EFFECTIVE MICROORGANISMS

Av Singh

There are few agricultural inputs that can transcend the boundaries of various forms of agriculture, yet many conventional, organic and biodynamic farmers espouse the merits of a fermented cocktail generically referred to as EM.

Effective micororganisms (EM) were discovered and developed by a Japanese agronomist Teruo Higa. Dr. Higa's concept is loosely based on a theory that there are three groups of microorganisms in the soil, namely 1) positive (regeneration); 2) negative (decomposition, degeneration); and 3) opportunists. According to the concept, the ratio of positive to negative is critical in determining whether the soil will be regenerating or degenerating because the opportunists will follow the predominant trend. Dr. Higa formed the concept by simply observing soils in nature. He classified soils into four categories based on the activities and functions of the predominant microorganisms, but notes that most soils are a composite of the four classes:

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1. Disease-inducing soils contain pathogenic microorganisms, such as *Fusarium,* which often comprise a significant proportion of the microbial population (up to twenty percent). Dr. Higa concludes that ninety percent of agricultural land worldwide can be classified as having disease-inducing soils and notes that in these soils the addition of high-N organic matter (i.e. fresh manure) leads to incomplete oxidation and results in malodorous and plant toxic substances. Moreover, these soils are characterized by having poor physical properties (i.e. compaction) and many plant nutrients are immobilized into unavailable forms.

2. Disease-suppressive soils are those dominated by antagonistic microbes (e.g. *Penicillium, Trichoderma, Aspergillus* and *Streptomyces*) that produce copious amounts of antibiotics. The microflora in these soils is generally aerobic (similar to compost tea) and the soil is characterized by excellent water retention and infiltration and generates a pleasant earthy odour during organic matter decomposition.

3. Soils that perform beneficial fermentations including the breakdown of complex organic molecules into simple organic molecules and inorganic nutrients such as amino acids, vitamins and antioxidants (all of which contribute to enhanced plant growth). These soils are generally characterized with a pleasant fermentative odour and have favourable soil physical properties. Moreover, despite being dominant with anaerobic microbes there are few pathogenic fungi or bacteria and the production of methane, ammonia and carbon dioxide are minimized.

4. Soils that contain significant populations of microorganisms that fix atmospheric nitrogen and carbon dioxide into amino acids, carbohydrates, and proteins. Most of us are familiar with *Rhizobium* and their symbiotic relationship with legumes to fix nitrogen, however, *Phycomycetes* (fungi that look like algae) and blue-green algae can fix nitrogen as well. These soils can maintain their fertility with only minor additions of organic matter.

From the above, it is obvious that the idealized soil would perform beneficial fermentation (soil #3) and with disease-suppressive abilities (soil #4). Dr. Higa developed EM to transform disease-inducing

soils into highly productive agricultural soil. EM contain over eighty selected species of microorganisms including predominant populations of lactic acid bacteria and yeasts, and smaller populations of photo-synthetic, N-fixing bacteria and actinomycetes.

EM technology differs significantly from that of aerobic compost tea, despite both having benefits to soil life. In contrast with compost tea, EM are cultured and produced under anaerobic fermentation and generally the microorganisms are of a known species and quantity. As a result, EM are the most studied microbial inoculants with overwhelmingly positive results (in terms of crop yield, disease suppression and pest control).

EM are used in agriculture via a number of methods. EM are inoculated into the rhizosphere (around the root) with the intention to regenerate soil, increase yields, or improve nutrient content of the crop. EM have also been used in livestock as a feed additive in poultry and have been added to ruminant feed to increase digestibility. EM have been used to spray on broiler litter, cattle and sheep bedding to help remove odours as well as tie up nutrients. Similarly, EM have been used extensively in composting as a catalyst for decomposition.

EM Bokashi is starter made from a mix of fermented organic waste, molasses0 and wheat bran. It contains large populations of EM which are dormant and when mixed with organic waste such as kitchen scraps or manure, the EM are activated and proliferate to produce rich compost full of nutrients and antioxidants. As well, Bokashi works extremely well when added to the finishing phase of aerobic compost piles.

How to make Bokashi

Ingredients:

100 lb wheat bran
12 L warm water
240 ml molasses
240 ml EM

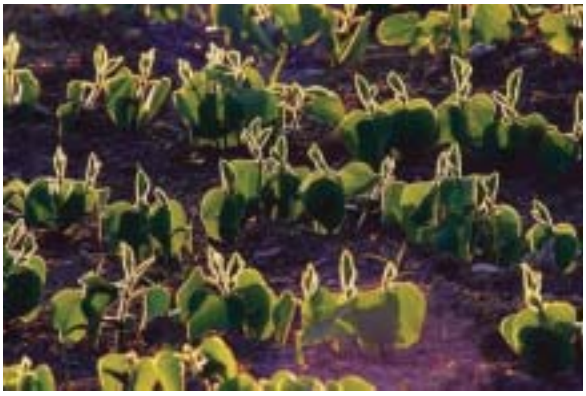
Prepare a diluted solution of EM, molasses and water at a ratio of 1:1:100.

Mix well and pour over bran and continue to mix until the final product is about 30% moisture

Place the material in a barrel and place a lid on the container to create an anaerobic condition.

Allow 3–5 weeks in the summer and 7–10 weeks in the winter and the bokashi should have a sweet and sour fermented smell (but not putrid).

The pH of the bokashi should be about 5. The material should be used immediately.



EM increased seed yield in soybeans.

The literature on EM is overwhelmingly favourable and includes many peer-reviewed publications that demonstrated a wide-spectrum of benefits including: increased seed protein, crude fat, and seed yield in soybeans; increased N uptake by cowpea from crop residues; control of *Sclerotinia* in turfgrass; increased yields in banana, oranges, peanuts, papayas, mangos; efficiency of compost production from three months to three weeks, etc. From this superficial scan of the literature, EM appear to have been successful in agronomic applications worldwide, but data are lacking from Canadian experiences. For those growers using EM technology in their agricultural practices, I would love to hear your testimony on the products you used.

Av Singh, PhD, PAg, is the Organic and Rural Infrastructure Specialist with AgraPoint in Nova Scotia and is available for comment or question at 902-896-0277 or at a.singh@agrapoint.ca.

For details on propagating EM using the "Bokashi method," see www.cityfarmer.org/bokashi.html.