Ecoscience Research Foundation

"Earthworm is the pulse of the soil, healthier the pulse healthier the soil"

VERMICOMPOSTING USING LOCAL VARIETIES OF EARTHWORMS

About two thousand five hundred species of earthworms have been identified in the world of which more than five hundred species of earthworms have been identified in India. These earthworms can be cultured or used in composting applying simple procedures either in pits, crates, tanks, concrete rings or any containers. Organic material to be used is recommended only after pre-processing or pre-digestion of respective material through partial anaerobic phase (done under black polythene cover or with a clay seal layer). The biodung composting technology standardised by Dr Priti Joshi is highly recommended as a pre-digestion mechanism.

Diversity of earthworm species varies with different types of soils and hence choosing a local or native species of earthworm for the local soil and for vermicomposting is an important step. There is no need to import earthworms from elsewhere. Local species of earthworms that are generally used in India are *Perionyx excavatus* and *Lampito mauritii*.

Compost pit of any convenient dimension can be dug in the backyard or garden or in a field. The most convenient pit of easily manageable size is 2m x 1m x 0.75m. [A tank may be constructed with brick and mortar with proper water outlets, or a plastic crate (600 mm x 300 mm x 300 mm) with holes drilled at the bottom or empty wooden crates (deal wood boxes/apple cases) or well rings made of cement or clay of 750 mm diameter and 300 to 450 mm height can also be used with slight modifications in the thickness of layers used. If nothing is available then four worn out car-tyres be placed one above the other and composting started in it. To make it simpler it can also be done in a 25-litre bucket]

Vermibed (vermes= earthworms; bed= bedding) is the actual layer of good moist loamy soil placed at the bottom, about 150 to 200 mm thick above a thin layer (50 mm) of broken bricks and coarse sand. Earthworms are introduced into the loamy soil, which the worms will inhabit as their home. About 100 earthworms (a combination of epigeics and anecics) may be introduced into a compost pit of about 2m x 1m x 0.75m, with a vermibed of about 15 to 20 cm thick. The vermibed should always be kept moist, but should never be flooded.

Handful? lumps of fresh cattle dung are then placed at random over the vermibed. The compost pit is then layered to about 50 mm with dry leaves or preferably chopped hay/straw. For the next 30 days the pit is kept moist by watering it whenever necessary. The bed should neither be dry nor soggy. The pit may then be covered with coconut or Palmyra leaves or an old jute (gunny) bag to discourage birds. Plastic sheets on the bed are to be avoided as they trap heat. After the first 30 days, as above, wet organic waste of animal and/or plant origin from the kitchen or hotel or hostel or farm that has been pre-digested is spread over it to a thickness of about 50 mm. This can be repeated twice a week. All these organic wastes can be turned over or mixed periodically with a pickaxe or a spade. Care should be taken not to disturb the vermibed in which the worms live. Keep adding garbage till the compost pit is nearly full. Continue to keep the pit moist for another 30 to 45 days, turning over the material in the pit with care avoiding injury to the worms. Turning over can be done on every fifth or seventh day with the help of a forked spade.

Regular watering should be done to keep the right amount of moisture in the pits. In 60 to 90 days the compost should be ready as indicated by the presence of earthworm castings (vermicompost) on the top of the bed.

The compost should be turned occasionally since this allows for aeration. If the weather is very dry it should be dampened periodically. The pile should be moist not wet and soggy.

