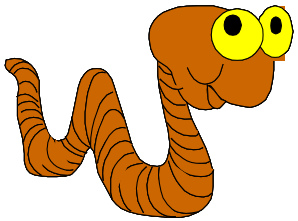
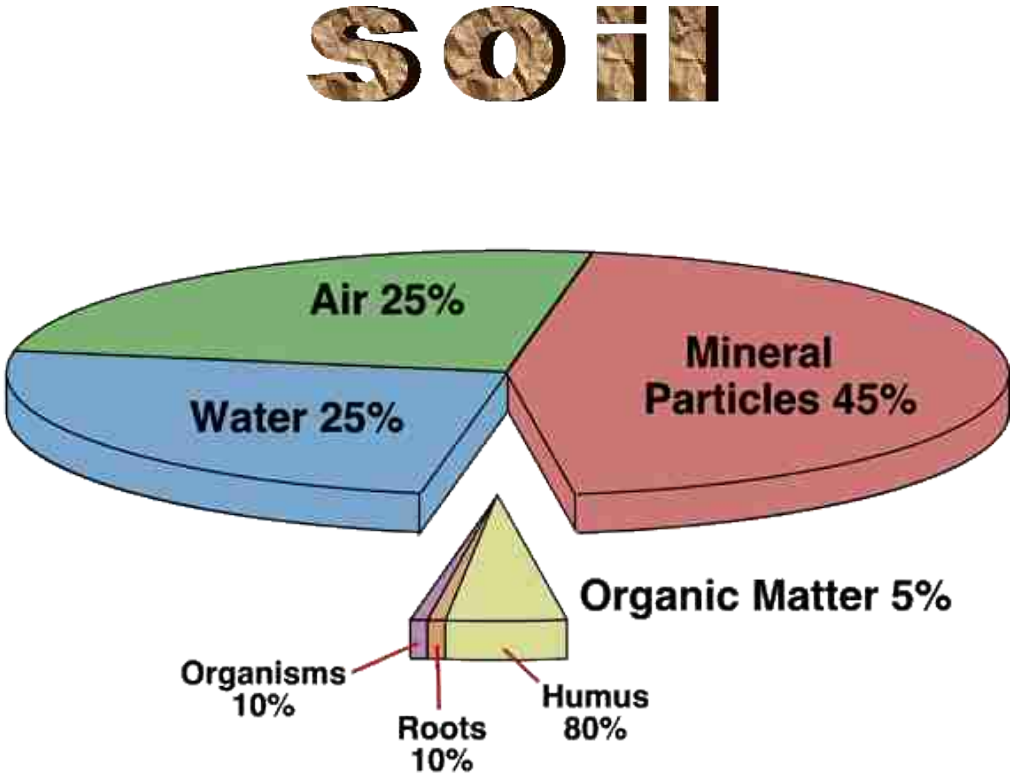
Life in the soil

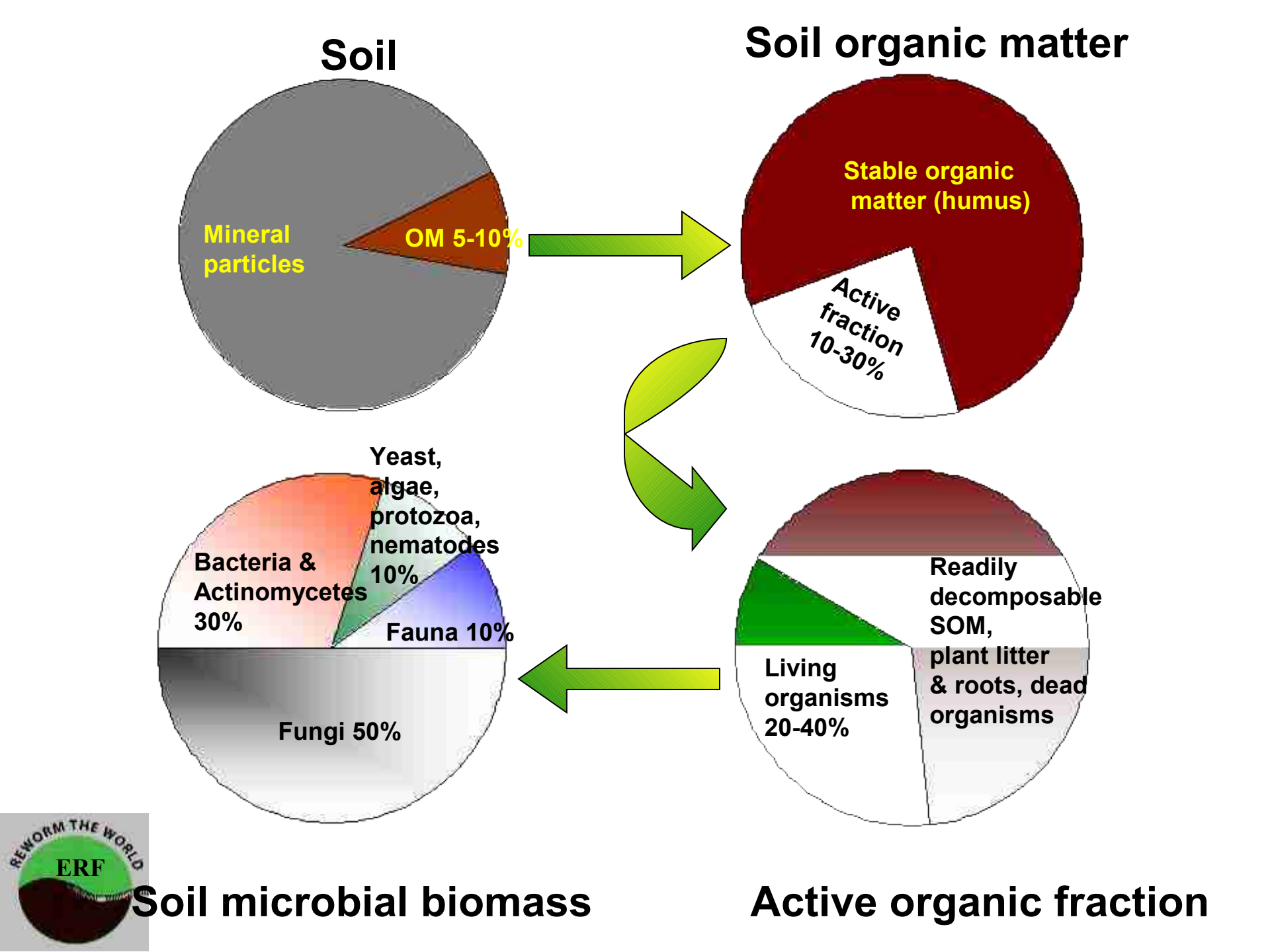


Sultan Ahmed Ismail

Ecoscience Research Foundation, Chennai

general proportion of components in a healthy soil




Soil
Mineral particles
OM 5-10%
Soil organic matter
Stable organic matter (humus)
Active fraction 10-30%
Yeast, algae, protozoa, nematodes 10%
Bacteria & Actinomycetes 30%
Fauna 10%
Fungi 50%
Soil microbial biomass
Readily decomposable SOM, plant litter & roots, dead organisms
Living organisms 20-40%
Active organic fraction
REWORM THE WORLD
ERF

SOIL BIOTA

Viruses	**kill bacteria causing release of body fluids**
Bacteria	**chemical factories, convert wastes to nutrients**
Fungi	**convert woody substances to digestable compounds**
Amoebae	**prey on bacteria and fungi**
Nematodes	**hunt on amoebae, attack roots, eat fungi**
Arthropods	**(collembolans, mites, etc) eat all of above**
Earthworms	**eat soil & leaf litter, drilospheres, bury litter**

SOIL is a living organism?

