*

Introduction of EM

Background

Even though we have used much chemical fertilizer and pesticides for a long time in our country – D.P.R. Korea, we could not apply enough high quality compost due to the limitation of organic matter resources. Moreover, abnormal climate continued from long ago and, in particular influences of natural disasters such as a severe flood and the long-term drought repeated in a few recent years brought serious difficulties in agricultural production. All these factors enhanced the acidification as well and the erosion of soil and, as a result, decreased soil productivity.

'Sustainable Agriculture' and 'Modern Nature Farming' to maintain stable crop products continually by conserving ecological environment of agriculture are extended on a world wide scale (Reganold et al, 1990).

Keeping pace with such a world trend research work began since the middle of the 1970's in our country to develop beneficial bacterial fertilizers such as nitrogen-fixing bacteria while laying the main stress on organic matter and combine it with microbiological technology. In the 1980's, it has been actively pursued so that some successes have been achieved (Ryang Hong-Gon, 1991, 1994; Lee Chun-Ho, 1994).

The humus content of soil in our country is below 1.5 percent and the content below one percent is common. In order to solve the food problem completely by farming properly in our country, it is necessary to improve soil and thus make soil fertility rich.

The fundamental methods to solve this problem seem, firstly, is to fix a correct level of organic matter dressing as well as mineral nutrients and combine these in a rational way. For this case a method should be found to overcome insufficiencies of organic resources. Secondly, it must improve the humus level in soil and maintain it continually. Thirdly, is to keep humus in soil that would be lost by erosive action.

Considering such a point of view, we feel that the Effective Microorganism technology studied and invented by Prof. Higa Teruo, can be the best alternative for increasing crop production by enhancing soil productivity in our country (Higa 1991: Higa and Wididana 1991).

Only 5 years have elapsed since the EM technology was first introduced to our country. However, we developed actively EM technology to meet our conditions, while referring to the research work of the former scientists as well as the experiences of other countries where this technique was widely practiced (Zafar Atlat et.al, 1997: Cho Cho Myint 1997). On the other hand, we made a good preparation to establish EM technical system completed in a comprehensive way by developing it to a higher stage.

The developing stages of EM technology until today in our country can be divided largely into three stages. The 1st stage – the period of 1994-1995 – is the stage when EM was produced in the pilot plants and their application effects were tested on a small area. During the 2nd stage – the period 1996-1998 EM was produced and introduced on a large scale.

Now, we are in the 3rd stage, and its target is to complete and introduce EM technology our way by developing it actively to rely on our materials and technique and meet our conditions.

EM Production on Pilot Scale

The preliminary experiments were conducted in 2 years in some research institutes with EM samples (stock and Bokashi) by consulting the preceding technique. In this process, we isolated and identified microorganisms of about 20 species that belong to photosynthetic bacteria, Lactobacilli, yeast, actinomycetes, filamentous fungi and nitrogen fixing bacteria, in Bokashi. Besides, based on the experiments of these incubating characteristics, we produced EM 1 on laboratory scale as a trial.

In spring of 1995, the pilot plants each with annual capacity of 100t were built in two regions. At these factories, trial production was successful in collaboration with the scientist of EM laboratory in Japan and the method of EM production was thus developed.

Mini-Plot Experiments with EM

Tests applying EM produced on laboratory scale along with the other EM from Japan were conducted in various forms of bioassay, plots, miniplots experiments etc. by using rice, corn and vegetables.

We could solve the technical method that can develop production of EM through the stage of such initial research work and thus make an opinion on effects of EM.

Creation of a Large-Scale Productive Capacity of EM

Achievements in Extensive Introduction of EM

A Research Centre for Compound Microorganisms of the Academy of Science, the research and production base of EM was built and inaugurated in June 1997. The total floor space of the Center is about 4,000 m^2.

Besides, in April 1999 an International Friendship Institute for EM Technology that has a floor space of over 1,800 m^2 was built and now produce EM stock and seed solution.

In this way, our country would have a large-scale production base for EM stock.

Plants for EM secondary solution were built extensively every year since 1996 and now they are increased to over 110. In these plants, the producers take three species of EM stock from the Center and make EM stock for secondary solution and produce by culturing it 30 times in sugary cultivation. Their productive capacity is approximately 500-2,000 tons a year.

Extensive Introduction of EM in Agriculture

Agricultural labourers in our country today call EM secondary solution as a popular "EM fertilizer". Cultivated area applied with EM fertilizer has been expanded every year since 1996 and increased to approximately one million ha in 1999. This fertilizer is used in various kinds of green crops mainly in rice and corn, the cereal crops.

The reason that the applying areas of EM fertilizer are extended rapidly in the last five years is related to the fact that the productive capacity of EM is increased very much.

The purpose of EM secondary solution in agriculture field, is to fully practice the various kinds of the effects such as the soil improvement for elevating soil fertility and further to find out the possibility of the method to solve the problems of two crops a year.

Dissemination of EM Technology

- **Lecture Training Course and Demonstration**

  Lecture and training courses to disseminate the technology on EM are underway in the Center once a week every year under the sponsorship of the Ministry of Agriculture. These meetings are organized largely in three groups – technicians of EM production and application and officers in charge of agricultural fields and it is mainly conducted in late autumn and winter – the farmers' leisure seasons. In addition to this, demonstrations are often conducted for technicians at the plants for EM secondary solution as well as for users at the farm plant every year.

