



EM•1[®] APPLICATION MANUAL

FOR FARMING

This manual presents basic information. Application depends on soil and climate conditions, and culture such as green house or open air cultivation. The values on this manual should be used only as a basic reference.

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FARMING WITH EFFECTIVE MICROORGANISMS® (EM TECHNOLOGY®)

1.0 INTRODUCTION

In the 1980's, Prof. Dr. Teruo Higa introduced the concept of Effective Microorganisms® (EM®). Thus, a group of beneficial microorganisms were cultured and used as a means of improving soil conditions, improving the efficiency of organic matter and nutrient utilization by crops. This technology proved to be highly successful and is now in use in over 120 countries. EM•1® Microbial Inoculant is the main product that is now produced in over 70 countries. It is a mixture of three main groups of beneficial microorganisms and contains all of their metabolites. It is a brown liquid product that has a sweet-sour smell.

1.1 AGRICULTURE

EM•1® can be used in all types of agriculture from growing crops to composting, controlling odors, and digesting wastes from livestock. Although it is completely natural and typically registered for use in certified organic farms, it is compatible in conventional farming systems. Although some care needs to be addressed with synthetic chemicals, conventional growers will benefit greatly using EM Technology®.

Our main objective in growing crops is building the soil. EM•1 will build soil structure, helping neutralize pH, increase organic matter, produce polysaccharides, increase retention of several nutrients, feed other organisms, and assist in drought tolerance. This is done through multiple applications throughout the growing season. Optimum results cannot be achieved with a single application. In general, we are targeting 40 gallons per acre per year. In some cases, such as with low-dollar crops like corn, cotton, soy, and wheat, we will suggest using 10-15 gallons per acre per season. With higher-dollar crops or in bioremediation cases we have had growers use as much as 200 gallons per acre per season and still benefit in a cost-effective manner.

Livestock operations have different objectives than crop producers, yet they will use the same basic materials we suggest in this manual. The number one issue with livestock is odor. The more concentrated the operation, the higher density of animals and larger amount of waste materials. The two main components of waste odors are ammonia (NH_3) and hydrogen sulfide (H_2S). EM•1 can fix both of these when used on a regular basis. The Ammonia can be converted to amino acids (protein building blocks) and the sulfur in hydrogen sulfide becomes a food for the microbes and is also a main component of proteins. EM•1 is used to fog, wash down, and compost manures. It is also used in lagoons and manure pits to digest solids and control odors.

1.2 USE OF BENEFICIAL MICROORGANISMS IN AGRICULTURE

Agricultural production begins with the process of photosynthesis by green plants, which requires solar energy, water, and carbon dioxide. Microorganisms do not provide much in the way of nutrients. However, they make the nutrients in the soils (whether present or added) available to plants through their metabolic activity. This means that one still needs to use nutrients when using EM•1. If nutrients are not added, the microbes will use the nutrients for their own survival and, eventually, nothing will be left for the plants.

The potential utilization rate of solar energy by plants has been estimated theoretically to be between 10 and 20%. However, the actual utilization rate is less than 1%. Even the utilization rate of C4 plants, such as sugar cane, which have a high photosynthetic efficiency, barely exceeds 6 or 7% during the maximum growth period. The utilization rate is normally less than 3% even for producing optimum crop yields.

Past studies have shown that photosynthetic efficiency of the chloroplasts of host crops cannot be enhanced much further. This means that their biomass production capacity has reached a maximum. Therefore, the best opportunity for increasing biomass production is to utilize visible light, which chloroplasts cannot presently use, and infrared radiation. These together account for about 80% of the total solar energy. We should

also explore ways of recycling organic energy contained in plant and animal residues through direct utilization of organic molecules by plants.

In the presence of organic matter, photosynthetic bacteria and algae can utilize wavelengths ranging from 700 to 1200 nm. Green plants do not use these wavelengths. Fermenting microorganisms can also breakdown organic matter, thereby releasing complex compounds such as amino acids for plant use. This increases the efficiency of organic matter for crop production. Thus a key factor for increasing crop production is the availability of organic matter, which has been developed by utilizing solar energy and the presence of beneficial microbes to decompose these materials. This increases the utilization efficiency of solar energy, builds soil structure, and helps retain nutrients in the soil for longer periods of time.

2.0 EFFECTIVE MICROORGANISMS[®] (EM[®])

Effective Microorganisms[®] or EM[®] is a mixed culture of beneficial microorganisms (primarily photosynthetic and lactic acid bacteria, and yeast) that can be applied as an inoculant to increase the microbial diversity of soils and water. This in turn can improve soil quality and health, which enhances the growth, yield, and quality of crops.

For decades agricultural scientists have discussed the concept of inoculating soils and plants with beneficial microorganisms to create a more favorable microbiological environment for plant growth. However, the technology behind the concept of Effective Microorganisms[®] and its practical application was developed by Professor Teruo Higa at the University of the Ryukyus in Okinawa, Japan.

Professor Higa has devoted much of his scientific career to isolating and selecting different microorganisms for developing beneficial effects on soils and plants. He has found microorganisms that can coexist in mixed cultures and are physiologically compatible with one another. When these cultures are introduced into the natural

environment, their individual beneficial effects are greatly magnified in a synergistic fashion.

EM•1[®] does not contain any genetically modified microorganisms. EM•1 is made up of mixed cultures of microbial species that are found in natural environments worldwide.

2.1 EFFECTS OF EM•1[®]

The following are some of the beneficial influences of EM•1.

- (a) Promotes germination, flowering, fruiting and ripening in plants.
- (b) Improves physical, chemical and biological environments of the soil.
- (c) Enhances the photosynthetic capacity of crops.
- (d) Ensures better germination and plant establishment
- (e) Increases the efficacy of organic matter as fertilizers.

Due to the above stated beneficial effects of EM, yields and quality of crops are enhanced. EM is not a pesticide and thus does not contain chemicals that could be construed as such.

2.2 PRINCIPAL MICROORGANISMS IN EM AND THEIR ACTION IN SOIL.

(1) Photosynthetic bacteria (Phototrophic bacteria)

Photosynthetic bacteria are independent self-supporting microorganisms. Like all microorganisms, photosynthetic bacteria synthesize useful metabolite substances from secretions of roots, organic matter and/or harmful gases (e.g. hydrogen sulfide) by using sunlight and the heat of soil as sources of energy. Metabolites are the biological by-products of metabolism. The metabolites include amino acids, nucleic acids, bioactive substances and sugars, enzymes, co-enzymes, vitamins, and several plant hormones, all of which promote plant growth and development.

These metabolites are absorbed into plants directly and also act as substrates for increasing bacteria. Thus increasing photosynthetic bacteria in the soil enhances other

beneficial microorganisms. For example, vesicular-arbuscular mycorrhizae (VAM) in the rhizosphere are increased due to the availability of nitrogenous compounds (amino acids) for use as substrates secreted by photosynthetic bacteria. VAM increases the solubility of phosphates in soils thereby supplying unavailable phosphorus to plants. VAM can coexist with *Azotobacter* as nitrogen fixing bacteria and enhance nitrogen fixing ability of legumes. Photosynthetic bacteria are also nitrogen-fixing bacteria that will often convert nitrogen-containing compounds into amino acids, enzymes, and vitamins.

(2) Lactic acid bacteria

Lactic acid bacteria produces lactic acid from sugars, and other carbohydrates produced by photosynthetic bacteria and Yeast. Thus, food and drinks, such as yogurt and pickles, have been made using lactic acid bacteria for a long period of time. However, lactic acid is a strong sterilizer. It suppresses harmful microorganisms and increases rapid decomposition of organic matter. Moreover, lactic acid bacteria enhances the breakdown of organic matter such as lignin and cellulose, and ferments these materials without causing harmful influences caused by not fully decomposed organic matter.