leaf and litter

organisms in the soil

Mites

organisms in the soil

springtails

organisms in the soil

Pseudoscorpion

organisms in the soil

Microarthropods in general

Soil organisms

insects

Soil organisms

ants

Soil organisms

Millipedes

Soil organisms

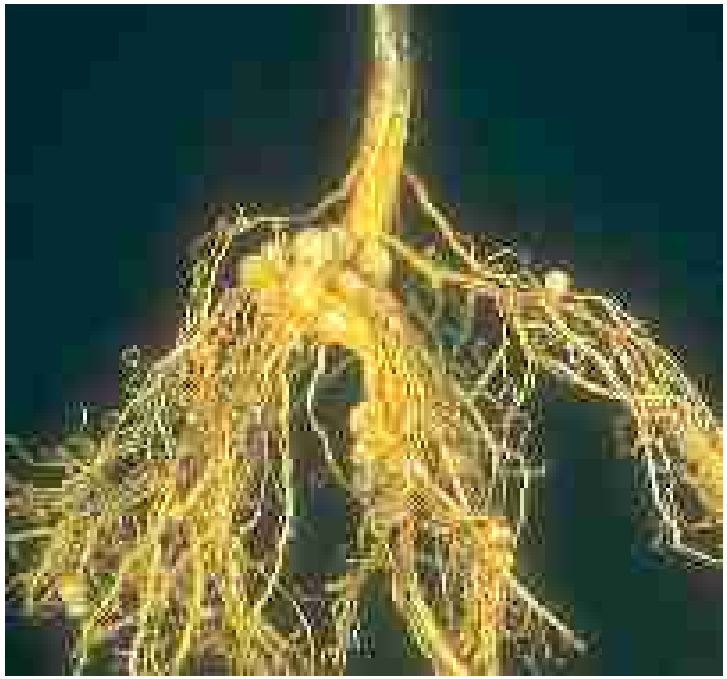
Termites

Soil organisms

Fungi

Soil organisms

Root nodules: symbiosis

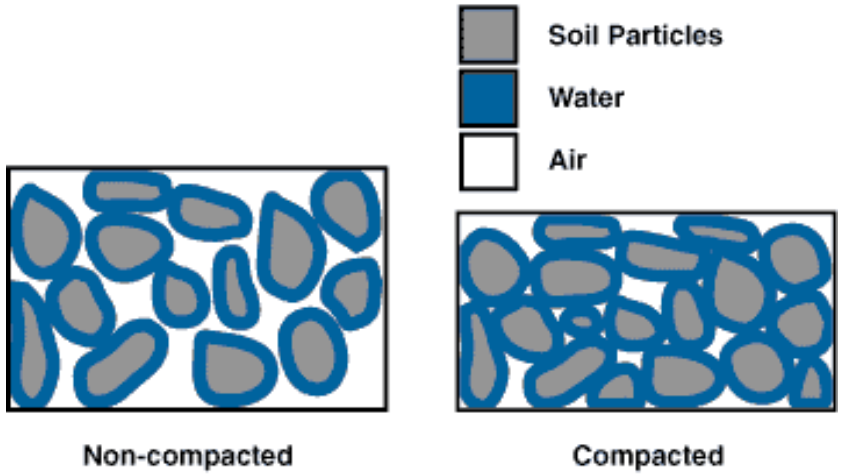


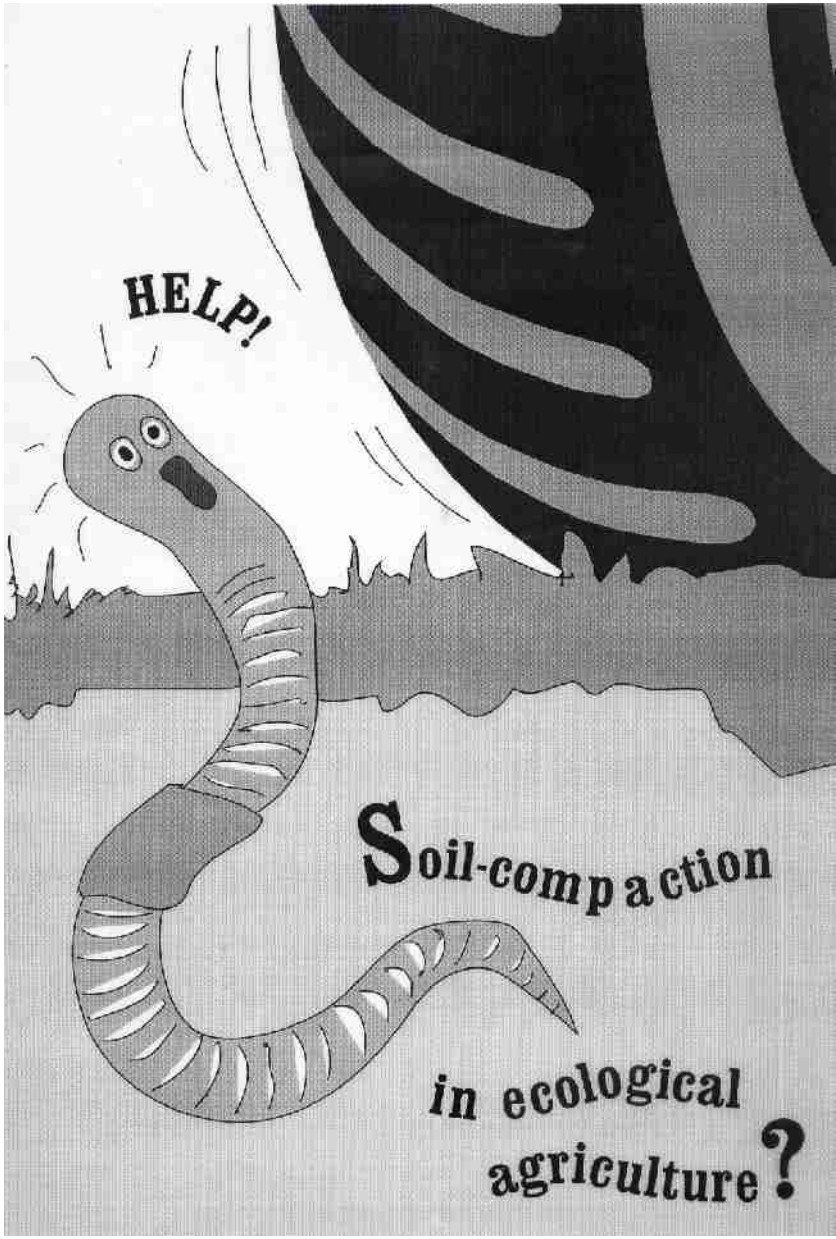
for nitrogen fixation. that's why we use green manure plants

