Sustainable Agriculture with EM Super Cera Ceramics

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The enforcement of the Organic Japanese Agricultural Standard (JAS) within Japan has enhanced the numbers of farmers shifting from conventional farming" to "organic farming". However, in most farms, soil has become highly oxidized and degraded due to long-term use of pesticides and chemical fertilisers in excessive quantities. Thus the conversion process to an organic system is difficult because of likely damage by pests to crops and harm by nitrate nitrogen.
The process of conversion from conventional to organic systems uses compost as a principal source of manure. As the compost used in organic farming is made through aerobic fermentation, it is troublesome to produce, time consuming and needs large facilities. Moreover, this compost contains a low density of useful microorganisms. Therefore, in many cases, compost made by the present organic method is of poor quality and inefficient in meeting the requirements of organic farming.
On the other hand, the EM technology is a method that can basically solve many problems of both organic and conventional farming, and there are many success stores in diverse environments, including Japan. Furthermore, the method we call "EM Super Cera Sustainable Agriculture" which is based on the use of "EM ceramics" is a simple agricultural method utilizing the latest developments in EM technology. This method enables the procurement of very high yields of quality crops at a low cost and on a sustainable basis by even inexperienced people or senior citizens.

1. Basic Technology of EM

The three pillars of the EM technology are 1) "Effective Microorganisms (EM1®)", a group of useful microorganisms, 2) "EM-X," an antioxidant generated by EM, and 3) "EM ceramics" made by firing a mixture of EM1, molasses, and EM-X with clay.
The principal objective of the EM technology in fields such as agriculture and environment is to use these three pillars, and enhance the density of Effective Microorganisms (EM) and build a high field of antioxidation".
EM Super Cera Sustainable Agriculture has three important sets of material: 1)"EM Super Cera C" which is EM ceramics, 2) high quality "activated (extended) EM solution", a liquid cultured by EM with molasses, and 3) EM Bokashi (in Japan we use "EM Rice Bran Pellets" - rice bran fermented with EM and made into pellets). Rice bran fermented by EM (EM-Bokashi) is a base material for promoting a stable increase of Effective Microorganisms (EM) in farmlands. It also acts as a high quality organic fertilizer. With an appropriate use of these three materials an increase in density of Effective Microorganisms (EM)" is obtained in farmlands and thereby an improvement of the antioxidation level.

Characteristics of *EM Super Cera C*

"EM Ceramics" are made by mixing EM, molasses, and EM-X with clay, and firing the mixture at 800 degrees Celsius. When the material is crushed into powder it becomes the "EM Super

Cera C". When used in farming, it raises the field of antioxidation and promotes the stabilization of a symbiotic environment of Effective Microorganisms (EM). It has the potential to promote fermentation and is used for soil improvement. In addition, it is effective in controlling insect pests when sprayed onto leaves.

Practical experiences on the effectiveness of EM Super Cera C

The beneficial effects of ceramic powder and how it works with crops in combination with EM is illustrated below:

This picture was taken on the 31st of March 2006. The winter in Japan is not as cold as in Europe, with temperatures averaging 8.8° C from December to March – which is still a severe condition for crop growth. The difference in growth in the right and left picture is the result of EM ceramics. Both plots used the same amount of EM and EM bokashi. Better growth was achieved by applying 10-20g of EM ceramic powder to each plant. Thus, soil with ceramics can stimulate the growth by improving the plant's ability to absorb nutrients and water. Moreover, the growth of plants is better even under low temperatures when EM and EM ceramics are combined and applied.

The Standard Method of Application of EM

The basis of EM agricultural methods is "soil improvement after harvesting / before planting", appropriate "crop management" and "effective measures to control insect pests". The above-mentioned methods could easily achieve and maintain an "increase of the density of Effective Microorganisms (EM) " in farmlands and "the improvement of the antioxidation level" within a short period.