(3) Yeasts

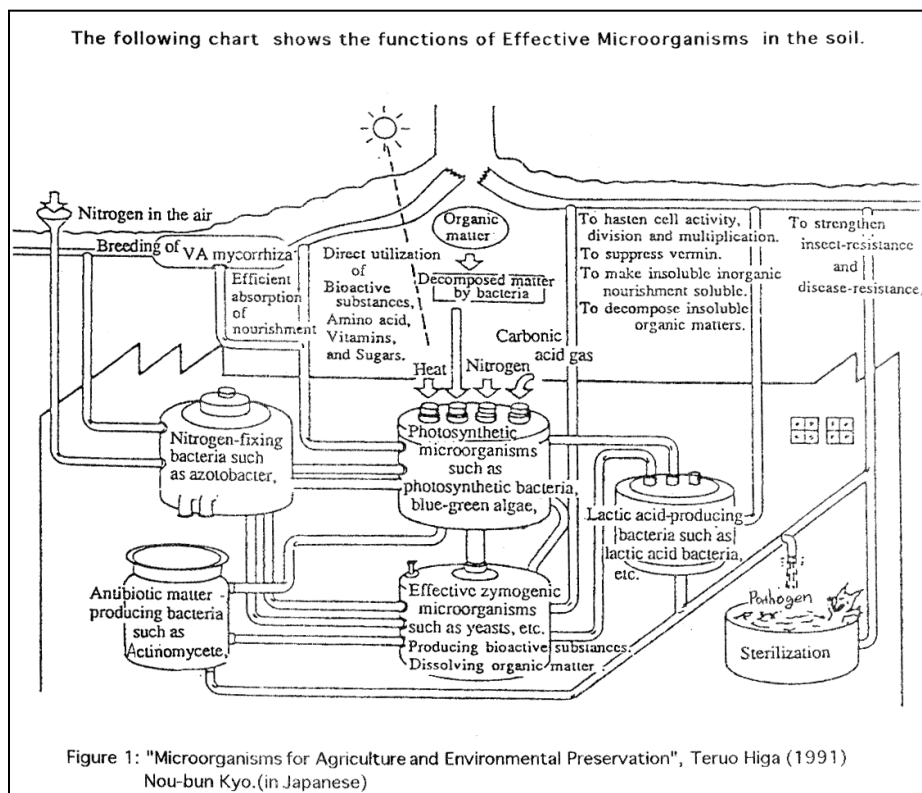
Yeasts synthesize anti-microbial and useful substances for plant growth from amino acids and sugars secreted by photosynthetic bacteria, organic matter and plant roots. Bioactive substances such as hormones and enzymes produced by yeasts promote active cell and root division. Their secretions are useful substrates for beneficial microorganisms such as lactic acid bacteria and Actinomycetes. Yeasts also produce all of the B-complex vitamins.

Each species of in Effective Microorganisms (photosynthetic bacteria, lactic acid bacteria, yeasts) has its own important function. However, photosynthetic bacteria is the pivot of EM•1 activity. Photosynthetic bacteria support the activities of other microorganisms. On the other hand, photosynthetic bacteria also utilize substances

produced by other microorganisms. This phenomenon is termed "coexistence and co-prosperity".

When the microbes in EM•1 increase as a community in soils, populations of indigenous microorganisms are also enhanced. Thus, the micro flora becomes rich and microbial ecosystems in the soil become well balanced, where specific microorganisms (especially harmful microorganisms) do not increase. Plant roots secrete substances such as carbohydrates, amino and organic acids and active enzymes. Microorganisms in EM•1 use these secretions for growth. During this process, they also secrete and provide amino and nucleic acids, a variety of vitamins and hormones to plants. Furthermore, in such soils, beneficial microorganisms in the root zone (rhizosphere) co-exist (symbiosis) with plants. Hence, plants grow exceptionally well in such soils that are dominated by beneficial microorganisms.

The following chart shows the functions of Effective Microorganisms in the soil.



3.0 APPLICATION OF EM•1®

Basically, EM•1 can be applied in four ways, namely as EM•1® Microbial Inoculant, EM5 solution, EM Bokashi and as EM fermented plant extract (FPE).

3.1 EM•1® Microbial Inoculant

EM•1® stock solution can be applied by:

- 1) Watering into the soil (by watering cans, sprinklers or irrigation systems)
- 2) Spray onto plants (foliar spray) by sprayer or watering can.

3.2 EM BOKASHI (EM fermented organic matter)

"Bokashi" is a Japanese word meaning "Fermented organic matter". It is made by fermenting organic matter (manures, dried plant material, etc.) with EM•1®, sugar, and water. Bokashi is normally found as a powder or as granules. Bokashi has been used by Japanese farmers as a traditional soil amendment to increase the microbial diversity of soils and supply nutrients to crops. Traditionally, Bokashi was made by fermenting organic matter, such as rice bran, using rich soils from forests or mountains, which contain various indigenous microorganisms.

However, EM Bokashi is fermented organic matter using EM•1® instead of forest or mountain soil. Thus, EM Bokashi is an important additive to increase EM•1® microorganisms in the soil. (Details on the preparation of EM Bokashi are discussed later.)

3.3 EM5 (EM fermented solutions)

EM5 is a fermented mixture of vinegar, spirits (alcohol), molasses and EM•1®.

It is used to spray the plant to suppress pathogens and keep away insect pests. (Details of EM5 preparation is discussed later.)

3.4 EM Fermented Plant Extract (EM-FPE)

EM fermented plant extract is a mixture of fresh weeds fermented with molasses and EM•1[®]. The main effect of this extract is to extract properties from the plants that supply quality nutrients to crops and also suppress pathogens and keep away insects.

4.0 EM•1[®] STOCK SOLUTION

EM•1[®] is yellow-brown liquid with a pleasant odor and sweet-sour taste. The pH of EM•1[®] should be below 4.0 and is usually in the range of 3.2-3.7. If it has a bad smell or foul odor or pH is more than 4.0, the EM•1[®] has deteriorated and should not be used. It is often suggested to pour down a drain or use in a compost pile.

4.1 USE OF EM1 STOCK SOLUTION.

EM•1[®] is semi-dormant. However, it can be used directly from the bottle. This is good for small applications such as an apartment where one is not going to use much product.

4.2 PREPARATION OF ACTIVATED EM•1

Activation of EM•1 is done purely for economical reasons. It is not a “dilution” of the original product. Activation does not change how the product performs in any way. Activated EM•1 can be used instead of the original EM•1 solution. However, this Activated EM•1 is inferior in regards to stability and cannot store as long as the original product. Nor can this solution act as a starter solution to make endless generation. The Activated EM•1 should be used within 30 to 60 days after it is made.

Materials (1:1:20)

This is the basic recipe for activation. You will notice the other recipes (except for Bokashi) build off of this basic recipe. All of these are made with a ratio of 1:1:20.