Importance of animals in agriculture

biogas slurry in agriculture promotes soil life

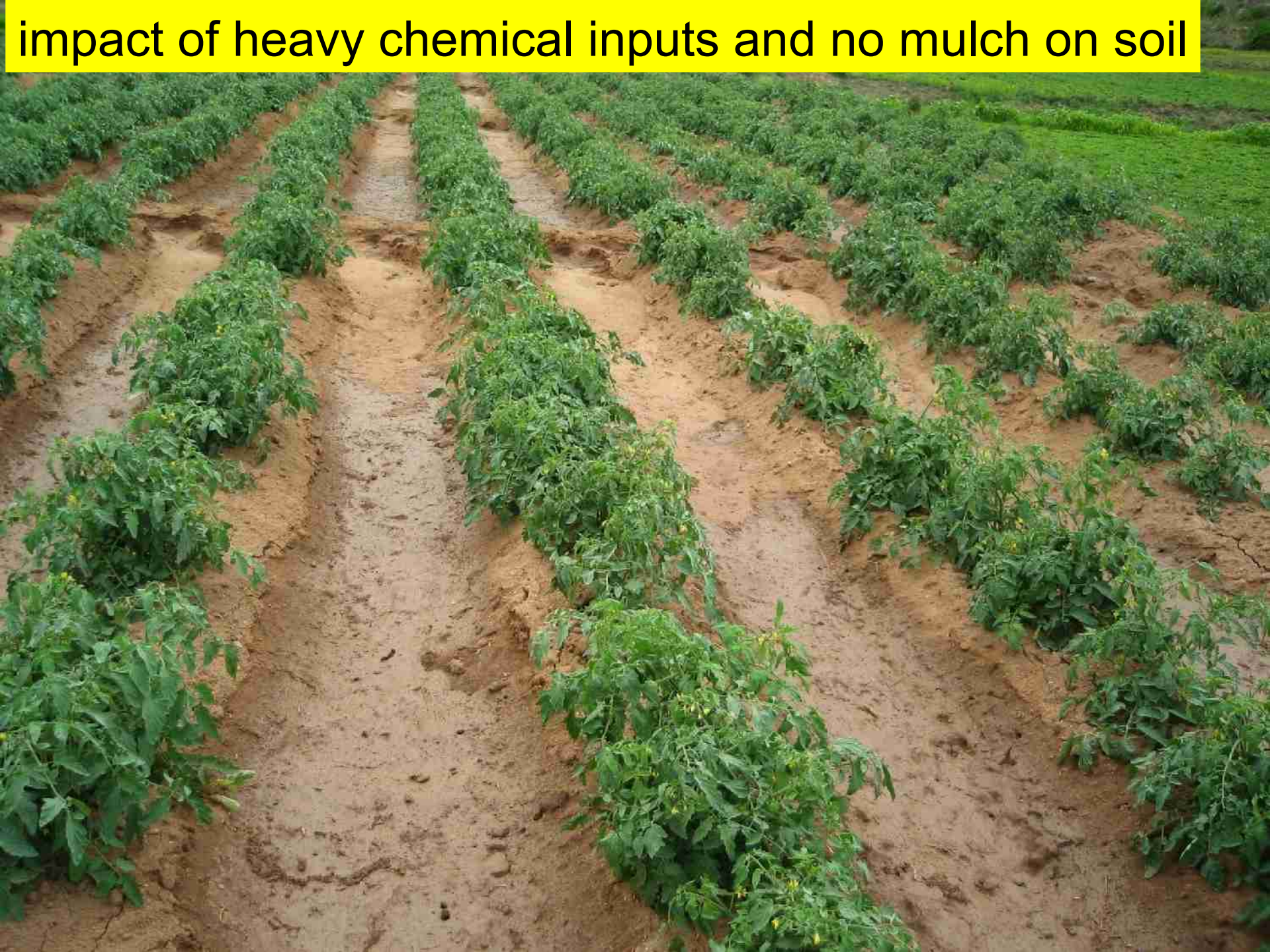
tractors can cause soil compaction





Soil compaction can affect plant growth

REWORM THE WORLD
ERF

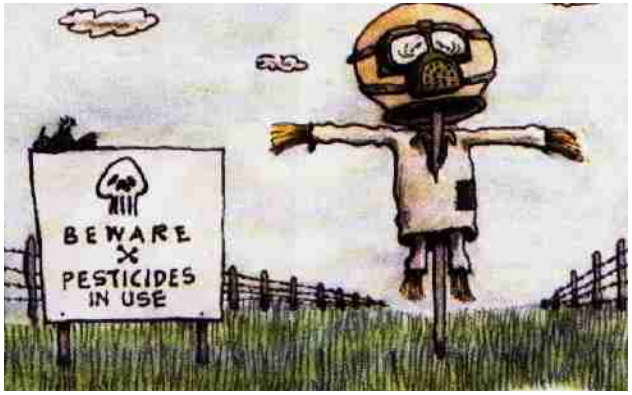

impact of heavy chemical inputs and no mulch on soil


burning of agro-waste on fields destroys microbes

Soil fertility

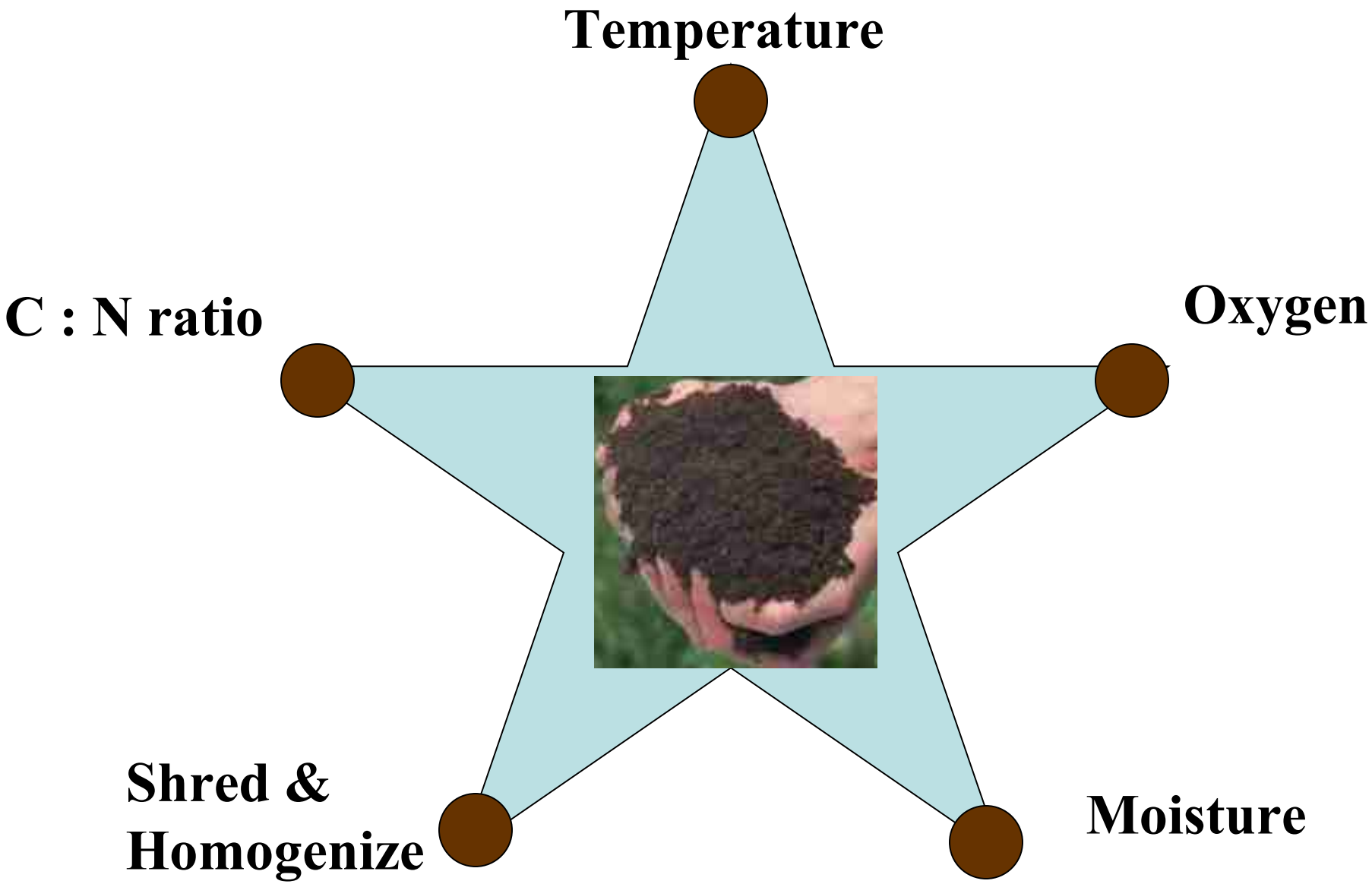
Vs

Soil health



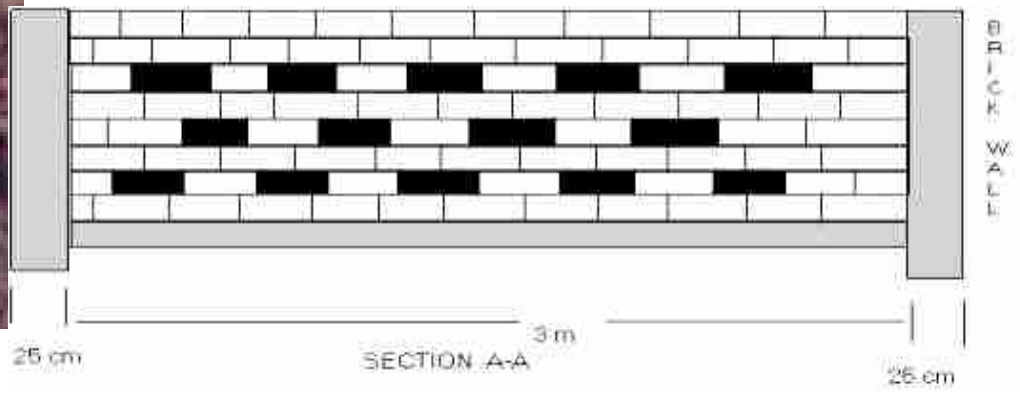
Importance to: Physical & Chemical parameters

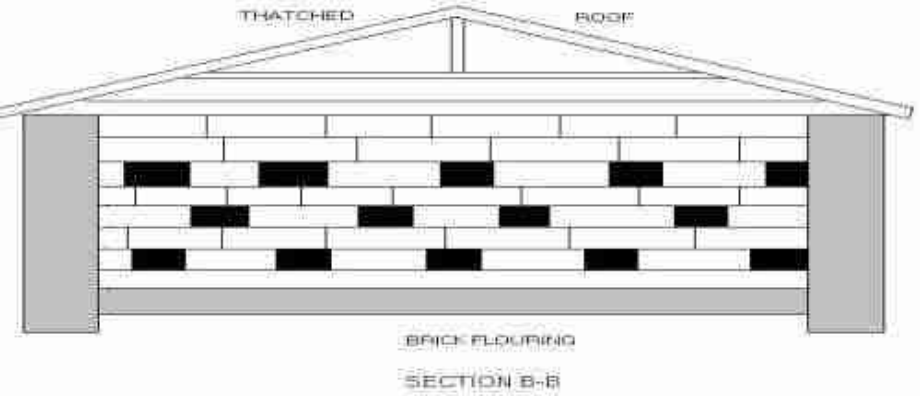
Importance to: Physical, Chemical & Biological parameters



