

THE IMPACT OF EFFECTIVE MICROORGANISMS (EM) IN VARIOUS FARMING SYSTEMS

This is a detailed document, dated April 2001, presenting information on the experience with Effective Microorganisms (EM) in Auroville's agriculture systems and its impact observed during the last two years. The knowledge has been gathered from organic farmers, local cultivators and researchers.

*The text is from a presentation given in **Thailand**, during an international workshop on E.M. technology programme sponsored by the APNAN (the Asian Pacific Nature Agriculture Network). A similar presentation will take place at the 7th International Conference in Nature Farming **in New Zealand**, January 2002. In the same year the author of this, Margarita Correa, will give an APNAN sponsored training course in E.M. technology and Environmental Solutions in Vietnam.*

Also courses, seminars, workshops and lectures in E.M. and E.M. technology are given in all states of India.

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Introduction

Auroville International Township (**longitude 79 54', latitude 12 North**) is located in Villipuram district of Tamil Nadu on the Coromandel Coast of southern India. It is included in the sub-humid tropics with arid tendencies. The area defined for the township is a plateau region with its maximum elevation of 32 mtr, located in the Matrimandir area. The land slopes away from this point to the coast and to heavier alluvial soils to the West. The annual rainfall average is 1.200 mm. mainly from the SW monsoon (June to September) and NE monsoon (November to December) with a dry period of approximately 6 months. The average maximum temperature is 37.2C and the average minimum temperature is 20C.

Auroville was founded by the Mother of the Sri Aurobindo's ashram in 1968 and is dedicated to the realisation of human unity.

In Auroville the agriculture systems have evolved an ideology based on collective participation, spirituality and appropriate technology.

Of the total area of about 3.000 acres only 356 acres are devoted to agriculture and approximately 158 acres are irrigated, while the rest supports dryland fields, orchards and timber crops.

Much of Auroville's soils are very poor; pH 5.8-6.2, very low NPK and micronutrients, low organic matter, poor water holding capacity. The soils are also very compacted. A primary focus has been research into natural soil fertility enhancement.

Agricultural experiments in Auroville are a synthesis of many different methods, such as Biodynamics, Permaculture, Organic farming, Effective Microorganisms (EM), Vermiculture, etc, and of progressive technologies for more conscientious water and energy use in irrigation, involving windmills, solar pumps, rainwater harvesting, drip and sprinkler systems.

The present paper presents information on the experiences with Effective Microorganisms (EM) in Auroville's agriculture systems and its impact in the last one-and-a-half years. The knowledge has been gathered from people such as organic farmers, local cultivators and researchers. Most of the agricultural farms in AV are using EM but today I will be only presenting three of them; AuroAnnam, Discipline and Annapurna. The animal husbandry and livestock program is running in the main dairy farms; Annapurna, Discipline, Gratitude, Siddharta Farm, and La Ferme Cheese (cheese factory), which includes a total of about 40 cows and calves.

Main Auroville farms under EM program

AuroAnnam: This farm is a part of an overall strategy for the promotion of organic and sustainable farming in Auroville. The focus is on cashew cultivation and also includes cashew farmers from the nearby region. Margarita (Colombian) is AuroAnnam's manager and Lucas (German) is AuroAnnam's steward. The total area of the farm is 14 acres, of sandy loam soil texture of which 4 acres have been under cashew for the past 30 years. There are also 72 coconut palms. Previously some of the land had been used for irrigated cultivation of soya, peanuts, gram and cow fodder, but this had become economically unsustainable. Later, an additional six acres were put under cashew (total today 639 cashew trees). Flood irrigation has been drastically reduced.

Heavy mulching of the coconut palms and the use of cover crops like *Stylosanthes Hamata* (Stylo) will also allow a drastic reduction in irrigation requirements. Instead of flood irrigation, we are planning to use micro sprinklers, and the areas already under irrigation, will be more intensively cultivated with various fruits and vegetables. A few cows will be introduced to achieve an optimum ratio between acreage and cattle, to decrease the need for outside purchases of organic manure, and to provide urine for the preparation of bio pesticides. In the open fields, mainly fodder crops (Elephant grass, Guinea grass and *Centrosema pubescens*) will be grown.