1. Warm Water 20 parts (110°-120°F)
2. EM•1 1 part
3. Molasses 1 part
4. Airtight Container
5. pH Meter or paper
6. Thermometer

Here is an easy chart to figure out how much of each ingredient for larger sized batches:

Ingredient	5 gallons	55 gallons	275 gallons	1200 gallons	2500 gallons	3000 gallons
EM•1®	32oz	2.5 gal	12 gal	55 gal	113.5 gal	136.5 gal
Molasses	32oz	2.5 gal	12 gal	55 gal	113.5 gal	136.5 gal
Water (110°-120°F)	4.5 gal	50 gal	251 gal	1,090 gal	2,274 gal	2,727 gal

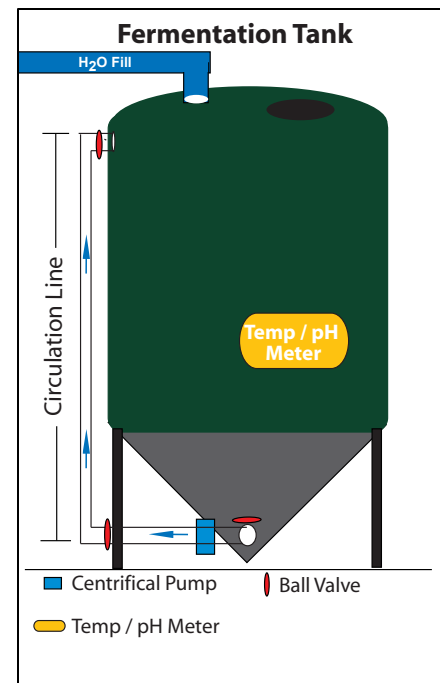
**The water amount is a close approximation. You will want to fill the container so it may end up being a little bit over. That is OK.*

**With larger tanks, make sure to use cone bottom tanks that can completely drain between batches.*

(2) Preparation

1. Pour Molasses into container.
2. Add hot water equal to 2x the amount of molasses. Water should be about 160-170°F.

3. Add cooler water until container is almost full (leave room for EM•1!). Make sure temperature is no higher than 120°F.
4. If pump is installed, circulate for 1 to 2 hours before mixing EM•1. This can be done while filling the tank.
5. Add EM•1.
6. Check the pH of the solution before closing and make a note of starting pH.
7. Close container. Affix airlock if desired. Or, you will need to open container several times during fermentation to release pressure. Not doing so can cause the container to rupture.
8. Check the pH of the solution in 24 hours and daily thereafter.
9. Once the pH drops below 4.0 allow Activated EM to mature for an additional 7-10 days before using.



5.0 BOKASHI

Bokashi is in many ways equivalent to compost, but it is prepared by fermenting organic matter with EM•1[®]. It can be used 14 days after fermentation. Bokashi can be used for crop production even though the organic matter has not decomposed as in compost. When bokashi is applied to soil, organic matter can be utilized as a feed for EM•1[®] microorganisms to breed in the soil, as well as supplying nourishment to crops.

5.1 Materials of Bokashi.

EM Bokashi can be made with any type of organic matter. For example, the following can be used as organic matter in preparing Bokashi:

Rice bran, corn bran, wheat bran, maize flour, rice husk, bean husk, rice straw, oil cake cotton seed cake, cotton seed meal, pressmud, bagasse, chopped weeds, sawdust. coconut fiber and husks. Crop residues such as empty fruit bunches in oil palm, wood chips, bark, fish meal, bone meal, manure of any animal, kitchen garbage, sea weed, crab shells and similar material. Sand has even been used!

However, rice bran is recommended as an important ingredient of Bokashi, as it contains excellent nutrients for microorganisms. Generally the use of at least three types of organic matter is recommended in order to increase microbial diversity.

Adding wood or rice husk charcoal, humate, zeolite, kelp, grass and wood ash, Biochar, etc., to Bokashi is desirable. These porous materials improve soil physical conditions and nutrient holding capacity.

5.2 Preparing Bokashi

There are many type of Bokashi, depending on the organic matter used. The preparation of a typical Bokashi is as follows:

Materials:

Material	Amount
1. Rice bran	2000lbs
4. EM•1	1 gallon
5. Molasses #1	1 gallon
6. Water #2	100-300 gallons

#1 If you do not have molasses, any kind of sugar can be used, but molasses is the best as it is usually the least expensive and contains up to 40 trace minerals.

Also, be sure the sugar has a brix of at least 77. Lower brix numbers tend to result in problems with fermentation.

#2 The quantity of water is a guideline. The quantity of water that needs to be added will depend on the moisture content of the materials used. The ideal quantity of water is that required to moisten the material, without drainage. Roughly to 30-35% moisture after mixed.

Preparation

Anaerobic-type Bokashi

1. Pile rice bran.
2. Dissolve molasses in the water (1:100). It is easily dissolved in warm water.
3. Add EM•1[®] into the above prepared molasses solution
4. Pour the EM•1[®] mixture onto the organic matter and mix well. Pour the mixture gradually and mix well while checking the moisture content. There should be no drainage of excess water. The moisture content should be about 30-40%. You can check it by squeezing a handful. Once squeezed, it should remain as a single unit without crumbling. However, on touching it should crumble easily.
5. Put the mixture into an airtight bag, container with a lid, or cover with a tarp. Close the container or bag tightly to maintain an anaerobic condition.
6. The fermenting period is usually about 2 weeks. The fermented material is now called "Bokashi". The Bokashi is ready for use when it gives a sweet fermented smell. If it produces a sour and rotten smell, it is a failure.
7. If storage is required, spread it on a concrete floor, dry well in the shade and then put into vinyl bag.

5.3 Using Bokashi

In general, apply 1lb per 100 square feet on the soil and scratch or disk in. You can apply more (maximum 5lbs per 100 square), when soil is poor or has little organic matter.

6.0 EM5 FOR INSECTS

EM5 is a non-chemical insect repellent and is non-toxic. EM5 is used to prevent disease and pest problems in crop plants. It is usually sprayed onto plants at a dilution of 1/500 - 1/1,000 in water. It is mainly used to repel insects by creating a sort of barrier. EM5 could also control insect populations. EM5 carried by insects to places of food storage could "contaminate" the stored food. The process of fermentation that takes place in the food due to EM5 makes it non-edible to insects, thereby diminishing populations.

In making EM5, ingredients may vary. A standard set of ingredients is listed below. However, to make effective EM5 for more persistent pests, more organic materials should be added (organic material that has a high quantity of antioxidants such as garlic, hot peppers, aloe, neem leaf, pruned green fruits, and grass) which are considered to be of medicinal value. When using such materials, they should be chopped or mashed in a mixer. Some or all of the materials may be used in making EM5.

6.1 EM5 Recipe

All Activated version of EM•1[®] are made using ratios of 1:1:20. The following is a standard set of ingredients for making EM5

Ingredients

1. Water	20 parts
2. Molasses #1	1 part
3. Vinegar #2	1 part
4. Distilled spirit (30-50 %) #3	1 part
5. EM1	1 part

#1 Blackstrap or cane molasses. Does not matter if sulfured or non-sulfured.

Also, be sure the sugar has a brix of at least 77. The higher the brix, the better.

Lower brix numbers tend to result in problems with fermentation.

#2: Apple cider, red wine, or white vinegar

#3: Anything 40% (80 proof) or higher.

Preparation

1. Blend the molasses with warm water (up to 120°F), make certain that it has been completely dissolved. You may use water up to 165°F for quick dilution of molasses. The molasses and water mixture should be between 110° and 120°F before adding EM•1®.
2. Add vinegar and distilled spirit, followed by EM•1®.
3. Pour the mixed solution into a plastic container that can be shut tightly (A glass container should not be used). Fill completely to prevent excess air in container to maintain anaerobic conditions.
4. Store the bottle in a warm place between 60° and 100°F (20-40°C), out from direct sunlight. The lower the temperature, the slower the fermentation.
5. When container is expanded by the fermented gas, loosen the cap of the container to release gas. Shut it tightly again. You may instead fix an airlock on the container to avoid having to gas the containers during fermentation. The gas produced during fermentation is CO₂, the same as when making bread.
6. Allow to ferment and mature for about 15 days after the initial pH drop. Final pH should be close to 3.5.

The EM5 is ready for use when the production of gas has subsided. The EM5 should have a sweet smell (Ester/alcohol).

Storage:

EM5 should be stored with lid tightly on in a dark cool place, which has a uniform temperature. Do not store in the refrigerator or in direct sunlight. Since the active ingredients are the metabolites and extracts, not the live microbes, EM5 can be used within up to a year after preparation.