The Star Concept of composting

Aerobic compost example: NADEP



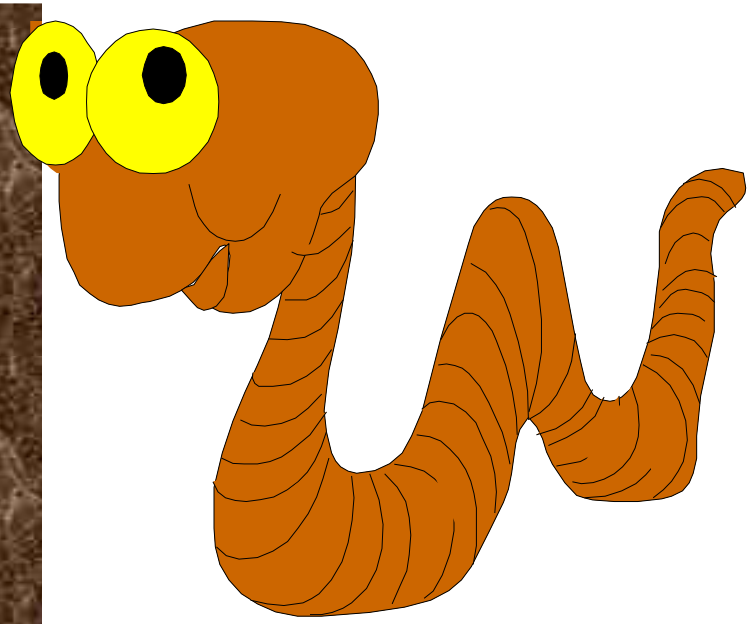


REWORM THE WORLD
ERF

Anaerobic digestion: example: Biogas

REWORM THE WORLD
ERF

Vermitech

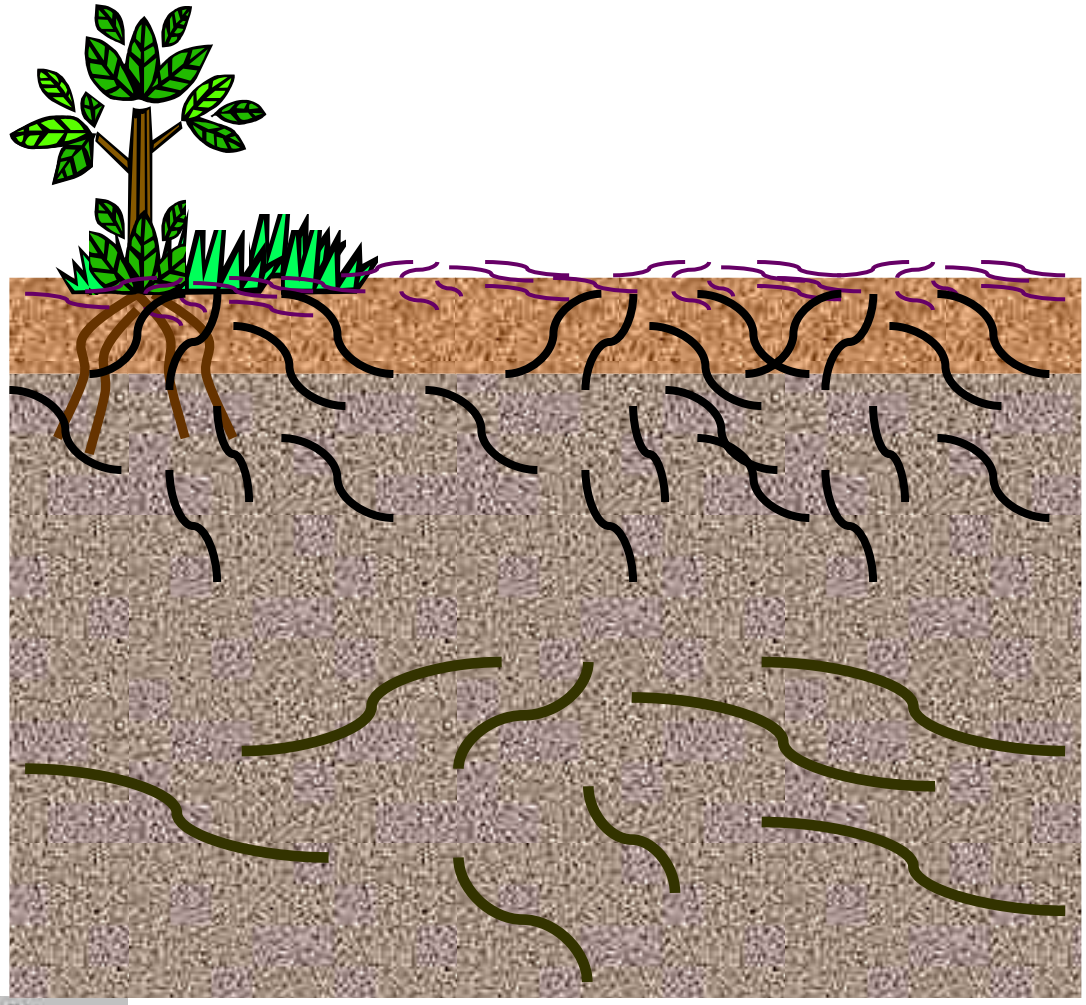


the science of earthworm biotechnology

REWORM THE WORLD
ERF

an earthworm

Earthworms
ecological strategies



Epigeic (surface)
Perionyx excavatus

Anecic (sub-surface)
“vertical burrower”
Lampito mauritii

Endogeic (inside soil)
“horizontal burrower”
Octochaetona thurstoni

REWORM THE WORLD
ERF

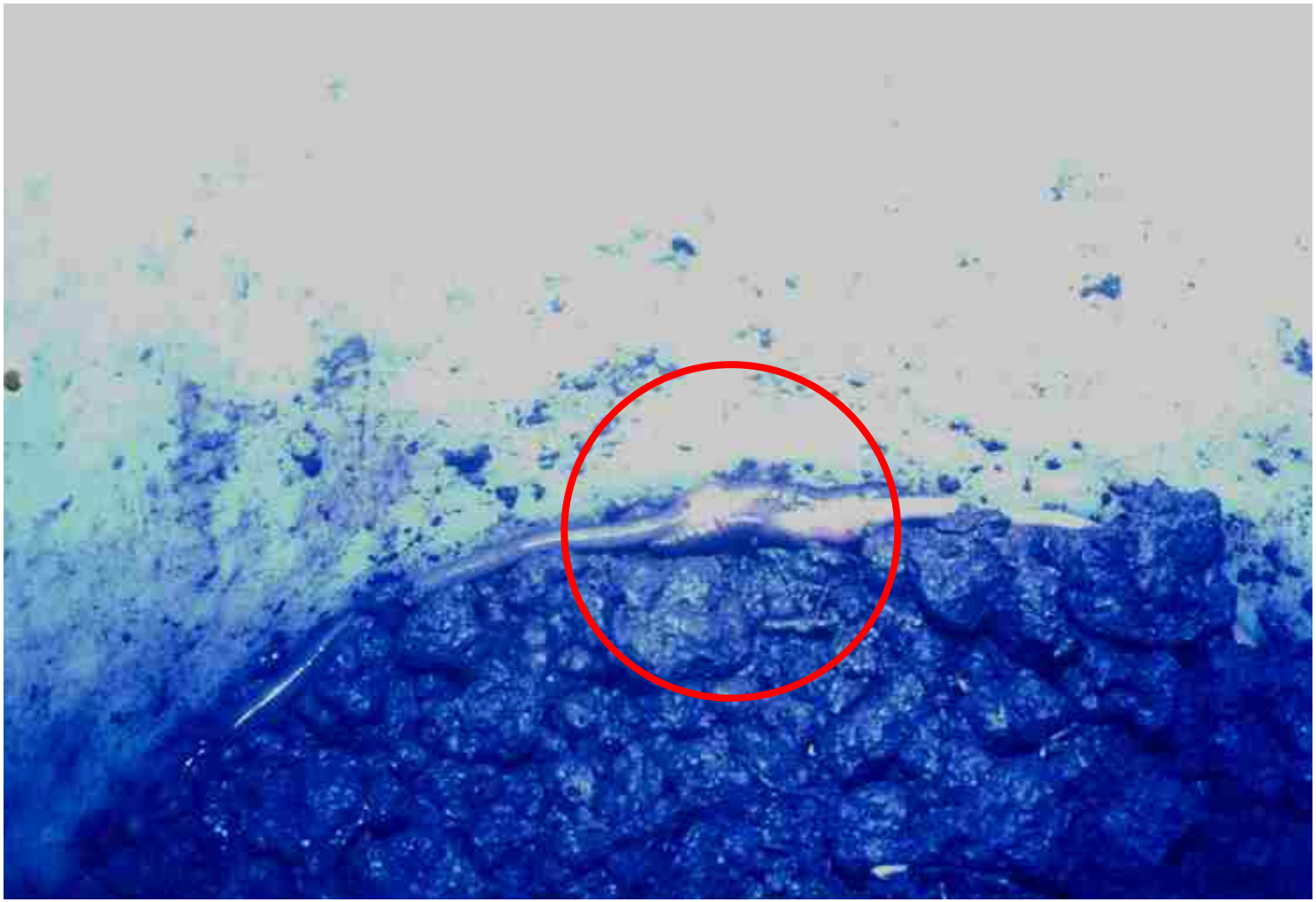
Perionyx excavatus: epigeic

Lampito mauritii: anecic

Octochaetona thurstoni: endogeic

REWORM THE WORLD
ERF

two earthworms mating



Cocoons of different species of earthworms

Indian surface dweller

exotic surface dweller

Eudrilus eugeniae

exotic surface dweller

for PRE-DIGESTION

BIODUNG composting

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BIODUNG composting

set up

BIODUNG composting

set up loosely covered with polythene sheet

BIODUNG composting

heap temperature in 5 days

BIODUNG composting

Steam during turning over in 10 to 15 days

BIODUNG composting

heap reduces in size in about 30 days

BIODUNG composting

BIODUNG compost after 30 to 45 days to be used for vermicomposting

Vermicomposting of the material in a tank

Screening before packing for the market.

Need not be screened for self usage.