Many people, mainly from Europe and India, visit Auroville throughout the year. Auroville is a kind of laboratory for different workshops; architecture, organic farming, sustainable agriculture, city planning, seed bank, renewable energy, etc. These visitors who visit AuroAnnam farm all come into contact with EM Technology. Students from different universities in the USA, France, Holland and Germany have had internships in AuroAnnam farm and there they learn about EM Technology.

Lucas is in contact with Indian NGOs working in the field of sustainable agriculture, and Margarita maintains links with Auroville farmers practicing different farming systems.

Discipline farm: Was started in 1968. The early work consisted of intensive soil building using compost and mulches. This farm consists of 26 acres of land; they are growing fruits (coconut, avocado, tamarind, papaya, pineapple, banana, pomegranate, guava, chiku and citrus: lime, grapefruit, tangerine), cow fodder, and vegetables (sweet potatoes, salad, spinach, bottle gourd). These are all linked to an extensive drip system and solar pump set. 5.5 acres are dryland, mainly mango orchard. The farm annually grows monsoon-fed red rice, and occasionally other field crops like millets and sesame. There is a dairy of 8 cows and 4 heifers.

Annapurna: Has 135 acres of land, and is the largest, but is still only partly developed. It is located approximately 10 km. from the Auroville city center, and has heavy black cotton soil. This farm was started in 1987 and grows mostly dry land crops such as millet, oilseeds, rice paddy and pulses, and is involved in a conservation program of indigenous genetic resources. In the monsoon time wetland rice is grown. There is a dairy of 9 cows.

Farming Systems

Leaf litter & organic waste

The first settlers of Auroville found barren wasteland devoid of topsoil, organic matter and plant life. Many settlements were started by drilling a well, putting up protective fencing, and then planting trees and watering them. Climatic conditions are such that development of biomass is abundant wherever land is fenced against stray cattle and protected against inconsiderate exploitation. Composting of leaf litter and organic waste is therefore fairly common in Auroville.

Earthworms

In his Treatise on Microbiology of the Soil (Dunod Publ.Paris 1958) Pochon, of the Institute Pasteur, gives various experimental results. The earthworms increase the quantity of lime in the soil. Their glands excrete carbonate of calcium (CaCO_3). Compared to the surrounding soil, the rejected excrements are five times richer in nitrogen, two times richer in calcium, two-and-a-half times richer in magnesium, seven times richer in phosphorus, and eleven times richer in potassium.

Composting with earthworms or vermicomposting, was introduced in Auroville in the late eighties. It can be mentioned that every good aerobic compost heap harbours earthworms, but vermicomposting is set up in such a way that the worms can multiply optimally and do thorough processing of all compostable matter. The end product is a compost of ideal constitution and structure.

Another useful and valuable product of vermicompost is vermiwash, which is said to have growth-promoting and pest-repelling properties. In order to harvest vermiwash, the vermiculture is handled slightly differently.

Biodynamic (BD)

Since 1997 biodynamic (BD) preparations made in south India have become available to Auroville farmers and gardeners. Annapurna farm and AuroAnnam farm have been the most active in their use.

The BD compost preparations are made from various plants in contact with animal parts, and undergo an elaborate processing before they can be used. The preparations are put into the heap or windrow when it is completely built up and sealed with a skin of plant material (e.g. coir fibres or cow dung slurry). They ensure an extremely thorough decomposition of the compostable matter and an end product of highest quality. Proper build-up, aeration, moistening, and at least one turning are required, as for any other aerobic compost.

Biomass

Because of the labour intensive nature of composting, (mainly the gathering and transporting of materials), some farms try to save time by direct use of biomass on the fields i.e. by mulching and green manuring.

The use of biomass for energy production is being explored all over the world, In the future; we may also do some experiments with such techniques (e.g. the recovery of gas from a compost heap).

Composting of sewage sludge has been done in Auroville only on a very limited scale, and will have to be developed further if we want to be able to handle and end-process it.

Effective Microorganisms (EM)

EM Technology is the use of a liquid culture of Effective Microorganisms. EM Technology was introduced into Auroville's farms in October 1999. It was first used in agriculture through spraying, and then with EM compost and Bokashi. Later EM5 and Fermented Plant Extract (FPE) in combination were used for Pest Management.

It was next introduced for animal husbandry, mainly for sick cows (wounds, legs problems, flies, larvae, fungus, mastitis, diarrhea, skin problems, injuries, and ticks).