Vermicompost can now be harvested from the bin/pit. The material should be placed in a heap in the sun so that most of the worms move down to the cool base of the heap. The compost is then sieved before being packed. . The earthworms and the thicker material, which remains on top of the sieve, goes back in the bin and the process starts again. Compost works best with a mixture of coarse and fine

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About a Friend of the Earth
Vermicomposting Using Exotic Species Of Earthworms
General Composting
Waste is a Resource
Waste that could be used for Vermicomposting
Do not waste waste, waste is precious
Waste Water Treatment
Botanicals
Vermiwash

How to collect native earthworms? Identify worm-inhabited soils marked by visible earthworm castings on the soil surface. Dissolve about 500gm jaggery (native sugar) and 500gm fresh cattle dung in 20 litres of water. Sprinkle on an area 1m x 1m. Cover with straw, leave cattle dung lumps and cover with an old gunny bag. Keep watering for about 20 to 30 days. A combination of epigeic and anecic native worms will aggregate here that could be collected and used.

materials, layered together.

An interesting fact is that it was Charles Darwin who was one of the first persons who noted the importance of earthworms, more than a century ago. These "creepy-crawly" creatures are the most useful gardeners. They break down dead plant material and other organic wastes, recycle the nutrients, and turn over the soil. You can collect earthworms from your neighbourhood or get earthworms from nurseries. One can also contact the local agricultural department, municipalities, and nurseries of the forest departments for earthworms. Since earthworms are now becoming big business one can also check in the firms/horticultures/nurseries, which deal in earthworms, but is always desirable to collect them yourselves.

FOUR-TANK SYSTEM

To simplify the loading procedure for composting in rural sectors where the availability of organic material is not in bulk, a four-tank system can be set up based on a combination of biodung composting method and vermitech technique that enables continuous compost production using cattle dung produced daily at cattle sheds, weeds, leaf litter and other farm waste. A tank 4m x 4m x 1m (l x b x h) is preferably made under shade of tree. This is then divided into four equal parts with 22.5cm brick walls that have vents to facilitate aeration as well as migration of earthworms from one tank to another. This unit is designed especially for the small farmer who approximately collects 20 to 30 kg of cattle or farm waste per day. The schedule of loading the unit is described in the Table.

In the same manner two-tank system for household garbage or less quantity of farm waste is recommended. This is a smaller tank 1m x 1m x 1m made above ground under shade. The tank is divided into two equal halved units vertically by a wall containing vents. An average family produces 250 to 500 gm of garbage that is added daily into one of the tanks. After a few days when a layer is formed 15 to 20 cm dry/green leaves and a thin layer of soil are made to cover it.

Period	Tank	Process
000 - 030	01	Collection of biomass and cattle dung
030 - 060	01	Soaking of biomass with water, cattle dung slurry, and covering it with black polythene sheet. This could be called as Biodung preparation.
	02	Collection of biomass
060 - 090	01	Inoculation of earthworms
	02	Biodung preparation
	03	Biomass collection
090 - 120	01	Vermicompost ready and migration of earthworms from pit 1 to pit 2.
	02	Vermicomposting
	03	Biodung preparation
	04	Biomass collection
120 - 140	01	Harvesting of compost and collection of biomass
	02	Vermicompost ready and migration of earthworms from pit 2 to pit 3.
	03	Vermicomposting
	04	Biodung preparation

TWO-TANK SYSTEM

Another layering of waste over a period of time follows this and it takes about two months for the tank to be filled. This is then covered with a black polythene sheet. The waste is now added to the second tank. The polythene sheet is removed after 15 to 20 days, allowed to cool for a day and about 150 to 200 locally collected earthworms are released into the biomass. It takes approximately 45 to 60 days for the biomass to be now converted into vermicompost. In the mean time the second tank gets filled and starts decomposing. The earthworms from the first tank by now start migrating into the second tank through the vents. The vermicompost is harvested from the first tank, which is now again ready for being filled.

The tank may be kept closed with a steel mesh cover to keep other animals away from damaging the set up. Out door plan requires about 10-20% more worms than the indoor method, as there are more predators and other climatic variables in open

cage system.

VERMICOMPOSTING USING EXOTIC SPECIES OF EARTHWORMS

Exotic species of earthworms have also been used in India for vermicomposting. Internationally three species of earthworms have received acclaim for vermicomposting, they being *Eisenia foetida* and *Eudrilus eugeniae*, which are exotic, and *Perionyx excavatus*, which is endemic.