Vermicompost

Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil

ammonifiers

nitrifiers

Priscilla, 2006

Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil

Phosphate-solubilising bacteria

Priscilla, 2006

Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil

Sulfur bacteria

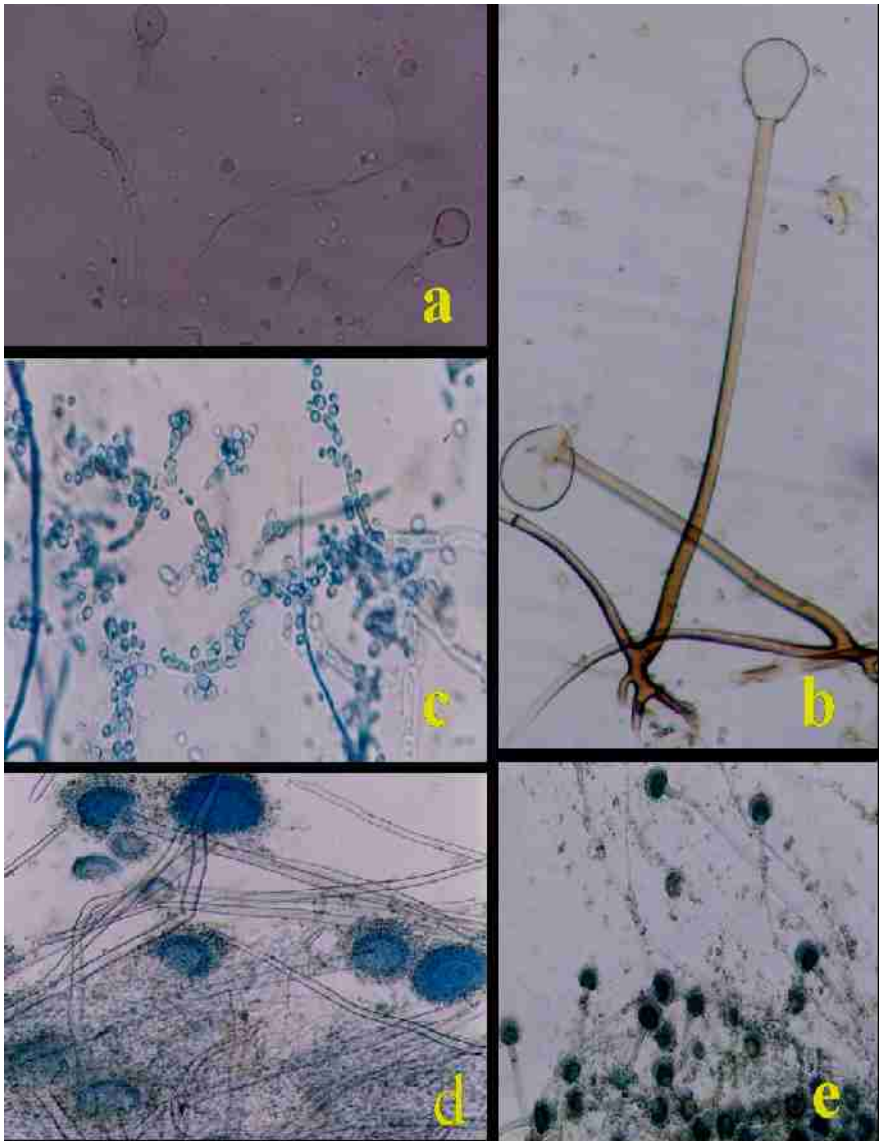
Priscilla, 2006

Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil

Fungal colonies from compost

Priscilla, 2006

Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil



- ***Absidia* sp.**

b. *Rhizopus stolonifer*

c. Yeast

d. *Aspergillus flavus*

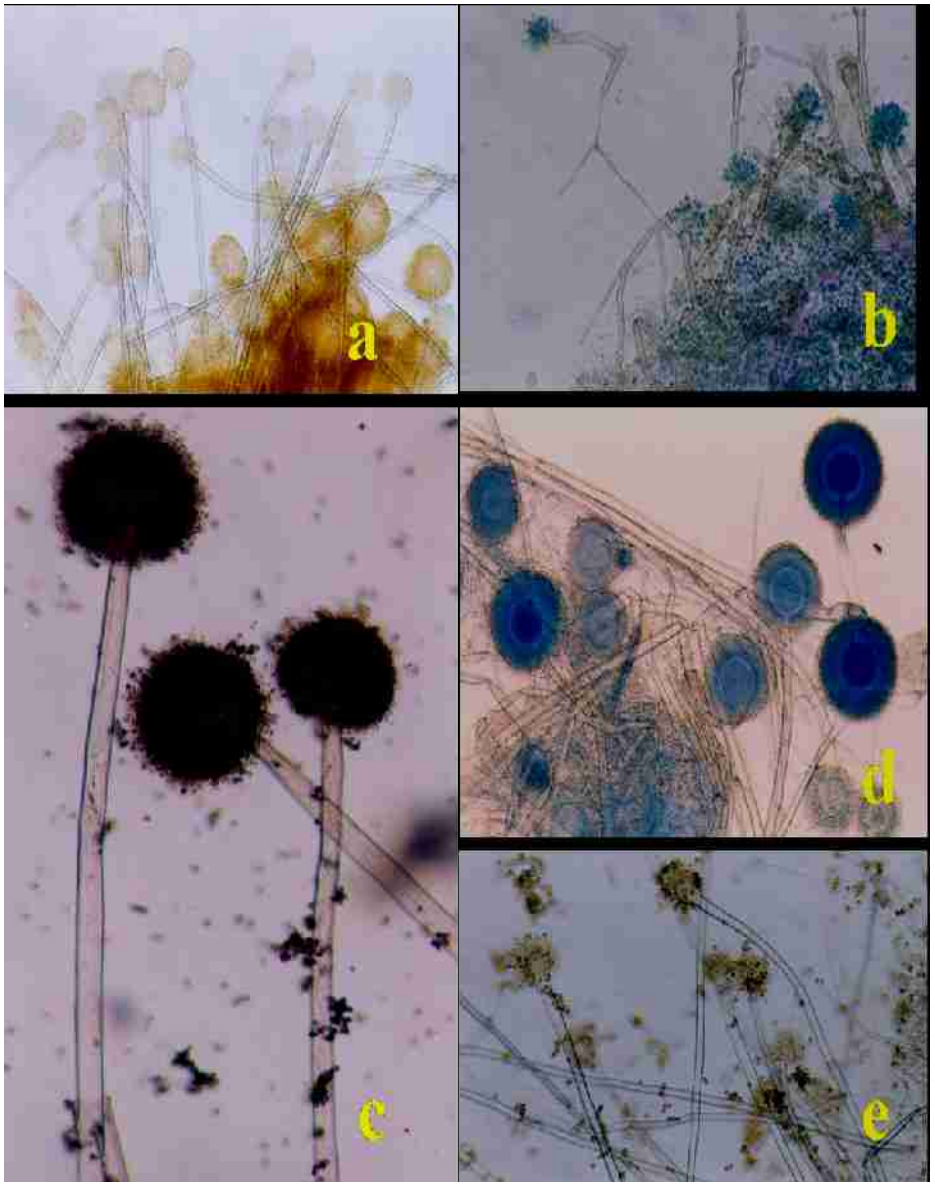
e. *A. fumigatus*

Scale 20µm

Priscilla, 2006

REWORM THE WORLD
ERF

Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil



- ***Aspergillus flavipes***

b. ***A. nidulans***

c. ***A. niger***

d. ***A. ochraceus***

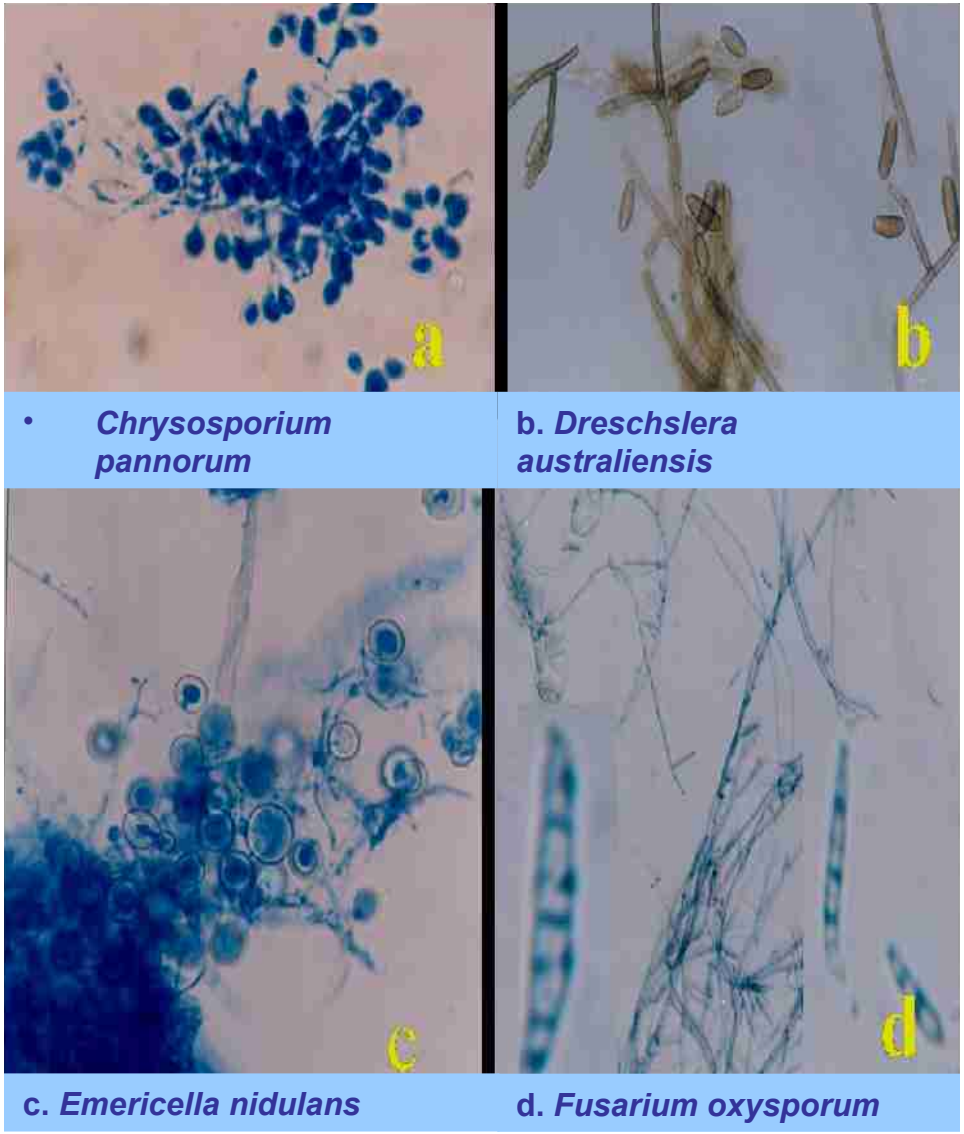
e. ***A. tamarii***

Scale 20µm

Priscilla, 2006

REWORM THE WORLD
ERF

Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil



- ***Chrysosporium pannorum***

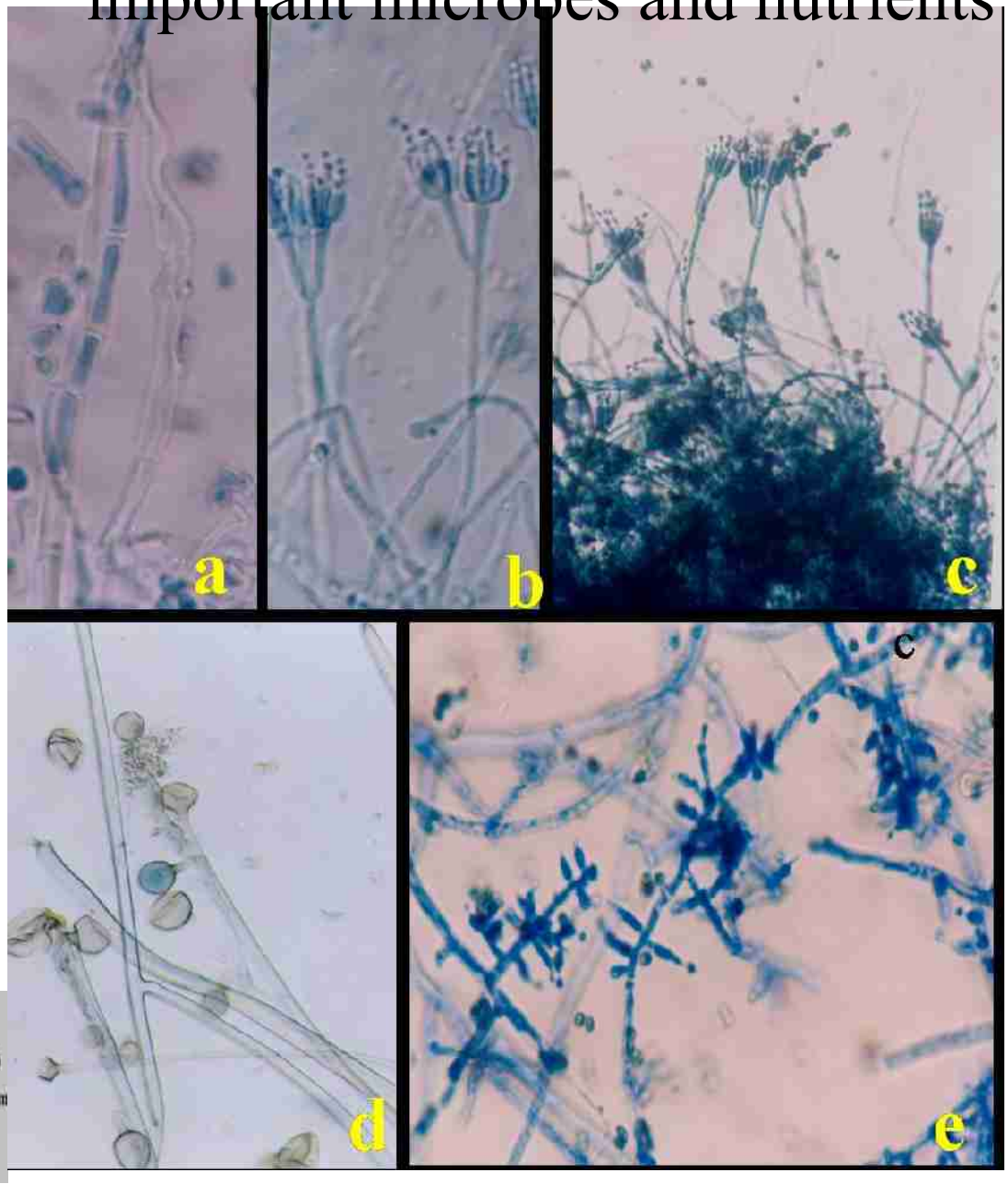
b. ***Dreschslera australiensis***

c. ***Emericella nidulans***

d. ***Fusarium oxysporum***

Priscilla, 2006

Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil



- ***Monilia sitophila;***
- ***Penicillium citrinum;***
- ***P. oxalicum ;***
- ***Mucor racemosus***
- ***Trichoderma viride***

Scale 20µm

Priscilla, 2006

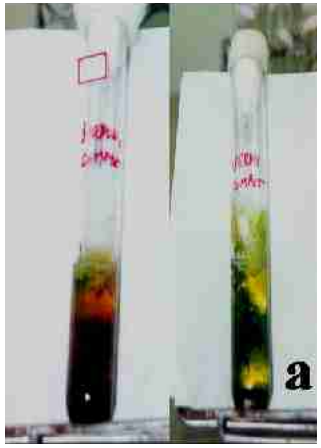
REWORM THE WORLD ERF

Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil

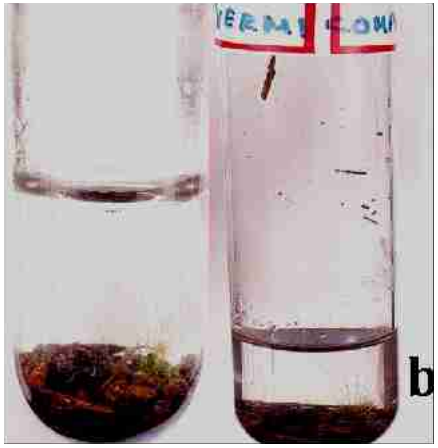
Thermophilic fungal colonies from compost

Priscilla, 2006

Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil



a. Algae from Biodung and Vermicompost

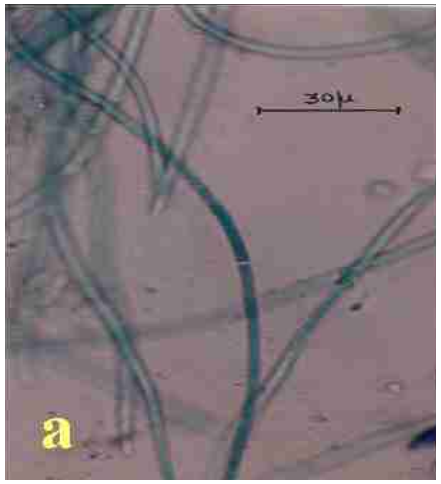


b. *Cladophora* sp. from vermicompost

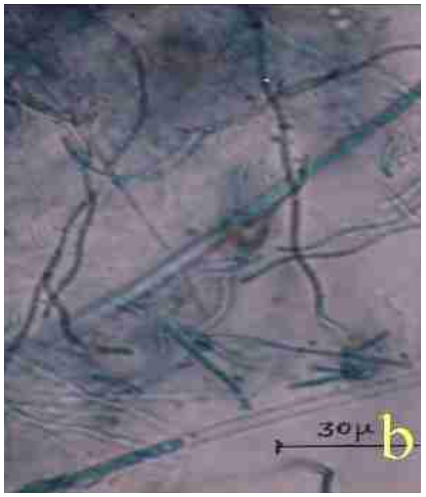
c. Algal cultures from various stages of composting

Priscilla, 2006

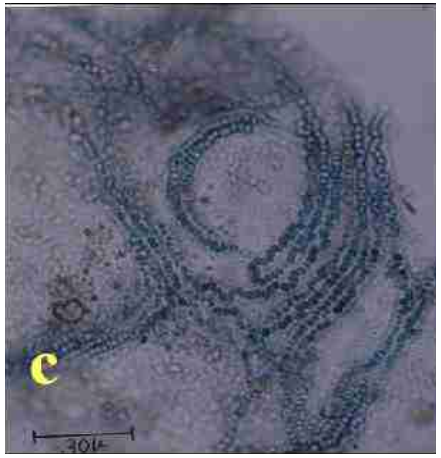
Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil



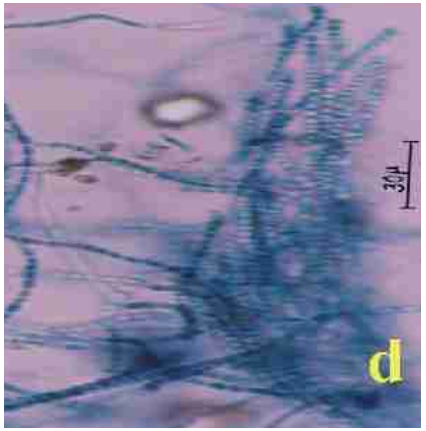
a. *Oscillatoria* sp.



