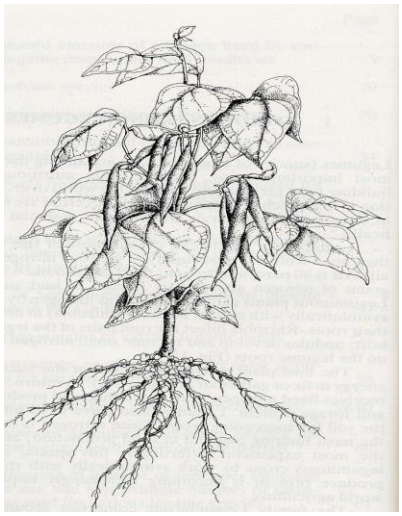
SUSTAINABLE SOIL FERTILITY MANAGEMENT
- *THE ORGANIC WAY*
HOW CAN SOILS BE MANAGED THE ORGANIC WAY?

1. Recycling back to the soil (via compost heap) all available organic waste materials

2. Biological Nitrogen Fixation through legume cultivation /green manuring

3. Vermi-Composting



1. COMPOSTING

❖Breakdown of organic waste materials by mixed population of microorganisms in warm, moist, aerated environment.

2. LEGUME CULTIVATION /GREEN MANURING

❖Legumes form mutually beneficial relationship (symbiosis) with micro-organisms which convert atmospheric N_2 into forms plants can use (*beans, peas, soybeans, clover,etc.*)

❖Certain legumes may be applied as green manures. After a crop has attained sufficient vegetative growth, it is ploughed into the soil. In this way, nutrients taken up by the crop are returned to the soil together with nitrogen fixed by bacteria in the nodules (Sesbania, leucaena, Lucerne, etc.)

3. VERMI-COMPOSTING

❖Featuring the addition of certain spp. of earthworms to organic matter (*dung, kitchen waste)*

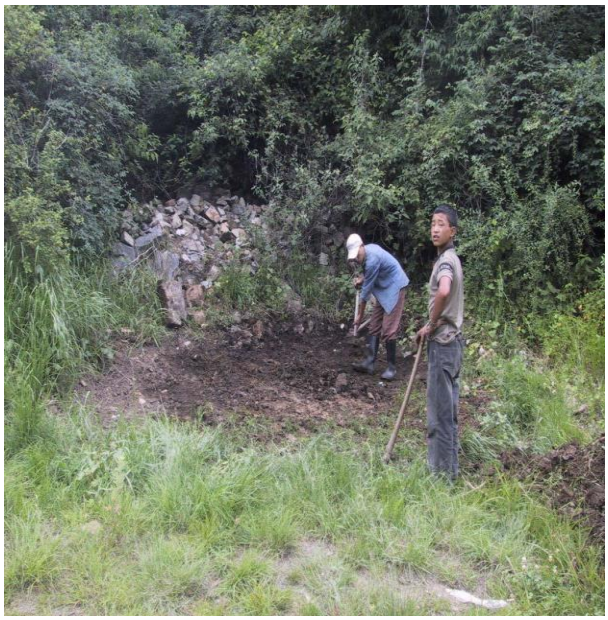
❖A process faster than composting

❖Material passes through the earthworm gut whereby the resulting worm manure (cast) are abundant in microbial activity and plant growth regulators

1. COMPOSTING TECHNOLOGY

1. Organic materials collected for composting

2. Chop materials (smaller the better)



3. Choose site with: sloping ground, shady place, wind break

4. Place layer of tree pruning / sticks / maize stalks / artemesia over a stone base

5. Place layers of tree pruning/ sticks / maize stalks / artemesia in crossway

6. Start piling chopped materials in layers (or mixed) of 10-15 cm. Do not press!

- If dung used, make slurry of dung in water and spray over each layer enough to moisten but not drenching

7. Once the heap has attained a height of 1.20 m^3 (spring, summer) & 1.50 m^3 (autumn, winter) cover with artemesia/gunny bags and allow natural process of degradation

8. Provide shade from rain and sun

- Prevent water logging

(**Day 3**)

9. Turn the heap once every seven days
- Moisten with water if materials appear to be dry (**Day 7**)

10. Once the heap has turned into compost:
- Spread to air dry for a few hours
- Sieve finished parts, pack into gunny bags and store in shade
- Use unfinished parts for next composting process (**Day 10**)

