Research on Nature Farming Systems In Malaysia: Applications of EM Technology

H.A.H. Sharifuddin[1], M.F. Shahbuddin[1], A.R. Anuar[1] and J. Samy[2]
[1]University of Agriculture and
[2]Malaysian Agricultural Research and Development Institute Serdang,
Selangor, Malaysia

Abstract.

1995 is the fifth year of research in Malaysia on nature farming using Effective Microorganisms (EM). This year also marks the expansion and extension of nature farming research conducted by the University of Agriculture, Malaysia (UPM) and the Malaysian Agricultural Research and Development Institute (MARDI), as well as testing and demonstration trials by other agencies including the Department of Agriculture (DOA), Golden Hope Plantation, Kelantan Agricultural Development Authority (KADA), Rubber Research Institute of Malaysia (RRIM) and in selected farmers' fields. A forum and workshop were held in 1994 to instruct representatives from different agencies, particularly DOA, on the use and potential benefits of EM in nature farming systems.

Research on vegetable crops grown in different soil types in the glasshouse and field indicated that the use of organic amendments with lower C:N ratios can produce vegetable crops comparable in yield and quality to those produced with chemical fertilizer. However, recent results have shown that rice and vegetable yields from EM applied with organic amendments are higher than those with chemical fertilizers.

Animal production research with EM began in 1994. Results so far indicate that chickens fed with EM had slightly higher weights compared with the control. EM fed to quail through drinking water increased their weight gain, decreased manure odors, decreased fly populations, and decreased the birds' excitement level.

Currently, experiments and observation trials are being conducted on the effects of EM on vegetables, fruit trees, rice, chicken and quail production at different locations in Peninsular Malaysia. Studies are also being conducted to determine the different types of organisms present in EM, and the mechanisms responsible for increasing crop and animal production, and protecting the environment.

Introduction

Malaysia was first introduced to Kyusei Nature Farming and the technology of Effective Microorganisms (EM) in November 1989 when representatives from the University of Agriculture, Malaysia (UPM) and the Department of Agriculture (DOA) attended the First International Conference on Kyusei Nature Farming at Khon Kaen, Thailand. Research on EM technology for food crop production began one year later in September 1990. For the first three years only UPM was actively involved in EM research that was largely confined to pot experiments conducted under glasshouse conditions. The Malaysian Agricultural Research and Development Institute (MARDI) began their studies on the use of EM for vegetable and rice production in 1994. Currently, the DOA. Rubber Research Institute of Malaysia (RRIM), Golden Hope Plantation and Farmers Organization Authority (FOA), are involved in EM trials.

To ensure cooperation among agencies responsible for agricultural development, a national committee was established in 1990, with representatives from UPM, MARDI, DOA, RRIM and the Malaysian Organic Farming Network (MOFAN). Presently, the Golden Hope Plantation, the Kelantan Agricultural Development Authority (KADA) and FOA are also represented on this committee.

Summary of Research Using Effective Microorganisms

Research results on the use of EM in nature farming systems have been presented at the second and third International Conferences on Kyusei Nature Farming, and the first, second and third EM Technology Conferences (Sharifuddin and Zaharah, 1991; Sharifuddin et al., 1994; Sharifuddin et al., 1996). The EM research reported in this paper deals mainly with studies conducted since 1993 on various aspects of crop and animal production.

Vegetable Production on Mineral Soils

A field experiment was conducted by DOA on a highly weathered acid soil (Ultisol) in which three types of bokashi plus chicken manure were applied to plots and planted to leaf mustard (*Brassica juncea* L.). Fresh weight yields for two consecutive crops were compared with the current farmer' s practice of applying chemical fertilizer plus chicken manure. Treatments were as follows:

T1: 20 t ha^{-1} rice straw bokashi + 20 t ha^{-1} chicken manure;
T2: 20 t ha^{-1} EFB bokashi + 20 t ha^{-1} chicken manure;
T3 : 20 t ha^{-1} POME bokashi + 20 t ha^{-1} chicken manure;
T4: Farmer's practice 800 kg ha^{-1} NPK (15-15-15) + 13.5 t ha^{-1} chicken manure.

Bokashi is a microbially fermented organic fertilizer that can be made with various agricultural and industrial organic wastes such as palm oil mill effluent (POME) and empty oil palm fruit bunch (EFB). Results of this experiment are reported in Table 1. The data show that the farmer's practice (T4) of applying chemical fertilizer with an organic fertilizer (i.e. chicken manure) gave a significantly higher first crop yield compared with the three bokashi + chicken manure treatments. However, there were no significant differences in the second crop yields which suggest that given sufficient time for mineralization, the three organic fertilizer treatments can support crop yields that are equivalent to the farmers current practice of using NPK + chicken manure.

