

An introduction to Asian Natural Farming



A Local and Microbial Approach to Agriculture

**ECHO Asia Regional Impact Center
Chiang Mai, Thailand**

Natural Farming

Natural farming is an integrated approach to farming which includes management of the following in various combinations:

- Soil and plant microbes
- Plant hormones
- Larger soil flora and fauna, i.e., earthworms
- Soil organic matter
- Garden, fruit and field crops
- Livestock
- Water, fish and other aquatic animals

The basis of the natural farming is healthy soil.



Natural Farming Basics

Natural Farming Topics

- Effective Microorganisms (EM)
- Indigenous microorganisms (IMO)
- Fermented crop production products (Bio-Solutions)
- Fermented livestock feeds
- Fertilizers made from livestock bedding
- Vermiculture
- Carbonized rice husks
- Household bokashi
- Institutional bokashi
- Farm bokashi
- Wood Vinegar

Natural Farming Basics

Natural Farming – Microbial Level

Natural farming, on the microbial level, generally makes use of cultured mixtures of microorganisms consisting mainly of:

- lactic acid bacteria
- purple bacteria
- yeast

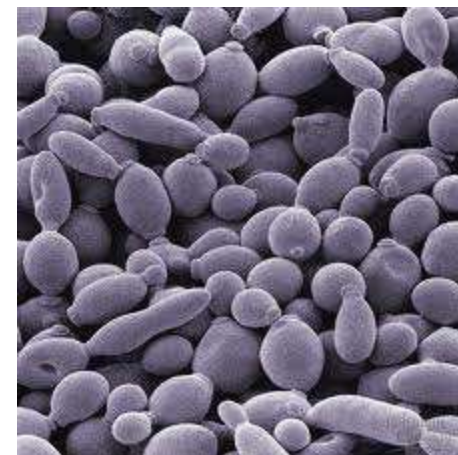
These beneficial bacterial are managed and introduced within crop, livestock and aquaculture systems to enhance overall health and production.



Lactic Acid



Purple Bacteria



Yeast

Natural Farming Basics

Natural Farming Benefits at Soil Level

- Improvement of the **biodiversity** and **population** of **soil flora and fauna** by adding/supplementing aerobic and anaerobic microbes that **degrade organic matter** which in turn release **amino acids, vitamins** and **enzymes** for the benefit of crops.
- Enabling the **delivery of plant nutrients** (by direct and indirect means) to the soil.
- Supplying **organic matter** from various natural fertilizers, composts and degraded plant/animal residues which ultimately improves and maintains **soil structure**.



Natural Farming Basics

Direct Natural Farming Benefits for Plants

- Boosts levels of **beneficial leaf surface microbes** such as **lactic acid** and **yeast** which reportedly increases the ability of plants to **defend against disease**.
- Supplements **availability** of **proteins, amino acids, vitamins, secondary nutrients** and beneficial plant **hormones** that stimulate improved growth and production.



Natural Farming Basics

Direct Natural Farming Benefits for Livestock

- Enables the production of **fermented feeds**.
- Maintains comfortable **animal bedding** that can later be used as organic fertilizer.
- **Reduces odors** in animal production areas.



Natural Farming Basics

Natural Farming – Which Kind?

Effective Microorganisms

EM was developed by Japanese horticulturist Teruo Higa, from the University of the Ryukyus in Okinawa Prefecture, Okinawa, Japan. The technology is now a trademarked term now commonly used to describe a proprietary blend of 3 or more types of predominantly anaerobic organisms that was originally marketed as EM-1 Microbial Inoculant but is now marketed by a plethora of companies under various names, each with their own proprietary blend (http://en.wikipedia.org/wiki/Effective_microorganism).



Effective Microorganisms

Natural Farming- Which Kind?

Korean Professor, Han Kyu Cho, is considered the father of **Korean Natural Farming**. Like EM-based natural farming, KNF emphasizes the management and use of microbes to enhance the environment that they are released into. However, Cho and his associates, focus upon the use of **indigenous microorganisms** as opposed to commercial EM.

Professor Cho has preached the gospel of NF throughout the Asia/Pacific and has attracted considerable interest in the approach.

With widespread interest and adoption throughout the region, depending on the locality, various versions of NF are referred to as Korean Natural Farming, Thai Natural Farming and Asian Natural Farming among others.