6.2 Using EM5

- Spray EM5 diluted in water 1/500-1/1000 to wet the crop.
- Mix with a sticker-spreader such as yucca, calcium lignosulfonate, or a product such as Oro Boost[®].
- Apply 3-5 gallons per EM5 once per week during regular pressure during growing season.
- Start spraying after germination, before pests and diseases appear.
- Spray in the evening or after heavy rains.

Since EM5 is not a pesticide, germicide or a harmful chemical, the application method is different from other agrochemicals. Chemicals are used to solve a problem forcefully and quickly and are applied at specific intervals. EM5, on the other hand, should be applied from the time of planting before the development of any disease or pests. If this is not done and diseases or pests appear, EM5 should be sprayed daily until the problem disappears.

Application can be done once or twice per week with a direct spray onto the plants. Direct spraying on harmful insects should reduce populations leading to eventual disappearance. A thorough spraying to the plant ensures good results. Continuous or regular sprayings ensure that harmful insects, which may have escaped or are recent additions, will be affected by the EM5.

EM5 works over time. Thus, regular applications are necessary for best results.

Although chemical applications may give rapid results, they are harmful to plants and soil and the people applying them. The long-term effects may be disastrous not only to the environment but also to the farmer's economic condition and health. EM5 has no adverse effect even with excessive applications. Additionally, incorporate post-harvest crop residues back to the soil as a pre-treatment before the next season.

EM5 contains EM•1[®]- therefore it contributes to the beneficial effects that EM•1 increasing yield and quality of the crop. Continued use of EM•1 season after season will result in retention of nutrients, requiring less nutrients over time, saving more money for the grower.

7.0 EM FERMENTED PLANT EXTRACT (EM-FPE) FOR PLANT HEALTH

EM fermented plant extract is prepared by using fresh weeds and the standard Activated EM•1 recipe. The acids in the Activated EM•1 extract various chemical compounds out of the plant materials, making them part of the liquid that is strained and sprayed on plants and soils. EM-FPE includes organic acids, bioactive substances, minerals and other useful substances from weeds. The production cost of EM-FPE is very low, because of the use of weeds. Weeds are loaded with antioxidants (bio-available vitamins and trace minerals) that help with plant health.

Another approach to this method is to make the FPE with companion plants. There are several books on the subject of companion plants. For instance, making a basil FPE and irrigating tomato plants with the solution will provide similar benefits as if the basil were growing beside the tomato plant.

7.1 Preparation of EM Fermented Plant Extract

The following is a standard set of ingredients for making EM-FPE

Ingredients (for 5-gallon bucket or drum)

- | | |
|-------------------------|----------------|
| 1.Chopped fresh weeds#1 | Fill container |
| 2. Water #2 | 20 parts water |
| 3. Molasses #3 | 1 part |

4. EM1 #4

1 part

- #1 Use strong weeds such as mugwort, artemisia, clover and grasses that are considered to be of medicinal value. Pruned green fruits and young shoots could be incorporated. The use of various types of weeds is recommended in order to increase bio-active substances and microbial diversity. The weeds should be cut in the morning.
- #2 Adding a little amount of seawater (0.1%) is useful to supply minerals to crops.
- #3 Also, be sure the sugar has a brix of at least 77. The higher the brix, the better. Lower brix numbers tend to result in problems with fermentation.
- #4 3% of water.

Items needed in making of EM-FPE:

Large plastic bucket or drum, weight to press chopped weed, black vinyl bag, and wooden lid.

Preparation

1. Cut weeds and chop well (1-2 inches long).
2. Put chopped weeds into bucket or drum, filling as much as possible without packing.
3. Mix EM•1 and molasses into warm water and pour the solution into bucket.
4. Completely fill container. Cover tightly.
5. Store the bucket in a warm place 60°F-100°F, out of direct sunlight.
6. Fermentation begins and gas is generated within 25 days. (depending on temperature).
7. Stir the weeds in the bucket regularly to release the gas.
8. The EM-FPE is ready for use when pH of the solution is below 3.5. Filter weeds using a cloth and spray liquid diluted in water. Weeds can be used to make EM Bokashi.

Storage:

EM-FPE should be stored in a dark cool place, which has a uniform temperature. Do not store in the refrigerator or in direct sunlight. EM-FPE should be used within one year after preparation.

7.2 Using EM-FPE

- Watering into the soil (1:1,000) by watering cans, sprinkler or irrigation system.
- Spray EM-FPE diluted solution (1:500-1:1,000) to wet the crop.
- Start spraying after germination, before pests and diseases appear.
- Spray in the evening or after heavy rains.
- Apply EM-FPE regularly. Applications can be alternated with EM5 or standard Activated EM•1.
- The combination of EM-FPE and EM5 is more effective.

8.0 EM•1 IN CROP PRODUCTION**8.1 Seed Treatment:**

Activated EM•1 can be used as a seed pre-soak.

1. Pre-soak seeds before sowing with diluted Activated EM•1. Soak time depends on the size of the seeds. The dilution is 1 part Activated EM•1 to 1,000 parts water

Seed Size	Example	Time to Soak
Small Seeds	Mustard	20-30 minutes
Medium Seeds	Cucumber	30-60 minutes
Large Seeds	Pumpkin	2-3 hours

*If seeds are known to be coated with fungicide, pre-rinse before soaking with diluted Activated EM•1.

8.2 RICE

Rice is separated out because of its unique growing requirements.

[Autumn treatment in temperate zones.]

(After harvest in the tropics)

After harvest, add all crop residues (rice straw and rice husk) to the field, and apply 450-700lbs of Bokashi per acre and 3-5 gallons of Activated EM•1 diluted with water for coverage.

[Raising of seedling]

To hasten germination and prevent diseases, soak rice seeds in Activated EM•1 diluted solution (1:1,000) until seeds are enlarged. It is preferable to change the solution daily. During raising of seedling, apply Activated EM•1 with water (1:1,000) total 4-5 times. Additionally, spray EM5 (1:500) to seedlings weekly.

[Growering through harvest]

At plowing, apply 450-700lbs of Bokashi per acre.

Apply 3-5 gallons of Activated EM per acre per week throughout the growing season.

8.3 FIELD CROPS (General Program For Most Crops)

[Preparation of soil]

1-2 months before seeding or transplanting, apply 450-700lbs per acre of Bokashi and 3-15 gallons activated EM•1 per acre

[Raising of Seedlings]

- Prepare a good soil for raising seedlings with lots of organic matter.
- Soak seeds (such as seed potatoes) in an Activated EM•1 diluted solution (1:1000) for approximately 30 minutes to coat seed with EM•1.

- After seeding, water with Activated EM•1 (1:1,000-2,000). Then spray EM5 (1:1000) 1-2 times a week. For seedlings purchased (pot seedlings), do a transplant dip of Activated EM•1 diluted solution (1:500).
- Drench furrow with a 1:500 solution of Activated EM•1 and water at a rate of 3-5 gallons per acre to help establish transplants or to speed germination.

[Growing period]

- Apply 3-5 gallons Activated EM•1[®] per acre per week either by spraying or injecting through irrigation system.
- Foliar spray in the evening with Activated EM•1, EM FPE, EM5 or a combination of all at a rate of 3-5 gallons per acre per week. Foliar feeding is done with a 1.5-3% nutrient solution. Plants should be sprayed on the leaves regularly at 7 - 14 days intervals. Addition of sticker helps EM5 increase effectiveness. Please do not spray EM5 at a dilution less than 1: 500.
- Bokashi can be applied any time during the growing season as an amendment. However, do not apply too much Bokashi at a time. Pay attention not to put Bokashi over the crop leaves directly, apply Bokashi around the crop base and drip line, as it tends to burn the leaves.