Table 1. Effect of Different Organic and Chemical Fertilizers on the Yield of Leaf Mustard (Brassica juncea L.) Grown on an Ultisol.

Treatments	Fertilizers	Application Rate	Yield (tons ha^{-1})	
			Crop1	Crop2
T1	Rice bran bokashi	20t ha^{-1}	8.25b	15.05a
	Chicken manure	20t ha^{-1}		
T2	EFB bokashi	20t ha^{-1}	6.00b	12.81a
	Chicken manure	20t ha^{-1}		
T3	Pome bokashi	20t ha^{-1}	9.50b	12.47a
	Chicken manure	20t ha^{-1}		
T4	NPK (15-15-15)	800 kg ha^{-1}	14.75a	14.45a
	Chicken manure	13.5 t ha^{-1}		

Bokashi is a microbially fermented organic fertilizer that can be prepared using various types of agricultural wastes such as:

POME = Palm oil mill effluent

EFB = Empty oil palm fruit bunch

Column means sharing a common letter are not significantly different at the 5% level of probability.

Vegetable Production in the Highlands

MARDI conducted an extensive field trial at the Cameron Highlands Research Station to compare the effects of different organic fertilizers on the fresh weight yield of Chinese cabbage (*Brassica chinensis* L.). The study consisted of 16 treatments which tested 9 types of organic fertilizers in various combinations and applied according to the manufacturer's recommendations. Results (Table 2) show that the highest rates of chicken manure in combination with the highest rates of NPK fertilizer gave the highest crop yields, ranging from 45.10 to 64.13 tons ha^{-1}. Interestingly, the highest single yield was due to EM (T1) in which the relative yield was 26 percent greater than the control (T3). This study is still continuing.

Table 2. Effect of Different Organic Fertilizers, Chemical Fertilizer and EM on Yield of Chinese Cabbage (*Brassica chinensis* L.) at the Cameron Highlands Research Station.

Treatments	Fertilizers	Yield (t ha^{-1})	Relative yield (%)
T1	CM 20t+NPK 2t+EM	64.13	126
T2	CM 20t+NPK 2t+Kozgro	61.13	120
T3	CM 20t+NPK 2t (control)	50.70	100
T4	CM 15t+NPK 2t	47.80	94
T5	CM 25t+NPK 1.33t	47.47	94
T6	CM 25t+NPK 2t	45.10	89
T7	Kokei A	41.67	82
T8	CM 20t+NPK 1.33t	41.20	82
T9	CM 20t+Glorkon 5kg	40.93	81
T10	CM 20t+Nissan Porous	36.06	71
T11	Complehumus	34.40	68
T12	CM 15t+NPK 1.33t	32.00	63
T13	Kozgro+NPK 2t	30.80	61
T14	Kokei B	22.86	45
T15	CM 25t	14.40	28
T16	Glorkon	6.40	13

CM = Chicken manure.

Where indicated, the amount of a fertilizer applied is based on t ha^{-1}.

Vegetable Production on Acid Sulfate Soil

A field experiment was also initiated by MARDI to compare the effects of different organic fertilizers on the fresh weight yield of Chinese cabbage (*Brassica chinensis* L.) grown on acid sulfate soil. Four types of organic fertilizer were tested including chicken manure and EM. Again, as shown in Table 3, the highest yields were obtained with chicken manure in combination with NPK fertilizer. However the very highest yield of 34 tons ha^{-1} was due to EM (T1) the relative yield of which was 21 percent greater than the control (T4). This study is also continuing.

Table 3. Effect of Different Organic Fertilizers, Chemical Fertilizer and EM on the Yield of Chinese Cabbage (*Brassica chinensis* L.) Grown on an Acid Sulfate Soil.

Treatments	Fertilizers	Yield (t ha^{-1})	Relative yield (%)
T1	CM 10t+NPK+EM	34	121
T2	CM 10t+NPK	31	111
T3	CM 15t+NPK	30	107
T4	CM 10t+NPK (control)	28	100
T5	CM 10t+Glorkon 1.2kg	24	86
T6	CM 10t+Glorkon 5kg	15	54
T7	Complehumus	11	39
T8	Glorkon 5kg	6	21

CM = Chicken manure.

Where indicated, the amount of a fertilizer applied is based on t ha^{-1}.