Since 1982 *E. eugeniae* has been promoted for waste degradation. *Eudrilus eugeniae* is reported to have surpassed both in feeding and reproductive rates compared to other species of earthworms. *Eisenia foetida* however is used in certain areas in India for domestic waste composting. After several experimentations the recommended method is as follows:

Fill the waste material into tanks followed by sufficient water to moisten the waste. The surface is then sealed with 25mm thick layer of soil paste, and at every 300mm distance, holes of 50mm diameter are made and sticks are introduced into them for two days and are later removed. This provides the track for air circulation. The tanks can also have holes of 15mm diameter all-round (walls) at 300mm apart to provide cross ventilation. The well-aerated material does not emit any foul smell. After two weeks the earthworms are released on the soil surface. They enter into the organic matter and mix through the crevices left on the surface. The set-up is left without disturbance for six weeks. Water is sprinkled occasionally on the surface during the composting process. The soil pack is then separated easily after two months, as these earthworms do not feed on the soil. The compost along with the earthworms is collected. In place of the mudpack, old jute (gunny) bags can also be used to cover the containers, but the bags themselves will get composted after some time. A crate (600mm x 45mm x 600mm) can hold a population of 1500 adult *Eudrilus eugeniae*, and 3000 to 5000 *Eisenia foetida* and *Perionyx excavatus*. Frequent harvesting of *Eudrilus eugeniae* is necessary to reduce population pressure and enables continuous growth of earthworm pop

GENERAL COMPOSTING

A compost heap can also be made layer by layer. In the bottom layer, place twigs, stalks, hay, wood chips or other coarse material, which allows air to flow at the bottom. Follow with a layer of high nitrogen material like manure or grass clippings (avoid grass if chemical pesticides have been used), leaves, manure, wood shavings, chopped weeds (picked before going to seed), vegetable and fruit scrapes, nut and eggshells. Sprinkle the material with water as you build the pile and repeat the sequence. The pile should be at least three feet high to trigger and sustain the required biological reactions. Don't let the pile get over five feet high, in which case the mass may pack down, squeeze out air and slow down decomposition. You can use a black polythene sheet to cover or alternatively use a jute sack as cover over the heap to retain the moisture. This is the set up for the Biodung method of composting. This can also be used as a pre-digestion exercise. Once cool (say after about thirty days), the earthworms can be introduced into the heap to proceed with vermicomposting.

WHEN IS THE COMPOST READY?

The compost is ready when the material is moderately loose and crumbly and the colour of the compost is dark brown. It will be black, granular, lightweight and humus-rich. To facilitate separating the worms from the compost, stop watering two to three days before emptying the beds. This will force about 80 per cent of the worms to the bottom of the bed. The rest of the worms can be removed by hand, and are ready to be transferred into the next round of compost making. The vermicompost is then ready for application.

The smell is earth-like. Any bad odour is a sign that fermentation has not reached its final goal and that the bacterial processes are still going on.

A musty smell indicates the presence of mould or overheating which leads to loss of nitrogen. If this happens, aerate the heap better or start again, adding more fibrous material and keeping the heap drier.

The compost heap can become ripe in three weeks but it can take up to three months also.

You can use the compost in your garden, around shrubs bushes and trees and in potted plants. Compost can be spread on the top of the soil and hoed in lightly to encourage the surface soil life. Roots from tender plants are then able to reach the compost and draw out its nutrients.

Vermicomposting is easy to practise, is ecologically safe and economically sound.

