

APPLICATION OF EM
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 (continuation from Kenya Worksho)

1.0 As Liquid

The EM stock solution is a yellowish-brown liquid, with a pleasant odour and a sweet-sour taste. The pH of this solution should always be below 3.5. If the solution has a foul smell or if the pH is over 4.0, the EM is not suitable for use.

1.1 *EM stock solution (EM prime)*

The EM stock solution could be applied as follows: -

(a) Application to soil after dilution – manually, using sprinklers or in drip irrigation systems.

(b) Spray onto plants as a foliar application.

1.1.2 Multiplied EM solution (Secondary/Extended EM solution)

If one cannot obtain required quantities of EM stock solutions, the available EM could be multiplied. However, this secondary/extended EM is of inferior quality to that of EM stock solutions. Therefore, the storage life of the secondary/extended solution is less than that of EM. The process of multiplication of EM is as follows: -

Material	For Agriculture	For Environment
Water (good quality)	100 litres	100 litres
EM	5 litres	1 litre
Molasses	5 litres	1 litre
	(Or 5 kg brown sugar)	(Or 1 kg brown sugar)

Process of preparation:

1. Mix molasses and EM in water
2. Pour the mixture into a clean plastic container or drum, close tightly and store at ambient temperature

3. This solution is ready for use when the pH drops below 4.0, which approximately takes 5 – 10 days.

Use of secondary EM:

The secondary EM should be used as soon as possible. However if required, it could be stored for a maximum of 7 days in an airtight container in a shady place.

Precautions:

EM secondary solutions must never be multiplied, as one cannot prevent contamination. Once the secondary solution is extended, the microbial balance is altered and thus the efficacy of EM is lost.

1.1.3 EM Fermented Plant Extracts (EM FPE)

EM fermented plant extract is made from fresh weeds and EM. Therefore EM

FPE contains organic acids, bioactive substances, minerals and other useful organic compounds. The production cost of EM FPE is very low as weeds are used for this process.

Preparation of EM FPE

The recipe given below is for making standard EM FPE

<i>Material</i>	Fresh weeds (chopped)	14 litres (2 – 3 kg)
	Water	14 litres
	Molasses	420 ml
	EM	420 ml

Process of preparation:

1. Chop freshly harvested weeds into small (2 – 5) pieces and place in container.
2. Mix EM and molasses in water and add to weeds in container
3. Cover container with black polythene or vinyl.
4. Place lid of container on top of the black cover and place some weights on it.

Avoid having space between the liquid and cover (i.e. the container must be full)

5. Store the container in a warm (25 – 30c) place, away from direct sunlight.
6. Fermentation is initiated and gas is generated within 5 – 10 days. This depends on the ambient temperatures.
2. Stir the liquid in container regularly to release gases.

The EM FPE is ready for use when the pH drops below 3.5. Pour the prepared EM FPE into plastic bottles after removing weeds by filtration, using cloth.

Storage of EM FPE

EM FPE should be placed in a dark, cool place that has relatively uniform temperatures. It should not be stored under refrigeration or exposed to direct sunlight. EM FPE should be used within 90 days of preparation.

Application of EM FPE

There are many ways of applying EM FPE: -

1. Watering into soil at a dilution of 1:1000 by manual, sprinkler or drip irrigation methods.
2. Spraying to crops at a dilution of 1:500 to wet the plants.

The application should begin after crop emergence, but before the incidence of pests and diseases, as a prophylactic measure.

The spraying is done in the mornings or after rains, at regular intervals. The efficacy of EM FPE can be enhanced if mixed with EM 5 in equal proportions.

EM FPE is not a pesticide or a harmful chemical, and hence its method of application is different to that of the normal agrochemicals. Agrochemicals are generally applied to overcome a specific problem forcefully and rapidly, after it has emerged. In contrast, EM FPE should be applied from time of crop emergence, before the incidence of any pest and disease problems. If this practice is not carried out and problems appear, EM FPE needs to be applied daily until the problem is overcome.

EM FPE can be applied once or twice weekly, directly onto plants. A thorough spraying each time would ensure healthy plant growth. Direct spraying onto pests populations will reduce the populations, eventually leading to their disappearance.

EM FPE works over time through biological processes and hence regular applications are required. It is not harmful to the plant or soil. In contrast, although agrochemicals have the capacity for immediate benefits, their long-term effects are harmful to the environment and the economic status of farmers, as these chemical products are expensive.