- **Seminar for Technique and Experience**

  In the Ministry of Agriculture, seminars are given for technique and experience during the period from November to December every year. These are conducted also in two groups: technical groups for both EM production and usage and sometimes nearly 800 – 1000 participants are present at such a meeting. Through this seminar, the producers and consumers exchange their experiences with each other and therefore, the state measure is taken to generalize the best alternatives.

- **Types of Dissemination**

  Booklets for mass education, pamphlets and manuals on EM production and application are published in thousands of copies and thus distributed on national scale, Also many scientific movies on EM are manufactured and projected, and video cassettes of hundreds of copies are made to be distributed to every county. They are widely used for disseminating the technique among many people. Besides, the scientists often appear on TV and educate EM effects in a national way.

Extensive Introduction of EM Technology to Various Field of National Economy

EM technology began to be introduced not only to agricultural production but also to the other fields from 1999.

First of all, EM technology is also practiced in the area of environment purification and a factory of EM-fermented sewage manure was inaugurated and began production in Gumchon Sewage Purification Plant situated in Pyongyang in spring last year. Its annual production capacity is approximately 2,000 t.

Experiments to purify with EM the waste water from paper producing plants and tanneries are conducted nowadays. Furthermore, applying tests with EM are conducted in a large way such as livestock, orchard and fish farming. Even in the field of medical science and light industry science, research assignments are formulated and undertaken to develop medicine, healthy cosmetics, antiseptics, etc. with EM.

Some Problems to Develop EM Technology in our Korean Way

Research on the Principle on EM Technology

It is necessary to clarify the character of the former EM and grasp completely the principle of EM technology. Only doing so, can we become fully competent in EM production technology and further develop it keeping with our specific realities for our country. The most important is to solve perfectly the production technology of EM stock and seed solution necessary for its mass production.

Solution of EM Productive Technology Depending on Our Materials and Technique

The important materials required in the production of EM stock No. 1, 2, 3 are the molasses and fish-fermented juice. It is very important to search for an alternative

saccharide in our country where molasses are not produced. For that reason, we are continuing widely the research work to alternate the molasses with starch sweetner of maize, potato and yam. In particular, as many plants for EM secondary solution are situated in all parts of the country and they produce saccharide themselves, it is necessary to find out saccharide resource to meet the regional character.

In addition, we pay a deep attention to the method to alternate fish-fermented juice required in the production of EM stock No. 2,3 in the actual condition of our country.

Method to Elevate the Effect of EM as Soil Improvement

One of the important effects of EM is considered the improvement of soil. This effect is largely depended on dressing amount of organic matter of high quality. At present, the organic resources consist of only crop straw such as paddy straw under our conditions, but, we feel the lack of it in absolute quantities. Therefore, a supplement technique to enrich the soil fertility by using biological N_2fixing in considering our poor condition in soil.

Establishment of Scientific EM Dressing System

Scientific basis of dressing time, amount and method of EM fertilizer to be used should be realized according to the species of our crops, our climatic and soil conditions and the levels and demands of our agricultural labourers. On the other hand, there is a need for types and method to make the agricultural labourers produce and apply EM in a simple and easy way.

Rational Combination of EM and Other Beneficial Bacteria

The effect of EM differs according to the kinds of crops, soil and climate in the concerned area. Particularly, in order to produce fruitful results of EM as fertilizer, we should find out a method to obtain the best effects of beneficial bacteria such as N_2fixers and phosphorous solubilizing bacteria giving the first consideration to photosynthetic bacteria. Moreover, the development of EM in the type of organic – inorganic – EM is our urgent target.

Conclusion

Nearly five years have been elapsed since EM-technology was firstly known to D.P.R. Korea. The features of the process of EM-technology during this period in our country is the technical development and productive introduction realized simultaneously on large scale in three dimensions before the research work.

In this process, a modern production base able to produce EM stock of more than 1,200 tons a year is built in Pyongyang, the capital of D.P.R. Korea and many plants for EM secondary solution are operated on a national scale.

All these successes are thoroughly obtained under the wise leadership and the careful concern of the great leader Comrade Kim Jong IL. Further, we are well aware of the fact that this is permeated with the lofty partriotic spirit of Chong Ryon (Patriotic Organisation of our Motherland) and compatriots in Japan, who are trying very hard for the food problem of our fatherland, as well as the support of INFRC and EMRO including Prof. Teruo Higa.

We aim to introduce EM technology to various areas including agriculture and develop EM itself completely in our way relying on our materials and techniques.

For this target, five tasks stated earlier should be carried out. First of all, the effects of EM fertilizer should be expressed in general at the agricultural area. We think that wide research and strenuous efforts should be made in order to solve this problem.

Industrial system of EM established in our country is a stable material and technical base that can develop extensively this technique not only in agricultural but also in the other industrial area. On the basis of this, we are sure that EM technology could bring better results in several industrial fields.

In this way, we would like to make our active contribution to the development of EM technology the common treasure of mankind.

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