Farms changing from conventional to organic farming are advised especially in the beginning to use more than the recommended amounts, especially of activated or extended EM, because it is very likely that these farmland soils are highly oxidized and degraded by prolonged excessive use of chemical fertilizer and pesticides.

Moreover, it is necessary to supplement the basic crop nutrients of nitrogen, phosphoric acid, and potassium by adding extra organic matter and even chemical fertilizers. In this process, the use of compost processed with faeces of domestic animals should be avoided because they contain antibiotics and chemicals. In contrast, it is important to use organic materials, which are fermented with high quality resources such as EM.

Soil Improvement with EM Technology

For soil improvement after harvesting (autumn) and before planting (spring), 5 kg EM Super Cera C is applied per 10a (10 a = 1000 sq m; thus 50kg EM Super Cera/ha) and a minimum of 0.3 t (300 litres) of undiluted activated EM solution. It should be appropriately mixed or diluted, depending on the situation of the field (paddy field, agricultural land, orchard, greenhouse).

For EM Bokashi (EM rice bran pellets), the basic rate of use is 100kg to 300kg/10a (1000-3000 kg/ha). (The addition of high quality organic matter is recommended for extra nutrition of the crops.)

EM at planting and during crop growth

Activated EM solution I diluted 1000 times and 1/1000-2000 of EM Super Cera C is added to the diluted solution. The solution is sprayed onto the plants at planting and at regular intervals

Insect pest management through foliar applications

Insect pests control requires the prevention of invasion and the development of a healthy soil. This objective can be achieved by adding 1/1000-2000 EM Super Cera C to 500-1000 times diluted activated EM solution and applying daily at least for 7-10 days from the time of planting.

Selected success stories with EM ceramics

A few cases of "successful farmers" of different commodities, who were able to switch from conventional agricultural methods is presented to exemplify the benefits of EM Super Cera farming. The common characteristic of these cases is to get an successful outcome of EM application rapidly by effectively utilizing the "three sets of material for sustainable agriculture."

A. Table grape culture – Nagano

The farm

The table grape vineyard of Mr. and Mrs. Sakurai is located at Tomi city (former Tobe-town), Nagano prefecture. This couple has been cultivating table grapes, mainly the variety *Kyoho*, for more than 30 years on a heavy clay soil, which had a drainage problem. The orchard has 40-year-old vines. Due to prolonged use of pesticides, chemical fertilizers, and herbicides excessively; they had various problems such as the loss of vigour of the vines, deterioration of the growth of new branches, and low yield because of the damage from disease and pests. Thus, they started using EM six years ago.

EM application for soil improvement

The farmers use the EM *Super Cera simple agriculture* method for soil improvement. In the first year they used 100 kg EM Super Cera C per 1 ha, 5 t (5000 litres) of high quality activated EM solution, 3000 kg of EM rice bran pellet s (EM Bokashi) as a base with an additional 0.5t of cattle dung/pig faeces compost (processed by adding EM Super Cera C for fermentation promotion) applied in autumn after the leaves had fallen.

In spring they used 5 t (5000 litres) activated EM solution, 2 t of cattle dung/pig faeces compost (processed by adding EM Super Cera C for fermentation promotion) per hectare.

After the spring cultivation, activated EM solution (mixed with 1/1000 EM Super Cera C) diluted 500 times was applied onto the leaves and the soil once a month from April to September, until harvesting. These sprays were efficiently performed with machinery.

The soil improvement achieved is based on soil recovery by not using herbicide and applying the high quality (fermentation promotion processed) compost with activated EM solution and EM Super Cera C. Weeding is done by machinery to save labour.

Impact of EM Application

One of the advantages of using EM is the drastic reduction of pesticide applications. In this vineyard the application of pesticides was reduced by 20 % in the first year, 40 % in the second year, and 70% in the third year.

