Application of Effective Microorganism (EM) Technology in Combating Brown Planthoppers (Khmer nick name: Momeach Thnoat)
By Neou Bonheur, August 2007

1. Background

Photo by Neou Bonheur

For the last several years, Cambodian farmers have enjoyed stable growth in rice production resulting in surplus rice outputs and increased rice export due to better access to improved farming technique, improved irrigation system, fertilizer inputs and pest control. Nevertheless, they still face a number of problems, including soil degradation, limited irrigation system, and limited knowledge on pest control, fertilizer use, and seed selection. This year infestation of brown planthoppers becomes a real concern among rice farmers in at least 12 provinces in the eastern region of Cambodia. The brown planthopper is a winged insect (about 2-3 mm long) that kill rice plants by sucking the sap from the plant. The outbreak of planthoppers occurred in many countries of Southeast Asia in 1980s. There is no scientific explanation on the cause of infestation; some suggest these insects may migrate from neighboring Vietnam (cited in Cambodia Daily 28 Aug.), some farmers said it might be caused by frequent rain, but environmental specialists link this problem to the excessive use of insecticides and Urea as nitrogenous fertilizers in the rice fields. As of August 23, planthoppers had been spotted in about 15,000 ha of seedling and 73,000 ha of transplanted rice across 28 districts (quoted from Hean Vanhan in Cambodia Daily 28 Aug.).

Different technique is used to combat the brown planthoppers, namely using mosquito nets, spraying used engine oil mixed with soups, and pesticides (Butyl and insecticide Bassan). According to some accounts from farmers, used engine oil can reduce to 80% of the brown planthoppers, while pesticide spraying has less effects. All these practices are either short term or ineffective solution, and at the same time they may have bad side effects on plants or soil microorganisms.

Photo by Neou Bonheur

Another method is EM technology, which is now adopted for sustainable agriculture by many countries in Asia and America, but it is recently introduced to Cambodian farmers. A demonstration was initiated on August 12 by Dr. Mok Mareth, senior minister, minister for environment, with the assistance of Neary Khmer Association for Health and Vocational Training (NKA) to control the planthoppers in rice field of approximately 0.30 ha in Kvav commune, Samrong district, Takeo province. The achievement is so great: 100% of brown planthoppers have been removed, but the most interesting effect is that the rice plants become much greener and healthier.

2. What is EM?

The concept of effective microorganism (EM) was developed since 1980 by Professor Dr. Teruo Higa, University of the Ryukyus, Okinawa, Japan (Beneficial and Effective Microorganism, 1994). EM consists of mixed cultures of beneficial and naturally-occurring microorganism that can be applied as inoculants to improve soil quality and plant growth. EM mainly consists of lactic acid bacteria, yeast, and photosynthetic bacteria which co-exist for the benefit of whichever environment they are introduced.

3. EM Application

EM technology finds wide application in our daily life, such as in improving environment, in sustaining sustainable practice in agriculture including soil improvement and pest control, promoting human health and hygiene, buildings and architecture, waste management, deodorizing, household environment and in other diverse areas (EM info website, or visit wikipedia). EM is now used in 160 countries all over the World. In Cambodia, EM has been introduced since 2004 by NKA which is now gradually recognized among farmers and environmental specialists.

4. EM Application in Agriculture

EM is applied in soil to benefit plants as follows:

- 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
- Promotes germination, flowering, fruiting and ripening in plants
- Improves physical, chemical and biological environment of the soil
- Enhances the photosynthetic capacity of crops
- Ensure better germination and plant establishment
- Increases the efficacy of organic matter as fertilizers
- Develop resistance of plants to pests and diseases.

5. Effectiveness of EM Application in Agriculture

Some positive effects were recorded in South India in the following areas (EM Info website):

Compost

- Compost can be prepared in as fast as three weeks, compared to a minimum of 3 months using conventional methods
- The compost is of very good quality with good texture and a pleasant odor

Fruits

- For papayas the income increased by 150%
- Cashew yields increased by 47.5%
- Mango yields increased by 15%
- Guava yields doubled
- Fruit orchard were much healthier
- In Japan, an average yield of rice has been increased from 540kg to 840-9000 kg/ 1000m2.