EM FPE does not have such effect, and even with excessive applications, the vigour of plants is enhanced, by the absorption of EM derivatives and developing antioxidants within the plant. This enhances the ability of plants to resist the influence of pests and diseases. Although EM FPE takes some time to develop beneficial effects, its use will certainly enhance the quality of the crop, the environment and most importantly the economic status of the farmer.

EM FPE is easily made by individual farmers at a very low cost. More importantly, the use of EM FPE over a long period of time improves the environment, which does not need repeated applications thereafter. It also facilitates the maintenance of healthy sanitary conditions for subsequent crops, especially if the crop residue is incorporated back into the soil, as in most organic systems. This also removes the demand for agrochemicals, thereby saving costs to the farmer, while enduring bountiful harvests.

1.1.4 EM 5 (EM fermented solutions)

EM 5 is a non-toxic chemical free insect repellent. It can also be used to prevent Pest and disease problems in crops. EM 5 is usually sprayed onto crops to prevent pests and disease problems. The rate of dilution is 1: 5000 or 1 : 1000 in clean water. EM 5 acts by creating a barrier around the plant, thereby protecting it from insect pests. In addition, contamination of stored feed by EM initiates a fermentation process in this feed, which makes it inedible to the insect populations. This too reduces insect populations. The ingredients used to make EM 5 vary. However, a standard list of ingredients is

given below. One could enhance the efficacy of EM 5 by the addition of organic materials having high quantities of antioxidants. These include garlic, hot peppers, aloe Vera, Neem leaf, prunings of fruit trees and herbs and grasses having medicinal value. These are chopped or mashed prior to addition.

Preparation of EM 5

The following list contains the ingredients for standard EM 5

Material	Water*	600 ml
	Molasses	100 ml
	Vinegar*	100 ml
	Distilled spirits*	100 ml
	EM	100 ml

* Clean water, preferably from an underground source, free of chlorine

* Natural vinegar is preferred over artificial acids

* Whiskey or ethyl alcohol could be used

Equipment needed include a large container for mixing ingredients, plastic bottles for storage and a funnel.

Methodology:

1. Blend the molasses with water, ensuring complete dilution. If required warm water could be used to hasten the process of dilution.
2. Add vinegar and spirits, followed by EM.
3. Pour the mixed solution into a container, which can be closed tightly. **Close the lid tightly, removing excess air, to develop anaerobic conditions. The chopped vegetable material could be added to this container. (Please note – Glass containers should not be used in the tropics).**
4. Store in a warm (20 – 30c) place, away from direct sunlight.

5. Release gas at regular intervals by partially opening the container and closing it again within a short time.

EM 5 is ready for us when the production of gas has subsided. Well prepared

EM 5 has a sweet fruity smell, similar to that of an ester.

Storage:

EM 5 should be stored in a plastic container in a dark cool place, which has a uniform temperature. If plant material was used, these could be filtered out at this stage. **EM 5 should not be stored in refrigerators or exposed to sunlight. Most importantly, EM 5 should be used within 3 months of preparation.**

Application of EM 5:

EM 5 is sprayed at dilutions of 1: 500 or 1: 1000 to wet the crop. Spraying could be initiated after seed germination or crop establishment, before the incidence of pests and disease, at regular intervals. It is best that EM 5 is sprayed in the morning or after heavy rains.

1.1.5 Bokashi Extract:

Bokashi is organic matter fermented with EM and is equivalent to compost in traditional organic farming. An extract of this material could also be used for pest control. This extract is made by soaking 100 g of bokashi in 10 litres of water overnight. The solution could be used for spraying crop plants.

There are many methods of making this extract. For example, 100 g of fresh kitchen garbage could be soaked in extended EM overnight and the liquid sprayed onto plants. However, this solution must be used within a very short period of time, as it could spoil very easily. One could also treat collected animal urine with EM and once the foul smell disappears, this could be sprayed onto plants at a dilution of 1: 1000.

Bokashi is equivalent to compost in traditional organic farming. However, it is prepared by fermenting organic matter with EM. Bokashi

is ready for use in 4 – 10 days, although the organic matter is not decomposed as in traditional compost. The application of bokashi to soils provides a medium for EM to develop. It also provides nutrients to crops.