“Asian” Natural Farming

EM vs. NF

EM and NF both use stock solutions comprised of lactic acid bacteria, purple bacteria and yeast. And both basic types of solutions are used similarly for various farming applications including:

- compost production
- odor reduction related to livestock production
- stimulation of flower/fruit production

EM solutions are commercially available and expandable for extensive application.



Comparisons and Contrasts

EM vs. NF

Indigenous Microorganisms refer to various homemade solid and liquid cultures of beneficial microbes. To culture beneficial indigenous microbes, these materials are concocted from various local materials such as forest/field plant materials as well as fruit, vegetables and even fish scraps and snails. Therefore, few, outside or purchased inputs are required.



Comparisons and Contrasts

EM/NF Cafeteria Approach is Common

Both EM and NF have staunch advocates and promoters. However, many farmers and gardeners use components of both systems. For instance, NF practitioners might sometimes buy commercial EM out of convenience for use in NF approaches but brew their own IMO products at other times. And often the term, EM, is used to refer to similar approaches, such as NF.

A blended approach



EM/NF Concerns

Broad claims about the potential benefits of EM and NF are often made. However, scientific evidence for many of these is still lacking or inconsistent.

Based on joint EM research, **Higa** and soil USDA soil microbiologist **James F. Parr**, acknowledged “the problem of reproducibility and lack of consistent results.”

They also dismiss the effectiveness of '**silver bullet**' single organism EMs due to the host of uncertainty about the conditions a single microorganism would be effective in. But they cite broader scientific acknowledgment that **multiple microorganisms** in coordination with **good soil management practices** “positively influence soil microorganisms and plant growth and yield.”