b. *Anabaena anomala*



c. *Anabaena ambigua*



d. *Arthrospira* sp

Priscilla, 2006

REWORM THE WORLD
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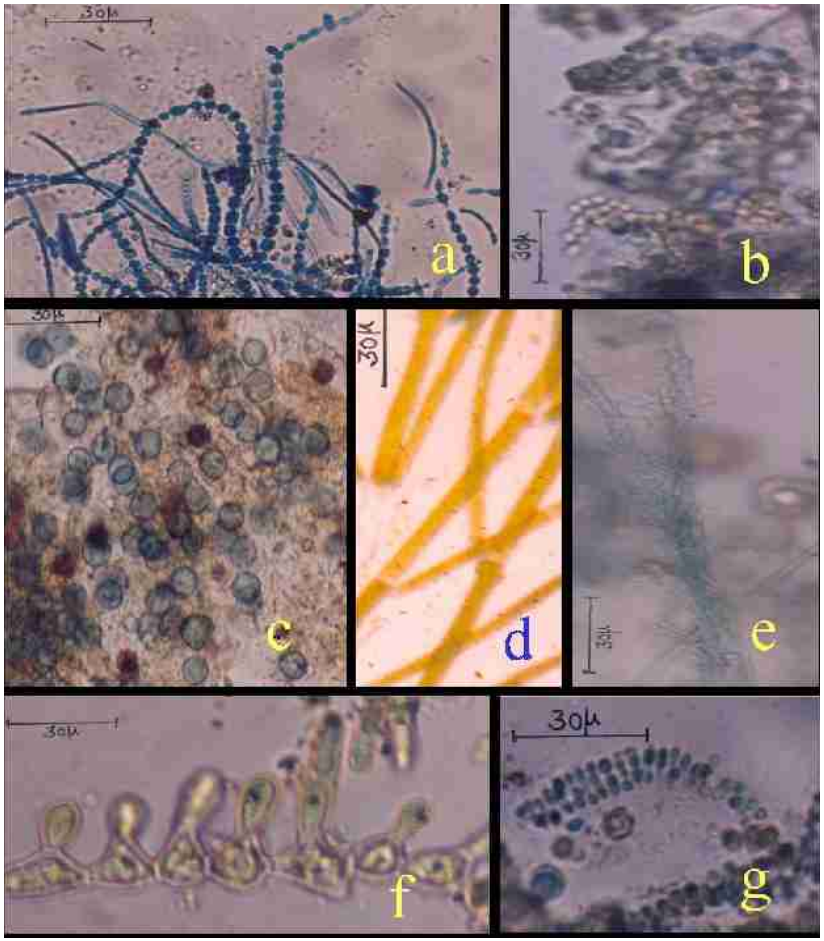
Earthworms *in-situ* or through vermicompost contribute important microbes and nutrients to the soil

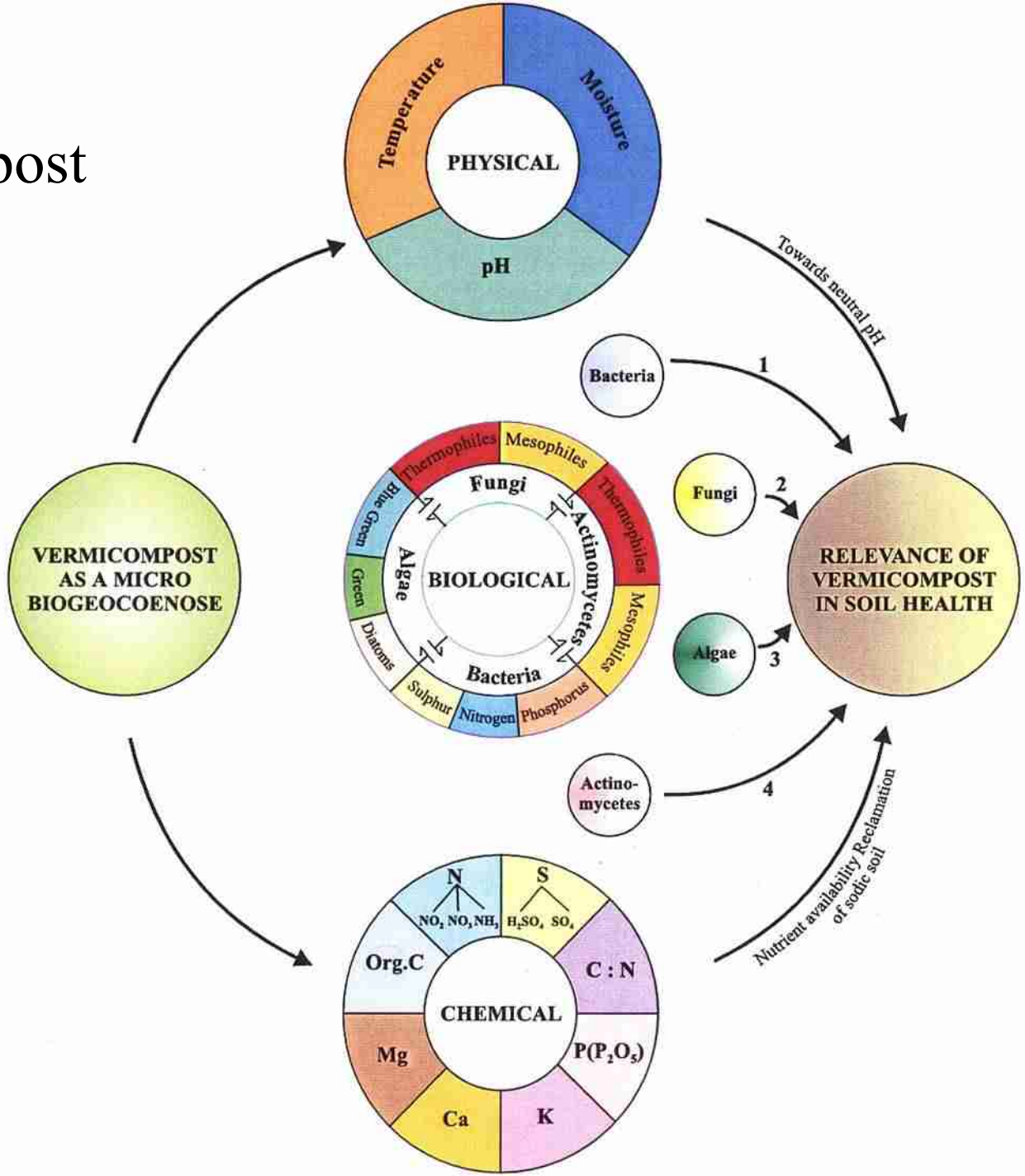
- ***Westiellopsis prolifiea*; b. Nostoc sp;**
c. *Protococcus* sp; d. *Cladophora* sp ; e. *Schizothrix* sp;
f. *Chaetonema* sp ; g. *Stigonema* sp.



Priscilla, 2006

Summary

vermicompost



Biodynamic chromatograms of vermicompost from different species of earthworms

Biodynamic chromatography

control

P. excavatus

E. eugeniae

L. mauritii

Dhakshayani, 2007

Biodynamic chromatograms of vermicompost from local earthworms (vermitech)

vermitech

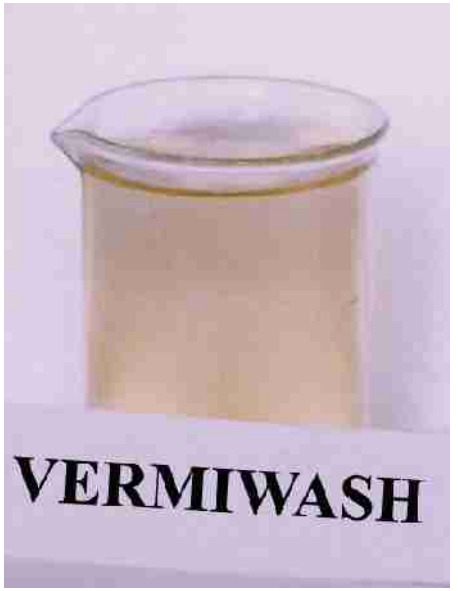
P. excavatus and L. mauritii **Dhakshayani, 2007**

REWORM THE WORLD ERF

in-situ composting improves soil health

Madhu Ramakrishnan, Pollachi

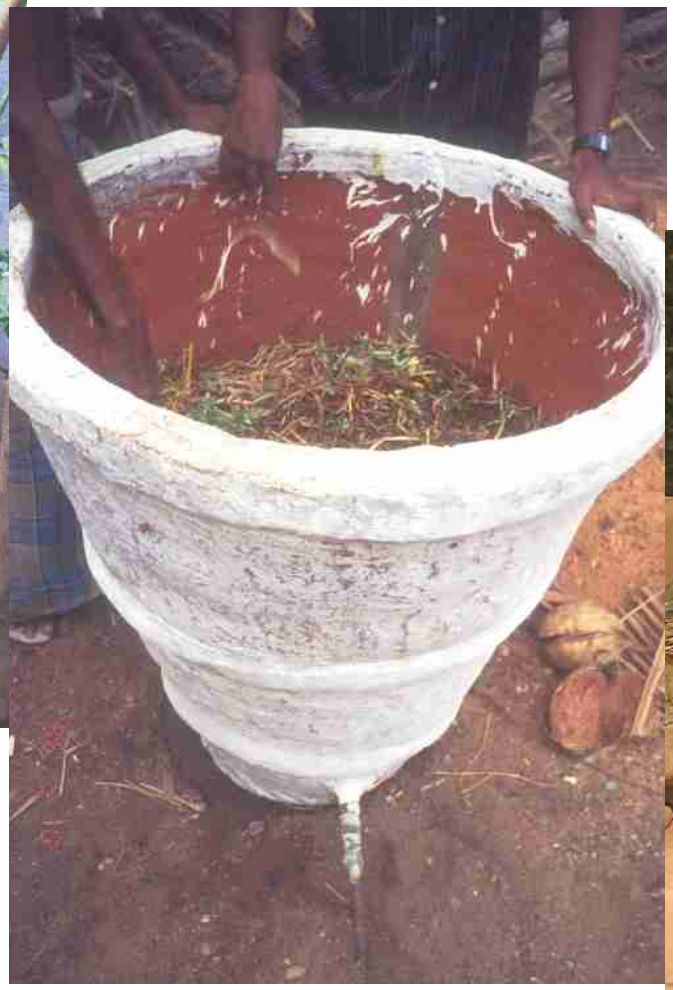
Earthworm burrows in the soil. These are called DRILOSPHERES