1.2.1 Standard Bokashi

The bokashi made under normal circumstances can be classified as "Aerobic" or "Anaerobic" on the basis of the process of manufacturing.

The advantages and disadvantages of the two types are as follows: -

Aerobic Bokashi

This can be produced on a large scale, and due to the open conditions, temperatures during the process of composting are higher. However, if the temperatures are not controlled during the process of composting with EM, the energy of the organic matter is lost. Aerobic bokashi maintains value of organic matter as in silage. However, mismanagement leads to rapid spoilage.

Anaerobic Bokashi

Due to the requirements of anaerobic conditions, making this bokashi is difficult. However, it has a superior quality if well made which enhances plant growth.

Ingredients for making Bokashi:

Bokashi can be made with most organic materials. A few examples of material that could be obtained from plants and animals are as follows:-

Plant materials

Rice, corn or wheat bran, maize flour, rice or bean husks, rice, wheat or corn straw, oil cake, cotton seed cake, pressmud, begasse, chopped residues and weeds, saw dust, dried sea weed, coconut fibre and husks, post harvest residue such as peel of fruit in food industries and empty fruit bunches of oil palm.

Animal Residue

Fish born meal, animal dung, crab shells, waste from meat industry and dead livestock. Another material that could be used is kitchen garbage.

Generally in Bokashi making, it is best to have a balance between plant and animal material in the ratio of 1 – 3: 1.

However, some form of bran obtained from grain is an important ingredient as it contains quantities of nutrients for microorganisms. It is also desirable to combine organic matter having high and low C: N ratios. As a general rule, it is best to mix at least three types of organic material in making bokashi to maintain microbial diversity. In making bokashi, one could use wood or rice husk charcoal, zealot, kelp, grass and wood ash. These materials help improve soil physical characteristics and nutrient holding capacities. They also act as points of anchorage for effective micro-organisms.

Preparation of Bokashi

Bokashi can be classified according to the ingredients. However, a typical bokashi contains the following: -

<i>Ingredients:</i>	Rice bran	100 litres*
	Oil cake	25 litres*
		15
	Fish meal	25 litres*
	(*by volume)	
	EM	150 ml
	Molasses*	150 ml
	Water	15 litres

* If molasses is not available, one could use sugar. Many use raw cane sugar, juice of ripe fruits and wastewater of alcohol industries.

* The quantity of water given is a guideline. The quantity of water that is required depends on the moisture content of the material used. The ideal quantity required is that needed to moisten the material without drainage.

Methodology – Anaerobic Bokashi

Mix rice bran, oil cake and fish meal. Dissolve molasses in water (dilution 1: 100). The use of warm water eases this process. Add EM to the solution of molasses. Pour the EM mixture gradually onto the dry ingredients and mix well, while checking the moisture content to avoid drainage of water. The moisture content of the final mixture needs to be approximately 30 – 40%. This can be checked by squeezing a handful. The handful of the mixture should remain intact, but crumble when touched. Place this mixture in a bag that does not permit air movement (e.g. paper or polythene). Place this bag within another polythene bag (black is preferred) to further prevent air movement. Close bags tightly to maintain an anaerobic condition and store in a dark place.

The period of fermentation is dependent on the climate. In the tropics, bokashi is ready within 3 – 4 days. The bokashi is ready when it has a sweet fermented smell.

A foul odour indicates that the process of fermentation has been disrupted, and the bokashi is not fit for use. Anaerobic bokashi should be used soon after preparation. If storage is required, the bokashi should be spread on a concrete floor for drying under shade. After drying, it could be placed in a polythene bag and stored, avoiding damage by rodents and other pests.

Methodology – Aerobic Bokashi

The process of mixing is similar to that of anaerobic bokashi. Thereafter, place the mixture on a concrete floor and cover with gunny (jute) bag, straw mat or similar material. The mixture needs to be protected from rain.

Under aerobic conditions bokashi ferments rapidly. The temperature increases and ideally the temperature need to be kept between 25 – 35C.

This could be achieved by regular checking of the mixture and mixing the material if the temperature exceeds 40 – 45C, which is the upper limit. The excessive rise of temperatures releases energy, and the bokashi thus made is of poor quality than that made at the prescribed temperatures.

The fermentation period for aerobic is also dependant on the location. In the tropics, aerobic bokashi could easily be made in 2 – 3 days.