Concentrations greater than 1:500 could cause a physiological problem or yellow spots on the leaves, especially in dry seasons, because of the pH of EM•1. This is more often a problem when foliar applications are made during the day.

[Combining With Agricultural Chemicals/Compatibility]

- Never store any EM solution in a tank with a concentrated synthetic material as it will kill all the microbes.
- Synthetic fungicides and pesticides tend to kill all the microbes in EM•1[®] within seconds. It is best to apply them separately, waiting 48-72 hours between applications.

- Most biological fungicides and pesticides and IPM programs are very compatible, and perhaps synergistic, with EM•1[®]. Combining applications can have better results than applying separately.

[Harvest]

To help maintain or increase organic matter, return all crop residue to the soil. Damaged and diseased plants could also be added into the soil. Apply 5 gallons per acre of Activated EM•1 on crop residues.

8.4 ORCHARD CROPS (Trees & Vines)

[Before and after planting]

- Make the planting hole and put 0.5lb of Bokashi and organic matter per hole.
- Make a planting mix per tree: 1 quart Activated EM•1, 1 pint humic acid, 1.5% complete fertilizer, and 2 TBS VAM.

[Growth period]

- Irrigate with 3-5 gallons Activated EM•1 per acre per week.
- Foliar Spray with 1.5% nutrient solution, 1 pint per acre sticker/spreader, 3-5% Activated EM•1 solution (1:500-1:1000). Foliar spray at least once per week during growing season in the evening.

[After harvest]

Crops can be washed with a 1% solution of Activated EM•1.

[Cover Cropping And Growing Between Rows]

Cover ground with leguminous or graminaceous cover crops. Mow several times a year and use the cuttings as a mulch. This system can prevent soil erosion, increase organic matter in soil and improve soil aggregate structure. Alternate row sod systems or mulch-sod Systems are recommended.

[Mulch with Activated EM•1]

- Grass Mulch is an important technique in nature farming. The good points of Mulch are as follows:
- To prevent soil erosion, to keep soil moisture, soil temperature and maintain a good environment for EM, to suppress weed, improve soil physical conditions by providing organic matter.
- To provide nutrients (particularly water soluble potassium) to crops.
- Always try to mulch and apply Bokashi or EM diluted with molasses on the mulch.

8.5 Potato Crops

Activated EM•1 provides potato growers with a solution to add to their nutrient programs that will help build soil and assist in nutrient efficiency. Below are three optional programs that are to be used in conjunction with an existing nutrient program. These programs may also be combined with some other soil building products such as Bokashi and compost, mycorrhizae, and humates (liquid or granular).

Anticipated benefits include:

- Better drought tolerance
- Increased nutrient efficiency
- Increased water retention in soil
- Increased shelf life

At Bedding:

Low: 5 gallons Activated EM•1 per acre

Medium: 10 gallons Activated EM•1 per acre

Intensive: 20 gallons Activated EM•1 per acre

Cutting:

Drench in a 1-3% Solution before transplanting.

Grow-out:

Low: 0.5 gallons Activated EM•1 per acre per week foliar

Medium: 1 gallon Activated EM•1 per acre per week foliar plus 1 gallon per acre in irrigation water.

Intensive: Up to 5 gallons Activated EM•1 per acre per week foliar plus 1 gallon per acre in irrigation water.

Post Harvest:

Spray with a 0.001% solution prior to storing.

Post Harvest Field Applications

Low: 5 gallons Activated EM•1 per acre

Medium: 10 gallons Activated EM•1 per acre

Intensive: 20 gallons Activated EM•1 per acre

8.6 GRASS CROPS (Alfalfa, Hay)

5 gallons Activated EM•1 per acre per cut.

Use a boom sprayer, run in irrigation water, or any other liquid fertilizer application method.

8.7 Corn, Wheat, Soy, Cotton

Do a seed treatment as noted above.

Apply 10 gallons Activated EM•1 per acre in the furrow at time of planting.

Can be knifed or watered in at time of planting.

9.0 EM•1 IN ANIMAL PRODUCTION

9.1 Effects of EM1 on livestock

1. Suppress Odors (including Ammonia and Hydrogen Sulfide)
2. Decrease Animals.
3. Improves Fecundity.
4. Improves Manure Quality.

9.2 APPLICATION OF ACTIVATED EM•1®

1. Spray in livestock barn.
2. Sprinkle on the bedding.
3. Use in Septic Tanks.
4. Use in Lagoon and Manure Pits

1) Spray Activated EM•1 In Livestock Barns.

Application.

Mix 1-4oz Activated EM•1 per gallon of water in sprayer. Spray all surfaces in barn with a sprayer. Spray all surfaces until visibly wet: floor, walls, ceiling and drain. In areas where water is used for washing, inject into water at a rate of 1:128. Splashing EM solution on animals does not cause problems, in fact it is good for them!

Spray barn every 3-7 days. In areas that are sprayed regularly, such as a milking parlor, use daily. Over time, the ratios can be decreased to as low as 1:1,000.

2) Put Activated EM•1 Into Septic Tanks.

Application

Put 1 gallon Activated EM•1 per 1,000 gallons of waste water either every tank filling cycle (if less than one month) or once per month. It is best to apply after the tank is empty in order to treat in-coming waste water.

3) Waste Lagoons and Manure Pits

Application

Calculate the total volume of lagoon. Divide by 10,000. That is the amount of Activated EM•1 needed per application. If manure is pumped through a sump, add Activated EM•1 at this point. If it is gravity fed, simply pour needed amount of Activated EM•1 anywhere in lagoon. It will travel in the liquid. There is no need to circulate or churn. There also is no need to spray on the surface.

If lagoon is in poor condition with lots of sludge, crust and odors, apply every other week until crust is gone and digestion of solids is occurring. Once lagoon is looking good, applications can be made once per month.

For a new lagoon or one that is in decent shape, one dose per month should be sufficient.

Application rate for manure pits is based on 1:10,000 for up to 30 days. If pits are pulled earlier than 30 days, application is 1:10,000 per pit cycle.

9.3 Dairy Applications

Spraying Activated EM•1 will eliminate odors almost instantly. The application rates will determine how long the effects will last. If odors haven't been eliminated at first, re-apply Activated EM•1 at a greater rate and/or more often to establish beneficial microbial populations.

Foot Baths:

Apply 1 ounce Activated EM•1 per gallon of water in footbath. Use Activated EM•1 instead of copper sulfate. Use all of the Activated EM•1 within 30 days after opening.

Methods for application for barns and loafing areas:

- Spray all surfaces and manures until moist (floors, walls, and ceiling).
- Applications should be done at 2-3 times per week. Dilute 3-4oz Activated EM•1 per gallon of water and spray surface until wet.
- If misting/fogging systems are in place, inject Activated EM•1 at a rate of 1:500 on a continuous basis.

Methods for milking parlor:

- Applications should be done daily as part of wash down. Dilute 3-4oz Activated EM•1 per gallon of water and spray surface until wet.

Solid Manure:

1. Arrange materials into windrow.
2. Dissolve Activated EM1 in the water (1:1:100).
3. Run windrow turner machine* through pile, incorporating EM mixture.
4. Check moisture. Should have starting moisture content of 50-60%.
5. Monitor temperature with compost thermometers. Turn when piles reach 145°F.
6. Piles should be completed in 40-45 days after 18-20 turns.
7. Spread on fields and plant.

If the mixture is correct, three to four days after initial mix there should be no ammonia odors in or around the piles.

*It is not recommended to use bucket or skid loaders when making compost. There are specialized machines that are designed for making compost. These machines will thoroughly mix and break up all the materials. A bucket loader will not ensure thorough mixing.

Methods for applications on pasture:

- Apply Activated EM•1 by spraying at a rate of 40 gallons per acre per year.