As things stand now, the vermiculture technology is all set to emerge as a big business of the next century. This versatile technique yields organic fertilizers, recovers energy rich resources, and makes for safe disposal of organic wastes and helps combat the spreading problem of environmental pollution. Today, many corporate units and business agencies are making a fortune by marketing vermicompost-an excellent soil conditioner-to the farmers and gardeners. India is still a long way behind in fully exploiting the promises of vermiculture technology for waste disposal and manure generation. With the amount of waste produced in India, the country could easily produce millions of tonnes of plant nutrients and considerably reduce the outflow of foreign exchange towards the import of fertilisers. Today, many industrial units covering paper, pulp and tanning make use of vermiculture technology for waste treatment.

ALTERNATES:

If animal dung is available in sufficient quantities then it is advisable to set up biogas (gobar gas) units. The gas may be directed to the kitchen or for heating water. The slurry can be used for composting purposes when amended with plant

WASTE THAT COULD BE USED FOR VERMICOMPOSTING

Agricultural waste	Agricultural fields: stubble waste, husk, straw, and farmyard manure. Stems, leaf matter, fruit rind, pulp and stubble. But be careful while handling an all-citric waste.
Animal waste	Dung, urine and biogas slurry
Urban solid waste	Kitchen waste from household and restaurants, waste from market yards and places of worship, and sludge from sewage treatment plants.
Agro industries	Food processing units: Peel, rind and unused pulp of fruits and vegetables, fine bagasse, pressmud and seed husk, stems, leaves and flowers after extraction of oil

DO NOT WASTE WASTE, WASTE IS PRECIOUS

Nature bestows everything in due balance - the hill and the valleys, the plains, the deserts, the meandering rivers and the voluminous oceans all bear testimony to the creation and the might of nature. The magnificent tall trees reaching the sky made Kahlil Gibran describe them in The Prophet as "poems that the earth writes on the sky".

Man is one peculiar animal in the biodiversity of nature. He has always preferred a forest edge. In dense forests he axed the trees, but did he cut them all? Well, no! And in the grasslands, he planted trees. Man therefore preferred to live along with the trees. Today's man is no more that Homo sapiens who had all these honest desires. He prefers to be called as the master of creation. He names his programs as "Man and the Biosphere." He justifies identifying himself distinctly different from all the other biological inhabitants on earth. This change of attitude has directed man to depend more on his technology than on nature making him forget that his technology one day may be his grave.

Man's unplanned behaviour and repulsive gestures have eroded the earth of its purity. He justifies his actions in the name of humanity by providing deforested land for food and shelter - I mean, agriculture and housing. Though to some extent true in countries with growing population, the callous disregard for forests is justified by planting monocultures through social forestry projects. Environmental lungs are getting diseased and the day is not far when we may demand for oxygen from an air devoid of it. There is absolutely no hope that we can survive anaerobically (Biotechnologists can think of genetic engineering here!). Better therefore plant your oxygen (I mean trees) today.

Forests support a large biodiversity of organisms ranging from the tiny microbes to the large mammals like the apes. Plants and animals have increased in their diversity since the coming of oxygen in the atmosphere, that is millions of years before even man existed. Man is the first and the only creature to establish a RED BOOK to record how unceremoniously he has destroyed diversity. Today, in spite of man, a large diversity still exists in South America, Africa and many parts of Asia. United States of America, the largest investor in multinational companies, who depends on products of natural origin, also probably has a large biodiversity, not on their soils but definitely in their supermarkets.

Talking of Sustainable Agriculture (SA), the stress normally is laid on soils, its fertility and its productivity. SA is a holistic approach. Healthy soils need good water and good air to support production. The SA component should therefore include water management and air quality. What has nature taught us? In natural ecosystems many of the organisms like the microbes (bacteria, fungi, actinomycetes and protozoan), microarthropods, molluscs, insects and the earthworms compost all the litter. The resulting humus is incorporated into the soil. Soils have a characteristic scent. Do soils really have that scent in them? The answer is a definite NO. Dry soil has no odour, water is odourless -- but healthy moist soils do give the characteristic scent. This is due to the sweat and blood of living organisms in the soil, as they toil to keep mother earth happy. We add tons of chemicals under the pretext of a green (colour and not prosperity) revolution and destroy the soil biological component, killing the earth in the process. The results are now evident in the form of non-productive "dead" soils. We then call them wastelands. They are not "waste" lands, but certainly "wasted" lands.