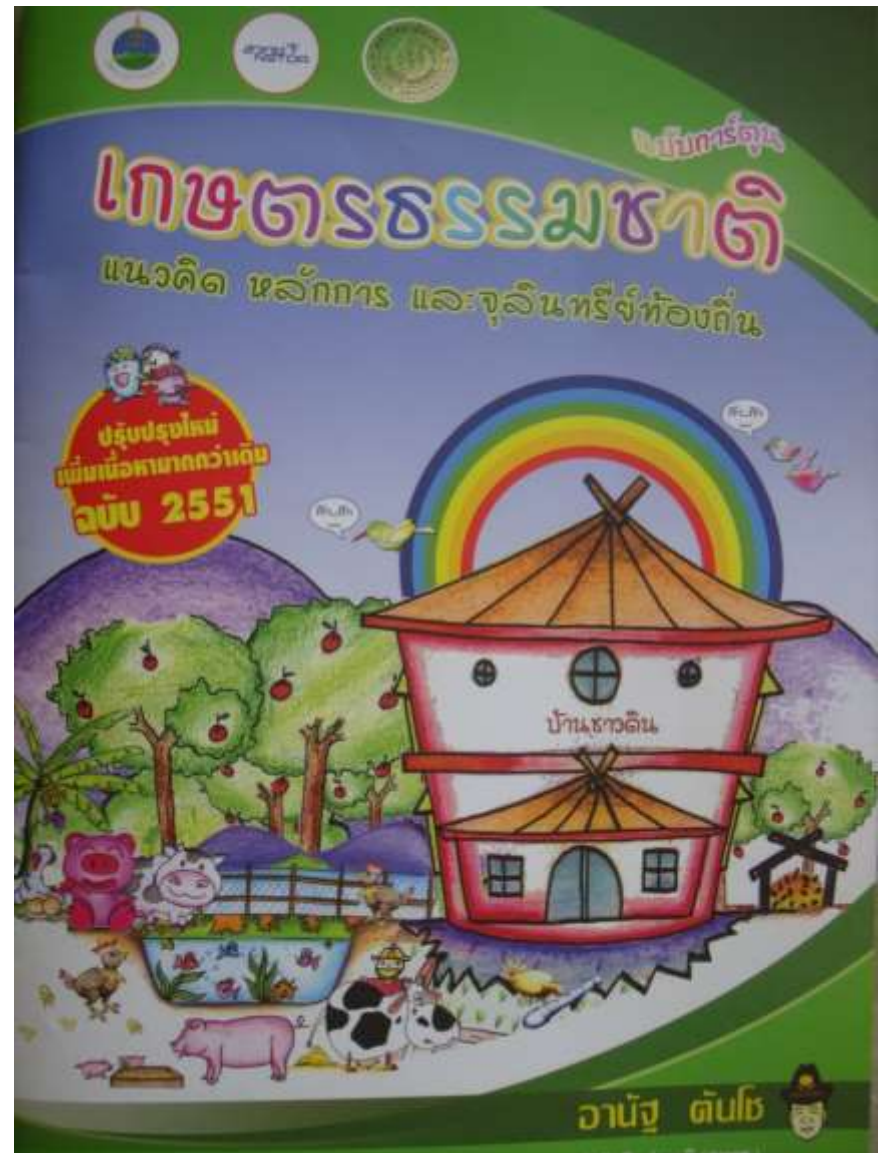


Mae Jo's NF Research and Promotion

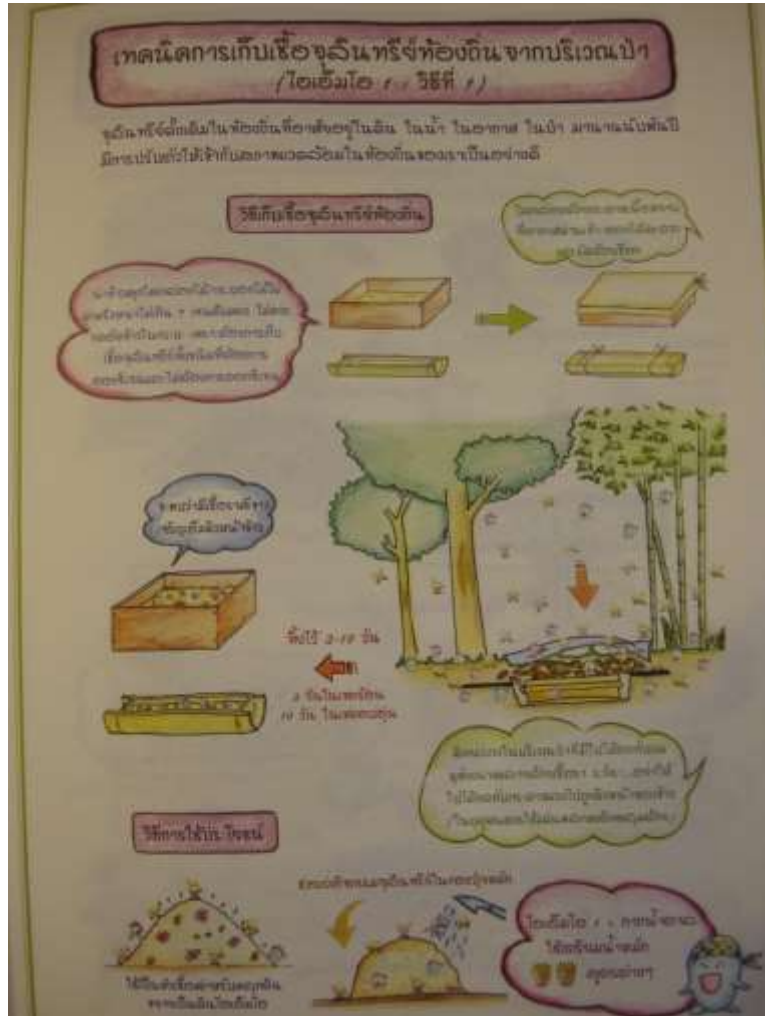
Encouraged by Professor Cho and other advocates of “Thai Natural Farming,” **Dr. Arnat Tancho** of **Mae Jo University** in Chiang Mai has been conducting research on the science of Natural Farming since 2000.

With support from the Thai National Science and Technology Development Agency, Dr. Arnat has produced several Natural Farming publications.

Natural Farming is widely promoted by Thai Government agencies such as the Land Development Department and the Royal Project. With such high exposure, Farmers throughout Thailand and neighboring countries have adopted NF/EM approaches to small-scale farming.



Asian Natural Farming Applications



IMO Method 1 (Forest Source)

IMO Method 1 refers to the procedure of collecting and using microorganisms indigenous to forest settings.

Fill a **wooden box** (or **split bamboo internode**) up to 7 cm long with **steamed rice** (do not compact). Cover the box with **porous paper** tied snugly with a rubber band. Place the covered container into a **shallow hole** in the forest so that leaves can accumulate on top (but without pressing down in contact with the rice).

During the rainy season, protect the box by covering the layer of fallen leaves with a plastic sheet. Leave out for **two to 10 days** depending on the temperature.