By gradually shifting from a chemical fertilizer system to a high quality organic fertilizer system supplemented with activated EM solution and EM Super Cera C, the leaves of vines have become thicker and smaller and the old bark of vines is easily removed, which are sure signs of vine rejuvenation.

In the grapes, sugar contents rose by two to three degrees in the first year of the shift and were

enhanced to 22 degrees. One single berry weighs about 13-15g, compared to 10 g in the past. In 2001 the vineyard produced 1.5t/10a, as compared to 1t/10a in the neighbouring farms. In 2002, the yield was around 2.0t/10a. “Bearing fatigue” a common phenomenon in vineyards did not appear, which is a notable point, indicating that the heavy bearing of one year did not affect the yields of the next year in this farm.

B. Lettuce cultivation - Komoro City, Nagano Prefecture

The farm
Komoro, Nagano, is famous for prosperous highland vegetables cultivation, because of its cool climate. Mr. Minoru Tsukada cultivates 8 ha of lettuce in Komoro and also acts as a leader of an EM cultivation group. The total extent cultivated by this group is approximately 20 ha.
Before the introduction of EM, the successful cropping programs of Mr. Tsukada’s group was affected due to the infection of soils by Fusarium. Although they had taken remedial measures by excessive soil sterilization and pesticides such as acaricides, the problem continued. Therefore, the experiments of this group is presented as an example of the benefits of using the "three sets of material for simple agriculture" to raise the density of EM and explain its effect in building a strong field of antioxidation, which enables successful cropping.

The video that will be presented highlights the potential of insect pest control by using the "three sets of material for simple agriculture." This short film focuses on a harmful insect called *Hamoguribae*, which primarily damages green leafy vegetables seriously.

Video

Although the data is not quantified, the video clearly presents the damage caused to the eighth leaf by *Hamoguribae* because they did not use EM at the early stages of planting the lettuce seedlings. However, the planting of seedlings raised with EM and which have the eighth leaf reduced the damage by *Hamoguribae*. More precisely, it was noted that eggs, which were laid on the leaves, did not hatch.
This observation can be considered similar to the phenomenon on stock breeding sites where EM restrains the outbreak of a harmful insect. With the use of EM, dead larvae were often seen in the drains. This suggests that an egg could not hatch or a larva could not metamorphose when the antioxidation level is high. This kind of phenomenon could also occur on the leave of lettuce plants, which have been supplied with EM.
The study on Mr Tsukuda's field showed the effectiveness of EM pest management programs in controlling Cabbage army worm, Common cabbage worm, mites and aphids. The exception were the moths, which could not be controlled without pesticides.

The use of EM in the lettuce fields
The program for soil improvement in Mr. Tsukada's field utilizes the same amount of EM and EM Super Cera C on the compost as the previous example of Mr. Sakurai's vineyard. The compost used primarily contains cattle dung, procured in spring. The manure is heaped until application in autumn, before the sowing of wheat. In order to stimulate the growth of wheat and improve the density of soil microorganisms the heaps of cattle manure are sprayed with EM three times in spring. In addition, just prior to the incorporation of the wheat as a green manure, the "three sets of material for simple agriculture" is ploughed in as an organic fertilizer.
Lettuce is cultivated on a continued basis from spring. Thus three cropping cycles are possible and after each cropping cycle, 150-300 kg of EM Bokashi (Rice Bran Pellets) is added to each hectare of land.
EM is also sprayed onto the leafy lettuce crop at a rate of 2000 l/1ha once in 10 days. The EM used is Activated EM, mixed with 1/500 of EM Super Cera C and diluted 300 times. Since this is a preventive measure more frequent application could be recommended, as there is no harm by excessive spraying of EM diluted solution.

