The Silent Heroes: Effective Microorganisms

Surhay Ragimoglu ALLAHVERDIEV[1], Natalia Olegovna MINKOVA[1], Denis Viktorivich YARIGIN[1], Gökhan GÜNDÜZ[2]

Abstract

The importance of non-toxic food and non-polluted natural resources depends on a clean environment. Effective microorganisms (EM) are a consortium of benefical microorganisms. These microorganisms change the balance from degeneration to regeneration. EM technology is widely used in agriculture, waste treatment and health. The application of EM technology can be integrated with standard agricultural fertilizers and reduces the usage of these chemicals. EM technology is non-toxic and cheap. Many studies are conducted about the effectiveness of EM technology and some of its results are critized. The critics are mostly related to wrong usage and application procedures. Education, training and good knowledge about microorganisms and its applications will provide more effective results in future.

Key Words: Effective microorganisms, Biotechnology, Agriculture, Health

Sessiz Kahramanlar: Etkin Mikroorganizmalar

Özet

Toksik olmayan gıda ve kirlenmemiş doğal kaynaklar temiz bir ekolojiye bağlıdır. Effektif (etkin) mikroorganizmalar (EM) faydalı mikroorganizmaların bir araya gelmesi olarak tanımlanabilir. Bu mikroorganizmalar dengeyi yıkımlamadan (degeneration) tekrar oluşuma (regeneration) çevirirler. EM teknolojisi tarım, atık endüstrisinde ve sağlık alanlarında geniş bir şekilde kullanılmaktadır. EM uygulaması standart gübreler ile beraber yapılabilir ve bu tarz kimyasalların kullanımını azaltabilir. EM teknolojisi zehirsiz ve ucuzdur. EM teknolojisinin etkinliği ile ilgili birçok çalışma yapılmıştır ve bazı bulgular olumsuz sonuçlar vermiştir. Bu olumsuz sonuçlar çoğu kez yanlış kullanım ve uygulama ile ilişkilidir. Bu konuda yapılacak eğitim çalışmaları ve bu tür mikroorganizmalar hakkında bilginin arttırılması gelecekte daha etkili sonuçlar alınmasına yol açacaktır.

Anahtar Kelimeler: Effektif mikroorganizmalar, Biyoteknoloji, Tarım, Sağlık

Introduction

The increase on the human population effects our future in many ways. One of them is enviromental stresses and their effects on human and plants. Plants, due to their roles in the carbon cycle, are also nutrient sources for humans and animals (Zhou et al., 2009)**.**

Environmental pollution is a major stress factor for human and plants. Thats why many researches focus on this subject and try to create more resistance against these factors. One of them is to increase the immune system of human and plants and provide better photosynthesis and all related physiologic activities (Higa and Parr, 1994; Okorski et al., 2008; Ke et al., 2009; Datla et al., 2004)

Plants can’t be imagined without soil. Therefore, plant-soil interactions are an important key factor for these physiologic activities. Studies conducted indicate that EM (Effective Microorganisms) may influence development conditions for microorganisms living in a given soil, thus affecting plant growth and development. Moreover, Effective Microorganisms may have an effect on the availability of nutrients (Kleiber et al., 2014).

[1]Sholokhov Moscow State University for Humanities, Russia
[2]Bartin University, Faculty of Forestry, Bartin, Turkey

The flow chart in Figure 1 shows the organic matter transformations by soil microorganisms and the development of soils that can be disease-inducing, disease-suppressive, zymogenic, or synthetic.

Effective microorganism knows as EM can be described as a consortium of beneficial microorganisms (primarily photosynthetic and lactic acid bacteria, yeast, actinomycetes, and fermenting fungi) that can be applied as inoculants to increase the microbial diversity of soil (Kleiber et al., 2014; Sigstad et al., 2013; Abd, 2014; Namsivayam et al., 2011).

The functions of benefical microorganisms can be summarized as:

• Fixation of atmospheric nitrogen
• Decomposition of organic wastes and residues
• Suppression of soil-borne pathogens
• Recycling and increased availability of plant nutrients
• Degradation of toxicants including pesticides
• Production of antibiotics and other bioactive compounds
• Production of simple organic molecules for plant uptake
• Complexation of heavy metals to limit plant uptake
• Solubilization of insoluble nutrient sources
• Production of polysaccharides to improve soil aggregation (Higa and Parr, 1994; Szymanski and Patterson, 2003).