When you retrieve the rice from the forest, you should see a **white mold** growing on it. This harvested IMO 1 material (including the old rice) can be mixed with **molasses** (at a 1:1 rate) and fermented in a paper-sealed **ceramic crock** for at least one month.

The resulting fermented IMO material can be used to make various IMO solutions and products. For instance, the fermented IMO product can be **mixed with water** (0.1-0.2%) and sprayed onto **transplanted seedlings** to help them with their establishment.

Another IMO 1 product is called **IMO soil**. It is produced by first mixing the fermented material with water and then applying the solution to new **batches of compost**. The solution helps to increase microbial activity in compost piles, thereby shortening the composting period. The finished IMO 1 compost can then be applied as a culture to **activate a larger batch of IMO soil**. Such IMO soil is recommended for application to areas previously farmed with chemicals but still have soil organic matter rates higher than 4%. This amendment will help **restore microbial balance** and **improve soil structure**.

Asian Natural Farming Applications



Fermented Bio-Solutions

Fermented bio-solutions can be made from various readily available materials such as **fruit**, **vegetables** and even **fish scraps** and **snails**.

Brown sugar or molasses is mixed with these various materials. High sugar concentration reportedly helps **increase osmotic pressure** which causes plant/meat cells to burst and release beneficial **bio-ingredients** (e.g. **hormones** and **nutrients**).

The mixture is placed into **crocks** about **2/3 full**. **Porous paper**, such as newsprint, should be fastened over the mouth of the container. The environment inside the container will be **partially anaerobic**.

Microbes in the mixture also produce enzymes that break down the fruit and meat tissues and release the **beneficial bio-ingredients** from the cells.

Asian Natural Farming Fermented Products



Fermented Green Vegetable Solution

Fresh vegetables and **sugar** are combined and fermented to take advantage of high levels of **plant hormones** in the cells of the plants as well as secondary/supplemental nutrients, lactic acid producing bacteria and yeast.

Vegetable shoots, which are better than lower leaves, should be **harvested in the morning** when microbe and hormone levels are at their highest.

Chop the **vegetables** finely and mix them with **brown sugar (3:1 rate)**. **Supplemental IMO solution** will help culture indigenous microbes.

Fill container about **2/3 full** and press mixture down with stone. Allow to **ferment over 15-20 days**. The finished product should have a “sour” but not smelly odor.

Mix **20-40 ml of the product per 20 liters** of fresh water and apply to crop foliage to **increase the presence and activity of beneficial plant microbes**.

Asian Natural Farming Fermented Products



Fermented Fruit Solution

Fermented fruit solution provides a hormone/enzyme solution which helps **stimulate improved fruit production**.

Ripe, sweet fruit are mixed with **brown sugar** at a **3:1 ratio** and placed in crock (2/3 full).

Allow mixture to ferment for **5-15 days** (depending on temperatures; hotter=shorter).

A **0.1% solution** of the fermented fruit liquid can be applied to young flowering/fruiting crops to assist in **good fruit development**.

Asian Natural Farming Fermented Products



Fermented Fish/Cherry Snail Solution

A solution made from **fermented fish** or **cherry snails** is an effective **nitrogen source** which **stimulates effective microbes** for plants grown in natural farming systems.

Fish scraps or **crushed snails** are placed in earthen or plastic crocks with an **equal part of sugar added on top**.

Minerals and amino acids will break down within **7-10 days**. Add a couple of handfuls of IMO 2 to dissolve fats on the surface of the solution. A “sour” odor will be present when fermentation is finished.

Apply to plants and soil at a rate of **20 mm/20 liters of water (1000 parts)**. Can also be applied to compost to stimulate microbes.

The fish/snail IMO is 1.1% N, 1.12% P, 1.03% K, 1.66% Ca and 0.24% Mg.

Everybody Loves Compost



but....

Composting Is Not Easy



Challenges:

- Finding green and brown materials
- Maintaining proper moisture is an art
- Considerable labor and follow up in keeping the pile aerated



Preparing the natural bedding



Add rice husks...



...and a few pigs.



...local soil and sea salt...

Rice husks, saw dust, dried leaves,
etc. provide the brown material...



...and happy pigs provide the rest

Using Natural Bedding for Other Agricultural Uses



Like other good composts, rich natural bedding is full of plant nutrients. It is beneficial for crop production, resulting in vigorous plants.