Vegetable Production on Muck Soil

A 2 x 3 factorial (EM x fertilizer source) experiment was conducted to determine the effect chicken manure, POME and chemical fertilizer, with and without EM, on the yield of leaf mustard (*Brassica juncea* L.). The results presented in Table 4 indicate that the first crop yields were highest for the chicken manure + POME treatment and somewhat less for chicken manure alone; however, there were no statistically significant differences between these two treatments. First crop yields for chemical fertilizer were significantly lower than the other treatments. This may reflect a low fertilizer use efficiency due to unfavorable soil physical conditions that were ameliorated in the other treatments by organic matter. Also, there appeared to be little effect of EM on the first crop.

Table 4. Effect of Different Organic Fertilizers, Chemical Fertilizer and EM on the Yield of Leaf Mustard (*Brassica juncea* L.) Grown on a Muck Soil.

Treatments	Fertilizers	EM applied	Yield (kg ha^{-1})	
			Crop1	Crop2
T1	NPK 450kg ha^{-1}	Yes	490c	1550d
T2	NPK 450kg ha^{-1}	No	3490bc	1250d
T3	CM 20t ha^{-1}	Yes	5570ab	5550b
T4	CM 20t ha^{-1}	No	5560ab	3950d
T5	CM 20t ha^{-1} + POME 20t ha^{-1}	Yes	7120a	9550a
T6	CM 20t ha^{-1} + POME 20t ha^{-1}	No	7490a	4970bc

CM = Chicken manure.

POME = Palm oil mill effluent

EM = Effective Microorganisms

EFB = Empty oil palm fruit bunch

Column means sharing a common letter are not significantly different at the 5% level of probability.

The second crop yields were again highest for plots treated with chicken manure and chicken manure + POME. As before, the lowest yields were with chemical fertilizer. This time there was a pronounced effect of EM with significantly higher yields for chicken manure + EM (T3) and chicken manure + POME + EM (T5) compared with the non-EM treatments. This may indicate that some additional time is needed for EM cultures to become established in the soil ecosystem.

Vegetable Production on Sandy Tin Tailings

In Peninsular Malaysia, lowland vegetables are often grown on sandy tin tailings (i.e., from mining operations) because of the scarcity of space. These "soils" are highly unproductive because of low fertility and poor physical properties. An experiment was conducted to evaluate organic fertilizers as amendments to improve the productivity of these marginal lands. A demonstration area was established for testing different amendments. Results thus far have shown that a) EM5 was effective in controlling plant pests and diseases, although concentrations above 1:500 can cause leaf injury, and b) 20 t ha^{-1} of chicken manure along with EM4 and EM5 can produce optimum yields of kangkong (*Ipomoea teptans*) and long bean (*Vigna sesquipedalis*)amounting to 31.5 t ha^{-1} and 6.2 t ha^{-1}, respectively.

Rice Production

MARDI has initiated two experiments in several of the major rice growing areas of Peninsular Malaysia. The purpose of these experiments is to evaluate the effects of various organic fertilizers in combination with chemical fertilizers on rice production. Results shown in Table 5 indicate that there were no significant differences in rice yield among treatments T1 to T10. However, the highest yields were obtained with Sacom + NPK + EM 4 (T 1) and POME + NPK + EM 4 (T2) compared with the corresponding treatments without EM, i.e., T5 and T10, respectively. Sacom is a compost produced mainly from rice hulls. This study will be continued for several more years to reach a final conclusion.

Table 5. Effect of Different Organic Fertilizers, Chemical Fertilizer and EM on Rice Yields in Peninsular Malaysia.

Treatments	Fertilizers	Yield (kg ha^{-1})	Relative yield (%)
T1	Sacom+NPK+EM4	3921 a	101.5
T2	POME+NPK+EM4	3916 a	101.3
T3	NPK (80:30:20)	3865 a	100.0
T4	Straw +NPK	3864 a	100.0
T5	Sacom +NPK	3730 a	96.5
T6	Straw+NPK+EM4	3523ab	91.1
T7	Sesbania +N	3499ab	90.5
T8	Complehumus	3438ab	88.9
T9	Sesbania+N+EM4	3418ab	88.4
T10	POME+NPK	3409ab	88.2
T11	No fertilizer	3054 b	78.9
T12	Sesbania	3040 b	78.7

Column means sharing a common letter are not significantly different at the 5% level of probability.
Sacom is a compost produced from rice hulls.