Cleaning Animals:

- Periodically wash the animals with a solution of Activated EM•1 at one ounce per gallon of water. This is good for the animals' hides and skin. It will also help loosen any dirt that is stuck to their fur.

9.4 Poultry Applications

Directions For Use in Houses With Litter:

For best results, begin with fresh shavings/litter and use for a minimum of three consecutive flocks. Caution: Do **NOT** use Activated EM•1 on litter where PLT has been used previously as it tends exacerbate ammonia release. Also, do not run disinfectants or antibiotics through fogging lines as these will kill the microbial populations built up in the houses.

1. Spray & wash all surfaces, fans, and inlets of poultry barn with a diluted solution of Activated EM•1 and water at 1:500 ratios. No insecticides, sanitizers or acids are necessary. Addition of these products will adversely affect the effectiveness of Activated EM•1.
2. Spray floors with 2 gallons/1000 square ft. Activated EM•1 as follows:
 - Spray bare floors with 1 gallon/1000 immediately before new sawdust/shavings are spread – a little dampness is good under litter to inoculate floor with beneficial microbes in Activated EM•1.
 - Top dress new litter with the remaining 1 gallon/1000 1-3 days before chick placement.

Note: If available run through misting system at a rate of 1:1,000 with fresh water during life cycle of the flock. Cycle - 1 minute ON and 5 minutes OFF in summer. 1 minute ON, 2-3 minutes OFF in winter if possible.

3. For subsequent flocks, follow step 1 above, then:

- De-cake floors and top dress with 10 gallons/1000sq. ft. (100 gallons in the brooding area) Activated EM•1 1-3 days prior to chick placement.
- If tilling litter, use 7.5 gallons/1000 prior to tilling and 1 gallon/1000 1-3 days prior to chick placement.

Storage:

Store in a closed container. Do not store in direct sunlight. Do not allow to freeze. Store at temperatures from 50°F-90°F. Use by “Best Used” date stamped on label.

9.5 Hog Applications

Misting/Fogging For Odor Control

1. If your facility has a misting/fogging system in place for cooling, Activated EM•1[®] can be added into the water at a ratio of 1 part AEM•1[®] per 1,000 gallons of water. For best results, run the solution on a timer that cycles for 10 seconds every hour when the building is open (summer) and 10 seconds every 30 minutes when the building is closed (winter).
2. Prior to running the AEM•1[®], flush the lines to clean out any gunk as nozzles may plug. Continued use of Activated EM-1 will keep the lines clean.

Wash down

1. Spray & wash all surfaces, fans, and inlets of poultry barn with a diluted solution of Activated EM•1 and water at 1:500 ratios. No insecticides, sanitizers or acids are necessary. Addition of these products will adversely affect the effectiveness of Activated EM•1.
2. Spray floors with 2 gallons/1000 square ft. Activated EM•1 as follows:

- Spray bare floors with 1 gallon/1000 immediately before new sawdust/shavings are spread – a little dampness is good under litter to inoculate floor with beneficial microbes in Activated EM•1.
- Top dress new litter with the remaining 1 gallon/1000 1-3 days before chick placement.

9.6 Horse Applications

Horses are very inefficient eaters. As such, they produce lots of manure and very strong urine. Activated EM•1 provides a simple and affordable solution to controlling the odors. You can apply it on floors, walls, ceilings, and even wash the animals with it. Manure can be composted quickly as well and put back into the fields where the horses are grazed. Here are some of the basic applications:

Clean the barn and stalls:

1. Spray & wash all surfaces, fans, and inlets of poultry barn with a diluted solution of Activated EM•1 and water at 1:500 ratios. No insecticides, sanitizers or acids are necessary. Addition of these products will adversely affect the effectiveness of Activated EM•1.
2. Spray floors with 2 gallons/1000 square ft. Activated EM•1 as follows:
 - Spray bare floors with 1 gallon/1000 immediately before new sawdust/shavings are spread – a little dampness is good under litter to inoculate floor with beneficial microbes in Activated EM•1.
 - Top dress new litter with the remaining 1 gallon/1000 1-3 days before chick placement.

Add bedding

Spray or top-dress AEM•1[®] onto bedding. The minimum amount of AEM•1[®] to be used should be at 0.001 gallon per square foot (1 gallon per 1,000 square feet) of poultry barn. This calculated amount should be diluted in just enough water to cover floors

adequately.

Total AEM•1[®] per barn will vary on the size of the barn and the age of the bedding and manure.

Additional Options:

To increase the benefits of the odor control, it would be advisable to ferment the bedding at least two weeks prior to use, essentially making it into bokashi.

Alternatively, you can add bokashi to the bedding as a top dressing.

Composting manure:

Add 1.5 gallons Activated EM•1[®] per ton of fresh manure and compost as normal, following normal moisture and turning instructions.

Water troughs:

Clean the trough thoroughly and fill with fresh water. Add a 35mm EMX Ceramic (1pc for ever 30 gallons of water) unit on the water line or into bottom of trough to structure the water. The water will stay cleaner longer and quench the animals' thirst much better.

For further reading, we also suggest a book written by Ernst Hammes: [Healthy Horses: Horse Care with Effective Micro-organisms](#). It is available through Amazon.com. This book has quite a bit of practical information for the horse owner.

10.0 EM•1 IN AQUACULTURE

EM•1 is useful for growing all types of fish because it improves water quality.

Application

- Put Activated EM•1 into the pond. (0.01% of total water in the pond) or (1:10,000) every month. Please check the odor of water regularly. If the bad smell is not suppressed, add Activated EM•1 at shorter intervals.

- Mix EM bokashi into feed for fish (1-5% of feed) to raise the productivity.

11.0 IMPORTANT ASPECTS OF USING EM•1

(1) EM® IS ALIVE

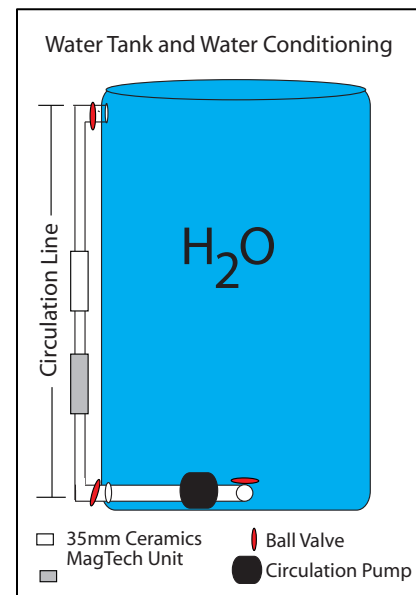
EM is a living entity. Therefore, EM is completely different from chemical fertilizers or agrochemicals. EM does not work when applied in the same method as chemical fertilizers or agrochemicals. It is important to note that EM increases population of beneficial microbes in the soil.

(2) USE GOOD QUALITY WATER

It is important to use good quality water when watering crops, diluting EM•1, preparing Bokashi and EM5. Using polluted water (high BOD, Low DO) causes infection of pests and diseases, reduction of yield and crop quality. If you cannot get good quality water, install a tank for water conditioning. Filter the water with charcoal before filling the tank and circulate through EM-X® ceramics and a magnet (see figure left).

(3) Storage of diluted solution

It is desirable to utilize diluted Activated EM•1 solutions within 3 days. To avoid spoilage, mix only what is needed per application.



(4) Storage information

- Store of EM•1 - up to 12 months in a closed container, in a cool and dark place, (There is no need to store in refrigerator).

- Check smell if in doubt. EM•1 always has a sweet and sour smell. If smell is foul, do not use it.
- After the cap of bottle is opened and air comes in, a white membrane may be observed on the surface of EM•1. This is yeast and does not cause a problem.