After **4 months** of use as livestock bedding, the material can be used as **natural fertilizer**. However, in Thailand, minimum levels of plant nutrients are required in commercial natural fertilizers. As a result, such fertilizer must have been used as bedding for a **minimum of 8 months** (two pig production cycles).

The material can be mixed directly with soil as a crop fertilizer.

After several months...



...a great fertilizer/compost material for gardens,
orchards and fields

Traditional Pig Feeding



Traditionally, pigs have been allowed to forage on their own for food in addition to being fed kitchen waste and whatever else that might be seasonally available (grain, chopped paper mulberry leaves, wild/cultivated vegetables, forage grasses, fruit, etc.)

Finely sliced banana stalk, though offering minimal nutrition, makes up the bulk of traditional pig feed in parts of SE Asia.

Banana stalk, leaves and grains are either soaked to soften or cooked (using fuel and time).

Commercial feeds are usually too expensive to be fed exclusively.

Fermented Pig Feed

Local feed sources are a major means of reducing the cost of raising hogs.

Feed materials that are usually easy to find include **banana stalks, water convolvulus, papaya fruit** and other **vegetables/fruits**. These should be **sliced finely**. Mix fruit/vegetable portion with **4 kg brown sugar** and **1 kg salt**.

Ferment 3-7 days in a covered barrel. Finished silage can be stored/fed over 1 week (lactic acid keeps silage from spoiling). Silage **older than 1 week** is less acidic and will begin to spoil. Spoiled feed has strong alcohol smell and pigs will refuse to eat. However, old feed can be given to **ducks, chickens** and **catfish** or **re-fermented** with fresh materials.

For a **balanced feed**, the fermented portion can be offered along with a supplemental mixed feed comprised of 30 kg red soil, 30 kg cow manure, 120 kg rice bran, 50 kg corn meal, 20 kg soybean residue meal, 5 kg fish meal, 5 kg bone meal and liquid IMO.



No Matter How You Slice it...



Traditional hand slicing of banana stalks is time consuming but still very common

Recently innovated automatic banana slicers get the job done in a fraction of the time

Time to Ferment



Sliced materials are mixed with sugar, salt and IMO solution ...

...packed tightly into barrels and covered ...



... and left to ferment for 3-7 days. The finished product should have a pleasant “fermented” smell.

What Makes Fermented Plant Material Nutritious?



Similar to the production of **digestible bacteria** in the **stomachs of ruminants** (enabling cows to survive off even a diet of rice straw), the fermentation process converts sugars to acids; mainly **lactic**. In the presence of lactic acid, fermentative bacteria that proliferate in the process become a significant **source of protein**.



In addition to fermented feeds, typical upland hog rations include rice bran, fruit, vegetables and portions of commercial feed.

This process offers adequate animal growth/production and considerable feed savings as well as less grain and fuel dependency.

UHDP's Fermented Feed Ration

Everyday, the Upland Holistic Development Project (Thailand) feeds each of its breeding sows the following daily ration (split into morning and evening feedings):

- 4-5 kg of fermented banana
- 600 gm of ground corn
- 600 gm of rice bran
- 400 gm of commercial pellet feed
- 400 gm of dried paper mulberry leaves



UHDP staff report that a 1 grown pig will consume 1 med-large sized banana stalk per week and that a 1 small pig will eat 1 small stalk per week.

How Much Land to Produce Pig Feed? (An Estimate)

- 1 med-large sized stalk a week for each sow equals approx. **4 stalks per month**. That's **48 stalks per sow per year**.
- Recommended planting distance of **2 m (within rows) x 3 (between rows) m**. With 1600 square meters per rai (Thai land unit), that should come out to **266 banana plants established per rai**.
- Too thick? Try **3 x 3 m = 178 plants per rai**.
- If the soil is fairly fertile and moisture is adequate, then according to UHDP's estimates, these 177 to 266 plants established in 1 rai should become an equal number of healthy clumps.
- It is estimated that a **healthy clump** of local banana should produced **6-7 stalks a year**. 6.5×178 is **1,157 stalks per rai per year**. 6.5×266 is **1,729 stalks per rai per year**. According to UHDP's calculations, that ought to produce enough stalks to feed between **24-36 sows per rai per year**.
- Given Murphy's law, bad weather and possibly overly optimistic expectations, perhaps we should lower the estimate to a carrying capacity of **20 sows per year per rai** (1600 square meters).