Insect pests feed on nitrogen oxides emitted from the plant body. The true reason of the outbreak of insect pests is the production of nitrogen oxides with the decline in plant metabolism due to excessive fertilizer application. Thus, soil improvement is fundamental for controlling insect pests as highlighted in the example with vineyards
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Fundamentally, the amount of the "three sets of material for simple agriculture" depends on the condition of the soil. However, the best is to apply amounts in excess of the basic recommendation in order to condition the microorganisms in the soil, so that insect pests do not easily affect the crops.
Since the introduction of EM, soil epidemics have not appeared on this farm and cultivation

without pesticide became possible. In addition, soil sterilization was not required, thus saving labour.

The study also showed that although the size of the lettuce heads was the same, one head of lettuce often weighs 4 kg. Therefore, thirteen to fourteen heads make up a 5 kg case while previously sixteen heads were required for one 5 kg case. This clearly indicated the development of heavier heads of lettuce. It is understood that when applying EM, the density of cells becomes higher and thus increasing the weights. This phenomenon can be seen in any crop cultivated in the soil, when EM is adequately applied. Therefore this lettuce is greatly appreciated by the consumers.

C. Apple Cultivation – Aomori Prefecture

The EM system network Hirosaki Ltd. has about 50 members and a cultivation area of approximately 80 ha. It is a group using a very high quantity of EM in Japan.

Using EM in apple orchards

After harvesting of apples the “three sets of material for simple agriculture” (per 1 ha 50 kg EM Super Cera C, 3,000 l activated EM solution, 3000 kg EM bokashi) are applied as a soil improvement measure.

In addition, from the time of bud break in April to harvest in October 1 ha/1000 l of activated EM solution (mixed with 1kg EM Super Cera C) is applied onto the soil. In addition, the EM solution is diluted 300 times and applied on the leaves once a month with 1/1000 of EM Super Cera C. A foliage application of 1/500 of EM Super Cera C was sprayed in August and September.

The beneficial effects of EM

With the application of EM enhanced vigour of the trees was observed, which is considered a result of the improvement of photosynthetic ability. Moreover, roots also became vigorous by the application of higher quality organic matter (EM bokashi).

By raising the quantity of ceramics in the foliar applications later in the season, both green and ripe apples were harvested. The characteristic of an EM apple is its excellent taste. The evaluation of the quality of an apple not only depends on the change of acidity, sugar or water content but also on taste, which cannot be easily quantified. However the list presented shows the increase in the numbers of apples handled by EM system network Hirosaki Ltd. The demand for the fruit can easily be estimated from this data.

This case study clearly showed that the vigour and strength of the trees were restored by the improvement of the soil, which was easily done by using the technology of EM Super Cera Simple Agriculture. An added benefit was the lower use of pesticides. Furthermore, it clearly showed that by adequately improving the soil with the "three sets of material for simple agriculture," highvalue crops could be produced.

D. Moss phlox Manuring Practice, Hitsuji Yama Park, Chichibu City

In 1999 the Saitama prefecture and the city of Chichibu planned the planting of 130,000 propagules of moss phlox in Hitsuji Yama Park as a "flower community development project",

which was one of the Chichibu community activation strategies. During the period 2000 to 2004, 474,000 plants were established on 14,500 square meters. The number of visitors to the park in April, when moss phlox blooms, increased from 160,000 people in 2002 to 630,000 people in 2003.

However, there were excessive rains in 2003, and insect pest problems occurred frequently. The Large patch disease, *Sclerotium blight*, was very prominent and the damage caused by the larvae of gold bug were severe.
Therefore, in the summer 2003, the city decided to introduce EM Super Cera simple agriculture for insect pest control and the growth stimulation of moss phlox. The other main application included the use of EM in management practices of a new planting site for the next year, as a measure against insect pests in the first zone, where the flowers were already blooming and insect pests had occurred, for growth of the plants, their maintenance, and as a soil dressing.
EM was introduced in the second cycle of planting in the park. At first, it was thought that the large quantities of compost used was the cause of root damage by the larva of the gold bug. Although chicken and cattle manure were the main components of the compost, it also included a large amount of bur clover. Thus, it was assumed that gold bugs lay eggs on bur clover.
The experience of the park was that even a strong pesticide has no significant impact in controlling this bug, and therefore, mulberry trees were transplanted in several places in the park. The bugs were allured to infest the mulberry trees, where they were trapped.
The management of the park developed two methods to reduce the damage from gold bug:
1) prevent hatching of laid eggs and 2) reduce the population and prevent further laying of eggs.
The park management also learnt from past experiences that densities of causal organisms of diseases such as *Sclerotium blight*, *Downy mildew*, and *Large patch*, were reduced when the "three sets of material for simple agriculture" were used. However, since the planting had already been carried out and pest infestations had already occurred in the first term zone an activated EM solution was chosen as a measure to control the density of pathogens.