Fruit Production

Research to determine the effect of EM on fruit production has begun at two sites. The first site is a mature dokong (*Lansium domesticum*) orchard, Preliminary observations indicate that the application of EM4 together with organic fertilizer resulted in better flowering and less severe canker problems on the stems and branches. Research at the second site involving a young dokong orchard has just started.

Poultry (Broiler) Production

An experiment was started in 1995 to determine the effect of EM on the growth rate of broiler chickens. While there were no significant differences between treatments, results indicated that EM can decrease the need for, and dependence on, agrichemicals and antibiotics normally administered to control diseases and improve weight gain.

Quail Production

Quail production is a relatively new agricultural industry in Malaysia. To ensure profitability, farmers must use agrichemicals to maximize weight gain, control diseases and reduce excitement. A trial was conducted at one quail farm to see whether EM might have beneficial effects on quail production. Results of the study are presented in Table 6. The birds were divided into two groups, with and without EM4 in their drinking water. Birds that received EM in drinking water (1:1,000 dilution) showed a higher weight gain of 6 percent; lower mortality rate, from 28 to 22 percent; and lower slaughter age, from 38 to 35 days, compared with birds that didn't receive EM.

EM also enabled the farmer to increase the carrying capacity for young birds from 800 to 1,200 to a compartment with dimensions of 2.44 x 3.05 m; to extend the period for manure removal from 4 to 7 days; and to reduce fly populations and minimize odor problems that cause excitement discomfort. These results strongly indicate that EM can provide substantial economic benefits to the farmer involved in quail production and to the consumer who is becoming increasingly concerned about food safety and quality.

Table 6. Effect of EM on a Number of Parameters that Reflect the Growth, Health and Production of Quail for the Malaysian Market.

Parameters	(-) EM	(+) EM
Average weight (kg/10 birds)	1.40	1.48
Slaughter age (days)	38.4	35.4
Mortality (%)	28	22
Carrying capacity for young birds (No./compartment)	800	1,000-1,200
Manure removal interval (days)	4	7
Egg production (No./3 days)	1,600	800-2,200

Public Relations Activities

A forum on the "Use of EM in Agriculture" was organized and conducted by the Department of Agriculture in 1994. The purpose of this event was to instruct the participants from various agencies, especially DOA, on the use and potential benefits of EM in nature farming systems. Speakers at the forum included Prof. H.A.H. Sharifuddin, University of Agriculture, Malaysia and Mr. Masayoshi Shibata, Pacific Consultants International who is in Malaysia under the auspices of the Japanese International Cooperation Agency (JICA).

A workshop on EM technology was organized and conducted by the University of Agriculture, Malaysia in 1994 with participants from DOA. MARDI. UPM. KADA and the Golden Hope Plantation. The purpose of the workshop was to instruct the participants on the history and philosophy of EM; use and benefits of EM; role of EM in nature farming; use of EM to improve soil quality, crop quality and plant protection; and preparation of bokashi using EM and agricultural wastes. A second workshop was held in 1995 mainly for the benefit of the

Farmers Organization Authority.

Conclusions

EM technology has created much interest in Malaysia. However, its use is still limited to research, testing and demonstration by responsible authorities. Before it can be made available to farmers, the Government of Malaysia requires that it pass a strict quarantine law which includes a period of extensive testing and a guarantee that it contains no exotic, engineered or harmful organisms. A program to fulfill these requirements is now underway and we hope that EM production can begin sometime in 1996.

References

Sharifuddin, H.A.H. and A.R. Zaharah. 1991. Utilization of organic wastes and natural systems in Malaysian agriculture. p. 71-78. In J.F. Parr, S.B. Hornick and C.E. Whitman (ed.). Proceedings of the First International Conference on Kyusel Nature Farming. U.S. Department of Agriculture, Washington, D.C., USA.

Sharifuddin, H.A.H., M.F. Shahbuddin and A.R. Zaharah. 1994. Effect of organic amendments and EM on production of food crops in Malaysia. p. 171-178. In J,F. Parr, S .B. Hornick and M.E. Simpson (ed.). Proceedings of the Second International Conference on Kyusei Nature Farming. U.S. Department of Agriculture, Washington, D.C., USA

Sharifuddin, H.A.H., M.F. Shahbuddin, A.R. Anuar, A.R. Zaharah and J. Samy. 1996. Nature farming research in Malaysia: Effect of organic amendments and EM on crop production. p. 145-150. In J.F. Parr, S.B. Hornick and M.E. Simpson (ed.). Proceedings of the Third International Conference on Kyusei Nature Farming. U.S. Department of Agriculture, Washington, D.C., USA.