Don't Forget the Worms



Food waste disposal



Growing market for worms



Demand for vermi-compost and leachate

Benefits of Vermiculture

Carbonized Rice Husks

Uses of Carbonized Rice Husks

- Substrate to organic fertilizer.
- Soil conditioner and ameliorant (a substance added to the soil to improve growing conditions for plant roots).
- Water purifier and waste water filter.
- Base material for making microbial inoculants (IMO and *rhizobia*).
- Pest control agent (silica helps repel snails).
- Can be used to make charcoal.
- Deodorizer/odor suppressant .

Rice Technology Bulletin (PhilRice)



Open-Type Carbonizer



Carbonized rice husks

Household Bokashi



Household bokashi is a method of intensive composting which has application in both home and institutional settings, particularly in the **management of kitchen waste**. Food scraps and other kitchen wastes are placed into a container which can be sealed with an air tight lid. These scraps are then inoculated with a **bokashi/EM mix**.

This mix usually takes the form of a **carrier**, such as rice hulls, wheat bran or saw dust, that has been inoculated with **composting micro-organisms**, often derived from EM (e.g. natural lactic acid bacteria, yeast, and phototrophic bacteria).



Under mostly **anaerobic conditions**, these microbes expand throughout the kitchen scraps, fermenting and accelerating breakdown of the organic matter. The user would place **alternating layers** of food scraps and bokashi mix until the container is full. If done correctly, there are no putrid odors.

The bokashi is allowed to ferment within the airtight container for **two weeks** before burial. After weeks of burial, the bokashi will break down into **soil-like** compost /soil amendment.

Besides providing a never-ending supply of soil conditioner, household /institutional waste is decreased with broader benefits for the environment.

Source: Wikipedia (of course)

http://en.wikipedia.org/wiki/Bokashi_composting#Bokashi_compost



Household Bokashi



Ingredients for a small batch of bokashi carrier (5 kg):

- 5 kg of rice bran
- 20 ml EM•1®
- 20 ml Molasses
- 2 liters of water

Procedure:

1. Mix molasses into the 2 liters of the water to dissolve and then mix in the EM•1®. Allow the culture solution to set for 5-7 days in a plastic bottle away from direct sunlight.
2. Mix the liquid thoroughly into the bran. You can do this in a bucket .
3. To check moisture content, squeeze some of the bran into a ball. If it holds shape and no extra liquid comes out then it contains the right amount of correct moisture.
4. If using a bag to store the starter mix, tie the bag tightly, squeezing out excess air. If using a container, press down the mixture and cover container tightly.
5. Place mixture somewhere warm and out of the way. Let it ferment for a minimum of two weeks. Longer is fine.
6. When fermentation is complete, you may notice some white mold on/in the bokashi. This is good. You can use the material as is, or dry for long-term storage. Black or green mold means some air got into the container or it was too moist and is undesirable. Do not use the starter mix if it has black or green mold in it.
7. Keep airtight during storage, whether dry or wet.



Household Bokashi

Now that we have the starter mix then we can use it in our kitchen composting system.

Using a plastic bucket with an air-tight lid, begin by laying a layer of newspaper or cardboard on the bottom. This helps to soak up excess liquid. Then place a handful of fermented starter mix in the bottom of the bucket.

Begin layering kitchen waste (as long as it isn't rotten) inside the bucket and scatter a thin layer of fermented starter mix on top of the waste. Continue layering until the bucket is full. Push the food scraps down inside the bucket to compact them every once in a while.



Once the bucket is full then set it aside and allow it to ferment with the lid tightly closed for two weeks. Afterward, bury the bokashi in holes or trenches in the garden under at least 15 cm of soil. After some weeks (depending on conditions), the fermented material will convert into a composted, soil-like material. When the composting process is done then the former food waste should not have any bad odor. It will add nutrients and microbes to the soil and contribute to improved soil structure.

Institutional Bokashi



A Natural Farming System for Sustainable Agriculture in the Tropics
Keith Mikkelson

Farm Bokashi – ARI recipe*



- ARI bokashi is a fermented fertilizer made from local resources in two weeks or less.
- Fermentation turns raw materials (manure, rice bran, etc.) into highly nutritious compost.
- Comprised of 70% organic matter and 30% soil.
- ARI bokashi has highly concentrated nutrients.
- The bokashi is ideal for applying around the roots of new seedlings as they are transplanted.
- Many useful organisms will live close to the crop roots and play a role of interaction between the plants and soil.