Others

- All flowers, trees, vegetables, grew faster and were healthier
- Bigger sizes were recorded in sweet potatoes and tapioca
- In seedlings, increment in growth doubled, producing very healthier plants
- Farm production increased
- Farmers increased their incomes, by running their farms with lower expenses
- There was less consumption of water in irrigation system

Pest management with EM5 and FPE

- Black sigota in bananas is controlled
- Eriophyd mite in coconuts is controlled
- Rhinoceros beetle in coconuts is controlled
- Tee mosquito bugs, nut borers, leaf miners, webber, leaf folders and flower thrips in cashews are controlled
- Caterpillars and bugs in vegetables are controlled
- In tomatoes and brinjal, bacteria wilt is controlled
- In orchids, virus-bacteria and fungus are controlled
- Citrus species affected by Gummosis (Diplodia natalensis) used together with copper sulfate, are recovered from very bad damage
- Fruit trees affected by Phytophthora nicotianae and Anthracnose (Colletotrichum gloeosporioides) are controlled

6. Application of EM in controlling Brown Planthoppers in Kvav Commune, Takeo province

In looking for optimal solution to combat the brown planthoppers that infest thousands hectares of rice in Samrong district, Takeo province, a demonstration on applying EM was conducted by NKA in Trapeang Khlok village, Kvav commune, Samrong district, Takeo province. About one hundred of participants were invited to attend the demonstration. A short instruction was given to the participants about technique for preparation of EM fertilizer "Bokashi", a Japanese term for compost, EM.FPE and Super EM5. The formula for preparation is summarized in table 1, 2, 3 below (for further information contact Mrs. Ing Sovanly, Director of NKA, Email: nearykhmer.nka@online.com.kh, Tel: 012 937 698).

The demonstration was simple: Bokashi fertilizer of about 20kg was spread and EM5 was sprayed in the rice field of about 0.3 hectare fully affected by brown planthoppers. About 75 kg of Urea was applied to this rice field last year, which may reduce the effectiveness of EM. The effects are slow but efficient. After one week 100% percent of brown planthoppers disappeared, and the rice plants grow healthier and greener. Now observation is still needed to measure the rice yield and compare it with previous season yield employing agrochemical technique.

Photo by Neou Bonheur

Table 1. Bokashi Fertilizer mixed with animal dung

Animal Dung	Rice husk	Rice brand	Bokashi	Molasses	Water	EM
20 L	20 L	20 L	50g	100ml	10 L	100ml

Use method: spraying about 200g per one m2. This Bokashi fertilizer can be applied immediately after its preparation.
Benefit: recover soil from degradation, improve fertility, improve growth of plants, increase fruits, increase weigh of rice grain, and improve odor and taste.

Table 2. Fertilizer and Pest control EM.FPE

EM	Mixture of plant leaves	Water	Molasses	EM.FPE
300ml	10 different plants	10 L	300ml	300ml

Use method: keep it for 7 days, mix EM.FPE 10cc with 500L of water, then spray in the affected areas in very 2-3 days.
Benefit: help the plants to grow healthier and remove pest, but keep beneficial living organism, including beneficial microorganism in soil.

Table 3. Pest Control Super EM5

EM	Molasses	Rice wine 28"- 40"	Vinegar
1 L	1 L	2 L	1 L

Use method: 10cc of EM5 is mixed with 10 L of water to be sprayed in the affected areas.
Benefits: help to kill and prevent pest, prevent plant from physical damage or infection, kill disease in soil, remove bad odor in animal cages, and clean wastewater.

7. Discussion

The positive effects resulted from using EM in controlling brown planthoppers are three folds: recovering of the affected plants back to normal conditions, plants grow better and healthier, and complete disappearance of brown planthoppers. There may be two reasons for their disappearance. First the brown planthoppers could not resist unfavorable environment created by EM5 (mixture of plant leaves of

different strong flavors and smell); therefore they either could not survive or flew away. Secondly, the insects could hardly eat on rice plants, because plants became stronger after soil improvement with Bokashi fertilizer.