Soil fertility has become one of the most important jargons of a conventional agronomist. This term has been directly correlated to fertilizers. The absurd notion: "more fertility with more fertilizers" has indeed robbed the soil of its fertility. The traditional concept to evaluate the soil had been its quality or health. Soil health is a more appropriate term as it reflects the entire system and not just the chemical status of the soil. Soil health not just includes the physical and chemical characteristics of the soil but also the biotic components of the soils. It is the "living" soil. Though multitudes of soil organisms are related to soil health, earthworm is the pulse of the soil. Thus healthier the pulse, healthier is the soil. To an agronomist soil may be a mineral matter. It is not so to a traditional farmer who calls the soil, mother. Soil to a SA farmer is a living organism and not just mineral matter. A living organism is characterized by the presence of a digestive system, a respiratory system, a circulatory system, an excretory system and a reproductive system. A soil can also be described to possess these systems, as the soil can "digest" any dead organism buried into it, can "respire", can "circulate" nutrients through it, can selectively "excrete" salts to the surface in saline soils, and helps the plants establish a "placental" connection to it. Venerated as "mother" by the SA farmer, he always wants her to be "dressed" with mulch and does not strip her to sun's fury as

does a conventional farmer.

Nature pollutes the environment but knows how to handle it. Man also pollutes, but the pollution he and his technology have produced is such that neither he nor his technology knows how to handle it. He calls this end product as garbage, and dumps it just anywhere, as he strongly believes in NIMBY (Not In My Back Yard).

There are 21 major cities in the world and more than half of these exist in Asia, where a large amount of organic biomass is being wasted. There is a tremendous demand for organic matter in the soils today. On one hand the soils are starving for want of organic matter while on the other man is setting to flames agro waste and urban-based compostable wastes. One established solution to this problem of satisfying the soil's demand as well as solving the problem of organic waste management is composting. Technology on composting is abundantly available in our country. Ranging from the typical anaerobic composting to a variety of aerobic composting procedures (biodung composting, Nadep composting, vermicomposting, etc) have been time and again proved on field situations.

Though one single solution cannot handle the problem of all the garbage from urban centres, a variety of composting procedures can indeed be tried and implemented. The cost of establishing such composting procedures in large scale may range from a relatively low cost to extremely high costs when sophisticated machinery is involved. The Governments, Municipal Corporations, Municipalities and Panchayats can definitely start Pilot units and then expand them on commercial basis. The act of composting garbage is not new as the civic bodies were accustomed to do these decades back. Why, even today in some smaller towns the dumping yard is popularly known as compost yard.

Interested citizens can compost their garbage within their premises. Garbage means "material of no use" or "refuse". Once we start composting garbage then garbage is no more a "refuse" but a "resource".

Do not waste waste, waste is precious. Any takers!!!

VERMIWASH

Foliar Sprays are a part of plant growing practices. Worm worked soils have burrows formed by the earthworms. Bacteria richly inhabit these burrows, also called as the drilospheres. Water passing through these passages washes the nutrients from these burrows to the roots to be absorbed by the plants. This principle is applied in the preparation of vermiwash. Vermiwash is a very good foliar spray.

SETTING UP OF A VERMIWASH UNIT
Vermiwash units can be set up either in barrels or in buckets or even in small earthen pots. It is the principle that is important. The procedure explained here is for setting up of a 250 litre barrel.

An empty barrel with one side open is taken. On the other side, a hole is made to accommodate the vertical limb of a 'T' jointed tube in a way that about half to one inch of the tube projects into the barrel. To one end of the horizontal limb is attached a tap. The other end is kept closed. This serves as an emergency opening to clean the 'T' jointed tube if it gets clogged. The entire unit is set up on a short pedestal made of few bricks to facilitate easy collection of vermiwash.