As in anaerobic bokashi, the mixture is ready for use when it has a sweet fermented smell, and white fungi is observed on the surface. If it has a foul odour, the process of making bokashi has failed. This bokashi should also be used soon after preparation. However, if storage is required, bokashi is spread on concrete floors and dried under shade, prior to storage in polythene bags. The materials should also be protected from rodents and pother pests.

The preparation of good bokashi is not easy, and one should practice it several times. The key to make good bokashi lies in maintaining the required moisture content and temperatures.

1.2.2 Bokashi from animal wastes

This bokashi uses wastes from animal husbandry units.

<i>Ingredients:</i>	Animal manure	2 parts
	Rice bran	1 part
	Rice husks	1 part
	EM and Molasses	As for standard bokashi

Preparation

Mix the dry ingredients well. Dissolve EM and molasses in water (dilution of 1 : 1: 100) as for standard bokashi and spray the solution onto the dry ingredients with a watering can.

Mix well until the moisture content lies within 30 – 40%. Heap the mixture on a dry floor to a height of 15 – 20 cm and cover with a gunny (jute) bag.

During fermentation, the temperature needs to be maintained between 35 – 45C. Hence regular checking of temperatures and mixing for

aeration, if required is recommended. The bokashi is ready for use when it has a sweet fermented smell and white filamentous fungi on the surface. If it has a sour or foul odour, the material is not fit for use.

1.2.3 Bokashi from soil for raising seedlings

Ingredients	Soil	20 parts by volume
	Bokashi (aerobic or anaerobic)	1 part
	Rice husk charcoal	1 part
	EM and Molasses	As for standard bokashi

Methodology

The soil, bokashi and charcoal are mixed well. EM, molasses and water are mixed (dilution 1: 1: 100) and sprinkled onto the solids to ensure a uniform moisture content of 30 – 40%. The final mixture is covered with a gunny bag (jute) and a plastic sheet. Mix the fermented bokashi several times to maintain temperatures between 35 – 40C. The fermentation process takes approximately 3 weeks, during which period, the mixture should be covered with a polythene sheet to prevent drying. The bokashi is ready for use when it has a sweet fermented smell and white fungi are observed.

Application:

This bokashi – soil mixture could be used when raising vegetables, fruit crops and forest trees especially in nurseries.

1.2.4 Bokashi from rice straw

This material can be prepared easily under most field conditions.

Ingredients:	Rice straw (chopped)	200 kg
	Straw from weeds	50 kg
	Rice bran	5 kg
	Chicken manure	10 kg
	EM and molasses	As for standard bokashi

Methodology:

Dissolve EM and molasses in water at a dilution of 1: 1: 100. Soak a part of the rice straw in the EM solution, drain the water and place on

clean dry floor. Tread on this straw to remove trapped air and heap to a height of 30 cm. Soak a part of the dry weeds in the diluted EM solution and place on the heaped wet straw. Trample heap to remove trapped air and heap to a height of 10 – 15 cm. Mix a part of the rice bran and the chicken manure and sprinkle on the surface of heap to a thickness of 1 – 1.5 cm. Mix well with a hand fork or similar implement. Repeat this process until the height of the heap becomes 1 – 1.5 metres.

Cover the heap with a gunny bag and thereafter with a plastic sheet to obtain anaerobic conditions and prevent the infiltration of rainwater.

The fermentation process takes 5 – 7 days, and when the temperature drops, turn the heap, cover and leave for another 5 – 7 days. Thereafter, it is ready for use. White fungi will be seen on the surface.

1.2.5 Bokashi made in 24 hours

Ingredients Straw (any type)	10 parts
Bokashi (aerobic or anaerobic)	1 part
Rice bran	1 part
	18
EM and molasses	As for other types at a dilution of
	1:1:100

Methodology:

Soak the straw in the EM solution and mix well with rice and bokashi. Place on clean dry floor to a height of 15 – 20 cm and cover with gunny (jute) bag.

Mix well after 18 hours and continue fermentation for another 6 hours. It is ready for application thereafter. If the temperature of the bokashi is high, uncover and spread it for aeration.

1.2.6 Bokashi as an animal feed

This is a very effective feed for livestock. It is made as per standard bokashi, using only rice/corn bran as the dry ingredient.

1.2.7 Bokashi for the environment

This bokashi also uses rice/corn bran as the dry ingredient. The process is as for the standard bokashi.