There might be other factors causing disappearance of planthoppers such as whether condition, biological behaviors, soil conditions and existence of predators. Predators of this insect include spiders *Pardosa pseudoannulata* and *Araneus inustus*. The outbreak of brown planthoppers may be caused by a combination of whether condition, soil condition with excessive agrochemical inputs, the absence of predators such as frogs or spiders and the life cycle of the insects. It observed that planthoppers gradually disappeared by the end of August from the rice fields in Kvav commune at the time of good sun exposure. Soil treated with EM enables reactivation of beneficial microbes and production of useful organic compounds for rice plants to resist the planthoppers.

But there is an open question about how this EM selectively removes only brown planthoppers, while other beneficial livings or predators of the insects are not affected. EM specialists believe that EM only removes harmful insects or pest by activating the beneficial microorganisms and microbes, and suppressing the harmful microorganisms. Fish can be a good indicator of healthy environment. In Japan the activated EM is applied to polluted rivers to clean up the waste water, after which fish even return back to the system. As experienced by Mrs. Sovanly, cultured fish grow larger with applied EM. EM is used to remove bad smell in ponds or sewage system, which is a sign of harmful environment to human beings and other form of lives.

Perhaps there is a need to see the real benefit in monetary terms resulted from applying EM in comparison with conventional technique such as insecticide, organic compost, and chemical fertilizers (Urea). According to Mrs. Ing Sovanly, the EM fertilizers are cheaper compared to chemical fertilizers, rice yields increases to 4-8 ton per hectare, and rice is more tasteful. Experiences of some countries such as in Malaysia, Japan, and India show an increase in productivity and income following EM application, but this has to be further tested in many areas of agriculture in Cambodia. EM specialists indicate that application of EM technologies does not mean to exclude other agricultural practice such as the use of organic composts, but EM can not work well with chemical fertilizers or insecticides.

EM is now cultivated in Cambodia by a team of Japanese experts under the supervision of Dr. Higa. This would make the EM products accessible cheaply to Cambodian people for various applications. There is however a need for promoting knowledge across Cambodia which may take time and resources. But conflicts may occur among those who make profits from trading traditional agricultural products such as insecticides and fertilizers and those who chose to adopt environmentally sound EM technologies, which may shift the market preference in the Cambodian society. Fake EM under different name is also found in Cambodian market, which would cause confusion and disbelief in real EM.

8. Conclusion

The successful application of EM technology in controlling brown planthoppers in tested rice fields of Kvav commune proves that EM can be a real efficient alternative to agrochemical methods such as the use of insecticide and chemical fertilizers. More tests and observation in larger scale are required to confirm its effectiveness and possible side effects. There might be a fear by some specialists that rice or fruits produced with EM may have effects on human health, but over 20 years of studies by Dr. Higa and his associates have shown that fruits or grains from EM are much healthier and tasteful. This has been confirmed by successful EM application in Cambodia through relentless efforts of Mrs. Ing Sovanly. Organic rice, mango, and pepper produced with EM in Cambodia were sent to Microbial Resources Center (MIRCEN) in Bangkok for analysis in February 2007. The result is that no harmful microorganisms exist in these sample products. Many countries now adopt this EM technology as part of their national programs. Apart from the ability of EM to improve agricultural productivity, and to control pest and insects in agriculture, EM finds wider application in many areas of human society. EM will find its application in many other areas in Cambodia, provided there is a good access by Cambodian institutions and people to gain more knowledge on various EM technologies and applications. In addition, systematic studies and researches should be conducted to gain better knowledge in application of EM in many fields of economic development and environmental preservation. There is a real possibility for application of EM in *sustainable management of the Tonle Sap Biosphere Reserve*, including but not

limited, to agriculture, aquaculture, livestock, human health and hygiene, organic compost from solid waste, flooded forest residues, fish meal and other aquatic weeds (Water hyacinth and Memosa Pigra), deodorization for fish processing, improved water quality and waste management in the cities.

Reference:

1. Teruo Higa, University of Ryukyus, May 1994, “Application of Effective Microorganism for Sustainable Crop Production”;

2. Teruo Higa and James F. Parr, 1994, “Beneficial and Effective Microorganisms for a Sustainable Agriculture and Environment”.

3. Ing Sovanly, Neary Khmer Association for Health and Vocational Training, January 2004, “Effective Microorganism”.

4. Cambodian Daily, 28 August 2007.

5. Ministry of Environment, July 2007, Environment Bulletin No 20.

6. EM info website, August 2007.