Keeping the tap open, a 25 cm layer of broken bricks or pebbles is placed. A 25 cm layer of coarse sand then follows the layer of bricks. Water is then made to flow through these layers to enable the setting up of the basic filter unit. On top of this layer is placed a 30 to 45 cm layer of loamy soil. It is moistened and into this are introduced about 50 numbers each of the surface (epigeic) and sub-surface (anecic) earthworms. Cattle dung pats and hay is placed on top of the soil layer and gently moistened. The tap is kept open for the next 15 days. Water is added every day to keep the unit moist.

On the 16th day, the tap is closed and on top of the unit a metal container or mud pot perforated at the base as a sprinkler is suspended. 5 litres of water (the volume of water taken in this container is one fiftieth of the size of the main container) is poured into this container and allowed to gradually sprinkle on the barrel overnight. This water percolates through the compost, the burrows of the earthworms and gets collected at the base. The tap of the unit is opened the next day morning and the vermiwash is collected. The tap is then closed and the suspended pot is refilled with 5 litres of water that evening to be collected again the following morning. Dung pats and hay may be replaced periodically based on need. The entire set up may be emptied and reset between 10 and 12 months of use.

Vermiwash is diluted with water (10%) before spraying. This has been found to be very effective on several plants. If need be vermiwash may be mixed with cow's urine and diluted (1 litre of vermiwash, 1 litre of cow's urine and 8 litres of water) and sprayed on plants to function as an effecting foliar spray and pesticide.

VERMIWASH ANALYSIS REPORT

pH	7.48 ± 0.03
Electro conductivity dS/m	0.25 ± 0.03
Organic Carbon %	0.008 ± 0.001
Total Kjeldhal Nitrogen %	0.01±0.005
Available Phosphate %	1.69 ± 0.05
Potassium (ppm)	25 ± 2
Sodium (ppm)	8 ± 1
Calcium (ppm)	3 ± 1

Copper (ppm)	0.01 ± 0.001
Ferrous (ppm)	0.06 ± 0.001
Magnesium (ppm)	158.44 ± 23.42
Manganese (ppm)	0.58 ± 0.040
Zinc (ppm)	0.02 ± 0.001
Total Heterotrophs (CFU/ml)	1.79 x 103
Nitrosomonas (CFU/ml)	1.01 x 103
Nitrobacter (CFU/ml)	1.12 x 103
Total Fungi (CFU/ml)	1.46 x 103

OTANICALS

Organic farming does not mean just addition of manure but a set of practices. One such practice is to use plant protection sprays against pests and for pest control.

Vermiwash is an excellent foliar spray when diluted to 10% and sprayed on plants early morning or late evening. This can also be mixed as vermiwash: cow's urine: water in the ratio 1: 1: 2 and used effectively to also check the pests. Vermiwash has also been observed to be very effective when mixed with *Panjakaavia*.

Panjakaavia is one important method which has been propagated by Dr Natarajan of Kodumudi. This is prepared by mixing five important ingredients obtained from the caw, which includes urine, dung, milk, curd and ghee. These ingredients are further mixed with tender coconut water, sugar-cane juice and ripe bananas. The preparation after maturation period is diluted to 3% with water and is used as a foliar spray. This works well in making the plants disease resistant.

Several plants such as *Azadirachta indica, Pongamia glabra, Calotropis* sp, etc, have potential insect repellant properties in them. Extracts of these as well as common plants such as Ginger, Garlic, Onion, are also used in pest control.

Organic sprays if used in higher concentrations can also damage plants. It is therefore essential that the user when prepares the botanicals sprays his preparation on a few plants and monitor them for one or two days to see whether they char. If they char then the solution needs further dilution, else it should be safe for spray.

Learn to spray on the underside of the leaves as insects mostly shelter themselves on the underside of the leaves.