APPENDIX: 1 BOKASHI AND COMPOSTING

1. MANURE BOKASHI

(1) Materials

1. Manure	1 Ton
2. Activated EM•1	2 gallons
3. Molasses	2 gallons
4. Water	100-300 gallons

(2) Preparation

1. Spread manure
2. Dissolve Activated EM•1 and molasses in the water (1:1:100)
3. Spray the EM•1 diluted solution on the dry ingredients with a watering can. Or inject into a compost turner.
4. The moisture content should be 30-40%.
5. Heap into a large mound and cover with a large tarp. Weight down the tarp to keep as airtight as possible.
6. During fermentation the temperature should stay around 35-45 °C.
7. Bokashi is ready for use when it gives a sweet fermented smell and white mold is observed. If it has a sour and rotten smell, it is failure.

2. COMPOSTING WITH ACTIVATED EM•1

(1) Materials

1. Feedstock	1 ton
2. EM•1	2 gallons
3. Water	100-300 gallons

Compost Turner

(2) Preparation

8. Arrange materials into windrow.
9. Dissolve Activated EM1 in the water (1:1:100).
10. Run windrow turner machine* through pile, incorporating EM mixture.
11. Check moisture. Should have starting moisture content of 50-60%.
12. Monitor temperature with compost thermometers. Turn when piles reach 145°F.
13. Piles should be completed in 40-45 days after 18-20 turns.
14. Spread on fields and plant.

If the mixture is correct, three to four days after initial mix there should be no ammonia odors in or around the piles.

*It is not recommended to use bucket or skid loaders when making compost. There are specialized machines that are designed for making compost. These machines will thoroughly mix and break up all the materials. A bucket loader will not ensure thorough mixing.

3. COMPOST TEAS WITH ACTIVATED EM•1

Compost tea and Activated EM•1 are compatible. Combining them actually improves the quality and shelf life of the tea. A drawback of compost tea, besides not knowing exactly what it is in it, is that it has a short shelf life (24 hours at the most) because the microbes that are brewed require air. This is the reason why it is aerated for 24 hours. The photosynthetic bacteria in EM•1 are able to release O₂ into the tea and will be enough to at least double the shelf life of the tea.

Simply make compost tea according to directions. After 24 hours of aeration shut off aeration unit and add 1 part of Activated EM•1 to 50 parts tea. Do not aerate again or microbial metabolism will change to an oxidative state and could actually kill plants.

APPENDIX:2 SOIL FOR RAISING SEEDLINGS.

(1) Material

1. Soil	20 parts
2. Bokashi	1 part
3. Perlite	0.25 parts
4. Redwood bark, coir, or rock wool	20 parts

(2) Preparation

Mix soil and bokashi together.

Fill trays.

Add treated seeds.

(3) Application.

Use this soil for seedling trays of vegetables and fruits.

APPENDIX 3: HYDROPONIC AND AEROPONIC SYSTEMS

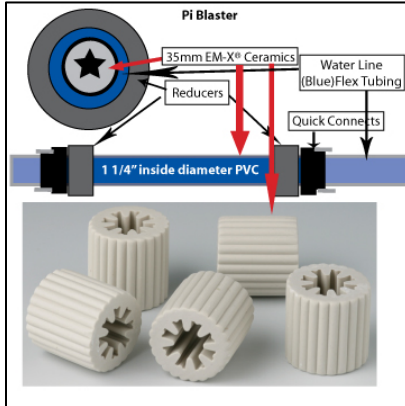
Here are some basic instructions. TeraGanix has a separate manual specifically for greenhouse production. If you are running a greenhouse, please contact us for your copy. Hydroponics systems can be completely in liquid or use small amounts of soils. Most of the nutrients are fed into the water that the plant roots rest in. Additional foliar applications may or may not be made, depending on the grower.

Aeroponics is a growing technique similar to hydroponics, however, the plants receive all their nutrients via foliar application, nearly every day.

- 3%-5% solution EM•1[®] Microbial Inoculant.
- 0.5% sticker spreader.

- Feed with a 1.5%-2% solution of nutrients.

Water can also be conditioned using our 35mm Pipe Ceramics. For every 1,000 gallons of water in tanks, use 4 sets of the 35mm EMX Ceramic pipes. They can be put inside a 1 1/4" PVC pipe and plumbed directly into the main supply line. This will help condition the water and pull out dissolved solids in the water. If the unit is set up on a circulation system, you will notice it makes better use of the ceramics.



In the water lines, add EM•1[®] Microbial Inoculant starting at a rate of 1:1,000 (1 teaspoon per gallon) and as needed to maintain recommended dilution ratios with replacement water. Continue to use nutrient solutions as EM•1[®] is not a replacement for nutrients.

APPENDIX 4: SOIL CLASSIFICATION ON THE BASIS OF MICROBIAL ACTIVITY

(1) Disease-inducing soil

The percentage of *Fusarium* in all fungi is high (more than 15 - 20%) in this soil.

When raw organic matter containing high nitrogen is applied, this soil produces a foul odor. Maggots develop in the soil together with many harmful insects. Pest and disease infestation is high with significant damage to the crops.

Therefore, applying raw organic matter is harmful for crops in this soil. Application of raw organic matter hardens the soil. The soil physical conditions deteriorate. In case of rice fields, gas is generated. Application of high quantities of chemical fertilizer and/or agricultural chemicals leads to the development of this type of soil.

(2) Disease-suppressive soil

Microorganisms which produce antibiotic substances exist in this soil. Thus, soil borne diseases do not develop easily. As Microorganisms such as *Penicillium*, *Trichoderma*,

Streptomyces are active, the percentage of *Fusarium* in all fungi is low (less than 5%) in this soil.

When raw organic matter containing high nitrogen is applied to such soil, foul odors do not develop. The soil has the fresh sweet smell of mountain soil after decomposition. Soil aggregation and permeability are improved. On cultivation, pest and disease infestation is very low, but the yield is not so good. If this soil links up with a "Synthetic soil", productivity is enhanced.

(3) Zymogenic soil

This soil primarily contains zymogenic microorganisms such as lactic acid bacteria and yeasts. When raw organic matter containing high nitrogen is applied, this soil develops an aromatic fermented smell. The populations of fermentable fungi such as *Aspergillus* and *Rhizopus* are increased. The percentage of *Fusarium* in all fungi is low (less than 5%) in this soil.

The water-stable soil aggregate is high, and the soil becomes soft. Thus the solubility of inorganic nutrients enhances. The presence of amino acid, sugars, vitamins and other bioactive substances is increased in this soil, thereby promoting growth of crops.

(4) Synthetic soil

This soil contains microorganisms such as photosynthetic, nitrogen fixing bacteria.

Under stable soil moisture conditions, the soil quality is enhanced by addition of small volume of organic matter. The percentage of *Fusarium* in all fungi is low in this soil. This soil often links up with a "disease-suppressive soil"

Zymogenic-synthetic soil

When "Zymogenic-soil" and "Synthetic soil" are linked, it becomes an ideal soil for crop production. Such as soil is termed "Zymogenic-synthetic soil".

1) Teruo Higa (1991) "Microorganisms for Agriculture and Environmental Preservation", P33-34, Nou-bun Kyo. (In Japanese)

APPENDIX 5: FOLIAR FEEDING

Foliar feeding rates will vary according to the size of the plant during the growing season. Our best programs have been starting at 1/2 gallon per acre per week and up to 5 gallons per acre per week. Leaves are sprayed until moist, not dripping wet.

We usually do a 3-5% solution of Activated EM•1[®] a 2-5% nutrient solution, and a wetting agent (sticker/spreader), mixed in tank with water. Liquid humate or lignin could be added to the mix as well. When using conventional fertilizers, go with the lower dilution. With natural or organic fertilizers, you can go 5% or slightly higher, depending on the type of plant.