Today EM is widely used in the cultivation of crops, vegetables and animal husbandry. It is either sprayed and used in composting, or to make Bokashi. It is also used as EM5 and FPE. The main materials used to make compost are leaf litter, coconut leaves, banana trunks and banana leaves, charcoal, kitchen waste, cow dung, horse dung, sawdust, chicken manure, waste flowers, bonemeal and ash.

Auroville's Bokashi is prepared with the following ingredients:

- Oil Cake..... 2.29%
 - Broken rice.....22.94%
 - Rice bran..... 53.54%
 - Green gram.....5.62%
 - Black gram..... 7.50%
 - Millets..... . 3.06%
 - Horse gram.....3.06%
 - Salt..... 1.99%
- 100%
- Organic jaggery (molasses)
 - EM extended solution
 - Water

After using EM Technology in Auroville's farms for 1.5 years, we have achieved the following results:

Agriculture

Compost:

- Compost can be prepared in as fast as 3 weeks, compared to a minimum of 3 months using conventional methods.
- The compost is of very good quality. It has a good texture and a pleasant odour.
- All waste organic materials in the farm can be used.
- Because compost is easy to make with EM there is no more need to buy garbage, always infested with pathogens, from the city municipality.



Margarita showing various kinds of E.M. compost

Field crops:

- In peanut crops, the biomass increased by 34%
- In peanut crops, the density (plant number/square metre) increased by 25%.

- In peanut crops, the yield increased by 43%.
- In soybeans crops, the biomass increased by 40%.
- In soybeans crops, the density increased by 69%.
- In groundnut, black gram and green gram crops, the biomass increased 72%.
- In groundnut, black gram and green gram crops the density increased 18%.
- Rice yields increases in the first year of application.
- Maize and sugar cane grew taller by 33%.

Fruits:

- For papayas the income increased by 150%.
- Cashew yields increased by 47.5%.
- Mango yields increased by 15%
- Guava yields doubled.
- Fruit orchards were much healthier.



Organic cashew growing under E.M. technology

Others:

- Generally, all flower gardens, trees, vegetables, grew faster and were healthier.
- Bigger sizes were recorded in sweet potatoes and tapioca.
- In seedlings, increment in growth doubled, producing very healthy plants.
- Farm production increased.
- Products of higher quality are generally associated with more labour, but with EM Technology the labor involved is low when it has been standardized.
- Farmers increased their incomes, by running their farms with lower expenses.
- There was less consumption of water in irrigation systems.
- The farm workers attitudes towards EM have been very positive, as they have realised it can be 100% organic.



Mulching system and E.M. technology applied in Discipline's vegetable garden



Saving electricity with a combination of charcoal and E.M. in the irrigation system



Big size Tapioca cultivated with E.M.

Pest Management with EM5 and FPE

- Black sigatoka in bananas is controlled.
- Eriophyd mite in coconuts is controlled.
- Rhinoceros beetle in coconuts is controlled.
- Tea mosquito bugs, nut borers, leaf miners, webber, leaf folders and flower thrips in cashews are controlled.
- Caterpillars and bugs in vegetables are controlled.
- With cow urine included the fungus attack in guavas is eliminated.
- With a preparation of fish meal and EM, fungus in mangoes is controlled
- In tomatoes and brinjal, bacteria wilt is controlled.
- In orchids, virus-bacteria and fungus are controlled.
- The Matrimandir gardens are visited every day by thousands of people. The rose gardens are under a special program of mulching, ash, EM and FPE.
- The most dramatic results were in citrus species affected by Gummosis (*Diplodia natalensis*); used together with copper sulfate, all of them recovered from very bad damage.
- Fruit trees affected by *Phytophthora nicotianae* and Anthracnose (*Colletotrichum gloeosporioides*), (two of the most virulent pathogens) are controlled.
- During monsoon, fungus attack on human feet is eradicated.



Coconut with pest before E.M. treatment



Healthy coconut, after treatment (one sees the helper applying a specially for coconut designed E.M. preparation)



E.M. treatment against Gummosis (*Diplodia natalensis*), one of the most dangerous fungi in the world specific to citrus trees



In the Matrimandir Gardens the rose beds are regularly mulched with dried leaves sprayed with E.M.

**** We are using:**

- FPE for all fungus problems.
- EM + EM5 + neem oil against insects.
- EM + EM5 + FPE for controlling all insects and diseases.



