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Effective Microbes (EM) - An Organic Agricultural Technology

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Microbes are a vital component in all ecosystems. In agriculture, their value cannot be overemphasized, due to their role in the soil as an interlink between the biotic and abiotic components and also between the grazing and detritus food chains. However, their role has often been neglected in conventional chemical farming systems. The interaction between microbes and plants developed with the process of evolution in plants, and hence the use of microbes singly or in mixtures of free living and naturally occurring species could enhance the productivity of most farming systems significantly.

Fungi, bacteria, actinomycetes and yeast are found in all ecosystems. They are used widely in the food industry, and these species play a vital role in agriculture to maintain and also enhance productivity. The technology of Effective Microorganisms (EM) is also based on the these species which contain a mixture of five genera of organisms, namely actinomycetes, ray fungi, photosynthetic bacteria, yeasts and lactic acid bacteria isolated from the respective environment. The technology of effective microorganisms was developed during the 1970's at the University of Ryukyus, Okinawa, Japan, by Dr. Teruo Higa, Professor of Horticulture, in 1983.

What are effective micro organisms?

Effective Microorganisms (EM), a culture of coexisting beneficial microorganism predominantly consisting of lactic acid bacteria, photosynthetic bacteria, yeast, fermenting fungi and actinomycetes cultured according to a specific method in liquid form. That are claimed to enhance microbial turnover in soil and thus known to increase soil macronutrients and increases plant growth, yield and treatment of sewages or effluents. Some of these micro-organisms are known to produce bioactive substances such as vitamins, hormones, enzymes, antioxidants and antibiotics that can directly or indirectly enhance plant growth and protection.

EM consists of a wide variety or multiculture of effective, beneficial and nonpathogenic microorganisms coexisting together. Essentially it is a combination of aerobic and anaerobic species commonly found in all ecosystems. EM contains about 80 species of microorganisms which are able to purify and revive nature. The main species involved are normally the *Lactobacillus plantarum, L. casei* and *Streptoccus lactis* (lactic acid bacteria), *Rhodopseudomonas palustrus* and

Rhodobacter spaeroides, (photosynthetic bacteria), *Saccharomyces cerevisiae* and *Candida utilis* (yeasts), *Streptomyces albus* and *S. griseus* (actinomycetes), and *Aspergillus oryzae*, *Penicillium* sp. and *Mucor hiemalis* (fermenting fungi) .

All of those are mutually compatible with one another and can coexist in liquid culture.

Uses of Effective Microorganism

The different species of EM have their respective functions. EM can be applied to many environments to break down organic matter. It is a natural and organic technology that has been found to be useful in numerous ways to benefit mankind. Some of the claims of EM applications include sustainable agricultural, industrial, health (livestock, pets and human), odour control, waste management and recycling, environmental remediation and eco-friendly cleaning.

The original use of EM was for agriculture. Hence EM was first applied to enhance productivity of organic or nature farming systems. Agricultural uses include greater release of nutrients from organic matter when composted with EM, enhanced photosynthesis and protein activity. Studies also identify greater resistance to water stress, greater mineralization of carbon and increased soil properties and better penetration of roots with the use of EM. The impact of EM in promoting plant growth by controlling or suppressing pests and diseases has also been reported from many countries.

Preparation of EM

EM-1 is the name given to the dormant concentrate of Effective Micro-organisms. To apply these Effective Microorganisms for agricultural use the EM-1 must first be activated. The activation of EM-1 is achieved by adding sugar cane molasses and water which allows the EM to start multiplying. This activated EM is known as EM-Activated (EM-A) and is prepared as follows:

Activating the Effective Microorganisms (EM)

EM is available in a dormant state and requires activation before application. Activation involves the addition of 7 L of chlorine free water and 1.5 kg of brown sugar to 3 L of dormant EM one week prior to application. These ingredients were mixed together in either a 15 L or 20 L container and stored in area with minimal temperature fluctuations. A major influence on the survival of microorganisms is the temperature of their environment, with significant temperature fluctuations impacting upon their survival. The pH is also a determining factor. It was indicated that the pH of the EM should be approximately 4.5

This activated EM must be allowed to 'brew' for a minimum of 7 days in an airtight fermentation tank which has a warming element. A fermentation process allows the activation of the micro-organisms whereby an optimal amount of beneficial bacteria is obtained. The EM-A needs to be then diluted with water (1: maximal 100), and can then be used for many different

applications. Once the EM-A solution is prepared, it must be used within 48 hours. The EM-A before dilution can be kept for a month in an airtight vessel.

Methods of application

EM was applied directly onto organic matter added to cropping fields, or to compost, which reduced the time required for the preparation of this bio fertilizer. EM is also added in the form of compost made with waste material such as rice husk and saw dust as a carrier, mixed with nitrogen rich material such as rice, corn or wheat bran, fish meal or oil cakes. EM can be applied in different methods as soil application @ 10 litres EM-A dilution per 100 m^2, as fertilizer spray or use a watering can to apply 5-6 x per growing season, as compost activation @ 1 litre EM-A dilution per m^3 compost, as seed disinfectant @ 1 litre EM dilution for 30 minutes, as bulbs and tubers treatment for 1 hour (Infected with *Fusarium* 6-7 hours, potato infected with *Ralstonia solanancearum* for 2-4 hours. EM-1 has a shelf-life of 12 months after production.

Advantages to Plants

- Encourages growth and maturity in plants and makes plants greener.
- Inhibits the growth of harmful bacteria that carry diseases in the soil.
- Acts as a natural fertilizer by adding organic matter to the soil.
- Controls the degree of soil moisturization and nutrient absorption.
- Improves the physical, biological properties and ventilation in the soil.
- Encourages rooting and flowering for plants.
- Detoxifies residual herbicides and pesticides in the soil.
- Eliminates the usage of chemical fertilizers.
- Act as insecticides, pesticides and repellant to pests like rats and plant hoppers

Conclusion

Organic or nature farming is considered a possible solution to many of the problems caused by industrialized agriculture. Hence EM is not a substitute for other management practices but an added dimension for optimizing our best soil and crop management practices such as crop rotation, use of organic amendments, conservation tillage, crop residue recycling and biocontrol of pest and diseases.

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