At first, “Hyakubairiki” was installed – a device enabling the stable mass culture of activated EM. For soil improvement, compost was made first with an activated EM solution, diluted 10 times and applied at a rate of 50 l per sq meter. Thereafter the compost was piled for three months to ferment. After the smell of ammonium had declined, 60 cubic meters of compost was applied per ha. The “three sets of material for simple agriculture” (100kg EM Super Cera C, 1500kg Rice Bran Pellets, 3000 l activated EM solution) were applied by a manual spreader or a power spray simultaneously with the application of the compost as the base of soil improvement. The material was ploughed and after a month, in autumn, the seedlings for the next year were planted. In 2004, in the second term zone the plants were sprayed 14 times. The spray contents and amount for one application were 10,000 l /ha with an EM liquid which was made up by mixing 1/1000 EM Super Cera C with an EM solution diluted 250 times. The results are presented in the table, and these clearly identify the reduction of larvae due to soil conditioning with EM. Furthermore, the incidence of Sclerotium blight, Downy mildew, and Large patch, was significantly lower in the treated region compared to that of plants in the region without EM.

In 2004 in the first term zone, two application patterns of EM were compared in areas where the large patch disease occurred. The first was three applications of EM diluted 50 times after spraying a pesticide. The second was where an activated EM solution was applied four times.

Growth recovery was faster with pattern 1, and there was an apparent effect. Recovery was slower with pattern 2, but visually detectable.
At present (2006) the park is even more enlarged. The city continues to apply EM for soil improvement and introduced sprinklers to spray the microbial solution. In the first and second term zone, they applied the same amount of additional fertilizer as in the autumn of 2003 and succeeded in controlling gold bug for two consecutive years in the second term zone. Since the controlling effect of gold bug was also seen in the first term zone, the repeated effect of the "three sets of material for simple agriculture" was confirmed.

These studies illustrated two clear benefits of adopting the "three sets of material for simple agriculture."
The first benefit is that EM has an effect in reducing the hatching of eggs of insect pests as seen in the lettuce cultivation. The second result is that EM has the potential to control soil pathogens, so that a growing plant shows recovery. In both cases, the use of "three sets of material for simple agriculture," raises the density of EM and thus builds a high antioxidation field.

Conclusions
This presentation has highlighted the potential of soil improvement by the EM application using various case studies. Hence, in conclusion, the basics of EM application are reviewed.
Effective Microorganisms are living organisms, and their usage is different from chemicals such as pesticides or disinfectants. Since the microbe are alive, it is important to keep in mind that their effectiveness lies upon the substrate, its quantity, environment, and input depend in a given condition.
The goal of EM application is to raise the density of the beneficial microbes and produce a stable antioxidation field. Numerous reports have proven that once the effect of antioxidation exceeds a certain critical point the results are very significant. A stable density of EM can be maintained by using EM Super Cera C. The studies presented are clear examples showing this effect. In all cases, the effect of soil improvement was observed in the first year. If the rate of success is low or there is no impact in improving soils when applying EM, this is most likely due to the low rates used. Thus it is always advisable to use the recommended amount in a small area than using only half of the recommendation in a larger area. This principle will provide the desired beneficial effects in a very short period of time.