F.P.E., Fermented Plant Extract for pest control

However, the most successful result with EM has been in mulching systems. This practice has reduced the amount of compost (ten times in cow grass field), retained moisture, reduced consumption of water and saved electricity. It creates a micro system around the plants and trees providing them with micro nutrients, and it helps to control bacteria and fungus.

Animal husbandry with EM

- Animals with injuries, infections (except inter-uterine) and mastitis have been cured. For these no allopathic medicines are required even antibiotics.
- Veterinary intervention has been reduced almost to zero.
- Calves are growing faster and are very healthy.
- There has been a considerable reduction of flies around and on livestock.
- The living spaces of livestock and poultry smell good.
- Overall health is very much improved.
- The quality of milk and sub-products of the milk (cheese, yogurt, cream) has vastly improved.
- Milk production has increased between 0.5 and 1 litre per cow per day.
- Previously, the running cost of a cow was US\$100 per year, now it has been reduced to US\$10 per year.
- Cows are much quieter and peaceful, and don't fight.



One of the many cows in Auroville, reared under an E.M. programme

Experiences with EM and other farming systems

In Auroville over the past thirty years, many experiments have been conducted with natural farming. At this point in time, there are several organic farming techniques being used. This most recent step has been to try and find solutions for problems with soil and crops and animal husbandry when techniques are mixed.

For the last six months, AuroAnnam farm has been running experiments for cashew crops, mainly with a combination of EM - BD and vermitechnology.

Here some comments on this subject under research.

BD and EM

The strongest objection for mixing BioDynamic preparations with other technologies is coming from those using biodynamic practices. It is not my intention to evaluate the advantages and

disadvantages of each system. My idea is to try combining both of them. Both offer natural and eco-friendly input.

"What happens when they are combined?"

The first experiments are on a small scale (some cashew trees). It is to find evidence of any damage or negative results. BD preps being used are correlated with the biodynamic calendar for the influence of the proper constellations.

Following E. Pfeiffer's theories two experiments are being carried out:

1.- EM + 500 + 503 + 505.

2.- EM + 500 + 502 + 507.

(BD 500 means cow horn manure.

BD 503 means Chamomile (*Matricaria chamomilla*). Ca & N.

BD 505 means Oak bark (*Quercus alba*). Ca.

BD 502 means Yarrow (*Achillea millefolium*). K & S.

BD 507 means Valerian (*Valeriana officinalis*). P.)

Now, when the harvest time has already started, the plot with experiment 1 is giving presently more yield than experiment 2.

However experiment 2 is giving better results for pest control.

The size of the trees and colour of the leaves also have big differences, the trees in experiment 1 looking much better.

It's by far too early to draw conclusions, and we will run the experiments for a longer period before expressing definite results. ***After the first harvest (June 2001), we can proudly tell that experiment # 1 gave a very high yield: compared with experiment # 2 the different was 612 % more..!***

Vermiwash and EM

The combination of EM and vermiwash produces a product with high anti-termite properties. Many trees with colossal attacks of termites and big colonies in the ground were 100% controlled and eradicated.

The queen is an extremely efficient reproductive machine, laying more than thirty thousand eggs per day. The feeding habits of termites are varied and interesting. Some species have developed a peculiar kind of agriculture. Their fungus crops are grown on a type of spongy comb-like structure. These strange structures, called fungus gardens, are kept in special chambers. It is known that termite colonies thrive in acidic conditions.

It has been mentioned that earthworms increase the quantity of lime in the soil. Their glands excrete carbonate of calcium (CaCO_3). They also produce a liquid (vermiwash), which is alkaline. This property of vermiwash changes the pH in the nest, which is detrimental to the termites. With this, the colony can be controlled. The EM with its beneficial micro organisms destroys the fungus gardens, cutting the livelihood of the queen and the colony. The result is that the termites are controlled and eradicated.



Margarita at a Vermiwash unit

The combination of EM and vermiwash enhances the chemical properties of the soil (e.g. N, P, K, Ca, and Mg are incremented). This mix used with 10% of cow urine produces an excellent insecticide.

Both are natural and eco-friendly systems, cheap and easy to use.

Conclusion

EM Technology has shown beneficial effects on many aspects of the environment, agricultural crops and animal husbandry. EM leads to the improvement of soil nutritional status, physical, chemical and microbiological properties, helping crops to grow healthy and strong. There is no more need to use chemicals and pesticides. The same holds for animal husbandry. It helps the farmer maintain an eco-friendly system, minimising the damage to natural cycles.

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