Many different EM forms are widely used in health, agriculture and waste treatment. EM has a great ability of enhancing maturity and furthermore it can help reaching the same level of compost maturity much faster. And there was no odor from the compost in which EM was used in the stable phase. It was one-week faster to reach the same degree of SOUR and R/N ratio for the 3-week process. Incorporation of efficient microorganisms (EM) potentialized the biological soil activity, contributing to a quick humification of fresh organic matter (Heo et al., 2008; Valarini et al., 2003).

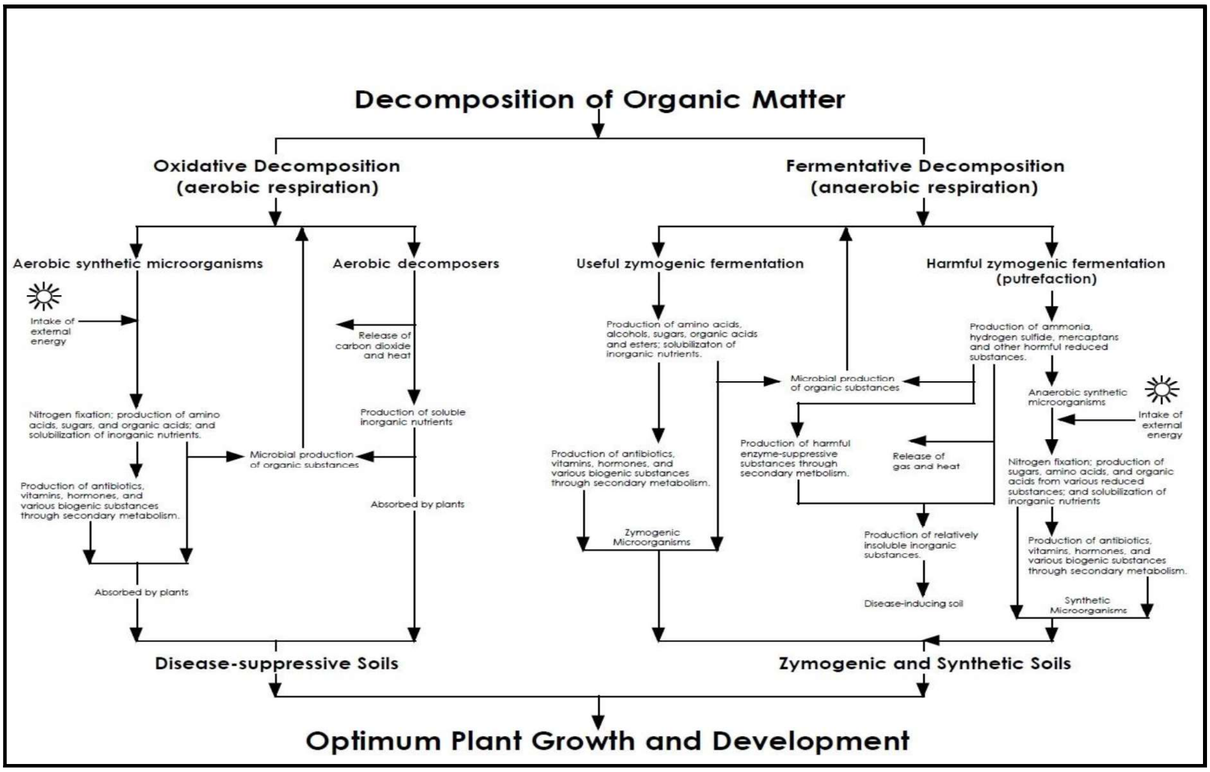

Figure 1. Flow chart of the organic matter transformations by soil microorganisms (Higa and Parr, 1994).

The usage of EM application in combination with compost enhanced wheat straw biomass, grain yields, and straw and grain nutrition. The highest NPK content in plant tissues with EM compost treatment demonstrated higher efficiency of the release of nutrients through organic and microbial application (Hu and Qi, 2013).