Application of drilospheres in the production of vermiwash

You decide Your model

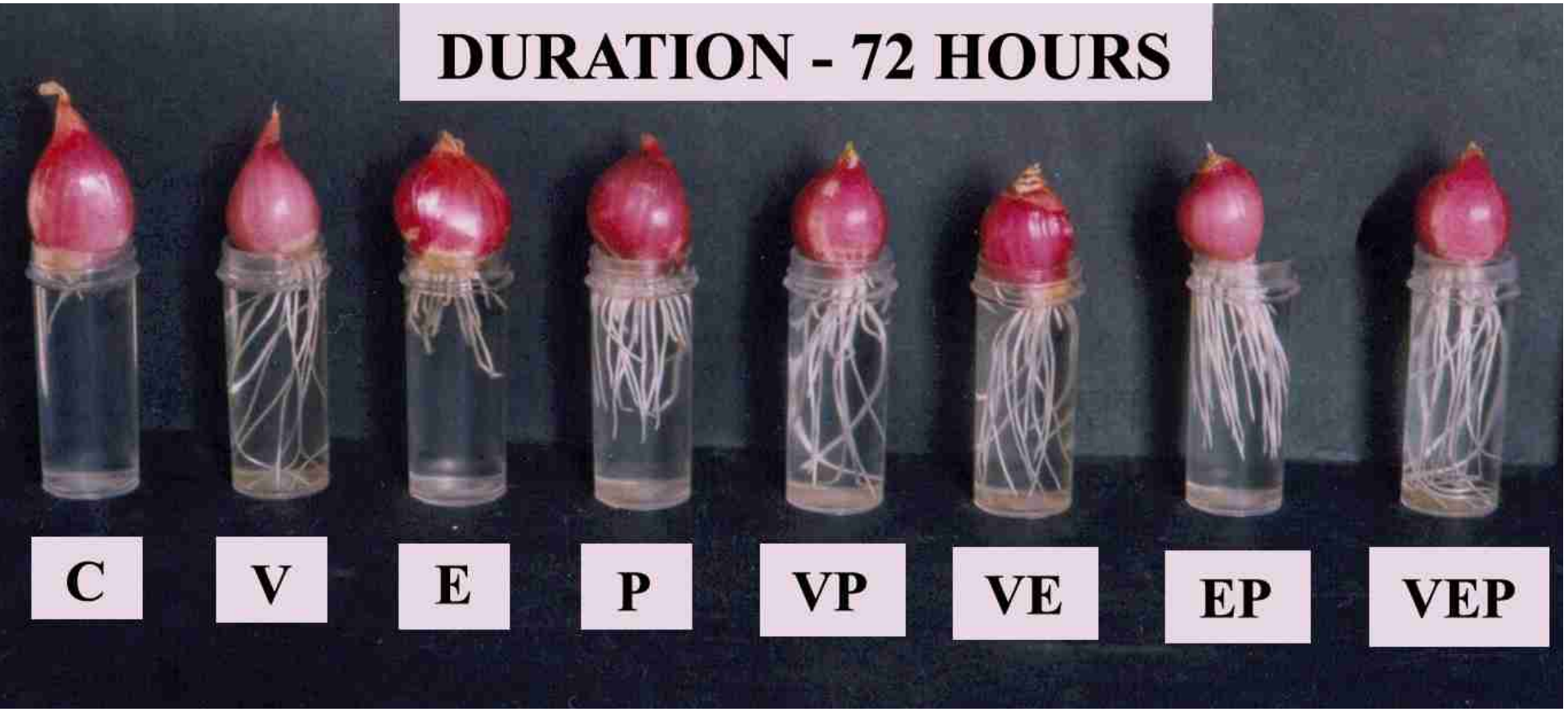
choose your model



REWORM THE WORLD

ERF

In case you prepare a liquid fertiliser you can try its efficiency by this simple experiment. Please observe the root growth



C: Control
V: Vermiwash
E: EM
P: Panchagavya
and their combinations

Simple compost units

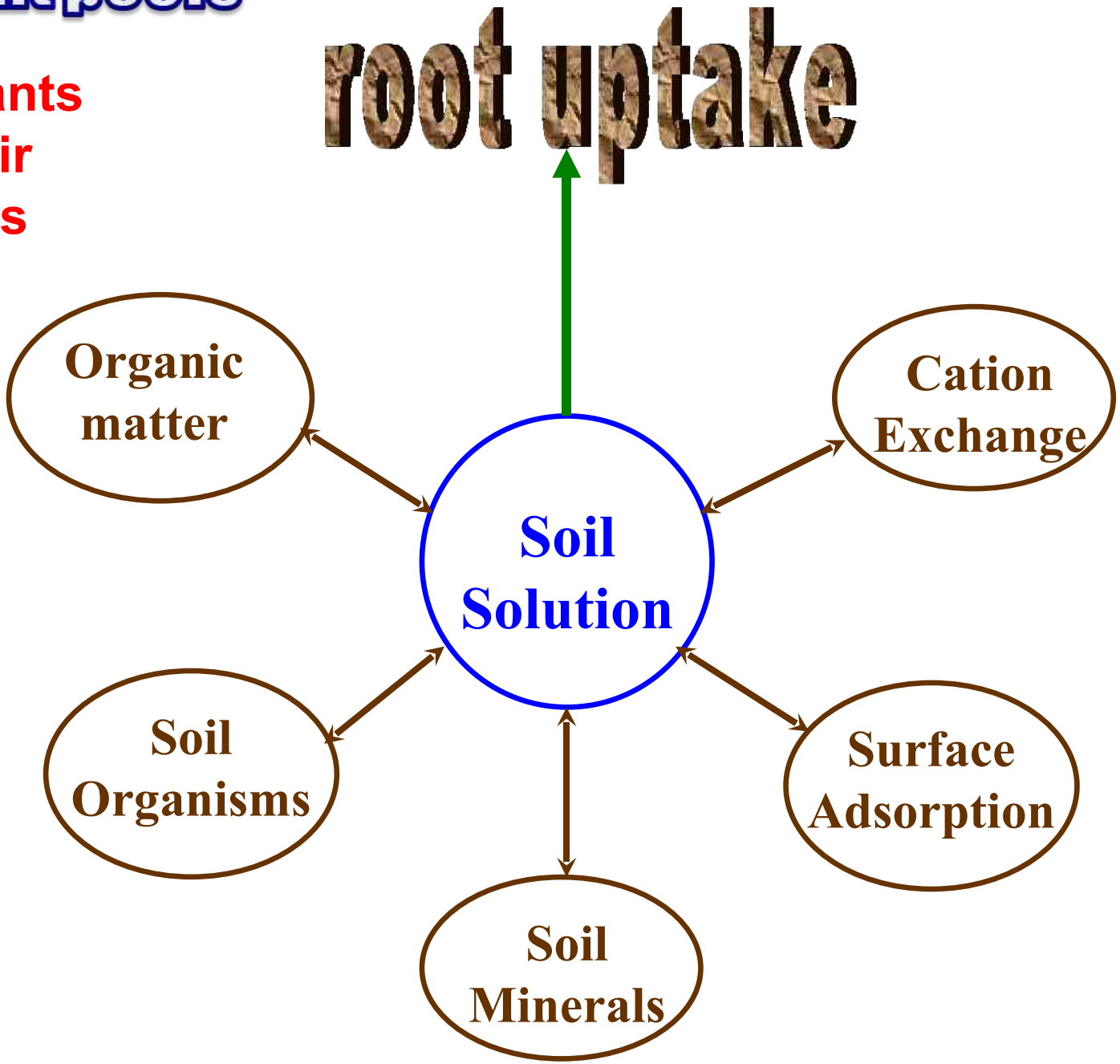
vermicompost
at Santosh Farms

compost
at Aurobindo Ashram

REWORM THE WORLD
ERF

Soil Nutrient pools

how do plants take their nutrients



when it rains and you hold an umbrella… Where does the water fall???

REWORM THE WORLD
ERF

the compost and manure should be fed in the soil where the canopy ends.

A goat eats several varieties of plants
the plants it does not eat have pest repellant properties

observe your GOAT scientist on the farm

and
prepare
a
decoction

Bioremediation
4½ years

Cattle: exceptionally good for organic farming and improving soil health
Gowshala, Gurukal, Kurukshetra

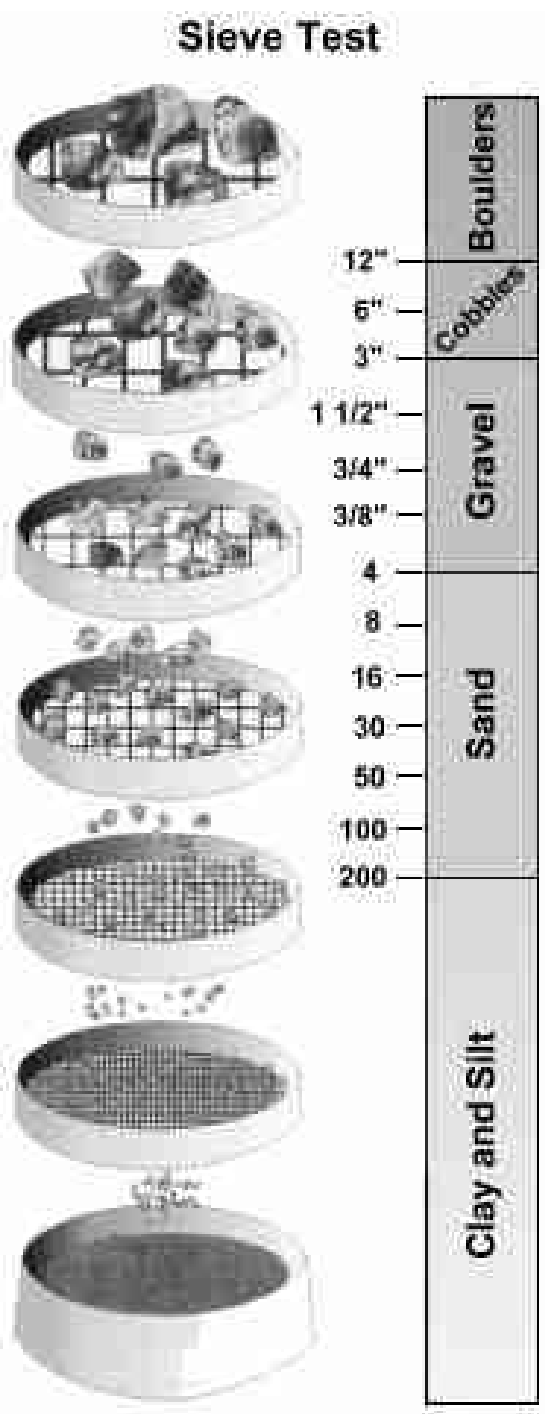
REWORM THE WORLD
ERF

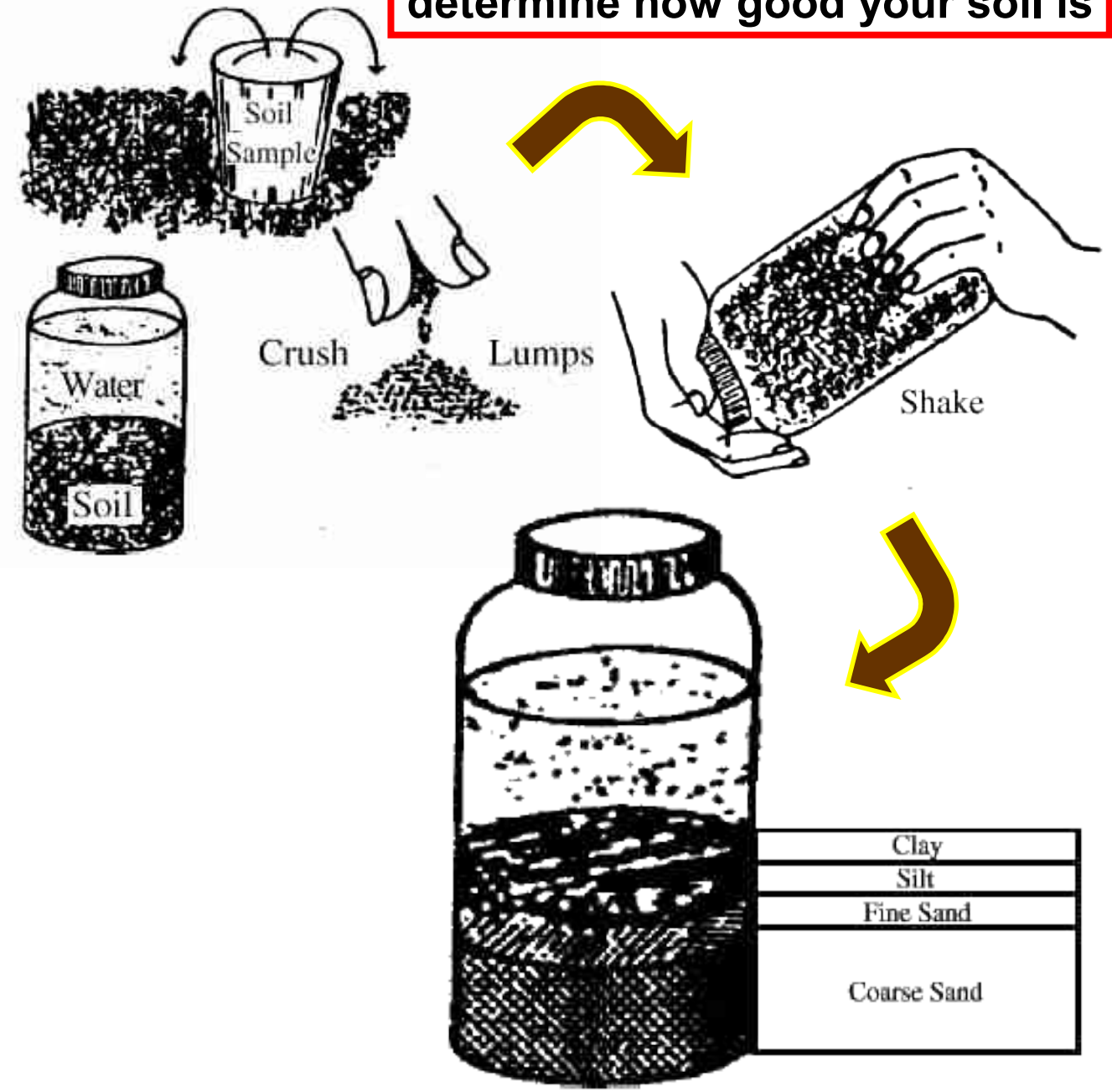
nutrimix

mix washings from cattle shed with irrigation water improves life in the soil magnificently