Farm Bokashi – ARI recipe



Materials

- Dried manure (50-60%)
- Rice bran (10-20%): food for microbes
- rice husk charcoal (5-20%): harbors microbes
- Soil from the forest (20-30%)
- IMO collected from the forest (a little)
- Fermented plant juice (a little) to help with the fermentation process

Preparation and storage

- Mix ingredients well under a sheltered area.
- Add water to 50% concentration (enough that when a handful of bokashi is squeezed that the material will stick together but no water will drip from fingers).
- Cover the mixed bokashi with rice straw or grass to help retain moisture and heat.
- Turn the mix each time it reaches 60 degrees C (usually once a day).
- Maintain moisture at 50%.
- Bokashi ready to use when temperature of material is the same as surrounding air and the manure can no longer be smelled.
- Can be dried and stored 6 weeks to one year.

Wood Vinegar

Charcoal production in 200-liter horizontal drum kilns



Two kilns in operation



Common, low-quality wood sources (e.g. bamboo)



Finished bamboo charcoal

Collection of Wood Vinegar



Approximately 30 minutes to 1 hour after having stopped feeding fuel into the kiln, if the smoke is yellowish and acrid, close off most of the outer vent.



Extend a hollow green bamboo pole (far end elevated to 45°) from the flue pipe. **Wood vinegar** can be collected with containers fastened underneath one to two holes, approximately 2 cm wide, drilled into the bamboo pole roughly 30 cm from the connection with the flue pipe.

- Thailand's Department of Agriculture reports that if wood is burned for 12 to 15 hours (or less, depending on the type and size of wood) in a 200-liter oil drum kiln, that 2 to 7 liters of raw wood vinegar can be produced.
- Leave the raw wood vinegar sealed in a bottle for approximately three months to allow sediments to settle.
- After settling, the useable layer of wood vinegar (second from the top) can be harvested with a syringe or siphon after first sucking out the light oil layer on top.

Composition of Wood Vinegar



Wood vinegar is not a microbial product. However, it is natural and derived from locally available materials.

The product approximately 200 components. These include:

- Alcohol (methanol, butanol, amylalcohol)
- Acid (acetic, formic, propiionic, valeric)
- Neutral substances such as formaldehyde, acetone, furfural, valerolactone
- Phenols (syringol, cresol, phenol)
- Basic substances such as ammonia, methyl amine and pyridine

Uses of Wood Vinegar*

- **Repel nematodes** – Tomatoes, 1:500 (apply to the base of plants); strawberries, 1:200 (apply to the base of plants); and black pepper vines, 1:1500 (apply in place of water).
- **Repel insect pests** - Cabbage and Chinese cabbage, 1:1500 (apply in place of water); corn 1:300 (spray onto leaves).
- **Control of fungal diseases** – Tomato and cucumber, 1:200 (spray onto leaves).
- **Control of root rot** – Tomato and cucumber, 1:200 (apply to the base of plants).
- **Reduce incidence of chili pepper flowers aborting** – 1:300 (spray onto leaves).
- **Improve flavor of sweet fruits and stimulate development of crops.** Mix solution rates of 1:500 to 1:1000. Wood vinegar prevents excessive nitrogen levels, improves plant metabolism and contributes to higher fruit sugar levels.
- **Stimulate compost production.** A solution rate of 1:100 will help increase the biological activity of various beneficial microbes and can decrease composting times.
- **Combat bad odor.** A wood vinegar solution of 1:50 will diminish the production of odor-causing ammonia in animal pens.
- **Supplement for livestock feed.** Mixed with livestock feed at rates of between 1:200 and 1:300, wood vinegar can adjust bacterial levels in the animal digestive tract which improve the absorption of nutrients from feed.
- **Enrich garden soil.** Use a strong solution of 1:30 to apply to the garden soil surface at a rate of 6 liters of solution per 1m² to enrich the soil prior to planting crops. To control soil-based plant pathogens, use an even stronger rate of 1:5 to 1:10.
- **Repel houseflies.** Dilute wood vinegar at a rate of 1:100 and apply to affected areas.

Summary



- Asian natural farming stresses the use of **local materials** and **natural inputs** for **small-scale** farm production.
- **Microbial processes** are exploited as much as possible.
- The concept is still new, evolving and expanding.
- Interest has extended beyond small farms to institutions and governmental agencies.
- Scientific support is still rudimentary but growing.