Other studies were carried out on different plants such as maize, tomato, pea, cucumber, cotton and mushrooms. The usage of effective microorganisms increased the yield in all applications (Szymanski and Patterson, 2003; Khaliq et al., 2006; Shah et al., 2001; Javaid, 2006; Ncube et al., 2011; Melloni et al., 1995; Muthaura et al., 2010; Vetayasuporn, 2004)

The use of EM technology has desirable effect by significant increase in organic matter, nitrogen, phosphate and potassium content of waste and can convert the waste into a byproduct which can be utilized as an ecofriendly soil fertilizer. It is also possible to use EM for municipal waste treatment (Namsivayam et al., 2011; Kale and Anthappan, 2012).

Another study shows the effect of EM that it can degrade the petroleum concentration of the petroleum contaminated soil by using co-culturing with *Sphingobacterium* sp. WY (Yoon, 2008).

EM technology in plants can be describes as a group of microrganisms that provide better Nitrogen fixation, and other benefits for the plants (Gest et al., 1950; Hodge et al., 2000).

Many studies were carried out to determine the effects of EM technology. Em application reduces the usage of inorganic fertilizers and protects the soil from additional inorganic contamination (Khaliq et al., 2006).

Another study decribes that EM application could protect the plant cell against the oxidative damage and could improve the survival of plants under saline conditions. EM application is believed to be the key to sustained environmental improvement and offers a real opportunity for eco innovation (Talaat, 2014).

Procedure

Baikal-EM1 which is especially used a lot in Russian Federation is also an important mixture of microorganisms. It contains *Lactobacillus casei* $9x10^7$ (cfu), *Lactococcus lactis* 5×10^7 (cfu), *Saccharomices cerevisiae* $2x10^6$ (cfu), *Rhodopseudomonas palustris* $4x10^6$ (cfu). A research about its application procedure and in order to fasten the ripening of these fertilizer composts, grain, industrial plants, vegetables-fruits and flowers - grown up in open and protected spaces are used for decorative cultures is as follows:

In agricultural production

- Cultivating the soil before planting in spring as 2 l/hec and as 5 l/hec in autumn after the residues are collected. After the fertilizer is composted to the soil, it is suggested that it is mixed into the soil.
- Processing of grains, industrial plants and vegetable culture seeds before planting is carried out as 1 l/ton seed ratio and the spraying solution is prepared with l liter EM/10 liters of water.
- During vegetation period, dropping fertilizers on plants should be 200-400 liter water/hec (depending on the injection tool).
- It is not advised to do the treatment under direct sunlight.

Grain cultures, 4 times (3 leafing phase, on tillering, stalk formation and earing phases) 5 l/hec.

Corn, 2 times (2–3 leafing phase and 6-7 leafing phase) 2 l/hec.

Sugar beet, 4 times (2 l/hec during 3–4 leafing phase, 2 l/hec during 7-8 leafing phase; 1 l/hec in the first ten days of July and 4 l/hec in the second ten days of August).

Sunflower, 2 times (1 and 1–5 in leafing phase) 5 l/hec. Potatoes, 2 times (during shooting, in flowering phase, budding phase) 2 l/hec.

Watering the plants below for m^2/3 l is done using 10 ml EM/l0 l water.

- 2-4 times for vegetables and ornamental plants (after the shoots appear and afterwards every 15-20 days).
- 2-4 times for fruits-strawberry species (at the beginning of growth season and before flowering, afterwards every 15-20 days).

In Compost Making

Compost material is moisturized at a rate of 60-70 % with Baikal EM1 solution solved at a rate of 1/100; mixed well and covered with polyethylene nylon. The ripening of compost takes 2-3 months. However, under 25-30 °C temperature, compost could be injected to the soil in 2-3 weeks. The rate of compost injection could change according to the products and agricultural technology used in greenhouses and open soil (RFMoHEB, 2004).

Conclusion

The success of EM Technology belongs on exact knowledge on its application procedure. The usage of more or less of these micro-biological fertilizers in quantity effects the result on the expected yield. It is suggested that training and advertising-educational teaching can be useful. The future of humans is a balance and harmony with the nature.

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