or allow water from fish ponds to mix with irrigation water

with just a bottle and water determine how good your soil is

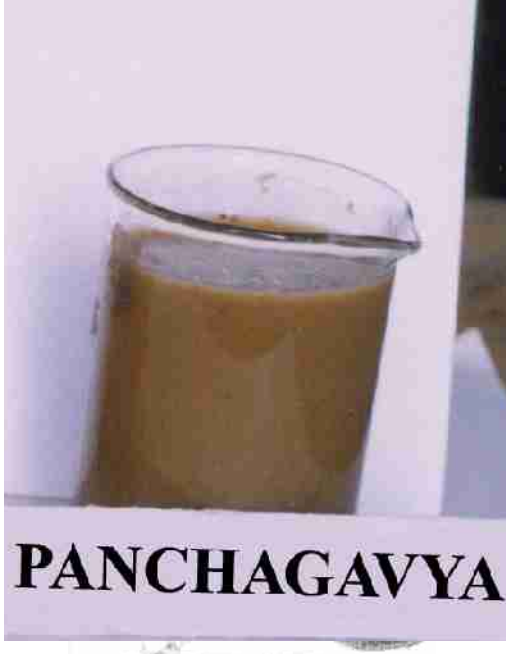




some recommended compositions.
applications of these
do not affect life in the soil,
they in fact improve soil health

Panchakavya

- Biogas slurry or cow dung 5 kg
- Cow's urine 3 litres
- Cow's milk 2 litres
- Curd from cow's milk 2 litres
- Ghee from cow's butter 1 litres
- Sugarcane juice 3 litres
- Tender coconut water 3 litres
- Banana 12 numbers



lactobacillus

First mix cow dung with ghee and small quantity of cow's urine. Leave this for 3 days. place this in a broad mouthed mud pot and add the remaining ingredients. Mix well by hand and **without** closing with lid keep in shade. Daily morning and evening mix well by hand. In about 10 days panchakavya will be ready. If you mix it daily with hand or with a wooden ladle it would keep well for a month.

Source: Dr Natarajan

FARMER'S EFFECTIVE MICROORGANISM (FEM)

Ingredients	Quantity
Pumpkin	3 kg
Banana	1 kg
Papaya	3 kg
Jaggery	3 kg
Egg	5 numbers
Non-chlorinated water	10 liters

PREPARATION :

Cut the vegetables into small pieces. Transfer these pieces into a clean plastic container. Mix jaggery in 10 liters of non chlorinated water till it dissolves well and add the eggs to it . Mix all the contents. Close the container with air tight lid. Open lid after 10 days to release the air. Mix well again. Keep the set up closed for 45 days.

COLLECTION OF FEM :

After 45 days there will be three layers in the container. The upper thin layer is in white color which indicates successive fermentation. The middle layer will be pure brown coloured liquid and the lower layer will be the semi solid formed by the dissolved vegetables. Open the tap fixed at the bottom of the container to collect the semi solid portion in one container. The upper and middle portions are collected in another container.

APPLICATIONS OF FEM :

2% to 5% concentration in water can be used as foliar spray on any crop.

It also acts as a weedicide if it is used with goat's urine.

It may act as a pesticide if used after being fermented with neem, papaya & leaves.

NOTE : It can be easily prepared at home.

research being worked by
M. ABDUL JALEEL

Source: Gopalakrishnan

AATTOTTAM

INGREDIENTS :

2. Goat dung (soaked in water overnight)
3. Goat urine (fresh)
4. Green gram after grinding (soaked in water overnight)
5. Goat Milk
6. Curd from goat milk
7. Banana (ripened)
8. Tender coconut water
9. Fermented coconut water
10. Sugarcane juice

PREPARATION:

Aattottam is prepared in a wide mouthed clean plastic container. Metal containers should be avoided. Fresh goat dung (soaked in water overnight) and goats urine are to be added into the container and mixed thoroughly. The other ingredients are then added one by one to the container and again mixed thoroughly. This is to be stirred twice a day in clockwise and anticlockwise directions. Aattottam stock solution is ready for use after 14 days. Keep in shade and cover with a thin cotton cloth to prevent insects from laying eggs and formation of maggots on the surface of the solution. The solution can be stored for a period of six months, provided it is stirred twice everyday. If the solution is too thick to stir over time, water or tender coconut water can be added in required quantities.

APPLICATION:

Apply 2% in water as spray during dawn or dusk on any crop.

The solution should be filtered properly before pouring into the hand sprayer. For best results, spray at the time of branching, before flowering and fruit setting.

- It provides excellent nutrients to the soil.
- It assists in plant growth and increases chlorophyll.
- improves branching, leafing, flowering and fruiting,
- It is easy to prepare
- Excellent plant growth promoter.

research being worked by

M. A. IMRAN MUSTHAFA

Source: Nammalwar

EGG LIME FORMULATION

Ingredients	Quantity
EGG	10 nos
LIME	20 nos
JAGGERY	250 gm

PREPARATION :

Take about 20 lime and squeeze the juice into a container (bucket). Take about 250 gm of jaggery and mix it well with the lime juice to form a solution. Place 10 eggs with their shells in the lime solution. Close the container with an air tight lid and keep it in the shade for about 10 days. On the 10th day, the eggs along with the shells inside the solution would have become rubbery like a rubber ball. Use your hand to mix the egg along with the shells in the lime-jaggery solution and top it up with equal quantity of jaggery solution (about 500 ml) to the lime-jaggery solution. Close the container tightly for about 10 days. After the 10th day the formulation is ready for use as a foliar and soil spray in agriculture field.

APPLICATION :

This formulation can be applied to crops such as paddy, wheat, banana, vegetables, greens, fruit trees

It helps in good plant growth.

It can also be mixed with *Panchagavya* and Vermiwash for better results

research being worked by

S. NAGOOR MOHAIDEEN

Source: Gopalakrishnan

GUNAPASELAM

INGREDIENTS :

2. Fish waste
3. Native jaggery
4. Clay pot
5. Water

PREPARATION:

Take a clean clay pot. of 10 litres capacity and fill with five liters of water. Add powdered native jaggery and stir well to dissolve in water. Then add fish waste and mix it thoroughly. Tie the mouth of the pot with a cotton cloth to prevent the entry of flies. Mix the pot every day by whirling the contents. After 14 days decant the liquid and use it as a organic liquid foliar spray.

APPLICATION:

Apply 3% to 5% in water as spray during dawn or dusk on any crop.

- It provides excellent nutrients to the soil.
- It assists in plant growth
- In addition with other sprays it helps in control of root grubs.
- It is easy to prepare
- Excellent plant tonic

research being worked by R. VINCENT

Source: Narayan Reddy

BIO CONTROL OF WHITE GRUB'S

To control the white grub in agriculture field

INGREDIENTS	QUANTITY
Cow's urine	1 liter
Water	9 liter
Ginger	100 gm
Garlic	100 gm
Asafoetida	10 gm

ginger

garlic

cow's urine

asafoetida

water

PREPARATION :

Mix the neem cake, turmeric powder, coriander powder together. Soak the neem cake in water for 1 day, filter the extract of neem cake then spray.

Take a clean pot and put 1 liter of cow's urine with 9 liters of water, crush the ginger, garlic, asafoetida and close the pot with a cloth & with lid, leave the set-up for about 15 days.

APPLICATION:

Recommended to use along with Neem cake (2 kg), Turmeric powder (2 kg), Coriander powder (2 kg), *Panchagavya* (2 liter), Vermiwash (2 liter) and *Gunapasela* (1 liter).
Spray the neem extract to both soil and plants.
Spray ginger, garlic, coriander extract to plants only.

research being worked by
P. JEYAPRAKASH

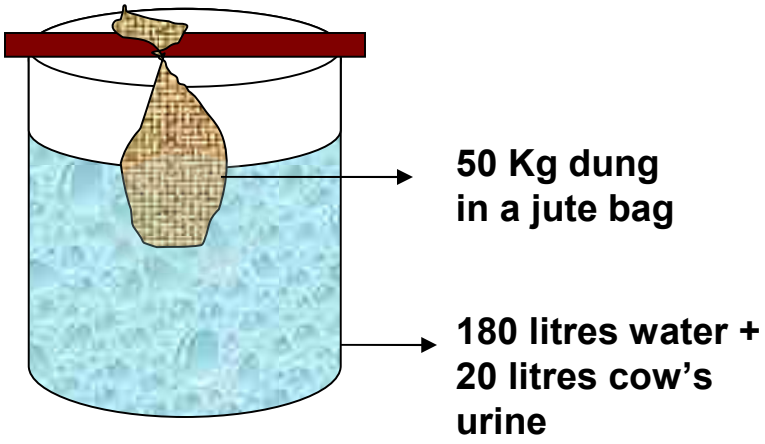
SOIL REJUVINATOR

Cow's urine	10 L
Cow dung	10 Kg
Jaggery	02 Kg
Pulse (any) flour	02 Kg

Mix in 30 litres of water, ferment for 20 days till bubble formation cease. Now add 200 litres of water; mix well and spray on soil. This quantity is sufficient for one acre.

Source: Pasumai Vikadan

Seed Treatment



Suspend 50 kg dung in a jute bag in a barrel (250 litres barrel) containing 180 litres of water and 20 litres of cow's urine. Leave for 20 days and mix regularly. Soak seeds in this liquid – duration depending on the thickness of seed coat.
For example soak 3 to 4 hours for seeds with hard coat.

Source: Priti Joshi

Seed Treatment

Cow dung	10 Kg
Cow's urine	10 litres

Mix these two with 20 Kg of termite soil / ant soil / soil from the shade of a big tree.

Mix all these into a paste and apply to about 60 to 100 kg of seed and air dry under shade, before sowing

Source: Priti Joshi

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