Woody materials take longer to break down. Chop them into very small pieces

Do Not:
Press over the heap at any stage of piling or add too much water

2. Biological Nitrogen Fixation Technology

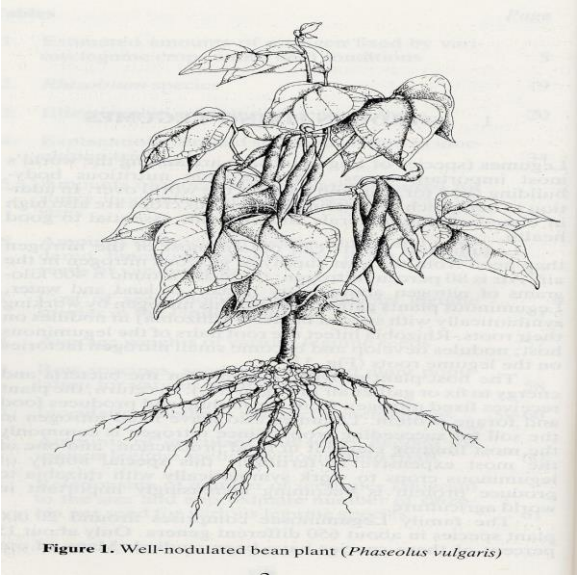
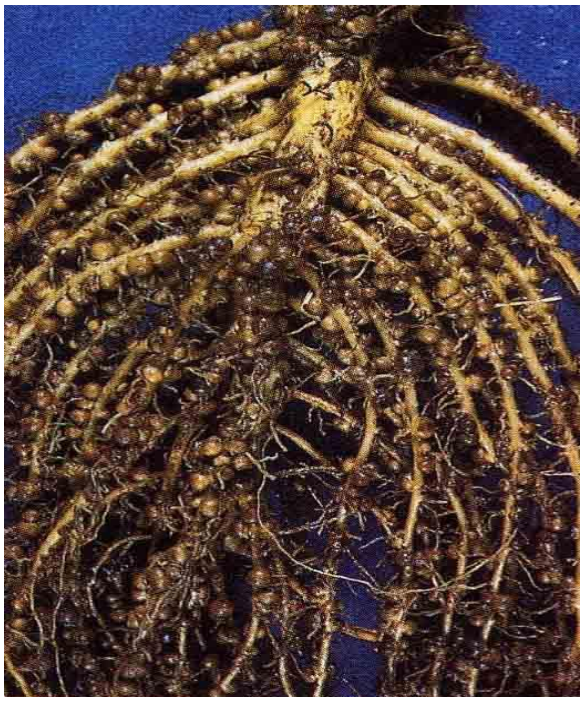


Figure 1. Well-nodulated bean plant (*Phaseolus vulgaris*)

Presence of nodules on legume roots indicate presence of *Rhizobium* bacteria

Nodules become N_2 factories as *Rhizobia* in nodules fix atmospheric N_2



(a and b) Ground nut (*Arachis hypogea*)
Size of nodules depend on the legume species

Soybean (G*lycine max*). Effective nodules are large, clustered on primary and upper lateral roots

Chick-pea (*Cicer arietinum*)

Nodules on forage legumes: Birdsfoot (*Lotus corniculatus*)

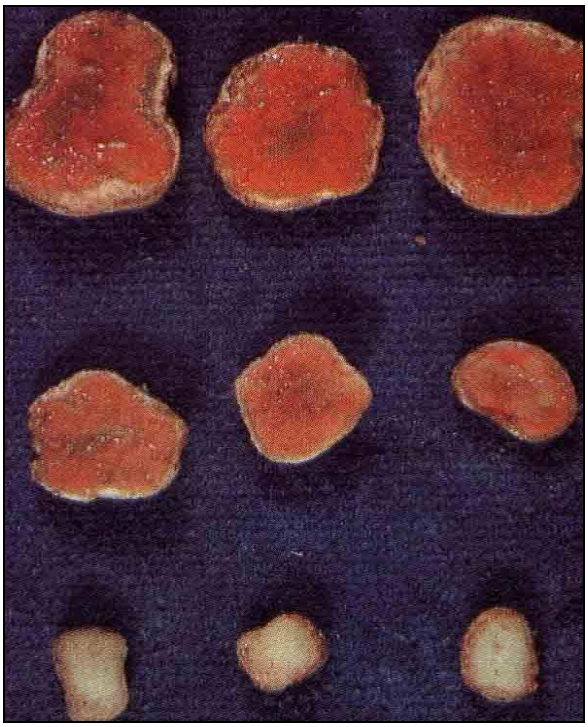
White clover (*Trifolium repens*)

Sainfoin (*Onobrychis viciifolia*)

Gaur (*Cyamopsis tetragononoloba*)
To determine effectiveness of rhizobia in fixing atmospheric Nitrogen slice nodules during flowering period and note color

(Section of *Trifolium* spp. nodules)
Effective nodules are deep reddish color inside but lose this color when senescent

Effective nodules of Crown vetch (*Coronilla varia*)



Soybean (*Glycine max*) nodules. Effective on top, ineffective on bottom

3. Vermi-Composting Technology

Cattle dung shredded into smaller parts

Spread and moistened with water

Tub filled and leveled

Worms added (day 1)

Covered with wet gunny bags

Protect from rain and shine

Wooden bins

Harvesting processed compost

Earthworm culture

Sieving the processed compost

Processed compost

Soil Microbiology Unit: Objectives

- Promote use of Biological Nitrogen Fixation (BNF) through microbial inoculants technology
- Build up a collection of agriculturally important strain of microorganisms (bacteria and mycorrhiza) for research
- Assess the effect of Effective Microorganisms (EM) Technology in agriculture & livestock management
- Monitor biological activity of soils under different land use
- Conserve soil biodiversity for sustainable agriculture through principles of organic farming (use of composts, microbial inoculants)

N Fixation Amounts From Different Plant Sources

(fixation varies with host, rhizobia, soil and climatic conditions)

Food/Grain Legumes (Common name)	**Scientific Name**	**Kg N/ ha/ yr**
Bean	*Phaseolus vulgaris*	40-70
Cow pea	*Vigna unguiculata*	70-350
Groundnut	*Arachis hypogaea*	70-120
Lentil	*Lens esculenta*	90-110
Mung bean	*Vigna mungo*	60-340
Pea	*Pisum sativum*	50-80
Soybean	*Glycine max*	60-170

N Fixation Amounts From Different Plant Sources

(fixation varies with host, rhizobia, soil and climatic conditions)

Forage legumes (Common name)	***Scientific Name***	**Kg N/ ha/yr**
Centro	*Centrosema pubescens*	130-400
Hairy/wooly pod vetch	*Vicia villosa*	110
Leucaena	*Leucaena leucocephala*	70-580
Sesbania	*Sesbania cannabina*	540
Stylo	*Stylosanthes* spp.	30-220
Sub-clover	*Trifolium subterraneum*	210
White clover	*Trifolium repens*	130