If applying pesticides, EM-1 is compatible with most biological pesticides, but not synthetic ones. In general it is OK to tank mix with biological pesticides as long as the mixture is sprayed within an hour. Several synthetic pesticides have been tested and kill all the microbes in the product in as little as 30 seconds. If using synthetic pesticides, apply separately, waiting at least 24-48 hours between applications.

Application Equipment Consideration

Best results are achieved when foliar sprays are finely atomized with a drifting mist. Any piece of equipment listed below will suit this purpose.

Orchard Fan Spray Rig	Both 3-point type and larger pull-behind PTO units work well (usually used for large acreage applications).
Boom-Type Sprayers	Some advantage can be gained by increasing sprayer pressure, tilting the nozzles back to a 45° angle to allow the spray to drift onto the plants.

Backpack Leaf Blower with Liquid Attachment	Good for applications from backyard up to 5 acres.
Hand Pump Sprayer	Backpack units designed for up to 90 psi are good for backyard gardens up to 1 acre.
Electrostatic Sprayer	Units impart a charge to the spray particles, causing them to adhere more readily to plants.

When to Foliar Spray:

- Foliar feeding is most effective in the early evening when temperatures are mild and wind is minimal. This has two main effects: Plant physiology shows that plants force sugars into fruits in the evening; and foliar feeding has a cooling effect on the plant forcing more sugars to the fruits. This results in a higher brix.
- When wind is minimal, finely atomized sprays drift readily.
- Absorption is further enhanced when weather conditions are humid and moist. The presence of dew on the leaves facilitates foliar feeding.
- Absorption is improved when sprays also reach and coat the undersides of leaves where the majority of the plant's stomata are located.

When NOT to foliar Spray:

- Do NOT spray during the height of the day (10:00 AM to 4:00 PM).

For Best Results:

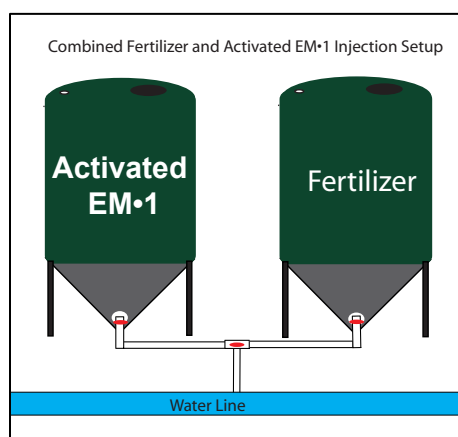
- Foliar feed once per week during the growing season.
- Foliar feed in the evening.
- During very wet periods, foliar feed one to three times per week.
- A surfactant or wetting agent added to the solution decreases surface tension on the leaf and facilitates absorption.

Assessing the results:

Within as little as four hours of day light after the foliar application the progress of the plants can be checked with a refractometer in a relatively simple process. Refractometers measure the brix, or sugar, in liquids. Begin by extracting a sample of sap from several of the crop plants before foliar applications. By testing several possible blends using several spray bottles, you can determine the best blend to use. Then follow the instructions below:

- Squeeze the leaves or stems with a garlic press or some other tool.
- Place the extracted sap in the refractometer to measure and record the reading.
- Use a spray bottle to mist a small sample of foliar spray blend onto the plants.
- After a short time, extract and measure another sap sample.
- If the Brix has increased, apply foliar feeding with that specific blend.
- A "placebo" spray of distilled water should be tested at the same time to discount any changes.

APPENDIX 6: COMBINING WITH FERTILIZERS



The use of agrochemicals, especially pesticides, may reduce the efficacy of Activated EM•1 by 50 - 60%, and will likely kill all microbial populations if mixed 1:1 within minutes. If synthetic/toxic chemicals (herbicides, pesticides, and fungicides) are used, applications should be applied separately. For fertilizers, the microbes are fine once diluted. This can be accomplished when using liquid fertilizer tanks and splicing them together at the dilution point with irrigation water prior to the field. See diagram at left. Notice cone bottom tanks are used. When the Activated EM•1 tank is empty, be sure to flush with clean water.

APPENDIX 7: LINE CLEANING (IRRIGATION, DRINKING WATER LINES, & WELLS)

All water lines eventually become clogged with various contaminants. Visual inspection of the emitters along the line or on any parts that protrude above the surface will usually show signs of scale. A good way to measure it is to watch your pressure gauges.

Typically bleach or sulfuric acids are used to clean the lines. Bleach is the least preferred method because chlorine is a salt, which really doesn't solve the problem of scale at all. It is also toxic to plants and soil biology.

Sulfuric acid is effective, especially in areas with high pH soils as it opens up the soils. However, acid can corrode equipment. Sulfuric acid is also a bit more expensive per acre than Activated EM•1.

Activated EM•1 will clean organic matter, salts, bio-film and roots from lines and wells. The residual microbes in the flush water are also beneficial to soil and plants. Treatments can be done during the growing season without any negative impact. The following works well for irrigation systems, drinking water lines, and wells.

Activated EM•1 is injected in the line at a rate of 5 gallons per acre.

Let the product sit in the lines as long as possible, even up to a month, before flushing lines. Make sure you can flush the lines. If there are any small emitters on the lines, you will want to remove them to avoid plugging. When flushing, run the water until it is clear for several minutes. Watch the PSI gauges to see the starting point. It will generally drop 4 to 5 pounds in 5 days. Repeat this cycle about once per quarter.

Once a line is cleaned, it is beneficial to continue using the Activated EM•1 as part of your regular nutrient program as it will keep the lines clean. Usually only during the first year is a line cleaning program required.

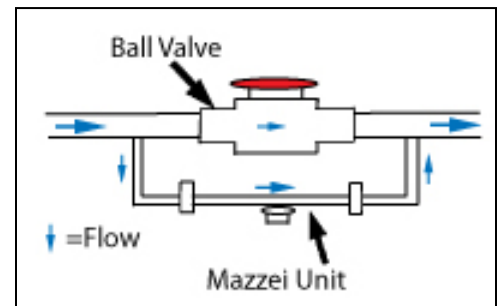
A similar treatment can be done for wells where the Activated EM•1 is applied at a rate of 1 part Activated EM•1 per 1000 parts water in the volume of the well. Pour down the well and let sit for at least three weeks to a month.

APPENDIX 8: IRRIGATION SYSTEMS

Irrigation Systems

No Fumigation

Activated EM•1 can be injected into irrigation devices by a pump or Mazzei® injector (pictured right) unit. With Activated EM•1, we recommend applying 60-80 gallons per acre per growing year (if continuous cropping and no fumigation is done) in the soil for high dollar crops and as little as 10 gallons per acre for low dollar crops such as corn, soybean, wheat, etc.



Cleaning lines (drip tape, emitters, center pivot systems)

Stop using bleach or sulfuric acid. They damage crops, biology of the soil and corrode equipment.

Inject 5 gallons per acre to fill lines. Shut off system and let material sit in lines up to 5 days. Flush lines with fresh water. Repeat 3-5 times per year depending on how hard the water is and how much scale and gunk is in the lines. Use pressure readings as indicators of when to clean the lines.

Fumigation

If fumigation is being done (K-pam, Methyl bromide, T-pam, etc), do not apply the Activated EM•1 until the kill time is almost complete (30 or 60 days). Between 1 and 7 days prior the kill time end, apply the Activated EM•1 through the irrigation system. For the first inoculation, apply a heavy dose of 5-10 gallons per acre to ensure establishment of the beneficial microbe populations. If the soil is continuously cropped or in rotation and re-fumigated between crop cycles, apply with suggested rates per crop cycle as the fumigant will kill the populations of microbes from the Activated EM•1. If the soil is not fumigated for at least one year, then use 60-80 gallons per acre per year to calculate the amount of Activated EM•1 needed.

Contact your local supplier: